1986-12-10

International Joint Commission. Third Biennial Report Under the Great Lakes Water Quality Agreement of 1978. 1986

International Joint Commission

"The Parties shall conduct a comprehensive review of the operation and effectiveness of this Agreement following the third biennial report of the Commission required under Article VII of this Agreement."

Article X(3),
Great Lakes Water Quality Agreement
of 1978.

Third Biennial Report
International Joint Commission
December 1986

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International Joint Commission

THIRD BIENNIAL REPORT UNDER THE GREAT LAKES WATER QUALITY AGREEMENT OF 1978 TO THE GOVERNMENTS OF THE UNITED STATES AND CANADA AND THE STATES AND PROVINCES OF THE GREAT LAKES BASIN

IJC Commissioners

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INTERNATIONAL JOINT COMMISSION

December 10, 1986

The Right Honourable Joe Clark, P.C., M.P.
Secretary of State External Affairs
Lester B. Pearson Building
125 Sussex Drive
Ottawa, Ontario K1A 0G2

The Honorable George Shultz
Secretary of State
Department of State
Washington, D.C. 20520

Dear Sirs:

With this letter, we transmit to Governments the third biennial report of the International Joint Commission pursuant to its responsibilities under the 1978 Great Lakes Water Quality Agreement. The report is also being sent to the Governors of the Great Lakes States and the Premiers of Ontario and Quebec.

Under the 1978 Agreement the Parties are to conduct a comprehensive review of the operation and effectiveness of the Agreement after receiving the present report. To assist in this review, the Commission's report provides views on the adequacy of the Agreement and on desirable future initiatives.

Robert C. McEwen
Chairman

P. -André Bissonnette
Chairman

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A. Introduction

In 1972, following extensive scientific studies and widespread recognition that the Great Lakes were seriously deteriorated by pollution, the Governments entered into a novel and far-reaching Agreement to address the problem.

The 1972 Great Lakes Water Quality Agreement was a clear demonstration that the two nations were committed to meeting their obligation under the Boundary Waters Treaty of 1909, even more far-sighted and impressive for its time, that "boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

The 1972 Agreement was a more specific response to the urgent need for action to lower nutrients causing massive algal blooms, fish kills, closed beaches and severe odour problems. It addressed several pollution problems and sources, initiating binational efforts to control a number of toxic and other hazardous materials from municipal and industrial wastes, pollution from shipping and dredging activities, and other major studies.

The binational, interjurisdictional mandate and resulting coordinated activity facilitated the massive cleanup effort by governments and industry of the 1970s and early 1980s. Major municipal programs with expenditures totalling over eight billion dollars, industrial controls and phosphate limitations on detergents produced a reduction, indeed a reversal in some areas, of eutrophication. Nuisance algal blooms are no longer common occurrences.

In addition, a number of specific regulations designed to control certain widely used toxic substances resulted in declining levels of those substances in indicator species. Changes in the distribution and abundance of certain invertebrates and fishes and restored wildlife reproduction have pointed to improved water quality conditions, in some cases. The visible conditions of lakes Erie and Ontario, once considered shameful, have improved to such a remarkable extent that this achievement has been internationally considered an unprecedented example of binational cooperation in environmental management.

Six years after the 1972 Agreement was signed, it was renewed, strengthened and broadened in scope. The 1978 Great Lakes Water Quality Agreement provided for a more explicit attack on toxics contamination and the control of various dispersed or nonpoint sources. Most importantly, the 1978 Agreement clearly demanded an ecosystem approach to the management and study of the Great Lakes basin.

The 1978 Agreement committed the Governments of the United States and Canada to restore and maintain the integrity of the waters of the Great Lakes basin ecosystem, to develop programs, practices and technology to the maximum effort necessary for a better understanding of that ecosystem and to eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes system.

In order to accomplish this Purpose, the Governments adopted General and Specific Objectives and agreed to undertake programs and other measures to achieve those objectives. Within the Agreement, the International Joint Commission was given certain responsibilities to assist Governments in collating and disseminating data, in coordinating certain activities and in advising the Parties and the State and Provincial Governments with respect to the Agreement. It also was mandated to advise on progress towards achieving Agreement objectives, the effectiveness of programs and other measures undertaken, and any other matters relating to Great Lakes water quality.

At the time the 1978 Great Lakes Water Quality Agreement was negotiated, the principal impetus for an ecosystem approach came from scientists, who were increasingly describing and explaining phenomena in terms of ecological systems. Despite its novelty in that context, the Governments' negotiators had the wisdom and foresight to incorporate an ecosystem perspective into the new Agreement.

It became increasingly clear, moreover, that the nature of the problems had changed and a comprehensive ecosystem approach was important to resolving them. Relatively straightforward measures had been used to control the massive and visible problem caused by phosphorus and other "conventional" pollutants, based on available technology, engineering expertise and substantial expenditures of money.

Toxic chemicals, however, are another matter. Despite the positive signs of recovery from the severe stresses of substances such as DDT, little overall progress has occurred in dealing with the generic problem using technological means. The problem is more severe and complicated than realized when the 1978 Agreement was signed. More and more chemicals are being produced and identified in the ecosystem, particularly polychlorinated organics which persist and bioaccumulate in the food chain. Regulations to control specific substances based on proven effects cannot keep up with the expanding scope of the problem. The sources are more elusive to identify and document; the effects more scattered and invisible.

The toxics problem will not be resolved simply by imposing additional technological and regulatory controls. It will require a more comprehensive and preventive approach to solving or, preferably, avoiding a more serious problem. A preventive approach may in turn require our societies to make the kind of product and process choices that will reduce or even eliminate the use of toxic chemicals at the beginning of the production and marketing processes.

Even if we implement effective preventive approaches today, the large number of toxic contaminants already in the system would remain. More immediate remedial measures are also needed. Specific water quality objectives, their achievement through permits and other programs, and measures that produce partial success must still be employed and accomplished. The 1978 Agreement provides a framework for dealing with both dimensions of the issue.

The ecosystem approach, which recognizes that the various parts of the natural and human systems are all linked together and must be understood in concert, has helped us begin to trace the various linkages involved in the toxics

issue, conceptually and in practice. The Great Lakes Charter, signed in 1985 by the Great Lakes Governors and Premiers, reinforces the Agreement and calls for such an ecosystem approach. The Governors and Premiers declared that:

"The planning and management of the water resources of the Great Lakes basin should recognize and be founded upon the integrity of the natural resources and ecosystem of the Great Lakes basin. The water resources of the basin transcend political boundaries within the basin, and should be recognized and treated as a single hydrologic system. In managing the Great Lakes basin waters, the natural resources and ecosystem of the basin should be considered as a unified whole."

The Governors have strongly reinforced their commitment to this approach to Great Lakes management by signing the Toxic Substances Control Agreement. Principle II, "An Integrated Ecosystem," states:

"The water resources of the basin transcend political boundaries within the basin, and should be managed as an integrated ecosystem."

The strategic objective of the Canada-Ontario Agreement Respecting Great Lakes Water Quality, renewed in March 1986, as outlined in Article II, reflects a similar commitment:

"The Parties agree that their long-term strategic objective is to restore and protect the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem as a multi-use resource whose base provides the setting and foundation for social development and economic investment."

The August 1986 Reference on Great Lakes levels also addresses a need to assess the consequences of current high lake levels and fluctuating lake levels in general within a broad integrated context. The costs and benefits that accrue to riparian, power, shipping and other interests as a result of fluctuating, high and low lake levels are important consequences. However, water quality, wetland succession, the Great Lakes fishery and a broad range of other ecosystem considerations are also important.

An integrated approach may make it possible to guard against the unintended consequences of basin activities, including those pursuant to the Agreement. For example, there is a potential problem connected with the resurgence of the Lake Erie fishery. A direct benefit of the multi-billion dollar, binational investment to stem eutrophication in Lake Erie is improvements in the fishery. As fish stocks are restored to harvestable condition, increased fishing pressures and subsequent riparian land use practices can have their own set of devastating impacts on the population dynamics of aquatic organisms, and force us to look ahead to the consequences of success with respect to restoring the physical, chemical and biological integrity of the Great Lakes.

While governments deserve praise for support of the ecosystem concept, there are mixed results in its actual implementation under the Agreement. In

governmental programs, the traditional separation of responsibilities and authorities between and among international, federal, state, provincial and local Great Lakes entities is often at odds with the pursuit of an integrated approach. All levels of governments tend to react rather than anticipate and are not accustomed to acting in a unified manner for continuing and coordinated management. Under current economic conditions, it is difficult for the responsible agencies to devote resources to activities and programs that tend to fall outside their narrowly defined mandates and short-term, measurable results. This tendency is often aggravated by academic and scientific training practices which still emphasize specialization and individual rather than cooperative initiatives. Further progress by governments to implement an ecosystem approach will depend on alterations in these practices as well as on the continued political will of the Parties.

Despite the rapidly growing recognition of the ubiquitous and complex nature of the toxic chemicals issue, it is very difficult to plan and support interagency, interdisciplinary programs on the transport, fate and effects of toxic chemicals in the Great Lakes Basin Ecosystem. In many instances, even greater coordination and cooperation would have been desirable, despite some successes and considerable efforts. The Commission continues to encourage and, where possible, directly facilitate increased coordination and cooperation between and among the various agencies, groups and individuals involved in Agreement work.

To engage in the basinwide ecological approach seriously often will not be consistent with maintaining the traditional, narrower domains and preferences of specific interests, including, to some extent, the jurisdictional and administrative boundaries between and within various governmental institutions. Governments may at times have to act in conflict with these various established interests to develop a coordinated ecosystem approach to Great Lakes problems. Otherwise, they may find themselves in greater conflict due to growing public insistence that actions be continued to safeguard the integrity of the Great Lakes. Increasingly governments and their constituents must compare the political and economic costs of an effective, timely and ongoing response to the political and economic costs of the failure to respond.

Research, monitoring and surveillance are crucial in the Commission's ability to discharge effectively its Agreement responsibilities. The Commission, directly and through the increasingly effective efforts of its Water Quality Board, tries to facilitate improved cooperation and coordination between and among the Parties and jurisdictions in these areas. Without adequate research, governments lack the information they need to determine Agreement priorities; without adequate monitoring and surveillance, the Commission and more importantly the Parties and the public cannot determine the extent to which Great Lakes programs are developed and implemented consistent with Agreement obligations.

If an ecosystem concept is to be successfully applied to the Great Lakes basin, we must first assess factors affecting the health of the lakes and attempt to understand how the interacting components of surface water, groundwater, the

atmosphere and living organisms affect the lakes. Second, we must develop the scientific or technical measures needed to remedy the problems identified. Third, consideration of the legislative, economic and sociological issues will also need to be addressed if solutions are to be found and applied in a timely, effective fashion. As an overarching concern, we must continue to build and maintain a constituency supportive of a Great Lakes basinwide ecosystem approach.

This report by its nature and background focuses primarily on assessing the development of scientific and technical measures to remedy Agreement-related problems. The Commission notes scientific accomplishments and its concerns about the overall state of Great Lakes science. It makes recommendations aimed at invigorating this central foundation of progress, and comments on promising program developments stemming from Great Lakes Water Quality Board and governmental activities – despite the continuing lack of an overall toxic control strategy.

Because progress in the toxic chemicals issue is needed, the Commission has attempted to assume a more active role in framing an approach to the problem; the Great Lakes Water Quality Board is taking the lead in this initiative. The Commission will continue to encourage the Board members to generate increased jurisdictional support for a serious attempt to define the scope of an effective toxics management strategy.

The primary responsibility for carrying out the programs needed for the success of the 1978 Agreement rests with governments. They also have the principal funding and enforcement capabilities. However, only with the resolve of all concerned, including the broader Great Lakes community, will progress towards restoring and enhancing the ecosystem of the Great Lakes continue.

Therefore, the Commission again stresses in this report the need for increased, broadly based public support for governmental programs aimed at advancing the 1978 Agreement goal to virtually eliminate the discharge of any or all persistent toxic substances. This task will require ongoing governmental research and program resource commitments that will be difficult to sustain without active public support and insistence. Our governments performed well in attacking eutrophication, and they have begun to address seriously the more insidious problem of toxic contamination. They deserve strong and continuing support as they undertake this critical issue for the future of the Great Lakes.

B. Assessment of the 1978 Great Lakes Water Quality Agreement

This Third Biennial Report of the International Joint Commission under the Great Lakes Water Quality Agreement of 1978 is intended primarily as an assessment of the operation and effectiveness of efforts by both Parties to achieve the goals set forth by the 1978 Agreement, and of the Agreement itself as a framework for action to protect and enhance the Great Lakes basin environment. In so doing, it is a contribution to the review of the Agreement that must be carried out by the Parties subsequent to receiving this report.

Procedure for the Review

In conducting its review of the 1978 Agreement, the Commission has used a number of sources as either direct input or background documentation. First, several earlier Commission reports are relevant to the review. These reports include the First and Second Biennial Reports (1982 and 1984 respectively), the Reports on Pollution of the Upper Great Lakes (1979) and Pollution from Land Use Activities (1980), the Interim Report (1981), Special Report on Niagara River Pollution (1981) and the Report on the Reference on Michigan-Ontario Air Pollution (1983). These Commission reports, together with the Board reports upon which they are largely based, provide a broad perspective of the Agreement and its effectiveness.

The Commission notes Governmental responses to the Niagara River Pollution and the First and Second Biennial Reports. These responses and other actions are hopeful indications that the Parties are increasingly responsive to the various reports of the Commission and its Boards, and that the Agreement continues to evolve as a dynamic, rather than static, instrument of cooperation.

Several Agreement commentaries and reviews from other bodies also have been helpful to the Commission in preparing this report. They deserve Governments' attention, in that they provide varying perspectives on the Agreement's effectiveness and propose a number of specific program and procedural modifications. The Commission notes that one of the organizations involved, Great Lakes United, has subsequently held its own series of hearings on the Agreement and will be preparing a report.

Of particular interest to the Commission's assessment, however, is the Special Committee Report of the U.S. National Academy of Sciences-National Research Council and the Royal Society of Canada (NAS/RSC). This report, issued in December 1985, is based on a comprehensive review of Great Lakes ecosystem issues, funded by the Donner Foundations and initiated with Commission encouragement. Many NAS/RSC observations and recommendations mirror or build on earlier Commission work.

Particularly useful contributions in the NAS/RSC report concern toxic contamination control, groundwater, Areas of Concern, toxic chemicals inventory, increased understanding of the sources and effects of long-range transport of toxic contaminants, fisheries resource management and the need for increased public awareness of toxic contamination. The discussions on epidemiological

studies, exposure and risk assessment also are useful. The NAS/RSC report is a valuable resource document to which the Governments should give attention during their review.

The Commission also invited and received a number of viewpoints on the Agreement during its 1985 Great Lakes Water Quality meeting in Kingston, Ontario. Articulate and well-reasoned submissions, some based on quite extensive and continuing analyses, were received from 13 organizations as well as individuals from around the entire Great Lakes basin. The Commission's Great Lakes Water Quality Agreement Boards, in particular the Water Quality Board, have commented on the future of the Agreement. Finally, a number of thoughtful statements from knowledgeable individuals have contributed to the Commission's deliberations on the Agreement and its adequacy.

With few exceptions, there is remarkable unanimity in the views expressed on the Agreement. Virtually all see an urgent need for a coordinated, binational, comprehensive approach to cope with Great Lakes toxic contamination. There is also widespread agreement on the need for increased attention to urban and rural nonpoint source pollution, in-place pollutants, the long-range transport of toxic contaminants, wetland areas, hazardous waste disposal sites, groundwater research and integrated transboundary monitoring. Reviewers are in general agreement that the input of toxic substances to the Great Lakes must eventually cease, thus reinforcing the Agreement philosophy of zero discharge of persistent toxic substances. Most reviewers also support the view that jurisdictions must find ways to take into account the cumulative effect of many different kinds and sources of persistent contaminants when granting individual discharge permits.

There is also general support for the continuation of the 1978 Great Lakes Water Quality Agreement. Most commentators agree that major revisions are unnecessary or could possibly conflict with the need for Governments to focus on implementing the existing provisions, both general and specific.

The Commission's Conclusions

The Great Lakes Water Quality Agreement is a unique and evolving international document combining broad vision with flexibility and pragmatism. The Purpose, General and Specific Objectives and Annexes constitute a dynamic undertaking worthy of the Parties' continued commitment. The Commission concludes that the important and changing issues related to the Great Lakes ecosystem can be addressed within the conceptual and management framework provided by the Agreement. Therefore:

1. The Commission *recommends* that the 1978 Great Lakes Water Quality Agreement remain in force and not be the subject of comprehensive renegotiation. The Commission further *recommends* that the Parties, in consultation with Great Lakes jurisdictions, undertake measures as may be required to clarify, strengthen and support the various provisions of the 1978 Agreement.

industrial point sources. The numbers provided to the Commission on point source program compliance, while suggesting considerable progress in municipal and industrial programs, cannot be taken at face value. Any inferred relationship between these facts and achievement of the purpose of the Agreement would involve a series of debatable assumptions.

First, as noted, the numbers represent "reported compliance" with domestic permits or requirements. The proportion of the total number of polluters (or more importantly of the mass loading of various pollutants), the period of time over which violations occurred, and the location are not specified in compiled statistics. Hence, it is not possible to translate directly from changes in the proportion of dischargers in compliance into the reduction in the amount of pollutants.

Second, the relationship between the limitations contained in permits/requirements and those required to achieve the General and Specific Water Quality Objectives is not clear. This is complicated by the fact that the requirements may vary between and even within jurisdictions, and are generally based on technology or effluent concentration. The Specific Objectives, however, relate to ambient levels and the recognized most sensitive use in all waters.

Third, compliance concerns only substances that are specified in domestic pollution control requirements. They are the substances being measured and, in a literal sense, are therefore permitted. Only to a limited degree do control programs during the reporting period address the problem of organic toxic substances, most of which fall outside the domestic regulatory system.

There have been, however, concerted efforts in recent months to prepare lists of priority toxic substances to be incorporated into control programs. As our detection capability becomes more sophisticated, and as we become aware of the presence and effects of more contaminants, "compliance" may be improving while the actual situation is getting worse.

Even if total compliance with an existing, comprehensive set of water quality objectives is reported and achieved, it is not clear that the information would accurately reflect the full impact of human activity on the ecosystem. The Specific Objectives are single parameter objectives only. They are highly dependent on establishing some linkage with actual regulations and the measurability of many toxic substances, and they do not reflect the combined effects of various substances which are often found together. Most Specific Objectives are based on short-term, acute, chemical, physical or biological impacts under laboratory conditions and do not reflect the synergistic, long-term, chronic and in-situ conditions that actually occur. The need for alternative measures of ecosystem quality, whether in terms of mass-loading or biological indicators, was discussed in the Addendum to the First Biennial Report. Increasingly, such parameters are being used and may, as they are perfected in the future, give a better indication of overall Agreement progress.

As one way to deal with this problem, the Water Quality Board has proposed creating provisions to establish a system of "benchmarks" to facilitate a common

determination of point source performance among the Great Lakes jurisdictions with emphasis on persistent toxic substances. The Commission recognizes the need for further work in this area and, therefore:

2. The Commission *recommends* that the development of appropriate measures for reporting and assessing point source performance in relation to the Great Lakes Water Quality Agreement be continued by Governments within their ongoing surveillance and monitoring programs.

Atmospheric Inputs

Atmospheric deposition is now widely recognized as an important source of pollution of the Great Lakes ecosystem. This recognition has increased greatly since 1978. However, insufficient monitoring of airborne toxic substances and inadequate source inventories make estimation of the extent of deposition difficult. There is considerable support for more intensive treatment of atmospheric deposition issues under the Agreement and discussions also must proceed on the required remedial programs as addressed in Article VI(1)(l). Accordingly:

3. The Commission *recommends* that the Parties give priority to the specification and application of required air quality-related activities under the Agreement, including collection and analysis of data on the sources, dynamics and effects of atmospheric pollution inputs into the Great Lakes Basin Ecosystem. These discussions should be coordinated with the ongoing, bilateral discussions that have been convened by the President of the United States and the Prime Minister of Canada.

Polluted Sediments

Another issue that has emerged since 1978 is that of polluted sediments in the Great Lakes system and their long-term impacts on water quality. In-place polluted sediments have been identified as a major problem by the Water Quality and Science Advisory Boards. In a workshop held by the Science Advisory Board in 1984, the process by which contaminated sediments may impact water chemistry and associated biota was discussed, and a range of remedial actions for treating such sediments was considered.

The Agreement calls for the development of criteria and guidelines for dredging operations because the dredging of contaminant-laden sediments and their disposal are potential mechanisms for reactivating water pollutants. A committee of specialists developed proposed criteria and guidelines, which were forwarded to the Commission in 1983, and subsequently published. Increased attention to this problem will become more important as other sources of pollutants are controlled and as the jurisdictions turn their attention to remedial action in key locations of concern. Accordingly:

4. The Commission *recommends* that the Parties increase efforts to develop and implement comprehensive sediment management programs, and that, in particular, the Parties ensure that the Dredging Guidelines developed under the Great Lakes Water Quality Agreement are applied.

The current focus on remedial action plans for Areas of Concern in the Great Lakes system, discussed in detail below, also highlights the importance of sediments and the need for additional research work in this area. Indeed, if the Parties and jurisdictions are to address Areas of Concern effectively, substantially increased attention must be given to polluted sediments. While the development of remedial action plans is a commendable and significant initiative, there is no clear understanding as to exactly how rehabilitation is to be achieved.

As the Water Quality Board stated in its 1985 report to the Commission, "... in most of the areas, it is not yet clear what remedial action, if any, should be taken or how it should be done." Since most of these areas contain many *in situ* contaminants, the Water Quality Board recommends increased research effort be directed towards sediment management. The Commission endorses this recommendation and believes that a better understanding of the sediment role in the movement and bioaccumulation of toxic chemicals and nutrients would enable managers to plan the rehabilitation of the Areas of Concern with much greater efficiency as well as increase confidence in the more general sediment management programs addressed above, including dredging and the disposal of dredge spoils. Therefore:

5. The Commission strongly *recommends* that the Parties direct increased research priority to the knowledge gaps inhibiting the management of sediments in the Great Lakes system.

Groundwater

In 1976, the Commission wrote to the Governments regarding a possible future area of controversy involving transboundary groundwater resources. It noted that expanded development along the boundary would place more pressure on groundwater resources and in turn lead to potential transboundary groundwater disputes. At that time, the Commission concluded that Governments would be well-advised to initiate a boundary groundwater survey as part of an anticipatory effort aimed at dispute prevention, a central purpose of the Boundary Waters Treaty of 1909.

In its Second Biennial Report, the Commission recommended increased attention to groundwater resource problems. It recognized a specific need for research on sampling geochemical and microbiological constituents and the development of standard protocols for the effective monitoring of potential leachate movement from toxic waste repository sites. Since the release of the Second Biennial Report, the Science Advisory Board has recommended a program

to map groundwater resources in order to determine the relationship between groundwater systems and pollution sources to the Great Lakes.

Groundwater mapping is expensive, but without knowledge of potential sources of contamination, the pathways to groundwater and the nature of groundwater strata in a region, jurisdictions will find it difficult to develop comprehensive anticipatory programs to protect and manage Great Lakes groundwater resources. Mapping is also important for managing nonpoint sources of pollution, many of which affect the Great Lakes through or from the groundwater of the basin.

While several Agreement reviews note that the 1978 Agreement does not specifically address groundwater issues, the Commission concludes that an ecosystem approach must of necessity include groundwater. Accordingly, the Commission views Great Lakes basin groundwater as an important Agreement issue.

6. The Commission *recommends* that the Parties fund and support groundwater mapping initiatives such as the program proposed by the Great Lakes Science Advisory Board.

7. The Commission further *recommends* that the Parties research, develop and implement a program of sampling geochemical and microbiological constituents in groundwater and develop standard protocols for the effective monitoring of leachate movement from toxic waste repository sites.

Integrated Transboundary Monitoring Considerations

The need for improved Agreement monitoring and surveillance systems has received considerable comment and is deemed by the Commission as crucial to its monitoring responsibilities under the Agreement. The issue also has broader significance along the Canada-U.S. boundary region.

Under the 1978 Agreement, the Parties agree to involve Great Lakes jurisdictions in the development and implementation of a coordinated Great Lakes monitoring and surveillance plan. The Agreement further stipulates that the Great Lakes International Surveillance Plan (GLISP) contained in the 1975 Annual Report of the Great Lakes Water Quality Board and as subsequently revised is to serve as a model for the development of this joint program.

In the spring of 1983, the Water Quality Board established seven lake and connecting channels task forces (one for each lake and for each of the upper and lower connecting channels). These Task Forces designed a surveillance plan appropriate to meet Agreement requirements. Specific portions of the revised plan were distributed to the appropriate States and Provinces in May 1986 and the Commission commended the Water Quality Board for its effort in developing a coordinated, ecosystem approach to Great Lakes surveillance. Accordingly:

8. The Commission *recommends* that the States and Provinces act immediately to review, amend if necessary, and implement their respective portions of the Great Lakes International Surveillance Plan. Further:

9. The Commission also *recommends* that the jurisdictions keep the Commission currently apprised of their monitoring and surveillance plan implementation efforts.

Since the Commission is dependent on information collected by the jurisdictions in order to carry out its responsibilities under Article VII of the Agreement, it views continuous and reliable surveillance and monitoring as critical to its functions under the Agreement and to the implementation of the Agreement itself. Therefore:

10. The Commission further *recommends* that as part of their Surveillance Plan implementation activities:

(a) The Parties and jurisdictions review the support structure available for monitoring and surveillance and determine the extent to which the existing support structure is adequate to meet expressed Agreement needs.
(b) The Parties identify current monitoring and surveillance activities that are critical as shared sources of Agreement information and ensure that these activities are maintained in the common interests of both countries.
(c) The Parties consider the development and designation of specific Agreement core monitoring networks as international monitoring networks.
(d) The Parties agree on consultation procedures to be followed prior to reaching decisions on the reduction or elimination of activities identified under (b) or networks designated under (c).

To anticipate future toxic substance problems, an early warning system is included in the Agreement (Annex 12(5)). An important aspect of an early warning system is the maintenance of biological tissue and sediment banks that permit retrospective monitoring of formerly unconsidered or newly identified toxic substances. Retrospective analysis of the toxic contaminant mirex in herring gull egg tissue and in Lake Ontario sediment cores is an example of the value of specimen banking. The Commission notes, however, that the majority of samples collected in monitoring and surveillance programs does not permit retrospective analysis. Accordingly:

11. The Commission *recommends* that specimen banking for biological tissue and sediment be implemented as an integral part of the Great Lakes International Surveillance Plan (Annex 11).

Problems associated with effective transboundary monitoring and surveillance have broad significance along the entire boundary, not only in the Great Lakes. The Commission uses many kinds of monitoring and surveillance data in its general activities. Often these data must be combined or aggregated in order to infer trends or draw policy conclusions. The process of combining data from various types of monitoring may be difficult and of questionable validity if the data to be combined are not compatible. On the other hand, the lack of coordination between and among agencies can and does result in redundant or duplicative data collection. Such problems have led the Commission to examine generally the feasibility of integrated monitoring networks.

Establishing and operating monitoring networks is a costly endeavor. In times of limited resources, assuring compatibility and eliminating redundancy can result in economic savings and increased effectiveness of monitoring, whether it be for sampling methods, site locations, analytical techniques, quality control or data reporting methods.

In the meantime, progress can be made within existing monitoring and surveillance programs by making sites or stations in the existing networks multi-functional. Sites could measure multiple rather than single parameters, while they maintain quality control and required statistical behavior of established protocols. Integrated sites combine the monitoring and measuring requirements of several environmental media (air, surface and groundwater, soil, vegetation, precipitation, etc.) at a single location with single operational control.

A valuable step in this direction is the development of "Internationally Designated Gauging Stations" along the United States-Canadian border. If water quality and air quality measurements could be added to these gauging station sites, a group of stations generating calibrated international standards for integrated air-water monitoring would be established. These stations could form a component of future cost-effective transboundary monitoring efforts.

12. The Commission *recommends* that Governments establish programs to make existing monitoring sites more multifunctional, and to develop new integrated monitoring sites.

Wetlands

Like groundwater, wetlands are not specifically mentioned in the Agreement. Wetlands and their protection from encroachment traditionally are not included in water quality programs. However, the Agreement provides the basis for fish and wildlife habitat protection, enhancement and preservation which are vital to a stable and productive aquatic community.

Protecting wetlands is only part of the overall issue. A number of other stresses on fish and wildlife resources exists, including overfishing, the introduction and proliferation of exotic species, and the linkages with nutrient and toxic substance reductions that require a concomitant and coordinated effort

by the responsible agency. It is becoming increasingly clear that environmental protection within an ecosystem approach and resource management have become inseparable. Accordingly:

13. The Commission *recommends* that relevant agencies make greater use of the Purpose and other provisions of the Agreement as a basis for cooperative research and management programs on wetlands.

The Commission initiated and assisted in a review of provisions to protect and restore the fisheries habitat at Sault Ste. Marie, while increasing the amount of water available for hydroelectric production. A process leading to the planning and construction in 1985 of remedial works and habitat improvement at the St. Marys Rapids was precipitated by the Commission using, in part, expertise from various agencies available to it under the Agreement, and funding from the private power companies and the Province of Ontario. While this project was small compared to the effort required to accommodate the problems occurring throughout the Great Lakes ecosystem, it demonstrated that multi-agency solutions can be achieved.

The Role of the Commission

Considerable comment has been received on how the Commission implements its Agreement responsibilities. Some observers expect the Commission to be an environmental advocate, while some agencies and participants in Agreement programs view the Commission as increasing its role as a coordinator of governmental action and programs, including data gathering. The Commission itself views its role under the Agreement as adequate as presently stated under Article VII of the 1978 Agreement and in the Boundary Waters Treaty of 1909.

The Scope of the Agreement

A proposal for the Parties to integrate water quality and quantity issues into a comprehensively revised Great Lakes Agreement has been raised publicly. The Commission also notes increased governmental recognition of the inseparability of water quality and quantity issues, as the recent Reference to the Commission on Great Lakes water levels indicates. While the Commission believes this is consistent with an ecosystem approach and the vision of future water use expressed in the Commission's 1985 Great Lakes Diversions and Consumptive Uses Report, it also recognizes that negotiations leading to such a comprehensive agreement would require substantial time. Such a process should not be allowed to divert energy and resources from the important, ongoing work of the Water Quality Agreement.

Another issue concerns the geographic extent of the Agreement, which now encompasses all of the Great Lakes basin and the international section of the St. Lawrence River. A desire has been voiced to include the downstream section of

the St. Lawrence River wholly within Canadian territory in the Agreement, a proposal which would also seem to be consistent with an ecosystem approach. The Commission notes that, under present institutional arrangements, a member of the Water Quality Board is from the Province of Quebec, and experts from Quebec have served on the Great Lakes Science Advisory Board.

C. The Nature of the Toxics Problem

An area that reflects all of the shortcomings of the present Agreement and related programs is the presence of toxic chemicals in the Great Lakes system – a primary concern about the Great Lakes, yet one that may not be fully resolved through any means. To a large extent the 1978 Agreement represents an international undertaking to prevent toxic pollution of the Great Lakes Basin Ecosystem. While a certain amount of interjurisdictional consultation and coordination has occurred, the institutional mechanism provided by the Agreement to manage toxic chemicals comprehensively has not been fully utilized. Without the coordinated support and commitment of the Parties, States, Provinces, the private sector and the public, any progress to control toxic substances in the Great Lakes Basin Ecosystem is likely to be slow and haphazard.

While residual quantities of some of the older toxic substances that were regulated in the 1960s and 1970s (such as DDT and PCBs) have declined in most areas, this trend may now have stabilized or even reversed. Other substances have not decreased significantly in the Great Lakes ecosystem, an example being dieldrin, a derivative of the insecticide aldrin and also a controlled chemical.

More importantly, many other persistent organic chemicals are now being identified in the ecosystem. These contaminants tend to bioaccumulate in the food chain and are associated with physical deformities, reproductive failures, tumors and other physiological effects in birds, fish and other biota. Changes in invertebrate and predator fish communities, in terms of species composition, age class distribution and size are identified and in some cases cumulative toxic effects are considered to be a probable contributing factor.

From these observations it can be concluded that, in the Great Lakes ecosystem:

- many more toxic chemicals and low ambient concentrations of chemical mixtures threaten the health of the ecosystem to an extent and in ways that were not realized in 1978, and many are not adequately addressed by existing monitoring and control programs; and
- many toxic chemicals bioaccumulate in predator species and can, in combination or singly, affect the health, diversity and resilience of biological communities and have possible long-term implications for humans.

There is a lack of knowledge about the combined impacts of numerous substances found together in water and biota, and about the chronic, low level impact as opposed to short-term, high level effects of single chemicals upon which most toxicity tests are based. Recent research suggests that some chemical mixtures are more toxic than predicted from toxicity data on the individual chemicals.

A broadly based, comprehensive strategy is required to deal with the multiple problems of toxic substances in the Great Lakes Basin Ecosystem. The strategy must be cooperative among all jurisdictions and sectors of society since

actions in one affect all others. The strong statement of purpose and direction outlined in the Great Lakes Toxic Substances Control Agreement signed by the Governors of the eight Great Lakes States in May 1986 is progress in this direction and must be fully considered by Governments as they develop a binational toxics strategy. A similar agreement expected between Ontario and Quebec will strengthen the importance of this initiative.

14. The Commission *recommends* that the Parties, together with the Great Lakes jurisdictions, jointly commence a formal, public undertaking to develop and implement a Binational Toxics Management Strategy for the Great Lakes Basin Ecosystem.

The latest findings and events concerning toxic substances confirm the need for such an overall strategy. We know that certain toxic chemicals pose grave risks to human populations. Intrusions of toxic chemicals on our lives, including the incidence of specific toxic chemical disasters, are occurring with greater impact and frequency. These occurrences cannot be viewed as system aberrations; rather, they may be the inevitable if unintended consequence of our industrialized society. More toxic chemical-related incidents are bound to occur. The questions thus become: How many? Where? How serious will be the consequences? What can be done to mitigate the production and use of toxic chemicals? We do not have a comprehensive solution. The Great Lakes Water Quality Agreement provides a basis, however, for the commitment and approach to deal effectively with Great Lakes toxics issues. This framework can be utilized by the Parties only when the Agreement's provisions are fully and aggressively implemented.

The policies outlined in Article II of the Agreement, the General Objective to free the Great Lakes system of substances that are toxic to life, and the programs necessary to achieve these goals must continue to form a sound framework for action. Better identification and quantification of the sources of toxic substances, coordinated planning and monitoring, and strong preventive or remedial action are all elements of a Toxics Control Strategy. Within this framework, immediate action can be taken on priority pollutants, such as those on the list identified by the Water Quality Board, and more broadly based, long-term strategies can proceed. Therefore:

15. The Commission *recommends* that the Parties use the current provisions of the 1978 Great Lakes Water Quality Agreement as a framework for developing a comprehensive strategy to control and reduce toxic substances in the Great Lakes ecosystem.

In order to maintain the attention at the most senior management levels and in the general Great Lakes community, a mechanism must be provided to carry out a joint review of progress under the Agreement on a regular basis. Therefore:

16. The Commission *recommends* that the Parties, together with the jurisdictions and the Commission as may be deemed appropriate, meet periodically at a senior level for consultations concerning progress under the Agreement and the implementation of a Binational Great Lakes Toxics Management Strategy.

D. Elements of a Binational Great Lakes Toxics Management Strategy

The Commission concludes that many of the basic elements needed for a Toxics Management Strategy exist in the Great Lakes Water Quality Agreement. Suggested improvements in these existing programs which are believed to be possible in the short term are discussed in the second section below. Other, more institutional elements which are needed for developing a more preventive approach to the toxics problem are lacking or only in early stages of discussion and development, and require substantial effort over the long term. These elements include increased program coordination, methods for adopting new objectives, encouraging new toxic control technologies and increasing local involvement.

Long-term and Institutional Elements

Increased Program Coordination

Successful implementation of remedial measures can be inhibited by insufficient coordination and fragmented responsibilities within and among jurisdictions. Pollution laws and regulations primarily evolved in response to conventional pollution, and operationally separate programs still exist, with few exceptions, for surface water, groundwater and air quality. Tackling the multifaceted toxic substances issue requires more communication and cooperation between programs than heretofore has been achieved. In particular, a review of institutional arrangements is required between programs concerning: water/land/air; ambient water quality/point and nonpoint source monitoring; water quality/fisheries management; and water quality/human health.

The Commission encourages continued efforts to increase the amount of professional and formal institutional contact between and among agencies, different levels of government and the private sector in order to identify and capitalize on opportunities for increased cooperation and consistency. Cooperative policy formation and implementation are key components in the process to define and implement an international toxics strategy that is productive and successful. Accordingly:

17. The Commission *recommends* that the Parties, States and Provinces review measures being undertaken to ensure maximum coordination within and among jurisdictions to reduce any fragmentation of responsibilities pertinent to toxic substances control, and to increase cooperative, mutually supportive policies and programs in all agencies.

Development of New and Revised Objectives

Concern has been raised about the relationships between concepts relating to the removal of persistent toxic substances from the Great Lakes, including those of virtual elimination, zero discharge and the nature of certain specific water quality objectives in the

Agreement. Even the definition used for toxic substances has been questioned because of its generality.

In the Commission's judgment, these terms reflect concepts or philosophies to govern control programs. Specific criteria required to assess ambient levels of pollutants and the need for other remedial actions are not necessarily inconsistent with such philosophies. They are complementary concepts. However, certain specific objectives may have to be modified or eliminated under Article IV of the Agreement to reinforce strict implementation of the above concepts and as greater understanding is gained of the impacts of certain substances on beneficial uses.

The Commission continues to support the development of new or revised Specific Objectives for incorporation into the Agreement. New objectives, including a new concept of ecosystem objectives, continue to be developed under the auspices of the Science Advisory Board. Eleven new objectives have been recommended since signing of the 1978 Agreement but have not been formally adopted.* The Canadian Government response to the Second Biennial Report notes that the matter will be given attention in the context of the pending Agreement review.

Nevertheless, as new problems become apparent and new objectives are developed or existing ones modified, it is important that they are integrated into ongoing regulatory programs. The 1978 Agreement contains a clause concerning adoption of revised objectives, but it is not clear how they are integrated into ongoing programs. Consequently:

18. The Commission *recommends* that the Parties, in addition to adopting the previously proposed Specific Objectives, consult on a practical procedure for ensuring the timely consideration and adoption of new or revised Specific Objectives required under the Agreement.

Further, as noted, new kinds of information and data can form the basis for new objectives. These can be based on end use (fishing, swimming, drinking), mass loading of degradable substances, indicator species and objectives for complex chemical mixtures. Assessment techniques include life-cycle bioassays, molecular and cellular probes, and data associated with avoidance reaction and behavioral abnormalities. Such information may require special evaluative and interpretive procedures which are not currently available but need to be developed. The Commission also draws attention to a recent report of the Aquatic Ecosystem Objectives Committee of the Science Advisory Board concerning the potential of using lake trout populations as an ecosystem

* These objectives are for asbestos, diazinon, lead, microbiological indicators, mirex, nutrients, pentachlorophenol, polychlorinated biphenyls, polychlorinated dibenzodioxins, polynuclear aromatic hydrocarbons, and selenium.

objective. To encourage the development of innovative, useful and scientifically valid approaches:

19. The Commission *recommends* continuing research into the process of developing and improving Specific Objectives.

Encourage New Widely Applicable Technologies for Control of Toxic Pollutants

Institutional mechanisms to encourage and facilitate the development and implementation of new technologies are important in reducing and controlling toxic substances. Incentives, in addition to potential economic advantages, could be provided to encourage the use of new technologies for point and nonpoint pollution sources. Disincentives, such as the lack of systematic revision of handbooks and codes of practice that put new pollution control technologies into practice, delays in patent processing, required revisions to zoning or pollution control regulations, should be avoided. Therefore:

20. The Commission *recommends* that Governments ensure their procedures facilitate the rapid approval and implementation of new technologies for the control of toxic pollutants.

Extending the Commitment

For several years, the Commission has stated the need for developing long-term, basic preventive solutions to the toxics problem, in addition to the shorter-term, reactive attention given to specific pollutants and incidents. While the concepts of recycling, reuse and replacement of toxic substances have received a great deal of attention, they have yet to be adopted widely and effectively in business and private lifestyles in North America. The manufacture, production, use and disposal of toxic substances have created monumental problems to which governments alone cannot provide all necessary solutions.

The Commission continues to believe that a major part of the solution, especially for the long term, is for individual citizens to engage in creative actions and economic decisions that include the control of toxic material as an important criterion and that will contribute to the elimination of persistent toxic substances in many production processes. Increased citizen involvement in activities such as recycling and the proper disposal of hazardous household products can occur through education, demonstration and involvement programs. The impressive degree of public involvement and knowledge present at the 1983 Indianapolis and 1985 Kingston Agreement meetings can and should be extended in productive ways.

At a concurrent session at the Kingston, Ontario Great Lakes Water Quality meeting, municipalities discussed their roles and interest in Great Lakes water quality. Sponsored by the City of Kingston and the Association of Municipalities of Ontario, this consultative meeting reached two basic conclusions:

1. municipalities have a role in applying aspects of the Agreement but need technical and financial assistance to develop and apply environmentally sound, cost-effective policies and procedures; and
2. municipalities should become actively involved in a basinwide effort to meet and work with senior governments and the Commission on matters of particular relevance under the Agreement.

Municipal representatives also stated a need for nonpoint pollution control plans, increased action against polluters, additional drainage regulations, erosion control, better public education and recognition of the economic advantages to protecting the Great Lakes as a recreational resource.

Senior governmental agencies alone are not able to bring about the level of direct effort necessary to deal effectively with toxics substances in the Great Lakes. The Commission believes that considerable expertise, interest and potential for action exists at the state, provincial and municipal level, which should be assisted and encouraged. The Commission commends this vital activity at these levels and by citizen interest groups and encourages their continued efforts.

The development of remedial action plans for the 42 Areas of Concern by the jurisdictions offers good examples of how the local community can be involved effectively in the process of restoring uses to these Areas. The views expressed in previous Biennial Reports and the 1980 Report on Pollution of the Great Lakes from Land Use Activities on public involvement and responsibility conclude that individual and local-area activities must be addressed and encouraged. Therefore:

21. The Commission *recommends* that Governments consider a major program of public and consumer education, and that increased support be given to localized and private sector efforts to reduce the use of toxic substances and to control their storage and disposal.

The Commission also concludes that public knowledge of existing efforts by the government and the private sector is not widespread. Additional information on actions and their expected results should be part of the program recommended above. Because solutions to the toxics problem will be less dramatic and more long term than those achieved with Great Lakes eutrophication, public interest and concern must be sustained over an extended period in order to develop citizen support and positive perceptions towards the control and prevention of toxic substances pollution. Thus the Parties could include active participation at all levels in carefully designed programs to lessen the use of persistent toxic substances and eventually prevent the toxics problem.

Coordinated public information programs that provide effective exchange between experts and citizens will also ensure that conflicting and confusing information is not received by citizens of different jurisdictions in the Great Lakes

region. Finally, as noted above, maintaining a high Agreement profile among the public and at the political level will help sustain strong support for a Binational Great Lakes Toxics Management Strategy.

Short-term Program and Information Elements

Elements of existing programs or Agreement provisions requiring more immediate improvement, redirection, renewed emphasis, or clarification include the identification of priority toxic substances, limited use zones, remedial action plans for Areas of Concern, improving control of toxics from point and nonpoint sources and improving planning and budgetary processes.

The Identification of Hazardous and Persistent Toxic Substances of Concern

Of the thousands of chemicals in the marketplace and the Great Lakes basin, only a few can practically be considered at any given time. A method to screen and establish priorities for serious problem chemicals is required in order to focus attention for monitoring, controls and preventive remedial action.

Annex 10 of the 1978 Agreement provides lists of hazardous polluting substances. The Parties are required to revise these lists continually and develop programs to minimize or eliminate the risk of release of those substances. It is not clear what use, if any, has been made of this Annex. The jurisdictions have their own lists of substances for hazardous substances regulation, which may be adequate for other Agreement purposes.

Annex 12 concerns those persistent toxic substances which are the principal pollution issue for the Great Lakes. While some substances (PCBs, DDT, mercury, mirex) have been banned or controlled, residuals remain. Many other chemicals are appearing, including a large number of new substances. Measures to monitor and control them, let alone assess their significance at the levels and in the combinations found, are not adequate at present. Further, a complete inventory of comprehensive, coordinated programs for their control does not exist. A short list of priority substances has been developed by the Great Lakes Water Quality Board as a focus for immediate action.

22. The Commission *recommends* that the Binational Toxics Management Strategy give priority to the identification jointly by the Governments of chemicals of urgent concern and specifically to the review of the purpose and contents of Annexes 10 and 12 of the Agreement.

Relationships between Specific Objectives, Water Quality Standards and other Regulatory Requirements

In the Preamble to the Agreement, the Parties conclude that the best means to preserve and improve water quality is by adopting common objectives and implementing cooperative programs and other measures to achieve them. Furthermore, the Parties recognize the importance of linking the Specific Objectives to regulatory programs. Article V includes the following language: "Water quality standards and other regulatory requirements of the Parties shall be consistent with the achievement of the General and Specific Objectives. The Parties shall use their best efforts to ensure that water quality standards and other regulatory requirements of the State and Provincial Governments shall similarly be consistent with the achievement of these objectives."

Because of Article V's central importance, the Commission has requested information from the Parties on how they are addressing this matter in setting jurisdictional standards on other requirements. The Commission has received general assurances from both Parties that the intent of the Agreement is being followed. The Commission concludes, however, that it is essential to understand precisely how this linkage is occurring in the various jurisdictions in light of the central importance of the Specific Objectives in assessing progress under and compliance with the Agreement. Furthermore, the Commission continues to see a need to understand and take account of multiple sources and cumulative effects of contaminants with respect to setting Specific Objectives.

23. Because the achievement of the General and Specific Objectives is such an important measure of Agreement progress, the Commission *recommends* that:

(a) the Parties and jurisdictions provide the Commission with a current assessment of their procedures and progress in ensuring that water quality standards and other regulatory requirements are consistent with achievement of Agreement Specific Objectives; and
(b) the Parties and jurisdictions advise the Commission in detail as to how, with respect to Specific Objectives, the cumulative impacts of various point and nonpoint sources of individual and multiple contaminants, both within and between jurisdictions, are taken into account in setting water quality standards and other regulatory requirements.

Resolving the Limited Use Zone Issue

Article IV and Annex 2 of the Agreement require the Parties, in consultation with state and provincial governments, to define limited use zones in areas within which some of the Specific Objectives may not apply. The Parties were to keep the limited use zones under review with the objective of reducing their size. The Parties also were to prepare an annual report on the progress of these measures.

The Commission has interpreted the Agreement as intending that Specific Objectives should apply everywhere in the Great Lakes system except within the defined limited use zones and certain areas of inshore waters where natural phenomena prevent their achievement. These natural areas also must be identified explicitly and reported to the Commission as early as possible.

Whatever their advantages or disadvantages, the Commission has been informed by the Environmental Protection Agency that limited use zones are viewed in the United States as justifying the use of dilution as a treatment method for pollution, contrary to the United States Clean Water Act of 1972. Limited use zones are seen as being inconsistent with the position that no one has the right to pollute, that pollution continues because of technological limits and not because of any inherent right to use the nations' waterways for the purpose of disposing or treating waste. Neither Government has designated such zones.

Concerned about the practicality of Specific Objectives applying everywhere, the Commission has encouraged the Parties to develop practical ways to address the positive features of the limited use zone provisions without implying that governments condone pollution. In its Second Biennial Report, the Commission outlined the following possible approach to the matter:

If the concept of limited use zones as outlined in the 1978 Agreement is unworkable, then the designation by Governments of areas where objectives currently are not being achieved, analagous to the Areas of Concern identified by the Great Lakes Water Quality Board, might be one of the options considered. Monitoring and surveillance programs would provide the basis for an assessment of the extent to which the various Specific Objectives are not currently being achieved, and the extent to which beneficial uses are being impaired. This, together with information regarding planned measures and a time-table for dealing with problems, would provide the Commission with a better information base for assessing the state of the Great Lakes system and the adequacy of governmental programs.

This approach would not address the provisions in Annex 2 that limited use zones shall not transect the international boundary or create certain conditions adversely affecting aquatic organisms and areas of extraordinary natural resource value.

This approach would produce an explicit designation of areas where Specific Objectives are not being achieved and the extent to which beneficial uses are impaired. It would create specific plans and timetables for dealing with the areas and uses identified, and provide a basis for tracking progress towards reducing the areas where objectives are exceeded and beneficial uses are affected. If the Parties were to provide the reports specified in Annex 2 based on such information, the Commission and others could assess overall progress with respect to the achievement of Specific Objectives, the restoration of beneficial uses and the adequacy of programs in a manner that is not presently possible.

24. The Commission *recommends* that:

(a) the Parties take measures to delineate those areas in the boundary waters of the Great Lakes system where Specific Objectives are not being achieved and to assess the impact on existing and potential beneficial uses;
(b) the Parties provide the Commission with a comprehensive baseline report, updated annually to assess progress in reducing the size and numbers of such areas; and
(c) the Parties identify those areas where natural phenomena prevent the achievement of some Specific Objectives.

Remedial Action Plans

The Great Lakes Water Quality Board has identified a number of specific locations, initially called Problem Areas and now Areas of Concern. These areas continue to suffer significant degradation, as defined by the exceeding of Specific Objectives, use impairment and other criteria. Little overall progress has been made towards eliminating them. Recently, however, at the request of the Water Quality Board, the Great Lakes jurisdictions have begun to develop remedial action plans to restore beneficial uses in these Areas.

The Commission welcomes the remedial action plan initiative as a substantial step forward in meeting the spirit of Annex 2 of the Agreement, as well as generally developing definite plans and commitments towards cleaning up Areas of Concern. Remedial action plans are consistent with the Commission's suggested approach to address aspects of the limited use zone problem, and they provide an important step forward in dealing with several major localized areas that are the most significant locations in which Specific Objectives are being exceeded and beneficial uses directly impaired.

25. The Commission considers the designation of Areas of Concern and the development of remedial action plans to be an important initiative deserving widespread recognition and support, and therefore *recommends* that:

(a) the Parties, jurisdictions and relevant municipal governments formally provide active support to the development and implementation of remedial action plans for Areas of Concern;
(b) all levels of government take steps to foster community support and involvement in developing and implementing the remedial action plans; and
(c) the Parties and jurisdictions keep the Commission currently apprised of progress being made to rehabilitate Areas of Concern.

Control of Municipal and Industrial Discharges

The control of discharges from major and minor point sources remains an important aspect of a comprehensive toxics strategy. The stringent application of standards, permits and orders consistent with the Agreement's provisions will be critical. It is essential that domestic requirements cover all substances of concern. In many cases, permits and control orders list only a few of the well-known persistent and nonpersistent toxic substances, and monitoring occurs only for those substances specifically listed. An inadequate list of substances of concern creates incomplete monitoring and enforcement.

26. The Commission *recommends* that the Parties, with the States and Province, conduct a regular, periodic review of existing permits or control orders and enforcement measures for all polluting substances and sources in relation to Agreement provisions.

In some cases, chemicals may have to be prohibited or replaced at their source if their intrusion into the environment cannot otherwise be prevented. A number of manufacturers have made substantial progress in this regard and often have found the effort to be financially advantageous. The Commission sees a necessity to tap the expertise, resourcefulness and commitment of the industrial and commercial sectors if toxic contamination is to be successfully addressed. Therefore:

27. The Commission *recommends* that Governments seek ways to actively engage industry in developing and implementing alternatives to processes and products that result in toxic byproducts entering the natural environment.

A Special Strategy for Nonpoint Source Toxic Pollutants

As control of point sources of pollution progresses, increasing attention turns to the more complicated problem of controlling nonpoint pollution sources. In the First and Second Biennial Reports and the Report on Pollution of the Great Lakes from Land-Use Activities, the Commission emphasized the importance of nonpoint source control strategies. These reports also noted several small-scale but highly effective nonpoint source demonstration projects that could serve as models for larger-scale governmental programs. These demonstration projects exemplify the Commission's view that the most effective solutions often involve improved housekeeping practices, local commitment and careful attention to use, storage and disposal of potentially polluting substances.

Changes in agricultural practices, improved urban design practices, preventing fugitive emissions from leaking or open pipes and dumps, and reducing the number of small sources of pollutants to prevent multiple nonpoint sources from becoming area sources are examples of the types of programs required. These demonstration programs should be developed and presented in

different applications and locations to ensure that they are widely used and included as a part of normal industrial and consumer operating practices. Accordingly:

28. The Commission *recommends* that the Parties develop a special strategy for nonpoint source toxic pollutants, with emphasis on the demonstration and use of broadly applicable techniques.

Pesticides

Pesticides are toxic chemicals licensed to control targeted species that adversely affect commerce or transmit disease. The ideal pesticide works only against its target species and is harmless to others. Unfortunately, pesticides also injure species which are not intended targets.

Careless and excessive pesticide use in agricultural and domestic activities can and has destroyed the sensitive ecological balance of natural systems. Several chemicals which are listed as Specific Objectives are pesticides or were once used as pesticides. Some of these – aldrin/dieldrin, heptachlor and toxaphene – are established or strongly suspected human carcinogens.

Both countries have legislation and programs that affect pesticide use. Some policies encourage while others tend to discourage prudent pesticide usage. Integrated pest management incorporates improved mechanical practices in agriculture with other non-pesticide techniques, such as sterilization of target species to reduce population levels, and can result in lower overall usage or more ecologically sound practice. These programs have received continuous but limited support, and should be encouraged. Therefore:

29. The Commission *recommends* greater attention to promulgating and enforcing stringent pesticide controls and regulations, taking into account the potential for the wider use of integrated pest management. These activities should form the basis for a comprehensive pesticide policy within the Binational Toxics Management Strategy for the Great Lakes Basin Ecosystem.

Hazardous Materials in Waste Disposal Sites

Indiscriminate or improper disposal of toxic and hazardous substances is recognized as the source of some persistent toxic contaminants in the Great Lakes, especially those found in groundwater near disposal sites. Government studies of the connecting channels are identifying this problem. All Great Lakes basin disposal sites, however, are potential sources of dangerous quantities of toxic chemicals. Accordingly:

30. The Commission *recommends* that a high priority be given to the continuing identification of the precise types and quantities of chemicals in disposal sites. These chemicals should then be removed or steps taken to ensure that they remain securely and permanently on site.

The disposal of small quantities of hazardous materials such as pesticides, solvents and contaminated oils from households, construction sites and small businesses also must be controlled. The Commission notes the existence of small-scale experimental programs for the centralized collection of substances, and encourages the implementation of these measures in Great Lakes basin communities.

Atmospheric Deposition

Many chemicals become water pollutants as a result of their deposition from the atmosphere. Because of the connection between Great Lakes pollution and atmospheric deposition, even from remote sources, strategies to control toxic chemicals in water must be integrated with those for airborne pollutants. The Commission addressed this issue under recommendation three of this report.

Improved Budgetary and Planning Processes to Assure the Resources Needed to Identify Toxic Substances and Their Impacts

Successful implementation of a coordinated strategy for toxic substances will require the provision of adequate governmental resources. Accordingly:

31. The Commission *recommends* that the Parties review their respective budgetary and planning processes to ensure that necessary resources are allocated to support the development and implementation of a Binational Toxics Management Strategy.

Additionally, increased cooperation is needed in research funding. For the most part, environmental agency research is performed independently according to uncertain short-term budgetary arrangements and under varying rules of the sponsoring organizations. The Commission suggests that Agreement-related research programs deserve a more unified, consistent and international approach. Independent, long-term joint funding by the Parties should be considered to remove differences in local and national procedures. Such funding could better support broadly-based studies consistent with an ecosystem approach. Therefore:

32. The Commission *recommends* that joint funding or at least more coordinated programs specifically supportive of Agreement research, monitoring and surveillance be initiated by the Parties.

E. Phosphorus and Other Nutrients

Past successes concerning phosphorus control clearly demonstrate the ability of the Parties to control a major pollution problem and the resulting environmental and economic degradation.

Programs to reduce phosphorus and other nutrients were to be based on the confirmation of target loads and allocations and were to be completed by May 1980. The Phosphorus Load Reduction Supplement, signed in October 1983, confirmed target loads for all lakes except Lake Ontario.

The programs to reduce municipal sources of phosphorus to 1.0 mg/L on a monthly average at large plants generally have now been achieved. Detergent phosphorus limitations have been retained in most jurisdictions, suspended and reinstated in Wisconsin, but have not been implemented by Ohio and Pennsylvania.

Article VI of the Agreement focuses on pollution from agricultural, forestry and other land use activities. The Commission's 1980 and 1981 reports on this subject based on the Reports of the Pollution from Land Use Activities Reference Group and the Task Force on Phosphorus Management Strategies emphasize that reductions in phosphorus from such sources are necessary in order to reach target loads in a cost-effective manner. The 1983 Phosphorus Load Reduction Supplement reiterates the need for such programs. It incorporates the submission of phosphorus load reduction plans to the Commission, which are to include the designation of priority management areas for urban and agricultural nonpoint programs and measures. The programs received by the Commission are now under review.

The Commission notes that considerable activity has occurred in two areas: developing national strategies and operating localized demonstration programs. One notable program by the U. S. Army Corps of Engineers to reduce nutrient loads to Lake Erie successfully demonstrates the pollution control and other benefits achievable from nonpoint measures. In its 1980 Report, the Commission concludes that a comprehensive, coordinated strategy is required. Without such a strategy, the continuity and effectiveness of such efforts in the face of conflicting pressures are in question.

The needed strategy includes:

(i) continued design and operation of major municipal wastewater treatment plants to a maximum effluent phosphorus concentration of 1.0 mg/L. Efficient operation according to design specifications is often a problem. Proper operator training, equipment maintenance and replacement are a continuing necessity.

(ii) further reductions in effluent concentration of specific plants as may be required to meet target loads agreed to in the 1983 Phosphorus Load Reduction Supplement to the Agreement, and subsequent loading allocations, and as may be achievable by improved technology.

(iii) continued application of detergent phosphorus limits, and its application in all Great Lakes jurisdictions.

(iv) continued support for technology development and demonstration programs for point and nonpoint phosphorus sources. In the case of nonpoint phosphorus, further development, announcement and support of a comprehensive remedial strategy are required. These should be based largely on broadly conducted but locally applied remedial plans, with adequate technical and other support to local efforts.

33. The Commission *recommends* that Governments continue to ensure the control of phosphorus inputs to the Great Lakes system, and that they develop and implement a comprehensive phosphorus management plan such as that outlined by the Commission.

Another related problem may be emerging. The strategies to control and reverse the effects of eutrophication in the Great Lakes are based exclusively on reducing phosphorus loadings. As point sources of phosphorus are controlled, attention is being directed to phosphorus in nonpoint sources of agricultural and urban runoff, sediments and airborne particulates. Yet, when nutrient control was first proposed, others besides phosphorus were also considered – particularly nitrogen, silica and carbon.

Now the Water Quality Board has reported to the Commission that nitrogen has continuously increased in the Great Lakes basin. The implications are yet unclear, but if the growth in undesirable plant species is shown to result from this trend, some control of nitrogen inputs to the Great Lakes may become necessary. Such measures will be more expensive than those for phosphorus because of the more complicated aquatic chemistry of nitrogen compounds and may have implications for the type of control programs, including those for nonpoint sources. Other nutrients also may play a role, which will require study and perhaps control.

The Commission believes that Governments may, in the near future, be compelled to address the question: After phosphorus, what? If other nutrients require control, significant financial resources may be required as they have been for phosphorus control and research since 1972. Unwise planning with respect to other nutrients may reduce the achievements of phosphorus control. The Commission does not recommend any particular action at this time, but does encourage the Parties and jurisdictions to begin to consider the implications of increased nitrogen levels in the Great Lakes.

F. Great Lakes Science and the Agreement

Historical Considerations

Viewed from a historical perspective, the Great Lakes research community has played a central role in alerting governments and the public to the need to become aware of the human impacts on the Great Lakes system. In the 1950s and 1960s scientists, working individually and collectively through learned and professional societies, were able to focus public and political attention on the Great Lakes. This attention led in turn to a Reference to the International Joint Commission in 1964 to examine and report on the pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. The Commission relied on members of the Great Lakes research community and others to serve on its study teams and to address the questions posed as a result of what was later called the Lower Lakes Reference. These experts, mainly engineers and scientists who had worked on water quality issues, worked under the Commission umbrella to build international consensus and commitment to address lower lakes eutrophication.

The Great Lakes research community continued to play a major role following the signing of the 1972 Great Lakes Water Quality Agreement. Direct, Agreement-related research as well as other study efforts were undertaken to support two other major Commission References, the Upper Lakes Reference Group and the Pollution from Land Use Activities Reference Group (PLUARG). Both studies highlighted the issue of toxic substances in the Great Lakes system and focused attention on the dangers posed by toxic substances. These studies, along with reports of the Commission's Great Lakes Research Advisory Board (now the Great Lakes Science Advisory Board), drew attention to the need for a Great Lakes ecosystem approach.

This involvement has continued and expanded with the 1978 Agreement and its emphasis on an ecosystem approach. The research community, with an expanding range of disciplines in the natural and social sciences, has continued to help solve a wide range of issues encompassed within the Agreement and has operated essentially as part of an ongoing decision-support system. This active and intense involvement of the Great Lakes research community in Commission work is an excellent example of the mutually supportive relationship between the Commission and expert advisors who serve on its boards, and how a binational effort can lead to important initiatives.

Many scientific aspects of Agreement issues are only vaguely understood and actual implementation is limited by incomplete understanding of the specific and cumulative causes and impacts of human activities on the Great Lakes system. Detailed understanding of how the Great Lakes system functions, including its institutional framework, is an ongoing and expanding requirement.

The Commission looks to the Great Lakes research community to anticipate the specific implications of human activities and help define the major emerging issues demanding research attention. Researchers also help to assess the predicted and actual consequences of human activities in the Great Lakes ecosystem and to

adapt and adopt policies, programs and other measures that are consistent with emerging ecosystem realities. The Parties will continue to benefit from sustaining a level of Great Lakes-related scientific expertise consistent with the historical role described above.

Science and the Agreement

The Agreement specifically commits the Governments to intensified research on the pathways, fate and effects of toxic substances and to maintaining research to seek maximum efficiency and effectiveness in the control of phosphorus introductions into the Great Lakes. The Agreement also contains explicit language (Annex 7) committing the Parties to encourage research to "investigate advances in dredging technology and the pathways, fate and effects of nutrients and contaminants of dredged materials." In fact, the Agreement contains numerous references to the need to develop and share necessary information and knowledge to understand how the Great Lakes system is used and abused.

New research needs related to the Agreement which have emerged since 1978 (such as groundwater, atmospheric deposition and in-situ sediments) and the complexity of the toxics issue have increased the stress on the Great Lakes research community and on the agencies and institutions supporting research. Most Great Lakes scientists were recruited when the principal threat to the lakes was perceived to be eutrophication, the solution to which hinged primarily on the ability to limit and assess the input of a single nutrient, phosphorus. In contrast, toxic substances, involving scores of biologically important contaminants in various permutations and combinations, is a more complex issue. The approaches used in phosphorus management and control often have limited applicability to toxic substances, and the research required is quite different.

In general, monitoring and research agencies have had limited ability to recruit personnel with the specialized training and experience to address toxics or to redirect the research of available scientists. All indications point to continued difficulty in the area of specialized recruitment. Furthermore, there is a growing need for involving additional disciplines in the natural, health, social and policy sciences to expand our understanding of the Great Lakes ecosystem and various impacts within it. While these factors have inhibited some agencies in addressing new research needs, the Commission is encouraged by recent efforts of several government agencies to establish training programs in the health sciences and the growing recognition of the importance of linking science to decision-making.

The Commission has repeatedly stated that its ability to carry out its Article VII responsibilities, and ultimately the Parties' ability to make wise resource decisions, depend on complete, accurate and timely data. Further, as the Commission has stated in its previous Biennial Reports, adequately funded, Great Lakes-centered scientific research is crucial. Some institutional aspects of managing Great Lakes science make it difficult to address important cross-media and interdisciplinary issues inherent in the ecosystem approach.

Toxic substances move across and between air, water, land and living organisms. Agencies studying the problem of toxics, however, often cannot support work which falls outside their media-specific mandates. Cumulative impacts of a range of stresses on the Great Lakes system are important. Ecosystem responses to processes of bioaccumulation of chemicals, lake eutrophication, sediment erosion and movement (including dredging activities), and the introduction of exotic species are all interrelated phenomena. Yet, often the best we can do is study these phenomena as discrete and separate aspects. For example, it would be difficult to assess the significance of current or potential dredging policies on the eutrophication or the toxic substances problem. Nor can we evaluate the significance of salmonid introductions on water quality in the Great Lakes, even though we are finding evidence of the importance of their effects.

Some research programs have become particularly important to joint Agreement efforts through practice and a recognition of their utility, thus transcending the needs of a single sponsoring agency. The Commission depends on these exceptional programs. Government decisions or proposals to reduce or eliminate such programs without consultation with other jurisdictions or with the Commission can have disruptive effects on other Great Lakes program elements.

A recent example is the major reduction in the Great Lakes Herring Gull Monitoring Program and in the scientific team that made the program an international success. The Commission is pleased to note, however, that some aspects of this program have been restored and encourages Governments to reinstate remaining program elements that monitored the overall health of the herring gull population. Observers in both nations believe this program provides some of the best data for informed judgment on overall progress in the management of toxic chemicals in the Great Lakes ecosystem. Herring gulls, which swim in the Great Lakes system, drink its waters and eat its fish, are showing some signs of improved reproductive capacity. Should this trend continue, it will be an encouraging development since research shows that reproductive success in herring gulls is correlated with chemical residues in the gulls and their eggs.

The reduction in the Great Lakes Herring Gull Monitoring Program, other planned or proposed reductions in funding, and the uncertain future of Great Lakes research organizations in both countries illustrate a weakness with the Agreement. Programs that produce shared Agreement information are important to the Commission and to the Parties. If programs are decreased or eliminated, especially in the absence of prior consultation with the other interested parties, it undermines the spirit of cooperation that is so important to Agreement success.

Long-Term Research

The Commission continues to point out the need for a cross-media approach for addressing pollution in the Great Lakes Basin Ecosystem. A better understanding of the relative importance of the

various pathways of toxic substances into the Great Lakes is needed, as well as developing better measures of the effects of these pathways and substances on the health of the aquatic ecosystem. Since many of these pathways result in exposure to human populations, there is a clear need to develop better assessments of the known and potential risks to human health.

One emerging concern which requires research is the relationship between the behavior of chlorine materials from various industrial and municipal sources and organic compounds in waters that can combine to produce chlorinated organic substances like chlorinated dioxins and furans. Environmental surveys of the distribution of chlorinated dioxins and furans show that these chemicals are generated in the effluents of sewage treatment plants, pulp and paper processing operations, incinerators and other unusual and unlikely situations.

Another area of research which has received little attention is the relationship between human health and the development of specific objectives under the Agreement. All known human carcinogens cause cancer in other animal species, but the converse assumption, that all substances causing cancer in non-human species will also cause cancer in humans, is not absolutely established. Scientific questions exist about how to extrapolate data from animal carcinogen studies to humans.

Several human carcinogens, such as polyaromatic hydrocarbons and arsenic, cause tumors in certain fishes and shellfishes. The policy of some regulatory agencies is that a substance causing cancer in a non-human species is a potential danger to humans. It may also be prudent to assume that a human carcinogen poses a serious hazard to aquatic organisms and ecosystems. Research is needed to develop risk assessment procedures for ecosystems and aquatic species using information about human carcinogens.

Bioassay studies related to human health usually use small mammals. The use of aquatic species in such studies is new, but results are promising. Aquatic species offer several advantages over small mammals, notably reduced costs, absence of certain laboratory diseases, and flexibility with respect to genetic variability in test animals. Because this type of research offers scientific advances with reduced costs in testing, the Parties should support research into how aquatic bioassay studies can assist in assessing human health problems among Agreement-related activities.

The increased use and application of epidemiological studies to the Great Lakes are encouraged. Research programs should examine the relationships between human health and the health of aquatic communities as one of the innovative techniques that can be used within the ecosystem approach.

Finally, a research topic that clearly requires strengthening is the role of socio-economic considerations in Agreement implementation. The toxic substances issue is generally recognized as one that will require substantial and sustained community support in attitudes and behavior to reinforce actions necessary to achieve the Agreement goal of virtually eliminating toxic substances. There is a need to understand and encourage the socio-economic factors involved.

34. The Commission *recommends* that Governments and implementing agencies develop appropriate mechanisms to encourage innovative, long-term, multidisciplinary research on the control, transport, fate and effects (including human health effects) of toxic substances in the Great Lakes Basin Ecosystem.

Midscale Ecosystem Experiments

A dilemma faced by the Great Lakes research community is the challenge to design, fund and implement research programs yielding quantifiable, reproducible results which are also directly relevant to the major policy issues faced by responsible agencies. Carefully controlled experiments conducted in microsystems like test tubes or aquaria are relatively simple, but the extent to which the results apply to the management of the Great Lakes system is another matter. Alternatively, one can monitor and then attempt to interpret events as they actually occur in the Great Lakes system, but that approach does not satisfy the goal to draw definitive cause-effect relationships, and the experiment basically is uncontrolled. It is difficult to develop and implement investigations that are relevant to real issues and which yield scientifically valid and meaningful conclusions. Midscale ecosystems such as limnocorrals, ponds and bays can be used as experimental areas as an alternative to the difficulties posed by large-scale investigations.

This dilemma is most apparent in the development of remedial action plans in the Areas of Concern. Areas of Concern pose severe problems in meeting Agreement objectives, and yet our information is imperfect about the probable implications of various management options. Therefore:

35. The Commission *recommends* that the Parties and jurisdictions consider the development of appropriate experiments in midscale ecosystems to test the potential application of promising ideas and approaches to remedial action plans and other programs.

Radioactivity

The use and the disposal in the basin of radioactive materials continues to be of concern to the Commission. Low-level radioactive waste originates from use of radioactive materials in schools, hospitals, industrial organizations and sources other than power production or military applications. One of the major existing sites for low-level radioactive waste disposal within the Great Lakes region, Port Hope, Ontario, is listed as an Area of Concern. Recent hearings and reports from atomic energy laboratories and regulatory groups in the United States and Canada suggest growing concern about a future shortage of disposal sites for these materials.

Until 1981, the Commission received information on radioactive concentrations in the Great Lakes region as part of routine surveillance activities. Recently, that information has come at uneven intervals. While the existing water quality objective which uses total exposure is still valid, specific isotopes are

especially noteworthy because of their longevity and acute toxicity. As sources of these isotopes are found in the basin, it is appropriate to augment the existing objective and to incorporate the measurement of these isotopes into the routine monitoring program. These should be reported to the Commission on a regular basis.

Risk Assessment

Risk assessment is a process to quantify the probabilities of occurrence of certain events associated with hazardous materials or situations. In environmental work, the important probabilities are for those certain biological effects resulting from exposure to a dangerous material or situation. The process does not present choices or strategies for decisions based on the estimated probabilities; any decision to take a risk is one of social policy or individual decision making, regardless of the ability to quantify the risk probability involved. Ensuring that all risks are fully described and measured and obtaining sufficient data that are meaningful to the recipients of the risk are difficult. Nevertheless, some regulators are under strong pressure to mandate risk assessment in regulatory analysis.

In some cases, several different models and approaches may suggest different risks with the same data set. Comparative risk analysis may reveal otherwise unrecognized risk possibilities. It is also difficult to present risk assessment results and use them meaningfully with untrained or nonexpert persons (a description which would apply to most of the Great Lakes or any other communities). Presumably, the ultimate objectives are to interpret and apply these results to policy decisions. The Commission is interested, therefore, in how risk assessment processes affect legislative, judicial, social, diplomatic and public decision-making processes.

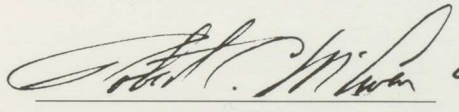
The methods, models and data used in risk assessments have been questioned generally but also particularly with respect to Agreement activities. Data related to the use patterns of chemicals for which a risk assessment analysis is being performed have not necessarily reflected the use patterns in the Great Lakes region. Exposure and demographic information, model epidemiological studies and other aspects of exposure analysis have used situations only remotely related to the Great Lakes.

These factors cause the Commission to continue to have limited confidence in the ability of current risk assessment analyses alone to provide reliable and relevant results with respect to decisions on activities related to the Great Lakes Water Quality Agreement. Accordingly:

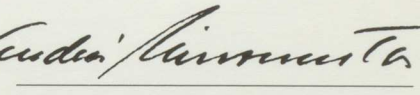
36. The Commission *recommends* that the Parties proceed cautiously with the use of risk assessment as a basis for pollution control regulations.

The Commission commends this series of general and specific, short-term and long-term recommendations to the Governments of the United States and Canada, and the Great Lakes provincial and state jurisdictions, as they enter into the important process of reviewing the provisions and accomplishments of the 1978 Great Lakes Water Quality Agreement.

Signed this 10th day of December 1986 as the International Joint Commission's Third Biennial Report Under the Great Lakes Water Quality Agreement of 1978.



Robert C. McEwen



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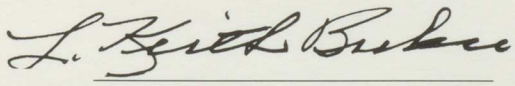

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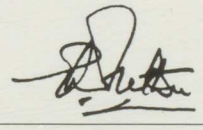

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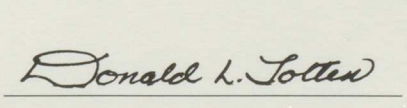

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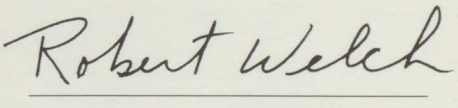

Robert S.K. Welch

The International Joint Commission is authorized ... to examine into and report upon the facts and circumstances of the particular questions and matters referred, together with such conclusions and recommendations as may be appropriate, subject, however, to any restrictions or exceptions which may be imposed with respect thereto by the terms of reference."

Boundary Waters Treaty of 1909

Article IX