

Seventh Biennial Report Under the Great Lakes Water Quality Agreement of 1978

to the Governments of the United States and Canada and the State and Provincial
Governments of the Great Lakes Basin

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"Toxic Substance means a substance which can cause death, disease, behavioural abnormalities, cancer, genetic mutations, physiological or reproductive malfunctions or physical deformities in any organism or its offspring, or which can become poisonous after concentration in the food chain or in combination with other substances."

Definition as agreed to by the United States and Canada in the Great Lakes Water Quality Agreement of 1978, as amended by Protocol on November 18, 1987

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CHAPTER ONE:

Introduction

The **Great Lakes Water Quality Agreement** (Agreement) between the Governments of the United States and Canada makes far-reaching commitments concerning the restoration and protection of the Great Lakes. These commitments include the virtual elimination of persistent toxic substances within a philosophy of zero discharge, and the adoption of an ecosystemic approach to achieving the Agreement's objectives.

Ensuring the integrity of the Great Lakes ecosystem requires attention to many complex and dynamic components that must be understood and incorporated into an effective plan to achieve the objectives of the Agreement. These interrelated components include the atmosphere, the surrounding land, a wide variety of biological species and their interrelationships and, of course, human activities.

The **International Joint Commission** (Commission) was assigned responsibilities to monitor and assess progress made pursuant to the Agreement, in particular the adequacy of actions by the two federal governments, the Province of Ontario and the eight states in the Great Lakes basin (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin). Part of this responsibility involves providing a report every two years as well as a continuing public information service on Great Lakes water quality issues. This biennial report is the seventh since 1981.

The theme of this report is that the time has arrived for a major shift in the way decision-making takes place for the Great Lakes ecosystem. In particular, society must adopt a clear and comprehensive action plan to virtually eliminate persistent toxic substances that are threatening human health and the future of the Great Lakes ecosystem. A consensus-building process is required that will allow all sectors of society (including governments, business corporations and associations, labour unions, and professional, consumer, and other organizations) to join in making the decisions to effect the required economic and social transition.

The primary focus of the action plan should be to **stop** the continued degradation of the Great Lakes ecosystem from persistent toxic substances. The community of people and interests that share this ecosystem must adopt a common, reasoned strategy to take the needed actions. In Agreement terms, the virtual elimination and "zero" discharge of all persistent toxic substances are the most critical management targets. The real task is much broader, however, and there must be interim steps en route to those targets.

It is first necessary to shift the burden of responsibility for demonstrating whether substances should be allowed in commerce. The concept of reverse onus, or requiring proof that a substance is not toxic or persistent before use, should be the guiding philosophy of environmental management agencies in both countries.

The Commission's **Virtual Elimination Task Force** (VETF) has provided a solid framework for that

action plan. The strategy deals with both existing and new chemicals, and was crafted by a team of experts with various perspectives on the issue. It has already received widespread support.

This report continues the focus of the previous Biennial Reports on the need for an effective strategy to resolve the problem of persistent toxic substances. It:

- reviews what has happened to the Great Lakes and their inhabitants, reasons for concern and a new way of thinking;
 - proposes that the Great Lakes Water Quality Agreement and the sustainable development concept provide valid frameworks for a new approach to decision-making and action;
 - emphasizes a broadly based commitment to the required fundamental changes;
 - reiterates previous recommendations concerning particular chemicals;
 - supports the Virtual Elimination Task Force's proposed approach to virtual elimination as a framework for a specific, immediate action plan for persistent toxic substances;
 - reviews progress with the Lake Superior pilot project for action on zero discharge;
 - comments on groundwater and incinerator concerns;
 - examines progress made in Remedial Action Plans and their usefulness as a model for local action;
 - addresses the evolving roles and needs of science, research and education in decision-making;
 - offers several principles and new recommendations.
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CHAPTER TWO:

What is Happening to the Great Lakes and Their Inhabitants?

Despite progress in cleaning up industrial and municipal pollution over the past 20 years, the integrity of the Great Lakes and life forms that depend on them remain at an unacceptable level of risk from persistent toxic substances. Effective solutions must be found and will require a new approach to environmental management.

Since the Great Lakes Water Quality Agreement was first signed in 1972, various forms of Great Lakes pollution have been identified and reduced. Technology, governmental regulation, and public and private funds have been directed at limiting inputs of phosphorus and other specific chemicals. It is more difficult for polluters to put wastes into the water, air and the ground. Discharges of contaminants to the Great Lakes and their levels in the environment have been reduced, the water quality has visibly improved, and some biological communities have been restored to viability.

In addition, much has been learned about the Great Lakes ecosystem, and a strong binational research community has been fostered by Agreement-related work. New networks and structures to manage and coordinate efforts among the various jurisdictions, primarily under the institutional umbrella of the International Joint Commission, have been created. Since the 1987 Protocol, however, these activities have come under bilateral rather than Commission auspices and have somewhat diminished in intensity.

At the same time progress on "conventional" pollutants was being made, scientists began to identify and understand more complicated issues concerning the use and discharge of toxic and persistent toxic substances. Many persistent chemicals stay in the environment and food chain for very long periods, accumulate in organisms, and injure the functioning of aquatic and other life. We have learned and continue to learn about the harmful impacts of persistent toxic substances on biota, including humans.

While earlier programs reduced some of these substances in the environment, inputs continue to exceed even interim objectives. Many still enter the Great Lakes environment from a wide variety of sources.

Health Effects of Persistent Toxic Substances

Over the past four years, the Commission's major focus has been the linkages between persistent toxic substances, environmental conditions and human health. These linkages have also been a matter of strong and widespread public concern. There are many examples at various scales, from the local issue to lakewide, continental and even global dimensions.

In April 1990, the Commission reported its concerns about the exposure of humans -- particularly children -- to persistent toxic substances, a subject that until then had not received extensive policy discussion. The 1990 and 1992 Biennial Reports contained summaries of pertinent research findings that document injury to humans and a range of fish and wildlife species.

The Commission warned that humans do hold persistent toxic substances in varying levels in their bodies, including their reproductive systems, as do many species of fish, birds, mammals and other biota. The Commission's declaration was and remains:

"What we do to the Great Lakes, we do to ourselves and to our children."

Little evidence has been presented, in the Commission's view, to seriously challenge these earlier findings or the urgent need to address them. Most of the subsequent debate has centred on methodology, on whether the Commission's science is "good" (an issue discussed elsewhere in this report), and on the economic significance of production and use of these chemicals.

And yet, mounting evidence continues to reinforce concerns about the effects of persistent toxic substances. Long-term exposure of fish, wildlife and humans to these substances has been linked to reproductive, metabolic, neurological and behavioural abnormalities; to immunity suppression leading to susceptibility to infections and other life-threatening problems; and to increasing levels of breast and other cancers. Available evidence also points to long-term reproductive and intergenerational effects.

One growing concern is effects on endocrine systems. Research has shown persistent chemicals such as PCBs, dioxins, atrazine, hexachlorobenzene, as well as other organochlorines and polycyclic aromatic hydrocarbons (PAHs), to be strongly implicated in the disruption of endocrine systems, including estrogenic effects, in laboratory animals and in wildlife. The substances appear to act as artificial, external hormones that disrupt the normal balance of hormonal activity in animals.

Studies have also shown similar effects in humans. Levels of these chemicals have been found in humans within the same range, or in some cases at even higher levels, as those found in adversely affected animals. The biological reactions are known to be similar. Furthermore, many of these hormonally active chemicals are found in fish, wildlife and human tissues in the Great Lakes ecosystem.

Biological impacts on organisms need not depend on long-term exposure. A number of studies have indicated that even single doses of some substances at a critical time can affect the offspring of a pregnant animal. Evidence of this phenomenon was given at a workshop held by the Commission's Great Lakes Water Quality Board in 1992 and in a recent review of dioxin by the United States Environmental Protection Agency.

Nor are the effects of persistent toxic substances found only in females. Various studies have indicated increased infertility as well as cancers and other abnormalities in male reproductive systems. Human sperm counts have been reported to have declined by 50 percent over the past 50 years. Sperm samples tested in one recent Canadian study indicated the presence of several persistent organochlorine substances.

We do not know what all of the effects of human exposure will be over many years. Future research will clarify whether low-level and long-term exposures, repeated exposures, or isolated short-term exposures at sensitive stages of fetal development are most critical. For the Commission, however, there is sufficient evidence now to infer a real risk of serious impacts in humans. Increasingly, human data support this conclusion.

Implications of Inaction

The questions then become: what -- if any -- risks of injury are we as individuals and as a society willing to accept? How long can we afford to wait before we act? Why take any risk of having such potentially devastating results? In this vein, the Commission poses a number of other specific but very fundamental questions:

- What if, as current research suggests, the startling decrease in sperm count and the alarming increase in the incidence of male genital tract disorders are in fact caused in part as a result of in utero exposure to elevated levels of environmental estrogens?
- What if, as current research suggests, the epidemic in breast cancer is a result in part of the great numbers and quantities of estrogen-like compounds that have been and are being released into the environment?
- What if the documented declining learning performance and increasing incidence of problem behaviour in school children are not functions of the educational system? What if they are the result of exposure to developmental toxicants that have been and are being released into the children's and parents' environment, or to which they have been exposed *in utero*?

The implications of any of the above questions being answered in the affirmative are overwhelming. The implications of all of the above questions being answered in the affirmative are catastrophic, in terms of human suffering and the potential liability for that suffering and attendant health costs. Mounting evidence points to the latter possibility. Surely, there can be no more compelling self interest to force us to come to grips with this problem than the spectre of damaging the integrity of our own species and its entire environment.

It is the conviction of the International Joint Commission that the risk of such damage exists, and that virtually any level of risk of this type should be considered too high to accept. Our society cannot afford to take this risk and should reduce it. Yet, Great Lakes basin inhabitants continue to be the recipients of persistent toxic substances produced and justified as the basis for jobs and our way of life.

The Commission strongly affirms that the dangers posed to living organisms from exposure to persistent toxic substances is the most significant problem to be confronted in the Great Lakes Basin Ecosystem. In terms of the Agreement and the human condition generally, policy makers must take this situation seriously and act accordingly.

Particular concern should be acknowledged for impacts on the development and functioning of the endocrine, nervous and immune systems in offspring of exposed individuals. This "hidden" effect injects additional urgency and importance to a precautionary approach. Additional research is needed but it must not be the reason to delay action. We also need a broad consensus-based strategy for changes as to how decisions are made with respect to producing, marketing and releasing persistent toxic substances to the Great Lakes and wider ecosystems.

CHAPTER THREE:

Strategic Thinking and the Need for Further Change

Persistent Toxic Substances: The Commission's Position

As research findings demonstrate linkages between persistent toxic substances and biological injury, they continue to reinforce the Commission's conclusions, which are fundamental to its proposed policy approach:

persistent toxic substances are too dangerous to the biosphere and to humans to permit their release in **any** quantity, and

all persistent toxic substances are dangerous to the environment, deleterious to the human condition, and can no longer be tolerated in the ecosystem, whether or not unassailable scientific proof of acute or chronic damage is universally accepted.

The Commission reiterates its stance that the very existence of human-produced persistent toxic substances in the Great Lakes ecosystem is inconsistent with maintaining the integrity of the ecosystem and hence with the Purpose of the Agreement. The Great Lakes Water Quality Board has confirmed that the risks to humans are high, that there is a real probability of substantial effects, and that such injury from certain persistent toxic substances merits immediate measures to protect human health.

The characteristics of persistent toxic substances make them much less amenable to traditional pollution control efforts such as discharge limits to set acceptable levels in the environment, end-of-the-pipe technology and disposal regulations. The idea of a non-zero "assimilative" capacity in the environment or in our bodies (and hence allowable discharges) for such chemicals is no longer relevant. The Great Lakes Water Quality Board supports this view, concluding that there is no acceptable assimilative capacity for persistent, bioaccumulative toxic substances. It states, therefore, that the only appropriate water quality objective is zero, even though interim objectives may be needed.

Within the environment's carrying capacity for human activity, there is no space for human loadings of persistent toxic substances. Hence, there can be no acceptable loading of chemicals that accumulate for very long periods, except that which nature itself generates. Moreover, conventional scientific concepts of dose-response and acceptable "risk" can no longer be defined as "good" scientific and management bases for defining acceptable levels of pollution. They are outmoded and inappropriate ways of thinking about persistent toxics.

The production and release of these substances into the environment must, therefore, be considered contrary to the Agreement legally, unsupportable ecologically and dangerous to health generally. Above all, they are ethically and morally unacceptable. The limits on allowable quantities of these substances entering the environment must be effectively zero, and the primary means to achieve zero should be the prevention of their production, use and release rather than their subsequent removal.

Consequently, vigorous policy is needed to eliminate all persistent toxic substances, except in very specialized, unavoidable, controlled and hopefully temporary applications. While a broad attack on these substances is required, we must begin somewhere. The Commission has previously proposed beginning with eleven Critical Pollutants* and still supports this approach. At the same time, the Commission has concluded that organochlorines are a major class of pollutants that should be addressed collectively due to their large number and the egregious characteristics of many of them.

The Commission's series of recommendations regarding the virtual elimination of various persistent toxic substances and certain precursors also remains valid. These recommendations would lead the Governments of the United States and Canada, in some cases in cooperation with other jurisdictions and

interests, to:

- **jointly develop a binational strategy for persistent toxic substances** to assure coordinated action in both commerce and the receiving environment;
- **adopt specific programs to achieve virtual elimination and effect zero discharge**, bypassing the tendency to consider these concepts as hypothetical and impractical;
- **give enforceable effect to Agreement principles and requirements** since the shared undertakings need to be applied rigorously and in a manner that will be enforced;
- **adopt and apply a weight-of-evidence approach** to deciding when to act on the basis of mounting evidence of chemicals as the likely cause of injury to the environment or human health;
- **strengthen the principle of reverse onus** to place the responsibility for proof that a substance is not harmful to the environment or human health on the proponents of a chemical's production and use;
- **end point source discharges of persistent toxic substances to Lake Superior** as a pilot approach to demonstrate the feasibility of achieving zero discharge;
- **sunset PCBs and seek public acceptance for their destruction** since, despite agreement on their dangers, they remain in use and in storage. The safe destruction of these highly toxic compounds is of critical importance, but highly contentious;
- **sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and seek an international ban on their production, use, storage and improper disposal**, as they continue to appear in wildlife even though not authorized for domestic commerce, and are still used in other countries;
- **consult with industry and other interests to alter production processes and feedstock chemicals to eliminate dioxins, furans and hexachlorobenzene as byproducts and to sunset wherever possible uses of lead and mercury**, as these substances are widely recognized as causing adverse ecosystem health effects;
- **consult with industry and other interests to develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks, and examine the means of reducing and eliminating other uses**, recognizing that socio-economic considerations must be taken into account in developing the strategies and timetables.

** The 11 Critical Pollutants were first identified in the 1985 Report of the Great Lakes Water Quality Board. They are total polychlorinated biphenyls (PCBs), DDT and its metabolites (including DDE), dieldrin, toxaphene, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), 2,3,7,8-tetrachlorodibenzofuran (TCDF), mirex, mercury, alkylated lead, benzo(a)pyrene, and hexachlorobenzene (HCB).*

Precaution in the introduction and continued use of chemical substances in commerce is a basic underpinning of the proposed virtual elimination strategy. It is generally agreed, in principle, that the burden of proof concerning the "safety" of chemicals should lie with the proponent for the manufacture, import or use of at least substances new to commerce in Canada and the United States, rather than with society as a whole to provide absolute proof of adverse impacts.

This principle should in the Commission's view, be adopted for all human-made chemicals shown or reasonably suspected to be persistent and toxic, including those already manufactured or otherwise in commerce. The onus should be on the producers and users of any suspected persistent toxic substance to prove that it is, in fact, both "safe" and necessary, even if it is already in commerce. As one participant at the October 1993 Biennial Meeting said, "Chemicals are not innocent until proven guilty, people are."

Current Approaches

Canada's Environmental Protection Act provides for the review of existing substances and control of

dangerous substances, but its implementation has been slow to address specific chemicals for regulation. It also appears possible that legal challenges will further render it ineffective in controlling persistent toxic substances. Provincial action under Ontario's **Municipal-Industrial Strategy for Abatement (MISA)** can also be used to eliminate discharges of persistent toxic substances.

The United States Government has stated that available mechanisms can be used to invoke regulatory action without definitive proof of a causal relationship. However, the Toxic Substances Control Act, which is used to screen the introduction of new chemicals, has to date failed to screen out many chemicals. Among existing chemicals, it has only limited the use and manufacture of PCBs. The Great Lakes Water Quality Board concluded that the act has been rendered ineffective for the timely control of existing chemicals.

The available approaches have not, in practice, been effective in either country to screen a multitude of chemicals. A realistic review of what chemicals have, in fact, been removed from commerce indicates that the current approach does not provide an effective screening process. Again, the Great Lakes Water Quality Board emphasized that the problem lies not with the basic legislation, but with "significant barriers to the effective implementation of this authority."

The basis for a precautionary approach and reverse onus can also be found in the Agreement. It is the unequivocal statement of the Parties to the Agreement that they intend to pursue an objective of virtual elimination of inputs within a philosophy of zero discharge of persistent toxic substances. These are forward-looking provisions, even if they were focused at the time on regulatory and technological solutions. However, society as a whole is beginning to realize the importance and implications of this approach, as it come to grips with the immensity of the persistent toxics problem. Even less well advanced is a determination to implement virtual elimination rigorously as a way to deal with persistent toxic substances. Pollution prevention programs, while an important step forward, do not necessarily enshrine this concept.

Weight of Evidence

The 1992 Biennial Report also urged adoption of a "weight of evidence" approach to reaching conclusions on these issues. This approach takes into account the cumulative weight of the many studies that address the question of injury or the likelihood of injury to living organisms. If, taken together, the amount and consistency of evidence across a wide range of circumstances and/or toxic substances are judged sufficient to indicate the reality or a strong probability of a linkage between certain substances or class of substances and injury, a conclusion of a causal relationship can be made. This conclusion is made on the basis of common sense, logic and experience as well as formal science. Once this point is reached, and taking a precautionary approach, there can be no defensible alternative to recommending that the input of those substances to the Great Lakes be stopped. As noted above, the burden of proof must shift to the proponent (manufacturer, importer or user) of the substance to show that it does not or will not cause the suspected harm, nor meet the definition of a persistent toxic substance.

The Commission's definition of "weight of evidence" is a pragmatic one and not based on arbitrary rules or formulae. It is consistent with the use of this term in science and law. The Commission's use of this term has, however, generated considerable discussion and different concepts from the perspective of various disciplines. Also, the question of standard of evidence in this field is evolving. Scholars and practitioners have been encouraged to consider more precise definitions.

The Great Lakes Water Quality and Science Advisory Boards, and the two federal governments in their responses to the 1992 Biennial Report, have all accepted such an approach in principle. It is clear, however, that in practice its application can result in different outcomes. This appears to be the case with

chlorine, because of different standards of evidence or different levels of acceptable probability. Governments, industry and other participants in the policy arena should collaborate to codify a set of guidelines as to what factors should be taken into account in weighing evidence.

Risk Assessment

Another relevant procedure is risk assessment. Clearly, the process of assessing the relative risks to the environment and/or humans from alternative actions is useful for some purposes. Both countries have formal frameworks for risk assessment that are, by and large, compatible, although some discrepancies in methodology exist and improved integration of human health and environmental risks is needed. Risk assessment is useful in decision-making, especially in setting action priorities, but is not directly relevant to the basic virtual elimination commitment. The Commission does not accept the argument that the elimination of persistent toxic substances should be subject to a risk-benefit calculation, as that is not the approach of the Agreement.

When risk assessment is used to provide information, however, it is important to pay careful attention to the communication of that risk information to the public. Underlying assumptions and caveats, as well as the question of different perceptions of risk across jurisdictional boundaries, also must be communicated. Of specific concern is the lack of uniformity in sport fishing advisories. The Great Lakes Water Quality Board recommended collective effort among state and provincial authorities to develop joint public advisories to ensure uniformity. Furthermore, there is a lack of **any** public risk information in most other circumstances.

A fuller accounting of environmental, economic and social values is also needed when making decisions. At one level, the determination of what natural resources are being used in human processes should be part of economic accounting. Similarly, the ramifications of "environmental" policy changes, which affect the amount of resources available for production and consumption (including reduction of the ability to pollute or use traditional technologies), must also be taken into account.

In some cases, it will not be possible to eliminate substances in use "overnight," especially if acceptable substitutes are not readily available, as that could cause serious short-term economic and social disruption. However, to continue to introduce new products without this accounting, and to continue resisting a strategy that changes our production and consumption habits and moves away from reliance on persistent toxic substances, will be disastrous in the long term from all perspectives. Again, a reasoned but sure process of transition, and a new way of thinking about production and consumption decisions, are needed.

Governmental Actions

Some governmental actions have been consistent with the concerns raised by the Commission. In their responses to the Commission's 1992 Biennial Report, the Governments of the United States and Canada voiced more definitively than before their intentions to focus on persistent toxic substances.

Certainly the amount of attention given to these issues has grown exponentially. Ontario proposed regulations intended to achieve zero discharge of organochlorines and other chemicals from the pulp and paper industry. In November 1993, the Ontario regulations became law. The Provinces of British Columbia and Quebec have proposed similar requirements. The United States Environmental Protection Agency is studying water-based alternatives to solvents in various industries. These are but a few examples.

The federal governments state that most of the Commission's specific recommendations are being

implemented. However, their primary focus is on specific (point) sources of pollution and, to some degree, agricultural chemicals. The remobilization of contaminants from sediments and landfills via groundwater and releases to the atmosphere via incineration are other significant issues requiring attention. It remains to be seen, moreover, to what degree current programs will lead to reducing releases of persistent toxic substances. They are unlikely to achieve zero discharge in most cases, or the virtual elimination of all persistent toxic substances.

The federal governments have not accepted the Commission's recommendation for a broad approach to deal with organochlorines, rather than the present approach of dealing with these thousands of compounds individually. The Commission's proposed approach envisions governmental consultations with industry and other interests to restrict, phase out and eventually ban the use of chlorine and chlorine-containing compounds from industrial feedstocks. This approach explicitly recognizes the need to take socio-economic and other consequences (including those of the available alternatives) into account in determining timetables.

The federal governments prefer to focus on individual chemicals. The Commission is concerned that, despite the worldwide concern for the use and discharge of organochlorines and both countries' commitment to the virtual elimination of persistent toxic substances, many of which are organochlorines, there is reticence in both governmental and industry declarations to begin consulting on a bold alternative to the wide-scale production and use of these compounds. The Commission remains confident that, as the federal governments seek to find an effective, comprehensive strategy to meet their Agreement obligations as well as general sustainable development strategies, they will need to embrace such a broad new approach to preventing the formation of hazardous substances.

Linking environmental issues to human health has received increasing attention from governments with efforts such as the Canadian Great Lakes Health Effects Program and the work of the United States Agency for Toxic Substances and Disease Registry.

However, it deserves even more collective attention from governments, the business community and all citizens. The Commission has devoted an increasing portion of its limited resources to addressing human health issues within the context of a continuing focus on overall ecosystem health.

Broader Efforts

Many other individuals and organizations in North America and other parts of the world are starting to address the mounting evidence of health effects. The Commission's reports and those of its Great Lakes Science Advisory Board have stimulated attention on and concern for the ecological and human health effects of persistent toxic substances, notably organochlorines, and the need for a broadly-based preventive approach rather than a chemical-by-chemical control approach.

Several domestic and international bodies have reached conclusions similar to that of the Commission about the need for broad action against organochlorines. These policy initiatives include:

- the 1992 Convention and the Ministerial Meeting of the Oslo and Paris Commissions for the Prevention of Marine Pollution (OSPARCOM);
- the conclusions of the International Whaling Commission's 45th Annual Meeting, May 1993;
- the Fifth World Wilderness Congress, Tromsø, Norway, October 1993;
- Barcelona Convention on the Mediterranean Sea (BARCON) biennial meeting at Antalya, Turkey, October 1993.

Various health professional organizations, including the American Public Health Association, the

Michigan State Medical Society, Physicians for Social Responsibility and the Ontario College of Family Physicians, among others, have also stated their concern for the effects and management of persistent toxic substances.

These activities underscore the need for an international approach to reduce and eventually eliminate chemicals that cause an array of detrimental effects on living organisms through short- or long-term environmental exposure. As similar problems and concerns arise in several regional seas and large lakes, and given the international commerce of many chemicals and their products, serious consideration must be given to a multilateral approach that not only manages but, more importantly, eliminates these problems.

While part of the increased effort must be oriented towards further research on cause-effect linkages and specific phenomena, the social and community implications also must be addressed. Maintaining a healthy society means more than failing to discover disease.

In 1986, the World Health Organization used its definition of health as a starting point for the **Ottawa Charter for Health Promotion** (Ottawa Charter). It emphasizes the dependence of health on the environment and identifies peace, shelter, food, education, income, social justice, equity, the maintenance of a stable ecosystem and sustainable resource development as components of health. It is not sufficient for governments, industry and commerce to react only to proven instances of injury. They also must provide a preventive program to enhance personal and societal security against unintentional intrusions on human health, at the same time other basic needs and a high quality of life are met.

While not widely recognized in practice to date, this philosophy is consistent with the ecosystem concept of the Great Lakes Water Quality Agreement, as well as the sustainable development concept embraced by the United Nations World Commission on Environment and Development (Brundtland Report). This also has subsequently become the policy of both federal and several state and provincial governments.

Just as human health is dependent on the absence of environmental degradation, however, ecosystem integrity is dependent on more than environmental quality. It also must include economic, social, cultural and political dimensions, not the least of which is a healthy population and healthy communities. The Commission has previously observed that "long-term economic sustainability, including the existence of a healthy and creative work force, depends on a healthy environment. Paradoxically, a healthy environment depends on the existence of vibrant local and regional economies."

Despite these efforts, an assessment of the overall policy response to the environmental health studies and public concern to date must be characterized as limited and disappointing. The mainstream response from individuals in government, industry and elsewhere is to debate the reality or magnitude of the risk to the health of humans and other components of the ecosystem. Even if the issue is recognized, the focus tends to be on setting priorities, developing lists, devoting resources to avoid action and lobby against it, largely on the basis of debatable short-term economic impacts, rather than on coming to grips with and addressing the enormity of the problem.

Responsibility

Many substances of concern continue to be released into the Great Lakes environment, even after regulatory action. None have achieved the distinction of reaching "zero discharge," even in the most liberal interpretation of that concept. Dealing with each of the thousands of chemically different but similarly structured compounds individually will be a never-ending quest. It will surely be time consuming, costly and ultimately futile, and is one reason why the Commission continues to recommend a generic approach to address a wide range of contaminants.

The action strategy must go beyond the scope of conventional regulatory tools and environmental policies to encompass broad tactics that eliminate the creation of persistent toxic substances and, in some cases, common precursors. The Commission is confident that North American scientific and entrepreneurial capacity, together with supportive government and labour policies, can -- over time and with a common

determination -- develop the required knowledge, technology and ability to achieve the Purpose and Objectives of the Agreement.

Clearly, governments alone cannot carry the burden. All sectors of society must accept their part of the responsibility to protect the integrity of ecological systems, including the full participation of labour and business. They certainly must do so if many of the Commission's recommendations are to be achieved, if the Purpose of the Great Lakes Water Quality Agreement is to be honoured, and if the long-term public interest is to be served.

All interests must also work together within a common framework and a clearer understanding of their collective and individual roles in the ecosystem. Their efforts should be based primarily on a preventive and environmentally conservative approach which recognizes economic, environmental and social goals as being compatible rather than inconsistent. **A consensus-building approach is essential which addresses the concerns of labour, industry, municipalities and other interests to ensure an orderly transition to an economy without persistent toxic substances.**

The nationwide United States program to encourage voluntary initiatives to reduce priority contaminants, referred to as "33/50," is a good beginning. The Great Lakes states have joined the federal government in a Pollution Prevention Plan for the Great Lakes, with early progress in the automotive and printing industries as well as more localized municipal efforts. In Canada, the multi-sectoral Round Table discussions and the Accelerated Reduction/Elimination of Toxics (ARET) program, Ontario's Pollution Prevention Pledge Program and voluntary pollution prevention partnerships between industry and the federal and provincial governments, notably those with the automotive and metal finishing industries, have also led the way. In addition, many corporations are integrating pollution prevention into their long-term investment plans. More needs to be done, however, with a much broader and more complete shift to the new way of business the Commission continues to propose in this, as in previous reports.

Chemical and associated industries have an obligation to protect human and other populations from the adverse effects of substances they bring into existence and use. The Commission recognizes and congratulates those industrial representatives who have responsibly engaged in dialogue with the Commission and others, and have taken pioneering steps to address these problems. It is important and inevitable that the business sector act increasingly to lead rather than resist a broad movement towards manufacturing processes that eliminate the production and use of persistent toxic substances, and that they embrace a new, ecosystemic approach to business and governmental decision-making.

CHAPTER FOUR:

Adopting Frameworks for Strategic Action

The complex problems of persistent toxic substances, many of which are entrenched in our modern economies and lifestyles, raise the need for a very basic reassessment of our production, consumption and investment processes. This review also requires a deliberate analysis of, and consensus on how to restructure economic activity and decision-making from something that has been largely isolated from

environmental realities to one that embraces a new relationship between economic activity and the rest of the ecosystem. It would involve a process of research, debate, consensus, alternative allocative mechanisms and decisive action.

The starting point should be a framework to develop a comprehensive understanding of how the ecosystem functions and how it is affected by change. To address policy as well as ecological issues, this framework should include not only various physical attributes of the ecosystem, but also various policy levers available to communities, governments, producers and consumers.

At least two conceptual frameworks exist that can help to organize this assessment for the Great Lakes ecosystem: the Great Lakes Water Quality Agreement itself, and developing knowledge about sustainable development. The latter is based on a concept of nesting economic and environmental decisions within the joint pursuit of long-term economic, environmental and social sustainability. Essentially, it too is an ecosystemic approach.

The Agreement Framework

The Agreement reflects a Great Lakes application of a general bilateral prohibition against polluting boundary waters and waters that flow across the international boundary to the injury of health or property on the other side of the boundary. This undertaking is found in Article IV of the Boundary Waters Treaty of 1909, confirming that the philosophical and legal roots of the public interest in environmental protection were recognized many years ago.

The Agreement was reviewed and revised by the Governments in 1978 and 1987. The first revision resulted in a new, expanded Agreement incorporating the significant concept of taking a broad, ecosystemic approach to the Great Lakes. The 1987 review left the main Agreement basically intact while adding several annexes with specific commitments in areas such as groundwater, atmospheric deposition, critical pollutants, Areas of Concern and research.

The Commission concluded in 1986 and again in 1992 that the basic Agreement provides a sound and comprehensive framework to address the problems of the Great Lakes ecosystem. The focus of attention should be on implementation of what the Governments of Canada and the United States have already agreed on, rather than on new undertakings. This conclusion remains valid, even in the face of new knowledge and understanding about the dynamics of the Great Lakes Basin Ecosystem.

For more than two decades, the Agreement and the ecosystem approach have served as international models. Aspects of the Agreement have been recognized as a model in discussions in several United Nations fora, including the United Nations Economic Commission for Europe, Commission on Environment and Development (which generated the Brundtland Report), the subsequent Conference on Environment and Development in Rio de Janeiro, and the new Commission on Sustainable Development, as well as many other international discussions.

The Commission accepted opportunities to be involved, in an observer capacity, in the United Nations Conference on Environment and Development, the Commission on Sustainable Development and other follow-up activities. In June 1992, United States Chairman Gordon Durnil spoke on behalf of the Commission to the Plenary Session of the United Nations Conference on Environment and Development at Rio de Janeiro. The Commission and its activities were described as a possible model for other nations sharing common resources and seeking institutional mechanisms for guiding cooperative sustainable development. The Commission considers it important to maintain contacts with these initiatives and its duty to offer expertise to the process.

Indeed, the Agreement seems to anticipate many of the findings of the United Nations' Rio Declaration and the related action plan, Agenda 21, which lays out an extensive list of international commitments for action during the next century. The Great Lakes Water Quality Agreement provides a suitable and established platform for implementing programs pertinent to Agenda 21. It can provide a basis for achieving both environmental integrity and economic vitality under the sustainable development programs announced by both governments, and make a significant contribution to global environmental security.

Some specific provisions of the Agreement can serve as models with broader applicability. Remedial Action Plans can provide potential laboratories for sustainable development at the local level. The Hamilton Harbour plan, for example, was an important factor in the recent designation of Hamilton-Wentworth as one of 21 communities around the world as Local Agenda 21 Model Communities. This program, developed under the auspices of the United Nations Environment Program and the International Council for Local Environmental Initiatives, is a response to the Rio Declaration. The designation clearly demonstrates the links between the Agreement and sustainable development frameworks.

Applying the Agreement to Sustainable Development Frameworks

More importantly, however, the Purpose of the Agreement itself would be well served by considering its implementation in conjunction with the concept of sustainable development by placing it within economic and social as well as environmental frameworks. A determined effort to develop integrated policy is critical to the effective pursuit of the Agreement. This approach would in fact also be consistent with the Commission's specific mandate. That mandate is contained most explicitly in the Terms of Reference of the Great Lakes Water Quality Board, which requires examination of the appropriateness of programs to achieve the Purpose of the Agreement in light of present and future socio-economic imperatives.

The Agreement also sets out various objectives for the natural and human environment that can be incorporated into sustainable development strategies. Economic and social issues inherent in both short-term economic recovery within the existing industrial structure, and in the longer-term structural and demographic changes that will emerge in the years ahead, must be considered to accomplish any of the Agreement's goals. Explicit incorporation of Agreement goals in this context is urgently needed to be prepared for economic recovery and the fundamental, structural change that is expected to transform the economy of the Great Lakes region.

Economic recovery in the Great Lakes basin can in fact be enhanced by programs to achieve the Agreement's goals. Recent Canadian economic studies have concluded that the implementation of Remedial Action Plans can yield direct and indirect economic benefits in a number of ways, and indeed are even critical to economic development in local areas. These plans are an investment in the future, generating opportunities rather than burdens. This is especially important as communities seek employment opportunities in a post-industrial economy. On a broader geographic scale, studies of the impacts of environmental measures appear to conclude that environmental measures have a positive statistical relationship with standard economic indicators such as national income and employment, although some specific dislocations do occur.

Economic and environmental sustainability are not only consistent but necessary to achieving healthy and vibrant ecosystems. Both can occur with a minimum of disruption by phasing in required changes to economic activity over investment cycles, reorienting product markets using normal mechanisms, and providing retraining and other programs to protect local communities and workers from sudden discontinuities. If short-term disruptions occur, they should be resolved by considering the environmental, economic and related social issues simultaneously and by consensus.

Competitive markets presume well-informed decisions and mobile factors of production and consumption. "Full-cost" pricing to take account of the use of natural resource and other environmental values, or at least informing consumers of those costs, will encourage well-informed choices. Selective use of economic instruments such as targeted tax measures, careful use of short-term permit trading to reduce pollution loads to zero most efficiently without condoning pollution, and direct market intervention are also possibilities. Labour mobility, either geographic or by learning new skills, and technological change must be taken into account in formulating change.

Nor can an isolated strategy for change be developed for the Great Lakes basin. Mechanisms are needed to ensure that Great Lakes industries are not placed at an economic disadvantage for being leaders in sustainability. Until such time as the markets offer a secure demand or premium for higher priced but sustainably produced products, some buffering mechanism may be required. An alternative is to encourage sustainable policies at least in North America, and preferably worldwide.

While this vision may seem unlikely to many people, the Commission believes it can be achieved. It can occur if we bring into reality the twin concepts that both nations have adopted domestically and internationally as central environmental policies: the ecosystem approach and sustainable development. In the Great Lakes-St. Lawrence basin, such a vision is consistent with and necessary to fully address the requirements of the Great Lakes Water Quality Agreement.

The objectives of Agenda 21 and of the Agreement will be achieved through sensitive economic and industrial policies as much as through traditional environmental policies and mechanisms. The Great Lakes Basin Ecosystem economy is larger and more diverse than that of most nations. It offers many opportunities to develop a new way of doing business, while maintaining and utilizing the basic premises of the market system.

The Agreement provides an institutional base to integrate and implement a wide range of policies and programs. Mechanisms for decision-making, such as in the Remedial Action Plans and Lakewide Management Plans, can easily be (and in some cases have been) inclusive of all sectors of society, including those listed among the "Major Groups" of Agenda 21. We encourage leaders in cities and regions to follow the lead of Hamilton-Wentworth and of American communities such as the Cuyahoga River (Cleveland) and St. Louis River (Duluth-Superior) in challenging citizens to achieve Agreement objectives within a sustainable development framework.

The institutional and substantive successes of the Great Lakes Water Quality Agreement could be a major showcase to demonstrate Agenda 21 objectives in Canada and the United States. To do this credibly, however, governments must seriously address the remaining "nonsustainable" activities, including the continuing discharge of persistent toxic substances into the Great Lakes system.

CHAPTER FIVE:

Reaching Consensus on Effecting Change: Awareness, Mechanisms and Shared Goals

Any strategy to implement the basic change in thinking that is required to address the virtual elimination problem effectively must be based on a common effort among consumers, producers, regulators and the public generally. All must have a shared vision and work together to achieve the strategy's objectives instead of denying the need for action, even when that action means fundamental change. Basic attitudes, habits and premises must be addressed. Everyone, but especially those persons influential in making or resisting change, should shift their energy from "why not to do it," to "how do we achieve it" within an

ethic of long-term sustainability.

Even though many public opinion survey findings reflect increased public concern about the environment, this attitude seems to be a fragile one in the face of such immediate needs as housing and jobs, especially when the latter are perceived to be at risk. The changes in institutional and personal responses previously described must be so fundamental that the old mindset of "jobs vs. environment" is replaced with a recognition that "environment = jobs."

A change of attitude about what progress means, from short-term benefits to long-term survival, requires encouragement. Committed support for this attitude shift depends on an informed community and hence on increased education and awareness at all levels. One place to start is with educators.

Education

The attitudes and knowledge of educators are central to the formation of knowledge and lifestyles in children, and to the perspectives of the next generation of decision-makers. The 1993 Report of the Great Lakes Educators Advisory Council states that if a community-based ecosystem approach is to become a reality, our children must develop the know-ledge, values and instincts to understand the inescapable links between environmental and human health in all its forms. Once this perspective is instilled, we will begin to see the success we all seek in how we interact with and sustain our environment and our economy.

To encourage that perspective in children, educators must be equipped to present new and important ideas in a creative, effective manner, both within "environment" as a specific subject area and through the vehicles of other academic and technical areas from the arts, to mathematics and medicine. Commission efforts have been directed at encouraging appropriate authorities to develop and mandate curricula that incorporate environmental awareness and particularly Great Lakes material into a variety of learning settings.

This approach was strongly supported in the responses of Canada and the United States to the Sixth Biennial Report. Ontario reported establishing a post-secondary pollution prevention training curriculum. The Canadian Green Plan and the United States National Environmental Education Act both provide for similar initiatives. However, they do not specifically provide the regional perspective needed to focus on the Great Lakes and their ecosystems. The Commission has not found any broadly applied, Great Lakes-specific educational programs developed in either country to date.

Several individual efforts are contributing to new program thinking in both countries. The Commission congratulates the teachers, schools and community organizations that are mobilizing children and adults to greater awareness and concern about the Great Lakes ecosystem. The Rouge River program near Detroit and the Little River project in Windsor are two specific examples.

The Great Lakes Educators Advisory Council studied the adequacy of training and information for teachers and environmental curricula for a number of years. It found that mandates, goals and curricula for environmental education vary considerably across jurisdictions. Notwithstanding some excellent programs in specific locations, they are on the whole inadequate. The Educators Advisory Council recommended a series of measures to improve curricula, and the state of knowledge and information exchange among teachers. Teacher training requirements, professional institutes and workshops, and improved information from the media, especially television, were elements of the proposed approach.

An Environmental Education and Information Clearinghouse for the Great Lakes was also recommended to expand knowledge and interest among educators and the public. It will provide a consistent source of

information that can coordinate and distribute materials from the large number of Great Lakes organizations producing such materials, as well as provide knowledge support and guidance. Momentum is increasing for the development of such a clearinghouse. The Commission continues to believe, as it has stated in three of its own reports, that such a clearinghouse is essential and worthy of the governments', industries' and citizens' support.

During 1991-3, the Council also assisted in organizing three summer institutes for teachers, to develop a deeper knowledge of Great Lakes issues. The pilot project, on Isle Royale, used seminars and field studies, an experience that was then applied in other locations in the Great Lakes basin. Such institutes are a useful tool for intensive professional development and could be developed on a regional or jurisdictional basis.

The Council's report also pointed out that other professions must learn to understand and respect environmental issues in their training, but that such opportunities are currently limited. This knowledge is crucial to resolving society's environmental issues since this, in the end, will depend on environmentally aware health professionals, engineers, land developers, news media and so on. However, the Educators Advisory Council noted, for example, that only 25 of 700 business schools in the United States offer optional courses on business and the environment. It recommended development of "environmental literacy" programs in all subject areas.

Many findings of the Great Lakes Educators Advisory Council reinforce the Commission's recommendations on curriculum development, teacher training and information exchange, contained in the 1991 Special Report on Great Lakes Environmental Education. This report followed an extensive process of consultation with educators throughout the Great Lakes basin, including a multi-site satellite television conference, as part of a program to consider the specialized information needs of key professional groups in the Great Lakes community. Clearly, the results of the Commission's and the Council's investigations have shown that education is a vital area for improved and expanded programs to enhance awareness throughout the Great Lakes region.

Health Professions and Further Initiatives

Another Commission effort was directed at consulting and encouraging action among physicians and other health professionals to increase their awareness of environmental health issues, particularly to identify and prevent health problems in clinical and public health situations. In the United States, a roundtable was held to develop professional education courses, conferences, and continuing dialogue and action among physicians, especially in Wisconsin, Michigan and New York. In Canada, in a slightly different approach, a wide range of health professionals was brought together to enhance awareness and discuss avenues for information exchange. As a result, a cross-disciplinary task force was formed to develop an environmental health information pilot project that addresses academic and clinical needs.

Specific attention was also given to the need for human health considerations in Remedial Action Plans and the involvement of local health professionals in these communities. In each case, binational links have been established, and these efforts have demonstrated that although there is a lack of knowledge among health professionals, there is a high degree of concern for the implications of environmental health issues. A survey of primary care physicians in Wisconsin, for example, demonstrated the lack of knowledge about the relationship between persistent toxic substances and health care. These efforts have also stimulated various follow-up actions by health care providers at the national association and local community levels, as well as binational links among them.

There is clearly a need to focus credible, relevant and targeted information toward key professional groups, in addition to efforts in the traditional educational contexts of schools and universities.

Widespread adoption of an ecosystem ethic depends on increased sensitivity to, and access to information about, Great Lakes ecosystem issues and their relationships to the daily activities of various professions. A new educational framework is needed to learn to do business in a way that recognizes the fact that the economy and the environment are two inextricably linked components of the same ecosystem.

Supporting the Great Lakes Community

Community awareness and responsiveness is an issue of broader scope than education. It also involves building institutions that focus on the development and integration of societal goals and consensus building.

Social scientists have noted that, while there are more than 100 definitions of community, they have one common characteristic: a community is a place where decisions can be made and action taken on those decisions. Resolving the large-scale challenges now facing us to achieve the objectives of the Agreement are no longer those of a government agency or two, but of whole communities working together in partnership with others. These communities will be at various scales: geographic, professional and sectoral.

One progressive aspect of the Agreement and the Commission's work pursuant to it has been the emergence of a Great Lakes-St. Lawrence ecosystem "community" and numerous more specific communities-of-interest under that umbrella. This development occurred first in the community of scientists working across jurisdictions and disciplines to enhance learning, understanding and the efficient use of resources. In recent years, the active community of Great Lakes interests has expanded greatly. A variety of new organizations have emerged over the past decade focusing on regional concerns.

Several governmental institutions have evolved to address Great Lakes ecosystem issues. This phenomenon has included a refocusing of the Great Lakes Commission, the Great Lakes Fishery Commission and the Council of Great Lakes Governors. A number of nongovernmental and municipal organizations also have involved interested citizens and specific interests. These citizens and organizations tend to begin at a nontechnical level, but become increasingly more sophisticated in knowledge and approach. A wide range of organizations fit this description, such as Great Lakes United, the Council of Great Lakes Industries and the International Great Lakes-St. Lawrence Mayors' Conference, to name only a few examples.

The Commission encourages this process and its broadening to new areas of the Great Lakes community of interest. Organizations whose mission is to inform and activate the general public should strive to broaden their membership and audience, by improving their media and public affairs approaches and the coordination among organizations to ensure consistent, accurate messages. All of these bodies have played an important role, even if temporary, in the institutional component of the Great Lakes ecosystem.

The voluntary sector is a key component in broadening Agreement awareness and involvement. This sector needs to be encouraged within the Great Lakes institutional mosaic, but the organizations and movements involved, while enthusiastic, are often stymied by lack of scientific data and interpretive skills. The Commission's Great Lakes Science Advisory Board has emphasized that empowerment, participation and involvement of the entire Great Lakes community in the achievement of the goals of the Agreement is vital to its success.

Scientists should make themselves available to communicate with these groups and with their local communities at large. Employers, whether governments, private sector or academia, should permit and

encourage such mutually beneficial linkages. Universities, colleges and other institutions of higher education in particular have a function in supporting the wider Great Lakes community. Beyond their educational roles, they can serve as catalysts to bring scientists, industries, governments and citizens together to learn from one another and to develop coordinated action plans.

Each academic discipline has a role in articulating and addressing issues inherent in sustainable development in the Great Lakes basin. Educational and research support of Great Lakes communities, particularly in understanding the implications of sustainability and carrying capacity of the environment, was one need identified at a Great Lakes Science Advisory Board workshop on this topic.

A specific application of this is the integration of scientific advice into Remedial Action Plans. This linkage has reaped substantial benefits in some locations. The Science Advisory Board urged that available analytical tools be applied more widely to assist in identifying cost-effective and timely improvements in Areas of Concern.

Integrated effort across academic departments in Great Lakes research, teaching and involvement must also be improved. Existing institutes or centres within universities and colleges can fulfil this role to some degree by including Great Lakes issues, especially in schools of natural resources, science, and business and by developing Great Lakes programs. The University of Windsor's Great Lakes Institute and the state university Sea Grant programs are examples.

In this regard, the Commission donated its own inhouse library of Great Lakes material over to the University of Windsor library, making its unique range of material more widely available for use by scholars and other interested persons from across the basin. Other donations have joined this Commission material, and it is hoped that this collection will continue to grow in volume and usefulness.

It is important for all interests to engage their local communities in discussions about how to apply sustainable development in the Great Lakes basin. New ways to facilitate dialogue and participation will be needed. To some degree, this has begun with bodies such as the Canadian Pollution Prevention Centre, the Ontario Environmental Citizenship Program, the State University of New York's Health Effects Program, the Ohio Coastweeks, and the advisory committees in the Areas of Concern. An action program to activate individuals and organizations to sustainable lifestyles, similar to the successful "Participaction" personal fitness program in Canada, could be organized by governments and/or nongovernmental initiatives.

Our own public information program continues to encourage the development of informed and active communities, and helps the Commission benefit from hearing a full range of views. Industry has become much more involved in discussing Great Lakes issues and is now more aware of the stark realities of the obligations contained in the Agreement. This increased dialogue has been accomplished in part through the efforts of persons in the business community who have worked with the Commission for some time. Use of the roundtable technique to bring various organizations, perspectives and interests together to discuss a particular issue has been an overall success.

Commission experiments with "live-by-satellite-television" also have been useful. The approach deserves analysis as governments and others engage in complex discussions about achieving sustainable development and the virtual elimination objective. Some practical mechanism for continuing to bring these communities together should be part of an international community development process that transcends geographic and sectoral lines, through periodic consultations and ongoing networking.

One significant way this dialogue has developed is through the Biennial Meetings on Great Lakes Water Quality. Various approaches have been tested since the first meeting at Indianapolis in 1983, and the

approach will continue to evolve to ensure improved dialogue and participation. The 1993 meeting in Windsor brought almost 2,000 people together to discuss, debate and learn, and to make their concerns known. For the first time, large numbers of participants from industry were present, along with environmental organizations, labour, aboriginal peoples, all levels of government, educators, health professionals, scientists and many others. It is this kind of amalgam that encourages greater understanding among various perspectives, and mutual action as well.

As successful as these meetings may be, however, these periodic events cannot provide for required continuous dialogue among all Great Lakes interests, especially on a smaller and local scale. The discussions initiated at recent Biennial Meetings -- particularly those among industry, citizens groups and government scientists -- need to expand, and groups such as native people, labour, land developers, marketing professionals and the media need to become more fully involved.

Ecosystem Boundaries

Geographically, the Great Lakes ecosystem does not stop at the map boundaries specified in the Agreement. Ecosystem boundaries are neither fully jurisdictional, geophysical or even demographic in their definition. They differ for the water, biological, atmospheric and human dimensions of the ecosystem. The scope of an ecosystem's boundaries can also differ depending on what economic, social or political parameters are being considered.

Ecologically, the Great Lakes Basin Ecosystem clearly extends downstream from the Agreement boundary at the end of the international section of the St. Lawrence River, deep into Quebec and possibly to the St. Lawrence estuary. There is evidence, for example, that contaminants are passing downstream from the Cornwall-Massena area and into the flesh of marine mammals and fish. This is a geographical and ecological reality requiring that, at a minimum, concern and dialogue should extend beyond the current "legal" Agreement boundaries. Whether or not these formal boundaries of the Agreement merit reconsideration at an appropriate time, from the Commission's ecosystemic standpoint, the issue will eventually need to be addressed in some manner if a fully ecosystemic approach is to be achieved.

In a number of ways, therefore, a significant modification of institutions and attitudes is required to help resolve Great Lakes Basin Ecosystem issues. The policy frameworks exist and are subscribed to by both federal governments. This allows a new way of thinking and mobilization of concern to move forward.

CHAPTER SIX:

A Specific Strategy to Accomplish the Virtual Elimination of Persistent Toxic Substances

Although virtual elimination of the input of persistent toxic substances has been a requirement of the Agreement since 1978, and their effects on the health of the Great Lakes ecosystem has been a concern for several years, the Commission still observes, as in 1992, that "we have not yet virtually eliminated, nor achieved zero discharge of any persistent toxic substance" from the waters of the Great Lakes Basin Ecosystem. Indeed, we have not even come close to elimination. Even substances that were in theory banned can still be found in use and being released to the environment. Many others have not been subjected to control or elimination programs.

In 1990, the Parties were urged to develop and implement "a comprehensive, binational program to lessen the use of, and exposure to persistent toxic chemicals found in the Great Lakes environment." In 1992, the Commission questioned whether:

"we ... want to continue attempts to **manage** persistent toxic substances after they have been produced or used, or ... **eliminate** and **prevent** their existence in the ecosystem in the first place. ... Since it seems impossible to eliminate discharges of these chemicals ..., a policy of **banning** or **sunsetting** their manufacture, distribution, storage, use and disposal appears to be the only alternative."

To contribute to the definition and resolution of the issue, the Commission created a **Virtual Elimination Task Force** (VETF) to investigate the Agreement requirement to virtually eliminate the input of persistent toxic substances into the Great Lakes Basin Ecosystem. Specifically, the Commission charged the Task Force to provide advice and recommendations about what a virtual elimination strategy should contain and how the strategy could be implemented. In its investigation, the Task Force necessarily included the **presence** of persistent toxic substances in the ecosystem, in addition to the Agreement requirement concerning **inputs** to the ecosystem.

The VETF provided its initial advice in a 1991 Interim Report to the Commission. In October 1993, at the Commission's Biennial Meeting on Great Lakes Water Quality, the Task Force formally presented its two-volume final report to the Commission.

The International Joint Commission adopts the report, *A Strategy for Virtual Elimination of Persistent Toxic Substances*, endorses its conclusions and recommendations and commends it *in toto* to all Great Lakes basin governments as a framework for action. In so doing, however, we draw attention to our own definitions of zero discharge and virtual elimination as set out in the Sixth Biennial Report, and to the need for specific attention and strategies for some chemicals, as specified in this and previous Commission reports. The VETF strategy is a mechanism for establishing priorities and identifying strategic intervention points, through a use-tree analysis, to forge a process to implement the Commission's other recommendations on persistent toxic substances.

The key components of the report are:

- a vision for the Great Lakes;
- a virtual elimination strategy for the Great Lakes; and
- a decision-making framework within which to implement that strategy.

Underlying the strategic design is an evaluation of why virtual elimination is not yet being achieved in order to understand and overcome those barriers. A vision of "ecosystem integrity, characterized by a clean and healthy Great Lakes Basin Ecosystem and by the absence of injury to living organisms and to society" is a guiding philosophy, but one that must be integrated with, and indeed foster viable economic activity.

Limitations to Current Approaches

Current practices to deal with persistent toxic substances have reduced the loadings to the Great Lakes but have limitations that preclude virtual elimination. Several factors are discussed in more detail elsewhere in this report:

- **Proof of harm** must be established before firm action is taken. Years could be required to prove a conclusive link, by which time damage has been done.
- Even when injury has been established, the focus is on management and control of releases on a chemical-by-chemical basis, rather than on strategically preventing the formation of the persistent toxic substance in the first place.

- **Incomplete remediation** or cleanup of persistent toxic substances already in the environment occurs, for example, in sediment and waste disposal sites.
- With few exceptions, releases are subject to single-medium laws and regulations that protect only air, land or water. This does not recognize that persistent toxic substances enter the ecosystem via many routes and, once released, migrate among media and become widely dispersed regardless of the source.
- The **special characteristics** of persistent toxic substances -- persistence, resistance to degradation, wide dispersion, and bioaccumulation -- limit the effectiveness of present laws and policies.
- **Assimilative capacity.** Current programs for the most part fail to differentiate between **toxic** and **persistent toxic** substances. They tend to rely on water quality standards or guidelines based on ambient pollution levels below which residual risks are considered minimal. Such water quality standards or numeric criteria are irrelevant for persistent toxic substances, except as interim guidelines toward the virtual elimination goal.

Other limitations include failure to implement existing laws, policies and programs, as well as limited funding and inadequate information bases. Current resources cannot hope to screen all the chemicals in use (variously estimated to be 60,000 to 200,000 in number) or even all new chemicals. It is especially difficult to identify chronic and sublethal biological effects that determine which chemicals meet the definition of being persistent and toxic. Further, despite existing laws, there is no clear mandate to eliminate releases of chemicals by specific target dates even when they are determined to be persistent and toxic.

Evolution in Thinking

There has been an evolution in thinking about environmental protection, moving from pollution control that manages individual substances, through prevention of hazardous substance generation, to environmentally-sustainable production and consumption, a hierarchy which can be defined in three stages:

Phase I: Controlling Releases

Phase II: Preventing Use or Generation

Phase III: Sustainable Industry and Product/Material Use

Any new strategy should emphasize prevention and sustainability. Conversely, much of current practice is based on the control model.

This reality led the VETF to articulate ten principles to guide a virtual elimination strategy, several of which have been described from the Commission's perspective elsewhere in this and previous reports:

- Anticipate and prevent pollution
- Incorporate remediation, treatment and control
- Adopt precaution
- Address the complete life cycle of the contaminant
- Apply to all sources and pathways
- Apply to all media
- Apply globally
- Reverse onus
- Involve all stakeholders
- Apply risk management

In addition, such an approach should be premised on allowing participants to examine the need even to

use specific chemicals and other raw materials, as well as market expectations and societal practices, from an ecosystemic standpoint. In some cases, it will be necessary to evaluate whole classes of chemicals or industrial processes that appear to lead to the formation of persistent toxic substances. A use-tree analysis helps to identify the source of chemicals and where and how intervention might be possible, most effective and orderly.

Sunsetting and eliminating the many persistent toxic substances in use will take time, even with a broadly-ascribed and determined effort by all governments and industry. The scale of this effort will be massive and in some cases cause ripples throughout the economy. The continued viability of the orderly transition of the economy is also in everyone's best interest. Further, there must be an adequate decision-making framework within which to conduct the long process of implementing the proposed strategy. It must allow the integrated, coherent examination of which chemicals are of concern (some of which have already been identified), priorities for action and intervention strategies. It should also provide for short- to long-term implementation targets, measures of progress as well as input from all interests.

The process for individual chemicals will also take time. Intermediate measures will be needed, such as setting interim standards or guidelines, progressive reduction of releases to the environment or holding facilities, and improved warning information about uses and inventories of target substances. New treatment and control technologies might be necessary as interim measures, and possibly as quite long-term measures, en route to achieving virtual elimination.

Components of the Strategy

The strategy incorporates a variety of operational components and employs a wide range of tools and opportunities. They include:

- ***Criteria and procedure to determine which substances are considered persistent, toxic and, therefore, subject to the strategy.***

Four criteria -- bioaccumulation potential, persistence, chronic toxicity, and evidence of specific causality/injury to biota -- are important in selecting and classifying target substances. While this process may help set priorities among thousands of chemicals, eleven Critical Pollutants have been identified and should be acted on immediately.

- ***Sources and uses of identified substances, identification of intervention points to eliminate and prevent inputs to the environment and deal with those already there.***

Contaminant uses, sources, quantities and fate in the ecosystem must be assessed in a comprehensive way. A shortcoming of past action is that only a portion of full life cycles are addressed at any one time. Large quantities of some persistent toxic substances are still produced and exported, or not produced but used and stored in the Great Lakes ecosystem. As a result, they continue to enter the environment by various routes.

- ***Examination of mechanisms such as legislation, regulations and programs; technology; economic instruments; education and consultation; and multi-stakeholder processes.***

Both the Great Lakes Water Quality Board and the VETTF have indicated that the United States and Canada have adequate legal authority but have not fully acted on it due to barriers to the effective implementation of this authority. These need to be removed.

Technology for improved treatment and applied pollution prevention is available or should be developed for:

1. prevention, such as changes to production processes, raw materials, and product formulation;
2. treatment and control of residual point and nonpoint releases to water, air and land;
3. effective and "safe" destruction of persistent toxic substances now in storage;
4. remediation or containment of contaminants in sediment, groundwater and waste disposal sites.

Economic instruments, including direct incentives, may also be a useful component of the virtual elimination strategy. Successful development and implementation of a strategy will also require understanding and support from various affected interests and the community as a whole. As noted elsewhere, communication and awareness play key roles in allowing people to enter into dialogue and participate in the processes to virtually eliminate all persistent toxic substances.

- ***Indicators of progress.***

Indicators of progress specific to the reduction and virtual elimination of persistent toxic substances as well as the specific element of zero discharge of inputs (and broader indicators of ecosystem integrity) are required to track success and failures in each component of the strategy. The Great Lakes Science Advisory Board has expressed concerns about the current availability of data on loadings of toxic substances, targets and organizing frameworks to assess relevant data and information, and has recommended corrective measures.

The strength of the process and advice of the VETF lies in the diversity of professional disciplines and the wide variety of skills and experiences contributed by Task Force members. Drawn from government, industry, academia and public interest groups, the members contributed in an open, constructive, consensus-building mode. Their spectrum of views on a common problem -- virtual elimination of persistent toxic substances -- enhanced their investigation and the validity of their advice. Further, the Task Force engaged in public dialogue through seven public workshops and distribution of its draft final report -- almost 3,000 copies -- for review and comment, as well as soliciting input and advice from a number of potentially affected groups.

The vision outlined for the Great Lakes, plus the strategy developed by the Virtual Elimination Task Force provides a useful framework for addressing the persistent toxic substance issue. The Governments of Canada and the United States and other governments and interests should adopt its recommendations as a basis for a broad strategic approach to persistent toxic substances.

Lake Superior: The Virtual Elimination Pilot Project

In 1990, the Commission was anxious to propose an approach to the various governments that would move beyond talking about virtual elimination and zero discharge to doing something. Lake Superior, at the head of the Great Lakes-St. Lawrence system, remains in good condition with respect to water quality and other indicators of ecosystem health, and has a relatively simple industrial profile in terms of the number and types of production units. Hence, the Commission acted on a suggestion that it be the starting point. It proposed the designation of Lake Superior as a pilot project for programs to address the Agreement requirements for virtual elimination and zero discharge of persistent toxic substances.

The federal governments, in cooperation with Ontario, Michigan, Minnesota and Wisconsin, accepted the Commission's advice. At the 1991 Biennial Meeting in Traverse City, Michigan, they announced a Binational Program to Restore and Protect Lake Superior, including a binational pollution prevention program. The Commission welcomed this initiative in its 1992 Biennial Report, and proposed that governments, among other things, declare a timetable for eliminating all point source releases of persistent toxic substances and consider a special designation of all or part of Lake Superior under an

international program such as the United Nations Biosphere Reserve Program.

The Commission has been informed of efforts to develop a program to eliminate priority pollutants for Lake Superior, and of a public involvement program to support this process. The level of effort and the expressed intent of the governments and other participants continue to be heartening. Yet, specific proposed timetables have not been put in place. Both federal governments have stated that they prefer to wait for more investigation, including more information on atmospheric deposition, before making a commitment on timing.

The Agreement calls for elimination of all persistent toxic substances. These should be eliminated as soon as possible. The fact that there are inputs other than intra-basin point sources should not prevent or delay action on those specific sources.

One action item in the Binational Program reads: "...complete an inventory of toxic air emissions and an assessment of toxic air deposition in the Lake Superior basin." The Commission's **International Air Quality Advisory Board** (IAQAB) has reviewed progress regarding this commitment and reported to the Commission in October 1993. The IAQAB concluded that the inventory of airborne toxics in the basin is inadequate and that there is no apparent, specific focus to estimate deposition (loadings) to the Lake Superior basin or to refine the current deposition estimates. Current inventories of emissions do not have the detail or the reliability needed for modelling atmospheric deposition to Lake Superior or any of the Great Lakes. Estimates of atmospheric loadings to the lakes cannot be improved until better inventories are available. The federal governments are urged to address this problem.

The IAQAB reported that progress has been made in the implementation of an overall Integrated Atmospheric Deposition Network called for in Annex 15 of the Agreement. In the Lake Superior basin, one master monitoring station and two satellite stations have been established, although the latter have not been formally recognized. Commitments to ensure that these stations meet required criteria and are supported and maintained on a continuing basis are needed.

A focus on research to improve understanding of the pathways, fate and effects of airborne toxic substances, required by Annex 15 of the Agreement, has not occurred. Research is needed for more accurate estimates of atmospheric deposition to Lake Superior. Specifically, a research plan emphasizing atmospheric processes, transfer coefficients and gas exchange processes is needed. The research plan should be developed as soon as possible and outline five-year goals and interim targets to obtain better loading estimates and an improved context for point source reductions of persistent toxic substances.

Provisions to monitor progress in implementing the selected measures for achieving virtual elimination and zero discharge of persistent toxic substances into Lake Superior are not evident to the Commission. To ensure progress on this pilot study, timetables should be promulgated during the next biennial period, and a framework for reporting baseline conditions and progress on the state of the Lake Superior basin should be developed as soon as possible.

Finally, the Commission was informed of a significant public involvement effort in the Lake Superior Binational Program. Some concern has been expressed, however, about the need for more effective participation by some interests. As with the Remedial Action Plans and other Agreement initiatives, the Commission believes that meaningful participation by all interests throughout the process is essential to achieving a comprehensive ecosystem approach and a long-term commitment from the Lake Superior community. The Commission is impressed by the efforts so far and suggests that measures be adopted to make the process as inclusive as possible for all interests.

Groundwater: Out of Sight, Out of Mind

Groundwater is an important source of drinking and irrigation water as well as base water flows to Great Lakes tributary streams. Direct groundwater discharge to the lake basins is also thought to be significant. Degraded groundwater resources in the basin therefore have implications for Great Lakes surface water quality and quantity. Yet, groundwater systems and their role and impact within the Great Lakes Basin Ecosystem have not received much attention.

Groundwater contamination by persistent toxic substances, such as chlorinated solvents, pesticides and radionuclides, has been identified in many basin locations. Apparently, these contaminants derive from leaking waste disposal and other sites via a combination of natural and anthropogenic pathways. Groundwater discharge thus contributes to the cycling of toxic loads to and from contaminated sediments throughout the Great Lakes, and particularly in most Areas of Concern.

Great Lakes pollution from the discharge of contaminated groundwater has largely been ignored, even though Annex 16 of the Agreement calls for identification of groundwater sources, mapping, sampling procedures and source controls. Only limited resources have been directed at understanding, controlling and remediating the current pollution sources and preventing further contamination. While it will be a major undertaking, effort should be directed by governments to determine the volume and pathways of groundwater entering the Great Lakes, both direct discharge and through tributary base flow. Estimates of the proportion of Great Lakes tributary base flow (groundwater discharge) range from 20 to 60 percent depending on various physical parameters. Much of this groundwater discharge, we also know, contains contaminants at some level.

It is also important to investigate the persistence of toxic compounds in groundwater (including the definition of persistence in this medium), how they affect the Great Lakes ecosystem, and how to control the sources, before more detailed recommendations on remedial and preventive action can be provided.

Incinerators: Burning the Evidence

Various pollutants, including heavy metals and other persistent toxic substances, enter the Great Lakes ecosystem through atmospheric fallout. In Lakes Superior and Huron, especially, a major portion of some pollutants enter in this manner, often originating thousands of kilometres/miles away. It is ironic that this fact is then used to argue for a delay or inaction or, in some cases, forgiveness of toxic loads from sources within the basin. Such a reason for delay was given in the governmental responses to the Commission's recommendation for a timetable for virtual elimination in the Lake Superior basin.

The Commission has increasingly received expressions of public concern about the number of large incinerators and their impacts on public and environmental health. While many specific sources lie outside the basin, they are in a real sense within the Great Lakes ecosystem. A growing number of incinerators operate within the Great Lakes region, contributing significantly to the load of contaminants, especially from the low-temperature incineration of industrial, commercial and household refuse containing plastics and solvents, coated papers and many other products.

The Commission expressed strong concern about this issue in its 1992 Report on Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region. The Commission's recommendations in that report, which can be appropriately incorporated into this report, included the phase-out of incineration facilities, or a requirement to eliminate the production and emission of a variety of persistent toxic and other substances, and establishment of uniform requirements for incinerators in the Great Lakes region based on the principle of zero discharge.

Any strategy towards virtual elimination and zero discharge of persistent toxic substances must address the significant inputs from incineration. It is an issue that can only become more urgent as the pressures

against landfill operations grow. The Commission urges the stringent regulation of existing facilities throughout North America, taking into account the need to ensure the zero discharge of persistent toxic substances from those stacks to the Great Lakes.

The Commission recognizes that the use of specialized, high temperature incinerators, kilns and other technologies being developed for the programmed destruction of substances such as PCBs is important to the capacity to eliminate the many stockpiles of these substances. Mobile or local installations are also desirable to avoid transportation of the substances themselves. Communities need to accept some form of technology to destroy these substances efficiently and effectively while ensuring public safety. Such technology must be used under carefully controlled procedures. The Commission supports, in principle, the destruction of persistent toxic substances through technologies including, if necessary, small-scale, high-temperature incineration in preference to perpetual and relatively uncontrolled storage.

CHAPTER SEVEN:

Remedial Action Plans: Ecosystem Approaches in Action

The Great Lakes Water Quality Agreement requires that a **Remedial Action Plan** (RAP) be developed for each designated **Area of Concern** (AOC) in the Great Lakes basin. These areas are specific locations around the Great Lakes that do not meet the Objectives of the Agreement and thereby cause or are likely to cause impairment in any of 14 specified beneficial uses or the area's ability to support aquatic life. RAPs are reviewed by the Commission in three stages: 1) definition of the problems and sources; 2) selection of remedial measures; and 3) confirmation of the effectiveness of those measures and restoration of the beneficial uses.

Evaluation and Status of RAPs

The RAP process in most of the 43 AOCs is advancing but at a slower rate than originally anticipated. As of October 1993, 38 Stage 1 RAPs had been submitted for review and comment. The remaining Stage 1 RAPs still under development are Wheatley Harbour (Ontario), Eighteen Mile Creek (New York), Kalamazoo River (Michigan), Black River (Ohio), and the United States side of the Niagara River (New York).

The Commission has commented on various accomplishments and deficiencies in the RAPs, particularly the adequacy of problem identification and of data. It has also strongly encouraged and supported the RAP process throughout the basin, especially encouraging a broadened understanding of what it means to "embody a systematic and comprehensive ecosystem approach" as required by the Agreement, the need to forge links to other local planning processes, and the value of meaningful public involvement.

Some Areas of Concern are shared by both countries in the connecting channels between and below the Great Lakes. These binational RAPs may incur special difficulties. The level of joint activity varies greatly and is generally too limited. The limited coordination and "cultural" differences in how RAPs are seen as part of governmental processes have led to considerable frustration for the individual jurisdictions and the public in these areas.

The role of the federal governments in these connecting channel RAPs has been minor and should be increased. An increased federal involvement may provide opportunities for more joint activities and breaking down the interjurisdictional barriers to an ecosystemic approach. Specifically, federal agencies should lead in the development and conduct of binational monitoring programs to track restoration of impaired uses in each connecting channel.

Most jurisdictions are now focusing on Stage 2 documents; some have already been submitted to the Commission for review. Significantly different challenges and opportunities are being confronted: developing pollution prevention programs so that areas will reap the benefits of cleaning up the old problems; and controlling persistent toxic substances still being released to the environment.

Meaningful public participation yields significant results. It is important to the success of the RAPs and needs to be encouraged throughout the process. Some jurisdictions are aware of this dynamic and have improved substantially the quality of public involvement. In other locations, participants report frustrating slowness and barriers to their making a difference, and concerns for insufficient progress. The patience of many citizens seems to be near a breaking point.

Citizen involvement needs to be matched by determined and timely governmental action. Remediation and continued pollution prevention cannot be accomplished unless government officials at senior levels come to grips with the magnitude of cleanup costs and start the process of securing the necessary resources.

Part of this challenge will be to develop sustained support and creative financing mechanisms to restore polluted areas. In an era of declining governmental resources, remedial and pollution prevention measures should be initiated in partnership with the private sector, particularly where private interests will benefit in direct and indirect economic returns from RAP implementation.

Significant Successes

The RAP program is one of the success stories of the Agreement. This success is most evident in areas that have engaged all of the relevant interests (stakeholders) in identifying and resolving issues. As the Commission has encouraged, wide involvement is becoming the norm rather than an exception. It may cause some perceived delays and complications in the regulatory process, but in the long term, it results in a better resolution. More agencies at all levels of government and the private sector are becoming involved.

In virtually every case, strong Public Advisory Committees and even more inclusive processes have paid dividends. Participants often become the leading proponents of community action in support of RAP and Agreement objectives, and recognize other local spin-off benefits. Citizens and certain specific interests become better informed and aware of the extent of problems, understand the reasons for action, and become more involved to the benefit of the community.

However, some jurisdictions still see RAPs as essentially mechanisms for regulation and enforcement, and therefore the purview of the agencies charged with environmental regulation. This is a major barrier to progress that can be overcome when local communities take on the problem and have a vested interest in its resolution. Key government agencies must continue to provide leadership, as well as technical and other support, but should not dominate the process. The table, *Some Significant Successes in Areas of Concern* highlights AOCs that have achieved significant successes in this regard to date.

New Issues

Human health concerns become a factor in developing RAPs when participants become aware of and recognize the need to include the broader human health context. This is most important in RAPs that include large urban areas, a concentration of chemical producing or using industries, and/or populations that rely on local fish for their food supply. Generally, these factors have not yet been incorporated into RAPs even where the issues are well known. For example, although remedial action planning is well underway and concerns for public health have long been expressed in the St. Lawrence River Area of

Concern, definitive human health data have just recently become available.

Some government agencies, such as Health Canada, are attempting to improve this situation. As a rule, however, awareness among government agencies, RAP teams, health professionals and the public is low and, in some cases, health factors are considered irrelevant to RAPs.

The Commission has been impressed with the emerging interest in the RAP process by health agencies and health professionals. This has occurred at the national, provincial/state and local levels in both countries. At roundtable discussions sponsored by the Commission in 1993, it was evident that more progress could be achieved from a concerted, binational effort to include human health considerations in the RAP process. It will also be important to inform and encourage a range of health professionals about local and wider environmental health concerns generally, since there is limited awareness of these issues among either clinical or public health practitioners. This points to the need for a program to keep health professionals who observe and deal with these issues informed.

With the development of Stage 2 RAPs, the need for public accountability for progress in implementation must be addressed. The Commission's vision of this crucial part of the RAP process has been conveyed in several specific RAP reviews but it is of general applicability.

Four matters are to be addressed at Stage 2:

- evaluation of remedial measures in place;
- evaluation of alternative additional measures to restore beneficial uses;
- selection of additional remedial measures to restore beneficial uses and a schedule for implementation; and
- identification of the persons or agencies responsible for implementation of remedial measures.

The Agreement, by listing these elements, demands accountability for the required actions. A Stage 2 monitoring plan should, therefore, be developed as a baseline against which remedial actions and timetables can be assessed.

One vehicle for providing accountability and sustaining good communication could be an annual report written for the general public, or another form of periodic update for each Area of Concern. Such a report would help citizens to track progress. New York State, for example, has recognized the need for "living" RAP documents and has prepared annual reports that serve this need. Tracking information related to RAP activities would also be more valuable if conducted on a binational basis and if made available throughout the basin via an electronic information system such as Internet.

RAPs need to incorporate the concept of **sustainable development**. This should be based on the idea that watershed restoration is an economic as well as environmental activity, one that is essential to a community's overall long-term viability. This approach should be understood and endorsed by RAP teams and other participants in the process. RAPs cannot remain, as they are in some areas, simply another tool to focus regulatory activity, as critical as such actions may be. They should be based on the pertinent watershed and the various activities within it, at a minimum. In some cases, they may need to consider factors beyond the local watershed boundaries.

The RAP model can also be a new institutional framework for local area development. Beginning with and focused on regional water resources, it can bring together a broad range of government agencies, industries and others to address local area restoration and the prevention of future degradation. This can only be done effectively in the context of the demographic, social, economic and environmental history, trends and plans for an area. Industrial, commercial, transportation and other land development, whether

in the past, present or future, are influential elements in a watershed's condition. Environmental quality considerations will increasingly be important to their future as well.

Adoption of this idea has begun in the Great Lakes basin. The Hamilton-Wentworth region, as noted earlier, has been recognized internationally for its initiative in promoting sustainable development. The RAP process is an important part of that initiative. With the projected success in cleaning up the pollution legacy of the past, the potential economic benefits -- both direct from the beneficial uses of the harbour region and indirect economic and social benefits -- other unsustainable practices have been identified for attention. Communities in other Areas of Concern might follow this example, as stimulation of local economies in environmentally sustainable ways, partly through Remedial Action Plans, will bring economic as well as environmental restoration to communities around the basin. The concept of Areas of Quality, or formal declarations of areas analogous to Areas of Concern where ecosystems are sustaining a high level of integrity, could well be a long-term goal of communities after the completion of RAP remedial and preventive programs.

Some Significant Successes in Areas of Concern	
Educating the Community/ Public Participation/ Developing a Sense of Community	• Collingwood Harbour • Cuyahoga River • Rouge River • St. Louis River
Community-Based Partnerships	• Hamilton Harbour • Cuyahoga River
Effective Use of Existing Federal Programs/Integration with State and/or Local Agencies	• Fox River/Green Bay • Waukegan Harbor • St. Louis River • Hamilton Harbour
Watershed and Sub-watershed Emphasis	• Rochester Embayment
Progress Towards Promoting Sustainable Development	• Hamilton Harbour
Integration of RAPs in Official Plans	• Collingwood Harbour • Hamilton Harbour
Enhanced Use of Enforcement Measures	• Grand Calumet River
Combined Sewer Overflow Controls	• Milwaukee Harbor • Rouge River • Hamilton Harbour • Collingwood Harbour

Accelerated Nonpoint Source Controls	• Maumee River
Habitat Rehabilitation	• Nipigon Bay • Thunder Bay
Pollution Prevention/Control at Source	• St. Clair River
Innovative Funding	• Ashtabula River

CHAPTER EIGHT:

Research, Science and Data Needs in a Changing World

One accomplishment of the Great Lakes Water Quality Agreement, and of the process in which the Commission has participated, has been the nurturing of a large community of knowledgeable, committed environmental scientists. They are engaged in many fields, including chemistry, physics, geology, climatology, biology, limnology, toxicology, engineering, agriculture, economics and behavioural sciences to name but a few. Important networks have developed among them which have brought further understanding as well as broad institutional and knowledge bases for Great Lakes research.

This chapter focuses on how to maintain and redirect this capacity to meet the demands of the 21st century. An adequate scientific capacity is essential to understanding the components and dynamics of the Great Lakes Basin Ecosystem and will serve as a critical basis to assess progress with respect to the issues discussed in this report.

Recruiting Scientists to Great Lakes Research

For many years, the federal governments have supported exemplary research and monitoring efforts through such institutions as the Canada Centre for Inland Waters, the Great Lakes Environmental Research Laboratory and other national laboratories. State and provincial governments and universities have also been responsible for research and monitoring activities without which we would know little about the Great Lakes and their problems. Secure resources are needed to reinforce and sustain long-term research programs.

One dimension of scientific capacity is recruitment. The finest minds should be attracted to the study of the Great Lakes ecosystem. The current body of experienced scientists is regrettably aging; many scientists will leave the working community over the next decade. Generally they are not being replaced due to hiring restrictions, lack of funding, or diversion into more rewarding professional areas. The Commission shares the Council of Great Lakes Research Managers' concern for the need to respond to the requirements for recruiting, training and developing a new generation of scientists. Also, as addressed elsewhere in this report, there is value in promoting science education and science literacy within other fields of study, and the transdisciplinary integration found in ecosystemic research.

Refocusing Institutional Science

The standard approach to scientific enquiry needs to shift. Awareness is required of the many linkages

between seemingly independent components, both natural and human.

Scientific institutions need to refocus on integrative approaches and empirical investigation. This is fundamental to the scientific community's capacity to serve the needs of Great Lakes policy into the next century. The issue of capacity building, highlighted in Agenda 21, is not only for underdeveloped countries.

Institutional science in particular has tended to divide knowledge into specialized compartments based essentially on reductionist thinking. For hundreds of years, it has been believed that phenomena can be explained by improved specificity and certainty in distinct areas of enquiry. It does not, however, provide a model to understand the "big picture," or to provide the basis for questions that are meaningful only within complex and dynamic systems characterized by uncertainty and disequilibrium. The Great Lakes (especially under the influence of humans) must be understood in this way.

Scientists who attempt to work in the broader context tend to face unsupportive institutional reward systems and other barriers. While there are notable examples of scientists with international reputations -- including our own advisers -- addressing Great Lakes issues in an integrative way, most scientists tend to focus within specific disciplinary fields and research streams.

This situation is reinforced by an educational system that channels students at all levels into specialized rather than integrative programs. From primary grades, students are not taught to explore and think across subjects, to link common threads, but rather to focus on narrow topics and established methodologies. Universities reward professors and students on the basis of expertise and publishing within narrow fields. Even where institutes and faculties are mandated to pursue cross-disciplinary studies, their intellectual roots tend to exist in separate academic departments.

How to nest the highly sophisticated, intensive research that advances knowledge of specific ecosystem components into an integrated, ecosystemic model concerned with the relationships among the components should become a major preoccupation of research managers and scholars. A holistic approach should also be applied in setting research priorities, as recommended by our Council of Great Lakes Research Managers. Restructuring scientific information and its relationship to policy should follow. The Council of Great Lakes Research Managers is itself promoting this approach by developing an ecosystem framework to assess research priorities.

Applying Science to Policy

The challenges involved in relating scientific knowledge to policy decision-making has been a consistent issue for the Commission's advisory boards, particularly the ability to relate scientific knowledge, as incomplete and uncertain as it may be, to policy questions that are often changing, urgent, and generated by nonscientific or even less than rational forces. The Great Lakes Water Quality Board has focused primarily on linking biological effects of pollution to policy. The Science Advisory Board has addressed this question in the context of a broad scientific basis for addressing the implications of sunseting chlorine-based products.

Models developed to assist both the providers and recipients of this information improve the transfer of scientific knowledge into decision terms, and vice versa. One such model has been the main thrust of the Council of Great Lakes Research Managers' assessment framework, and the Science Advisory Board has recommended the increased use of predictive models in RAPs.

Ecosystemic approaches to research and decision-making must be premised on including the entire system of relevant interrelationships in the analysis, at least initially. Traditionally, economists and

ecologists have not taken account of the essential linkages between their models. Limitations in natural resources have not been factored into classical economic analysis, and ecologists have generally ignored the role of human activities in the functioning of ecological systems. As a result, economic policy and environmental policy are separated by an enormous gulf. Ecosystemic approaches, and the newer concept of sustainable development, require a merging of these areas of discourse.

Scientists should strive to improve linkages between socio-economic and other scientific research, and with those same realms of policy. Some progress has occurred with an emerging science of ecological economics, institutional mechanisms such as the Canadian Roundtables on Economy and Environment, and the United States Council on Sustainable Development.

A parallel need is to link ecological and human health scientists. McMaster University and the University of Toronto medical schools and Tufts University have begun promising programs in this area. Appropriate mechanisms, including special institutions and chairs within universities, might be encouraged. Whenever different disciplines (such as health professionals or wildlife biologists) come together, new insights emerge. A good example of this was the meeting of scientists from over 20 disciplines at Wingspread in 1990 that led to the publication, *Chemically-Induced Alterations in Sexual and Functional Development: the Wildlife/Human Connection*. Canada's Tri-Council Eco-Research Grant Program is specifically designed to encourage linkages among the natural, social and medical sciences.

Sharing and Expanding Data

A related subject is the availability of broadly-based data on the state of the Great Lakes Basin Ecosystem. The Commission looks forward to the first of a planned series of State of the Great Lakes Ecosystem Conferences (SOLEC) to be held under the sponsorship of the Parties in fall 1994, and trusts that the information provided will be based on a comprehensive ecosystemic framework and will be responsive to the information needs pertinent to the Great Lakes Water Quality Agreement.

The basic biophysical data sets traditionally provided to the Commission are important and should be maintained. Procedures for coordinating, collecting and collating the scientific data needed to assess changes in the aquatic system, including loadings of phosphorus and toxic substances, should be continued. Governments should also continue a coordinated surveillance and data assessment program to support State of the Great Lakes Ecosystem reporting.

The Great Lakes Science Advisory Board has examined the question of State of the Great Lakes Ecosystem reporting and has reached conclusions that the Commission endorses. It encourages a comprehensive Great Lakes ecosystem report that provides the status of relevant aspects of the natural and human components of the Great Lakes Basin Ecosystem, and of the linkages or "interface" between them. While the required data are available now, there is inadequate understanding of their interface and how to merge data across the biophysical and socio-economic data sets. This is needed to measure progress through integrative approaches such as sustainable development and the ecosystem approach. Only through that integration can governments and others sufficiently understand the Great Lakes Basin Ecosystem.

This will require a synthesis of previously independent and often inconsistent measurement systems. Basic issues such as boundaries of space and time need re-examination when some parameters (such as air and trade) defy traditional political and hydrogeological boundaries and rely more on history or prediction than on static data snapshots. The Commission encourages work to develop a new synthesis of pertinent data and information, which complements conventional data gathering.

Experience with data synthesis, and the corollary development of new indicators of progress, will undoubtedly lead to new understandings about the implications of sustainability and of further ways to implement Agreement obligations. The Commission is exploring these implications for its own data and information needs.

Finally, a number of specific research needs have been brought to the Commission's attention. While all of these topics would benefit from additional knowledge and data, they have not been ranked in terms of their priority in obtaining resources:

- binational assessment of global climate change impacts on the Great Lakes, possibly as a regional pilot project;
- linkages between environmental quality, ecosystem stresses and human health;
- implications of sustainable development for communities, including measures of progress;
- implications of economic policy and trade commitments for the objectives and programs of the Great Lakes Water Quality Agreement;
- effects of persistent toxic substances on humans and other biota, including biological and functional deficits, particularly the disruption of endocrine, immune and nervous systems, and identification of chemicals causing these impacts and their sources;
- improved mapping of groundwater aquifers and pathways and contamination of groundwater by various chemicals to reduce uncertainty about groundwater contamination in the Great Lakes basin, particularly as it affects the Great Lakes. Specific research topics would include:
 - the location and role of conduits to the Great Lakes;
 - the cumulative impact of human activities;
 - the nature and quantity of contaminants in hazardous waste sites and extent of groundwater contamination from these sites;
 - persistence, transport and fate of pathogens and contaminants in and through groundwater;
 - impacts of land use practices, including pesticide and fertilizer application, deicing, landfills, underground storage, and groundwater-source heat pumps.

Whether the focus is on individual research topics or the larger issues of science and policy, it is essential that this research take place in an ecosystemic context to convey a new mode of thinking about the ecosystem, decision-making and scientific enquiry.

CHAPTER NINE:

Conclusions and Recommendations

The key conclusion of the Commission's analysis over several years is the critical and urgent need for an effective strategy to virtually eliminate persistent toxic substances from the Great Lakes ecosystem. The federal governments, other levels of government and society as a whole must reorient their approaches to decision-making in this regard. In the future, environmental and socio-economic factors should be jointly and openly considered within a consensus process to reach optimal decisions. A new way of thinking should be applied not only to the Great Lakes environment and the Great Lakes Water Quality Agreement, but to the entire range of human activities.

The Great Lakes Water Quality Agreement wisely sets out a rigorous standard for behaviour: the protection of the **integrity** of the waters of the Great Lakes Basin Ecosystem, which includes important links to human activities and well-being. Governments must ask whether we can afford to take the risk of **not** exercising sufficient caution.

The Commission also believes that our two nations are still at a turning point of opportunity. They can still make a difference. The legacy we choose to leave for future generations can be either one of diminished options and well-being, or an enhanced one. To choose the latter, a strong, coordinated plan of action with target dates is urgently needed. It should be designed to effect a new way of doing business, and be based on the consideration of six basic principles:

Principle 1

The Governments of the United States and Canada, along with the relevant states and provinces, should act decisively on the commitments of the Great Lakes Water Quality Agreement wherein they agreed that:

"The purpose of the Parties is to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem," and

"The discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated," within a philosophy of zero discharge.

It is the assumption of the Commission that the federal governments continue to agree on this fundamental statement of intent upon which the Commission builds its advice. Governments should also ensure that their actions are coordinated through effectively functioning mechanisms for consultation, cooperative research and common action.

Principle 2

Representatives of industry, when presented with evidence of ecosystem health concerns about substances used in commerce, should react by embracing open dialogue, data sharing and fact finding to resolve, rather than deny, concerns and effect an orderly and timely transition to those solutions.

Principle 3

Representatives of environmental and other organizations should offer their expertise to help develop pragmatic solutions to the transition issues that face governments, industries and their employees, consumers and others in adopting preventive strategies.

Principle 4

While the scientific process should be value neutral, scientists should be forthcoming in responses to public concerns and the provision of current information about the health of the Great Lakes ecosystem, especially as it relates to human health.

Principle 5

News media should review their policies about reporting on the widespread use and effects of persistent toxic substances and evaluate their responsibility to inform the public about them.

Principle 6

Citizens should constantly ask political, social and industrial leaders about the effects of the use and discharge of pollutants on this and future generations.

RECOMMENDATIONS TO FEDERAL AND STATE/PROVINCIAL GOVERNMENTS

The Commission has for several years consistently recommended measures to the governments to help deal with the vexing problems of persistent toxic substances and ecosystem health. Some of those recommendations have been formally accepted and acted upon, some have been formally accepted but without evident action, some have become law, and many have been ignored. The recommendations of the 1990 and 1992 Biennial Reports were based on evidence accumulated through the work of the Commission's technical boards, scientific workshops, roundtables, public hearings, reviews of scientific literature and other reliable sources. Therefore,

1. The Commission formally emphasizes and confirms the recommendations of its *Fifth* and *Sixth Biennial Reports on Great Lakes Water Quality*, issued in 1990 and 1992, respectively. [See Appendix A]
2. The Commission also reiterates its recommendation concerning incinerators in the *Report on Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region*. [See Appendix A]

The Commission further recommends that:

3. Governments adopt a specific, coordinated binational strategy within two years with a common set of objectives and procedures for action to stop the input of persistent toxic substances into the Great Lakes environment, using the framework developed by the Virtual Elimination Task Force.
4. Governments adopt a specific timetable for the virtual elimination of persistent toxic substances in the Lake Superior basin as part of their pilot project for zero discharge and virtual elimination, and publish an initial biennial State of the Lake Superior Basin report, including specific indicators of progress on virtual elimination and zero discharge of persistent toxic substances, not later than December 31, 1994.
5. Governments publish an initial biennial State of the Great Lakes Ecosystem report not later than September 30, 1995. This report should address specific measures of progress towards virtual elimination and zero discharge of all known persistent toxic substances in the Great Lakes basin, and include specific information on sources of pollutants.
6. Governments develop and use comprehensive frameworks for reporting on the State of the Great Lakes Ecosystem, including both the natural and human components of the ecosystem and linkages between them.
7. Governments continue to develop and support environmental curricula at all levels of education as a fundamental component in a new way of thinking.
8. Senior government officials allow Remedial Action Plans to be community led rather than dominated by regulatory agencies. To be successful, RAPs must integrate the efforts of all agencies, stakeholders and concerned community members towards restoration of beneficial uses within a comprehensive ecosystem approach.
9. Governments support incorporation of human health concerns and pollution prevention measures into Remedial Action Plans.
10. Governments encourage the publication of periodic updates of activities and goals associated with each Remedial Action Plan to allow improved monitoring of implementation progress and to communicate local experiences to other areas and groups.
11. Governments improve the understanding of groundwater pollution and its impact on the Great Lakes, and act to eliminate its causes.
12. Governments incorporate those radionuclides which meet the definition of persistent toxic substance in their strategy for virtual elimination.

RECOMMENDATIONS TO THE FEDERAL GOVERNMENTS

13. Federal governments provide coordinated national inventories of toxic air emissions to allow better

estimates of toxic substance deposition to Lake Superior. A binational group should be established to review, coordinate and propose means to (a) identify data requirements; (b) develop guidelines and timetables; (c) set priorities; and (d) propose and coordinate research.

14. Federal governments develop, by the end of 1994, a research plan to assist in developing estimates of toxic substance depositions to the Lake Superior basin.
15. Federal governments establish and maintain monitoring stations within an Integrated Atmospheric Deposition Network pursuant to Annex 15 of the Great Lakes Water Quality Agreement.
16. Federal governments ensure that the assessment and registration of pesticides and new chemicals in Canada and the United States include specific provision for considering environmental and human health implications including endocrine-mimicking and bioaccumulation potential.

RECOMMENDATIONS TO THE BUSINESS COMMUNITY, LABOUR AND THE MEDIA

No efforts of governments to virtually eliminate the discharge of persistent toxic substances, and few of the Remedial Action Plans to remediate Areas of Concern, will succeed without the full participation of business and industry. Other sectors of society also bear responsibility for promoting and informing their constituencies about persistent toxic substances and long-term concerns about the integrity of the ecosystem. Therefore, the Commission recommends that:

17. Senior officers of business enterprises in and near the Great Lakes basin conduct environmental audits of their procurement, production and marketing activities in relation to the goals of the Great Lakes Water Quality Agreement; develop and announce corporate environmental stewardship policies which include the concept of sustainable development; and prepare annual reports relating to that policy for public review and regular review by the enterprise's senior management body.
18. Industry and professional associations develop and implement environmental awareness programs and environmental stewardship and/or sustainable development guidelines for their organizations and members. These should include standards on environmental claims in advertising and on identifying and encouraging special labelling for products that do not incorporate persistent toxic substances.
19. Labour unions include in their negotiations the issue of transition to a sustainable economy without persistent toxic substances.
20. Governments, industry and labour begin devising plans to cope with economic and social dislocation that may occur as a result of sunseting persistent toxic substances.
21. The news media give greater priority to investigating, identifying and reporting on the sources and effects of persistent toxic substances, as well as on success stories about reducing ecosystem degradation and achieving its restoration, as critical issues in society.
22. Post-secondary educational institutions encourage the integration of education and research across the physical, biological, and social sciences to provide an integrated scientific basis for learning and policy making.

Signed this 15th day of December 1993 as the Seventh Biennial Report of the International Joint Commission pursuant to the Great Lakes Water Quality Agreement of 1978.

Gordon K. Durnil	Claude Lanthier
Co-chairman	Co-chairman
Hilary P. Cleveland	James A. Macaulay
Commissioner	Commissioner
Robert F. Goodwin	Gordon W. Walker
Commissioner	Commissioner

APPENDIX A:

Recommendations from the Commission's *Fifth and Sixth Biennial Reports on Great Lakes Water Quality* and the *1992 Report on Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region*

Recommendations of the Fifth Biennial Report on Great Lakes Water Quality

As our first general recommendation, we urge the Parties to:

I. take every available action to stop the inflow of persistent toxic substances into the Great Lakes environment.

Specifically, we recommend:

1. the Parties complete and implement immediately a binational toxic substances management strategy to provide a coordinated framework for accomplishing, as soon and as fully as possible, the Agreement philosophy of zero discharge.
2. the Parties and all levels of government, including local authorities, cooperatively develop and implement appropriate legislation, standards and/or other regulatory measures that will give enforceable effect to the principles and objectives of the Agreement on a basinwide basis.
3. additional review and coordination measures be put into effect to ensure other legislation and/or regulations presently in place that affect matters relevant to the Great Lakes environment -- or those enacted in the future -- are not inconsistent with Agreement Objectives.
4. the measures devised pursuant to the foregoing include provisions for initiation, implementation and coordination of action at all levels of government to enforce the enacted laws and/or regulations.
5. the Parties strengthen the principle of reverse onus in policies and programs concerned with the introduction of new chemicals, through appropriate legislation and/or regulations that include mandatory pretesting prior to approval for production and use.
6. the Parties, in their next biennial reports to the Commission pursuant to Annex 12:
 - report on the extent to which discharges of 11 Critical Pollutants previously identified by the Great Lakes Water Quality Board -- and known to have serious detrimental effects on living organisms -- have been explicitly considered in the issuance of National Pollutant Discharge Elimination System (NPDES) permits and control orders.
 - assure the Commission and the public that no municipal, industrial or combined sewer overflow discharges of these substances are or will be permitted.
 - assess and report on the extent to which these 11 substances are used, stored and released in the basin by nonpoint rural and urban sources, including landfills and groundwater, and the measures being taken to prevent their further release into the Great Lakes from these sources.
 - report on the extent to which monitoring is in place to confirm that discharges of these chemicals are not occurring.
7. the Parties designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance will be permitted. This recommendation should not prejudice or delay the implementation of our other recommendations.
8. The Parties sponsor and fund research projects to:
 - replicate and expand on studies which demonstrate relationships between chemical exposure

- and human health in the Great Lakes basin and elsewhere;
- identify other exposed populations and biological species and investigate the effects of chemical exposures on them.

Our second general recommendation is:

II. all levels of government accept, and encourage others to accept, their responsibility to implement the Great Lakes Water Quality Agreement, and give priority to actions that contribute to the protection and restoration of the Great Lakes Basin Ecosystem.

Specifically, we recommend:

1. the Parties and jurisdictions fully inform and involve local governments with respect to their potential contribution towards achieving the Purpose and Objectives of the Agreement, and local governments accept responsibility to assist in the implementation of the Agreement.
2. the Parties and jurisdictions review and strengthen Great Lakes fish consumption advisories as necessary, and re-evaluate stocking programs for those fish which pose a threat to the health of animals and humans when consumed.
3. the Parties prepare and urge the use of a comprehensive public information and education program.
4. the Great Lakes states and provinces incorporate the Great Lakes ecosystem as a priority topic in existing school curricula.
5. jurisdictions use Great Lakes Areas of Concern as focal points for the development of educational programs and materials.

To ensure Stage 1 requirements are met for Remedial Action Plans pursuant to Annex 2 of the Agreement, we make our third general recommendation that:

III. the Parties give high priority to the development and implementation of RAPs, taking into account the need for public involvement throughout the process.

Specifically, we recommend:

1. the responsible Parties and jurisdictions revise all RAPs that the Commission has found do not meet Stage 1 requirements.
2. the responsible jurisdictions accelerate the preparation and submission of RAPs for the remaining Areas of Concern and provide the technical and financial resources needed for their implementation.
3. the Parties and jurisdictions encourage the participation of interested organizations and individuals throughout RAP development and implementation by sustaining community participation groups already established, and creating comparable institutional mechanisms in the other Areas of Concern.
4. the jurisdictions include a detailed plan for public participation as part of the Stage 1 submission of RAPs.

Our fourth general recommendation concerns protection against spills, and thus suggests that:

IV. the Parties strengthen and adopt provisions for the prevention of spills of toxic and other hazardous substances from vessels and other sources, and ensure they are prepared to deal with emergencies that may arise.

Specifically, we recommend:

1. the Parties increase pilotage requirements for all vessels carrying oil and hazardous substances in the Great Lakes.
2. the Parties improve communication and tracking of all vessels carrying oil and hazardous cargoes.
3. the Parties enhance the capability of the Coast Guard and other relevant agencies to respond to all spills of oil and hazardous polluting substances.

4. the Parties review the adequacy of funding for spill-related monitoring and enforcement.
5. the Parties examine the extent to which the provisions of Annexes 4, 5, 6, 8 and 9 have been complied with, and take appropriate steps to remediate any deficiencies.

Our final general recommendation is:

- V. in order for the Commission to better assist the Parties in implementing the Agreement, the Parties should respond to the Commission's recommendations following every other semi-annual meeting of the Parties. This response should include the status with respect to implementation of these recommendations or the reasons why a delay has occurred or action has not been taken.**

Recommendations of the Sixth Biennial Report on Great Lakes Water Quality

The Commission recommends that:

1. the Parties adopt and apply a weight-of-evidence approach to the identification and virtual elimination of persistent toxic substances.
2. the Parties expand the definition of persistent toxic substances to encompass all toxic substances:
 - with a half-life in any medium -- water, air, sediment, soil or biota -- of greater than eight weeks, as well as
 - those toxic substances that bioaccumulate in the tissue of living organisms.
3. the Parties sunset PCBs and seek public acceptance of the means to effect their destruction.
4. the Parties sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and, in particular, seek an international ban on their production, use, storage and disposal.
5. the Parties, in consultation with industry and other affected interests, alter production processes and feedstock chemicals so that dioxin, furan and hexachlorobenzene no longer result as byproducts.
6. the Parties review the use of and disposal practices for lead and mercury, and sunset their use wherever possible.
7. the Parties, in consultation with industry and other affected interests, develop time-tables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined.
8. the Parties, in cooperation with Lake Superior states and provinces, establish a specific date at which no point source release of any persistent toxic substances will be permitted into Lake Superior or its tributaries.
9. the Parties, in cooperation with Lake Superior jurisdictions, agree to prohibit new or increased sources of point source discharges of persistent toxic substances; and establish a coordinated, planned phaseout of existing sources.
10. the Parties, in cooperation with Great Lakes jurisdictions, develop and implement educational programs that incorporate the Great Lakes and ecosystem considerations into existing curricula and educational programs at all age levels.
11. the Parties consider supporting, encouraging and cooperating in the identification and development of a UNESCO-MAB Biosphere Reserve proposal within the Lake Superior drainage basin as a means to further focus governmental, public, educational and scientific attention on preserving the high quality waters of Lake Superior;
12. the Parties join with jurisdictions and local governments in the identification and designation of sustainable development areas, and provide support under the Agreement's nondegradation policy to develop a model for conserving and protecting aquatic areas of high quality, including the Grand Traverse Bay region, within a framework of environmentally sensitive and sustainable economic development.
13. the Parties not revise the Great Lakes Water Quality Agreement at this time; rather, in their

forthcoming review, the Parties, in consultation with the Great Lakes states and provinces, focus on how to improve programs and methods to achieve the requirements and overall objectives of the Agreement.

Recommendations of the 1992 Report on Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region

Based on studies and information received to date, the Commission makes the following recommendations to Governments on air quality in the Detroit-Windsor and Port Huron-Sarnia region:

1. Incineration facilities in the region be phased out of use or required to eliminate the production and emission of dioxins, furans, PCBs and inorganic materials, especially mercury and hydrochloric acid.
2. Uniform state and provincial requirements be established for incineration facilities in the Reference region based on the principle of zero discharge of persistent toxic substances.
3. Governments monitor incinerator emissions for phosgene gas when chlorinated organic materials are being incinerated and institute effective controls to prevent the production of this gas.

APPENDIX B:

Reports Prepared since October 1991 by the Commission, its Boards and Institutions

International Joint Commission

International Joint Commission. *Synthesis of Views on the March 1992 Progress Report of the Air Quality Committee under the United States/Canada Air Quality Agreement*. [Washington, D.C. and Ottawa, Ontario], January 1993, 14 pp.

Commission mixte internationale. *Synthèses des opinions exprimées sur le Rapport d'étape de mars 1992 du Comité de la qualité de l'air prévu par l'Accord Canada - États-Unis sur la qualité de l'air*. [Washington, D.C. et Ottawa, Ontario], janvier 1993, 14 pp.

International Joint Commission. *Corrections to the February 1992 International Joint Commission Report on Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region*. [Washington, D.C. and Ottawa, Ontario], January 1993, 28 pp.

Commission mixte internationale. *Corrections apportées au rapport de février 1992 publié par la Commission mixte internationale sur la qualité de l'air dans la région de Detroit-Windsor/Port Huron-Sarnia*. [Washington, D.C. et Ottawa, Ontario], janvier 1993, 28 pp.

International Joint Commission. *Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region*. [Washington, D.C. and Ottawa, Ontario], February 1992, 48 pp.

Commission mixte internationale. *La Qualité de l'air dans la région de Detroit-Windsor/Port Huron-Sarnia*. [Washington, D.C. et Ottawa, Ontario], février 1992, 48 pp.

International Joint Commission. *Air Quality in the Detroit-Windsor/Port Huron-Sarnia Region*. Executive Summary and Recommendations. [Washington, D.C. and Ottawa, Ontario], February 1992, 5 pp.

Commission mixte internationale. *La qualité de l'air dans la région de Détroit-Windsor/Port Huron-Sarnia*. Résumé et recommandations. [Washington, D.C. et Ottawa, Ontario], février 1992, 5 pp.

International Joint Commission. *Sixth Biennial Report Under the Great Lakes Water Quality Agreement of 1978 to the Governments of the United States and Canada and the State and Provincial Governments of the Great Lakes Basin*. [Washington, D.C. and Ottawa, Ontario], March 1992, 60 pp.

Commission mixte internationale. *Sixième rapport biennal présenté aux gouvernements des États-Unis et du Canada ainsi qu'aux états et provinces du bassin des Grands Lacs, aux termes de l'accord de 1978 relatif à la qualité de l'eau dans les Grands Lacs*. [Washington, D.C. et Ottawa, Ontario], mars 1992, 60 pp.

Great Lakes Water Quality Board

Great Lakes Water Quality Board. *1993 Report of the Great Lakes Water Quality Board to the International Joint Commission*. [Windsor, Ontario], September 1993, 33 pp.

Conseil de la qualité de l'eau des Grands Lacs. *Rapport de 1993 du Conseil de la qualité de l'eau des Grands Lacs*. [Windsor, Ontario], septembre 1993, 33 pp.

Great Lakes Water Quality Board. Proceedings of a workshop on *Legislative and Regulatory Considerations for Virtual Elimination of Persistent Toxic Substances* held June 17-18, 1992 in Windsor, Ontario. [Windsor, Ontario], 1993, 15 pp.

Great Lakes Water Quality Board. Proceedings of a workshop on *Scientific Challenges for Regulatory Decision Making* held on November 16, 1992 in Chicago, Illinois. [Windsor, Ontario], 1993, 10 pp.

Great Lakes Water Quality Board. Proceedings of a workshop on held February 1-2, 1993 in St. Catharines, Ontario. [Windsor, Ontario], 1993, 43 pp.

Great Lakes Science Advisory Board

The Ecosystem Approach: Theory and Ecosystem Integrity. Report to the Great Lakes Science Advisory Board. [Windsor, Ontario], March 1994, 64 pp.

Our Community, Our Health: Dialogue Between Science and Community. A report on a workshop held September 14-15, 1992 by the Workgroup on Ecosystem Health of the Great Lakes Science Advisory Board. [Windsor, Ontario], March 1994, 56 pp.

Great Lakes Science Advisory Board. *1993 Report to the International Joint Commission*. [Windsor, Ontario], September 1993, 62 pp.

Conseil consultatif scientifique des Grands Lacs. *Rapport de 1993 à la Commission mixte internationale*. [Windsor, Ontario], octobre 1993, 68 pp.

Proceedings of the Third Expert Consultation Meeting on Bald Eagles in the Great Lakes Basin. Report of the Ecological Committee's Biological Effects Subcommittee to the Science Advisory Board. [Windsor, Ontario], February 1992, 29 pp.

Council of Great Lakes Research Managers

Council of Great Lakes Research Managers. *Great Lakes-St. Lawrence Research Inventory 1991/1992*,

[Windsor, Ontario]. November 1993, 178 pp.

Council of Great Lakes Research Managers. *1993 Report to the International Joint Commission*. [Windsor, Ontario], September 1993, 58 pp.

Conseil des gestionnaires de la recherche des Grands Lacs. *Rapport de 1993 à la Commission mixte internationale*. [Windsor, Ontario], septembre 1993, 58 pp.

Council of Great Lakes Research Managers. *Great Lakes-St. Lawrence Research Inventory 1990/1991, Summary Report*. [Windsor, Ontario]. April 1992, 110 pp.

Virtual Elimination Task Force

An Examination of the Integrity of Five Hazardous Waste Disposal Sites in the Great Lakes Basin. Report to the Virtual Elimination Task Force. [Windsor, Ontario], March 1994, 120 pp.

Bioindicators as a Measure of Success for Virtual Elimination of Persistent Toxic Substances. Based on a Workshop Held April 28-29, 1992, to the Virtual Elimination Task Force. [Windsor, Ontario], March 1994, 61 pp.

Source Investigation for Lake Superior. Report to the Virtual Elimination Task Force. [Windsor, Ontario], March 1994, 66 pp.

Virtual Elimination Task Force. Final report, *A Strategy for Virtual Elimination of Persistent Toxic Substances (Volumes 1 and 2)*. Presented to the International Joint Commission. [Windsor, Ontario], August 1993, 72 pp. (Volume 1) & 112 pp. (Volume 2)

Related Reports

Educators Advisory Council. *Final Report of the Great Lakes Educators Advisory Council to the International Joint Commission*. [Windsor, Ontario], September 1993, 28 pp.

Éducateurs de la région des Grands Lacs. *Rapport final du conseil consultatif des éducateurs de la région des Grands Lacs à la Commission mixte internationale*. [Windsor, Ontario], septembre 1993, 28 pp.

Summary of the Remedial Action Plan Forum. Based on a workshop held in conjunction with the IJC's 1991 Biennial Meeting, September 27-28 in Traverse City, Michigan. [Windsor, Ontario], 1992, 10 pp.

Great Lakes Educators Advisory Council. *Directory of Great Lakes Education Material*. Fourth edition. [Windsor, Ontario], March 1992, 77 pp.

International Air Quality Advisory Board. *Progress by the Parties in Completing an Inventory of Toxic Air Emissions and in Assessing Toxic Air Deposition in the Lake Superior Basin*. [Washington, D.C. and Ottawa, Ontario], October 1993, 52 pp.

International Air Quality Advisory Board. *Winds of Chance: The Effects of Air Pollution on the Great Lakes*. [Washington, D.C. and Ottawa, Ontario], August 1992, 15 pp.

Conseil consultatif international de la qualité de l'air. *Vents incertains: les effets de la pollution atmosphérique sur les Grands Lacs*. [Washington, DC and Ottawa, Ontario], août 1992, 15 pp.

Expert Group on Monitoring. *Monitoring for Integrated Analysis*. Final Report to the International Air

Quality Advisory Board. [Washington, D.C. and Ottawa, Ontario], March 1992, 48 pp.

Levels Reference Study Board. *Final Report of the Levels Reference Study Board to the International Joint Commission*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 152 pp.

Levels Reference Study Board. *Annex 1: Public Participation and Information*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 25 pp.

Levels Reference Study Board. *Annex 2: Land use and Management*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 322 pp.

Levels Reference Study Board. *Annex 3: Existing Regulation System-Wide Regulation, Climate Change and Crises Conditions*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 234 pp.

Levels Reference Study Board. *Annex 4: Principles, Evaluation, Integration and Implementation*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 289 pp.

Levels Reference Study Board. *Annex 5: Citizens Advisory Committee*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 27 pp.

Levels Reference Study Board. *Annex 6: Crises Condition Responses*. [Chicago, Illinois and Burlington, Ontario], March 31, 1993. 568 pp.

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