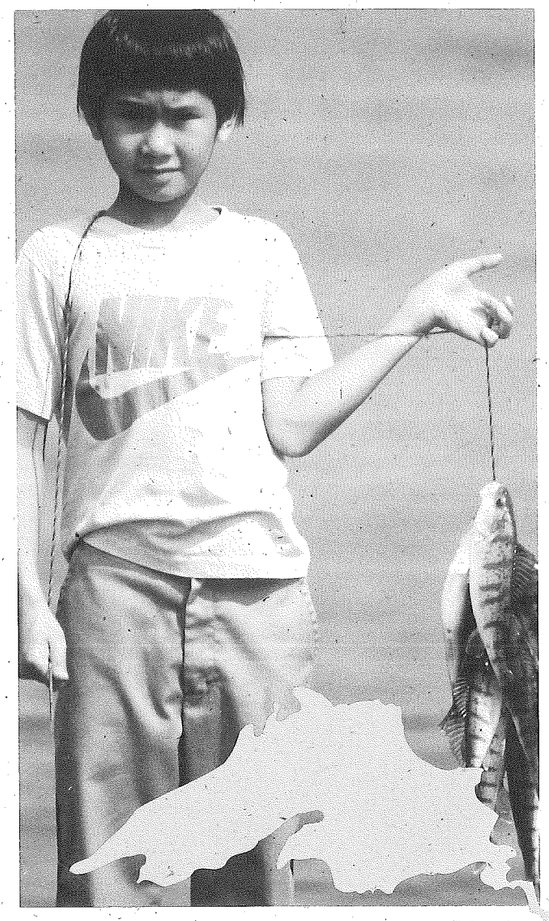
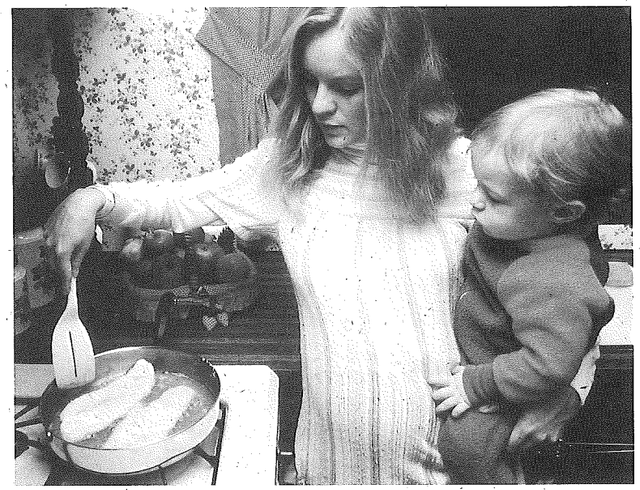
A Prescription for Healthy Great Lakes

REPORT OF THE PROGRAM FOR ZERO DISCHARGE





A Joint Project of the
NATIONAL WILDLIFE FEDERATION®

And the
CANADIAN INSTITUTE FOR ENVIRONMENTAL LAW AND POLICY

A Prescription for Healthy Great Lakes

Report of the
Program for Zero Discharge

A Joint Project of the
National Wildlife Federation®

and the

Canadian Institute for Environmental Law and Policy

February, 1991

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About the National Wildlife Federation:

The National Wildlife Federation is the largest citizens' organization in the U.S. promoting the wise use of natural resources. Headquartered in Washington, D.C., the Federation is comprised of 52 affiliate organizations. Total membership exceeds 5 million.

Since 1982, NWF's Great Lakes Natural Resource Center, based in Ann Arbor, Michigan, has operated a program of advocacy, litigation and scientific research directed at the problems of toxic contamination of the Great Lakes ecosystem. The Center is staffed by attorneys, scientists and policy specialists. For information contact:

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About the Canadian Institute For Environmental Law and Policy (CIELAP):

CIELAP is an independent, non-profit research institute founded in 1970. Based in Toronto, the Institute has published a wide number of books, articles and papers on numerous issues relating to environmental law and policy. One of its major emphases is the regulation of toxic chemicals in the Great Lakes environment. For information or a copy of our publications list, contact:

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Cover photography:
Woman with Child: Michigan Department of Natural Resources
Boy with Fish: Michigan Department of Natural Resources
Eaglets: Pete Nye

Preface

Forty years from now, our children and grandchildren will mark 1990 as a watershed year in Great Lakes protection. In May of last year, the International Joint Commission (IJC) issued a sharply worded report criticizing the Governments of the U.S. and Canada for their lack of progress in protecting and cleaning up the Great Lakes. The IJC concluded that the Governments must begin at once to take seriously their pledge in the *U.S.-Canada Great Lakes Water Quality Agreement* of zero discharge of the most dangerous toxics.

The IJC report was the direct result of demands made by several hundred Canadian and U.S. citizens at the IJC's October, 1989, meeting on Great Lakes Water Quality held in Hamilton, Ontario. The Commission listened to over eighteen hours of testimony as speaker after speaker came to the microphone to express concern and demand action.

A number of activities were set in motion by the IJC report. For example, the IJC established a Virtual Elimination Task Force that will soon be recommending a strategy to fulfill the Agreement's pledges.

Another important event happened in December of last year, when the U.S. Congress passed and the President signed the *Great Lakes Critical Programs Act*. This law sets strict deadlines for adopting new uniform water quality standards and application procedures that are consistent with the goals of the U.S.-Canada Agreement, and for completing plans to clean up toxic hot spots. This law has given a sense of urgency to the U.S. EPA's and the Great Lakes States' Water Quality Initiative and other efforts that are designed to integrate the Agreement's policies with existing domestic law in the U.S.

These and other events didn't just happen. They are directly attributable to the mounting fears, frustrations and growing impatience of the public. The events reflect a growing understanding of the devastating health effects of toxic poisoning on people and wildlife in this region.

About This Project

In December of 1988, two leading environmental groups, the National Wildlife Federation (NWF) and the Canadian Institute For Environmental Law and Policy (CIELAP), began the **Program For Zero Discharge**. The spirit of binational cooperation underlying this project befits the unified determination expressed by Canadian and U.S. citizens at the Hamilton IJC meeting. NWF and CIELAP representatives were among the many groups at that meeting who for years have been pushing the Governments to take seriously the promises of the U.S.-Canada Agreement.

The purpose of the **Program For Zero Discharge** is to reform government laws and regulations to implement zero discharge and the other goals of the Agreement. This report summarizes the first phase of the project. In this phase, we have researched the ways in which current government programs should be reformed.

In the second phase of the **Program For Zero Discharge,** beginning with the release of this report, NWF and CIELAP will be working with other groups and individuals throughout the Great Lakes region conducting education and advocacy campaigns to promote the recommendations in this report.

This report was written by a four-member team consisting of project managers Tim Eder and Paul Muldoon from NWF and CIELAP, respectively, Mark Van Putten from NWF and John Jackson.

This report was made possible by the dedicated efforts of many people who served as researchers, consultants, assistants and advisors to CIELAP and NWF. Condensing and summarizing the many hours of work and pages of technical papers into this small report in a way that does justice to these individuals' commitment and tireless efforts was a

difficult task. Copies of the research studies upon which this report is based are available by filling out the order form in the Appendix.

The following researchers, consultants and assistants contributed to this report:

For NWF:

Wayland Swain, Ph.D.; Jeffery Foran, Ph.D.; David Zaber, M.S.; Larry Fink, M.S.; Lorraine Lamey, M.S. and Michael Penn. Special thanks to Kathy Towler, Kris Olsson and Jennifer Reichle for their tolerance, support and assistance.

For CIELAP:

Susan Sang, Ph.D; Marcia Valiante, LL.M.; Joanne Rappaport; Burkhard Mausberg; Fe de Leon; Michael Hartke; Gary Loftus; Barbara Heidenreich, M.A., M.I.A.; Stacy Zosky and Paul Bentley, M.Sc.

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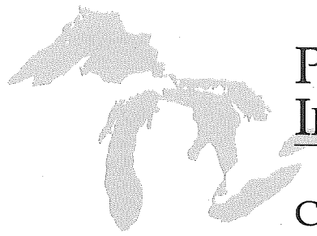

PART I
INTRODUCTION

CHAPTER 1
A Vision for the Future of the Great Lakes

All of us who care about the Great Lakes have dreams of how we want them to be in the future. Maybe your dream is to lie on a Toronto beach 30 years from now, watching your grandchildren swim in Lake Ontario. Maybe your dream is that your grandchildren can breathe the air in their community and eat food from the lands and water of the basin without fear.

The following anecdote is a vision of the Lakes' future shared by our project team:

It's a sunny May morning in the Year 2021. I have leisure time now, being retired, and decide to take my daughter and grandchild out to enjoy a day on the Great Lakes. We arrange a fishing trip on one of the numerous charter boats in this thriving Great Lakes community.

As we leave the harbor we pass several commercial fishermen, including some native people, as they empty their nets of the previous evening's catch. Some of their fish will become their dinner; the rest will be sent to restaurants and fish markets throughout North America.

As we troll along the south side of a small island a bald eagle swoops down and catches a pike from the lake. What a thrill as we watch it fly back to its nest! Through binoculars, we see that three eaglets hungrily await its return. I tell my daughter and grandchild what a marvel it is to see bald eagles thriving again throughout the Great Lakes. Not long ago, bald eagles feeding along most shores of the Great Lakes were unable to reproduce because of toxics in the fish they ate.

Luck is with us today. We catch our limit of lake trout and keep three. As we head back to shore, I remember the days when I worried about eating Great Lakes fish and am comforted to know that they are now safe.

I proudly tell my daughter and grandchild about the role I played with so many others in restoring the health of these marvelous Lakes. I tell them how, in 1989, I joined hundreds of citizens at a meeting of the International Joint Commission in Hamilton, Ontario, to demand that the poisoning of the Great Lakes be stopped. Our united calls for "Zero Discharge Now" spread throughout the Basin. Finally, government, industry and agriculture made the changes it took to clean up the Great Lakes.

Though our dreams may vary, we are united in a shared vision of healthy Great Lakes: an ecosystem in which we, our children and grandchildren, and the fish, birds and wildlife can all lead safe and healthy lives.

But a vision is not enough. Not only must we choose today what we want the condition of the Lakes to be in the future, we must develop and implement a strategy to achieve that vision. Our vision of a healthy Great Lakes will become reality only if we, the residents of the Great Lakes Basin, immediately make fundamental changes in the way we produce, use and dispose of toxic chemicals.

The toxic chemicals now permeating the Great Lakes are the major barrier to achieving our shared vision. Birds and wildlife, especially those that eat Great Lakes fish, are devastated by reproductive problems, birth defects and a host of other illnesses. Our health and our children's health are threatened by the same chemicals.

In this report, we offer our prescription for healthy Great Lakes. It is based on three measures of the Lakes' health:

- Whether women can eat Great Lakes fish without affecting the development of their babies;
- Whether wildlife that eat Great Lakes fish and other aquatic life thrive in the Great Lakes Basin; and
- Whether people can eat Great Lakes fish without increasing their risk of getting cancer.

A vision without a task is a dream,
A task without a vision is drudgery,
But a vision with a task is the hope of the world.

—Inscription on the wall of a 17th Century English church.

The strategy detailed in this report is aimed at cleaning up the Great Lakes and preventing further degradation so that the answer to these questions is yes.

The way in which others measure the health of the Great Lakes ecosystem may vary from our three indicators. What is essential is that Great Lakes Governments describe a vision of where their programs are leading, and that they define precise measures of their progress. So far, they have done neither.

Even if we act today, it will take thirty years to achieve our vision. It will take thirty years for the Great Lakes to cleanse themselves of the toxics already in the system, even if we totally cut off all sources by the Year 2000. This is the price we must pay for not fully understanding the sensitivity of the Great Lakes and their inhabitants to toxic chemicals. It is the price we must pay for not acting decisively when we began to understand.

CHAPTER 2

The Health Effects of Toxic Contamination

Our shared vision for the future of the Great Lakes is being shattered by the effects of toxic contaminants on people and wildlife.

Traditionally, pollution control programs have focussed on the threat of cancer to people. But the effects of toxic contamination of the Great Lakes are much broader and more insidious. The damage to wildlife and humans includes decreased ability to reproduce, birth defects, changes in behavior and abnormal development of babies.[1]

Our research focussed on the three major kinds of effects that coincide with our three indicators of ecosystem health: effects on children, damage to wildlife and increased cancer risks. We reviewed available scientific research to measure the extent of the damage from toxic pollution.

Effects on Children

> *. . . the Commission must conclude that there is a threat to the health of our children emanating from our exposure to persistent toxic substances, even at very low ambient levels.*
>
> International Joint Commission, *Fifth Biennial Report on Great Lakes Water Quality*, 1990.

Even this powerful statement from the International Joint Commission belies one crucial fact: the damage from toxic chemicals is not just a threat. It is real, and it can be seen in the children of women who ate contaminated Great Lakes fish. A landmark series of studies provides disturbing evidence that toxic chemicals in Lake Michigan fish has impaired the learning abilities of hundreds, if not thousands, of our children.

Children's performances on basic tests of learning skills are decreased by increased levels of toxic chemicals, such as PCBs, in their bodies.[2] Babies are exposed to these chemicals in their mother's womb and, later, from their mother's milk.

For example, after one eats a meal of fish contaminated with PCBs, levels of PCBs in blood increase dramatically.[3] The PCBs accumulate in body fat; each meal of fish adds to this stored reservoir of poisons.

When a woman becomes pregnant, the PCBs stored in her body are transmitted across the placenta to the fetus developing in her womb. Contaminated body fats are also converted into breast milk, exposing the baby to more PCBs after it is born. The most critical time for exposure is during pregnancy because of the extreme sensitivity of the rapidly developing fetus.

PCBs have serious consequences for the health of children. Studies of women who ate Lake Michigan fish found that their babies weighed less, had smaller heads and were born earlier than a control group of infants born to women from the same communities who did not eat these fish.[4] Children of the women who ate Lake Michigan fish were less mature in their physical movements and showed weaker reflex responses, even when controlled for differences in birth size and time in the womb. At seven months of age, the babies whose mothers ate Lake Michigan fish scored lower on tests of their visual memory than the control group of babies.[5]

The effects of PCB exposure do not disappear as the children grow older. There is disturbing evidence of long-term nervous system damage. The same children tested at birth and at seven months of age were tested again at four years of age. The children whose mothers ate more Lake Michigan fish performed less well on short-term memory and verbal skills tests than the children who were exposed to lower amounts of PCBs.[6] Performance on these tests is a strong indicator of future learning abilities.

> *The child that I am carrying right now has probably and is currently receiving the heaviest loadings of toxic chemicals that it will receive in its lifetime.*
>
> Kate Davies, former IJC Science Advisory Board member, spoken in 1989 while she was pregnant.

The scientists who performed these studies estimated that nearly 100,000 women in the eighteen Michigan counties near Lake Michigan eat as much fish as the mothers of the children tested.[7] Their children could suffer the same behavioral and learning disabilities.

Project scientists determined that levels of PCBs in Great Lakes waters would have to be reduced to one part per quadrillion in order to avoid the kinds of effects found in children of mothers who eat Lake Michigan fish.* Currently, PCB levels in the open waters of Lake Ontario and Lake Michigan are nearly 1000 times higher than the 1 part per quadrillion necessary to protect infants. Concentrations of PCBs are approximately 800 parts per quadrillion in Lake Ontario and 900 parts per quadrillion in Lake Michigan.

Our research focussed on PCBs as an example of the extent of the damage caused by toxic chemicals to human reproduction and infant development. It has been reported in

*Chapter 12 of this report details the method used to arrive at this level.

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Have we been subtly poisoning our unborn children and we don't know it? Is it possible that the fact that "Johnny can't read Susy can't write" may have very little or nothing at all to do with the quality of the education that they receive?

Wayland Swain, 1986

the scientific literature that most of the 11 chemicals on the IJC's list of Critical Pollutants in the Great Lakes, as well as other chlorinated pesticides and solvents, are human reproductive hazards.[8] Many of these same chemicals, including TCDD, hexachlorobenzene, DDT, lead and mercury are also human developmental toxicants.[9]

Some of the toxics that have already been absorbed into our bodies will remain there through our lifetimes. Women will pass this burden from generation to generation. We will still be able to detect PCBs being passed on to the babies of the great-great-great granddaughters of those mothers who ate Lake Michigan fish, even if future generations take in no additional PCBs.[10]

Damage to Wildlife

Wildlife in the Great Lakes are also suffering from toxic contamination.[11] The effects that have been observed include:

- *Population Declines and Reproductive Problems:* Bald eagles living near the Lakes are much less successful at reproducing than their inland neighbors. Mink have been virtually wiped out within five miles of Lake Ontario. A survey of scientific studies of fifteen kinds of birds, animals and fish in the Great Lakes found that all had experienced reproductive problems and/or population declines in the Great Lakes since the 1950's.[12]
- *Birth Defects:* Many fish-eating cormorants and terns from Green Bay and Saginaw Bay die soon after birth because twisted beaks and eye deformities make it impossible for them to catch food. In four island colonies of double crested cormorants in Green Bay studied between 1983 and 1987, birds were born with bill defects 42 times more frequently than in colonies outside of the Great Lakes.[13] Other birth defects in wildlife found in the Great Lakes include missing brains, missing eyes, internal organs located outside the body and deformed feet and wings. Birth defects occurred in almost half of the species studied.[14]
- *Behavioral Changes:* Biologists are finding increasing evidence of behavioral changes in wildlife that put their survival at risk. Gulls ignore their eggs. Terns leave their eggs at night making them easy prey for owls. Young lake trout swim upside down. Serious behavioral changes have already been documented in six species of wildlife.[15]
- *Sexual Changes:* Studies of herring gulls from Lake Ontario found male chicks with female sex organs. Similar abnormalities have been seen in mink and laboratory animals. This "feminization" is thought to be caused by the similarity in the chemical structure between female hormones and PCBs, DDE (a metabolite of DDT) and other pesticides.[16]
- *Increased Susceptibility to Disease:* Studies of beluga whales, terns and herring gulls have discovered suppression of their immune systems, the body's natural ability to resist disease.[17]

Scientists are convinced that toxic chemicals in the Great Lakes are the cause of these health problems in wildlife. Experiments have discovered, for example, that:

- Female mink fed a 30% diet of Lake Michigan salmon produced no live young, while control mink fed West Coast salmon were not affected.[18]
- Levels of only one part per million of PCBs in mink livers are associated with total reproductive failure.[19]
- Rats fed Lake Ontario salmon easily became frustrated, anxious and less active than rats in a control group.[20]

The health and behavioral problems listed above occur much more frequently in birds and animals that eat Great Lakes fish—fish that are contaminated by toxic substances—than in species that rely on other food sources. It is likely that toxic effects are also occurring in animals lower on the Great Lakes food chain although less information is available on them. This disruption of the food chain could deplete biological diversity and have unpredictable consequences for the ecosystem.

Increased Cancer Risk

Historically, the major public health concern from toxic contamination has been cancer. This fear is legitimate since many of the toxic chemicals in the Great Lakes likely cause cancer.

Many estimates understate actual cancer risk because they focus on exposure to only one chemical. This does not match reality. The residents of the Great Lakes region are exposed to a vast mix of chemicals.

In 1989, the National Wildlife Federation estimated the cancer risks for people who eat fish contaminated by four cancer-causing chemicals: PCBs, DDT, dieldrin and chlordane.[21] This study was based on levels of these contaminants found in fillets of Lake Michigan sport fish. The study concluded that cancer risks are much higher than previous estimates by governments. For example, eating one meal of lake trout each month throughout a person's lifetime would increase their cancer risks by one in one hundred. This increased risk would be added to the risks from other sources, such as at work, and in other food.

These estimates of cancer risk from eating Lake Michigan sport fish were based on the *combined effect* of only four of the approximately one hundred chemicals found in Lake Michigan fish. Insufficient monitoring data exists on the levels of the other chemicals in these fish to carry out cancer risk assessments.

These cancer risks are estimates based on studies of laboratory animals. This widely-accepted method illustrates the threat from toxic chemicals. But, the direct evidence of damage to wildlife and to children whose mothers ate Lake Michigan fish makes an even more compelling case for preventing future toxic pollution of the Lakes and for cleaning up the pollution that currently exists.

Levels of Toxics in the Great Lakes: Better or Worse?

The 1980's brought some good news about the Great Lakes. The levels of some toxic substances were dropping. But, it is premature to celebrate. The evidence of declining levels is limited to a few chemicals, notably PCBs and DDT.

Also, the improving trends slowed down in the late 1980's and in some cases came to a halt. Declines in DDT, chlorinated benzenes and PCBs, for example, have almost stopped.

Approximate Number of Lake Michigan Sport Fish Meals Associated with a 1-in-10,000, 1-in-100,000, or 1-in-One Million Lifetime Risk of Cancer (½-pound meal size, skin-on fillets)

	Cancer Risk		
Species/Size Class	1-in-10,000	1-in-100,000	1-in-1,000,000
Lake Trout (30" or more)	11 meals in your lifetime.	1 meal in your lifetime.	*
Lake Trout (20-30") Chinook Salmon (30" or more)	30 meals in your lifetime.	3 meals in your lifetime.	*
Brown Trout (Any Size) Lake Trout (10-20") Chinook Salmon (10-30")	70 meals in your lifetime.	7 meals in your lifetime.	One meal in your lifetime.
Coho Salmon (Any size) Walleye (Any Size)	150 meals in your lifetime.	15 meals in your lifetime.	One meal in your lifetime.
Yellow perch (Any Size)	420 meals in your lifetime.	42 meals in your lifetime.	4 meal in your lifetime.

*Eating a single meal of these fish results in a lifetime cancer risk in excess of one-in-one-million.

Moreover, despite the declines, these chemicals remain in the Lakes at levels that are unsafe for fish, wildlife and humans.

Current levels of toxic chemicals are harming wildlife. The Conservation Foundation testified before Congress in 1990 that, "It is clear that wildlife health problems have not been resolved in the Great Lakes basin, and that toxic chemicals are at the heart of the problem."[22]

The good news is misleading in an even more pernicious way. While total levels of some toxic chemicals are declining, the most hazardous forms of these chemicals are not dropping.

Some chemicals have many different forms. For example, there are 209 different PCBs, each called a congener. The toxic effects of each of these congeners differ greatly. While the total levels of PCB congeners have declined in the Great Lakes, those that remain are the most dangerous congeners.

For example, studies by the Michigan Department of Public Health found that, while total levels of PCBs in human tissue declined, the levels of the most toxic PCB congeners have increased. Those forms that have increased, the more chlorinated forms, are linked with tumor promotion, enzyme induction and other toxic effects.[23]

Finally, the declines in total PCBs and DDT occurred because of drastic action by government agencies. In the early 1970's, governments banned the manufacture or new use of PCBs, and banned the use of DDT. To date, many other chemicals threatening the Lakes are still being created and used, so we cannot expect to see their levels decline as rapidly as PCBs and DDT.

NOTES

1. For an excellent overview of the health problems created by toxic chemicals in the Great Lakes, see Theodora Colborn et al., *Great Lakes, Great Legacy?* (Washington D.C.: The Conservation Foundation, and Ottawa: The Institute for Research on Public Policy, 1990).
2. W. Swain, *Model Water Quality Standards To Protect Human Health From Reproductive and Developmental Toxicants.* (National Wildlife Federation, 1990). See the Appendix of this report for availability.
3. H. Humphrey, "Chemical contaminants in the Great Lakes: the human health aspect," in *Toxic contaminants and ecosystem health; a Great Lakes focus,* edited by M.S. Evans, (New York, N.Y., John Wiley and Sons, 1988), pp 153-165.
4. G. Fein et al., "Prenatal Exposure to Polychlorinated Biphenyls: Effects on Birth Size and Gestational Age," *Journal of Pediatrics* 105, no. 2 (1984): 315-20.
5. S. Jacobson et al., "The Effect of Intrauterine PCB Exposure on Visual Recognition Memory," *Child Development* 56 (1985): 853-60.
6. J. Jacobson et al., "Effects of in utero exposure to polychlorinated biphenyls and related contaminants on cognitive functioning in young children," *Journal of Pediatrics* 116 (1990) 38-45.
7. S. Jacobson et al., "Intrauterine exposure of human newborns to PCBs: Measures of exposure," in *PCBs: Human and Environmental Hazards,* edited by F. M. D'Itri and M.A. Kamrin (Boston: Butterworth Publishers, 1983), pp. 311-343.
8. B. Shane, "Human Reproductive Hazards," *Critical Reviews in Environmental Science and Toxicology* 23, no 10 (1989) 1187-95.
9. J. Shardein et al., "Potential Human Developmental Toxicants and the Role of Animal Testing in their Identification and Characterization," *CRC Critical Reviews in Toxicology* 19, no. 3 (1989): 259-339.
10. W. Swain, "Human Health Consequences of Consumption of Fish Contaminated with Organochlorine Compounds," *Aquatic Toxicology* 11 (1988): 357-77.
11. For a summary of these impacts see D. Zaber, *Model Water Quality Standards for Wildlife* (National Wildlife Federation, 1991). See Appendix to order.
12. Colborn, et al, op. cit., p. 134.
13. Statement of Timothy Kubiak, Environmental Contaminant Specialist, U.S. Fish and Wildlife Service, before the Michigan Natural Resources Commission, April 6, 1988.
14. Colborn, et al, op. cit. p. 138.
15. Ibid., p. 140.
16. Colborn et al, op. cit., p. 139.
17. Ibid., p. 134.
18. R. J. Aulerich et al., "Effects of feeding coho salmon and other Great Lakes fish on mink reproduction," *Canadian Journal of Zoology* 49 (1971): 611-616.
19. International Joint Commission, *1987 Report on Great Lakes Water Quality,* Appendix B, V.III, pp 6.1, 24-28.
20. H. Daly et al., "Ingestion of Environmentally Contaminated Lake Ontario Salmon by Laboratory Rats Increases Avoidance of Unpredictable Aversive Nonreward and Mild Electric Shock," *Behavioral Neuroscience* 103, no. 6 (1989): 1356-1365.
21. Barbara Glenn et al., *Lake Michigan Sport Fish: Should You Eat Your Catch?* National Wildlife Federation (1989), See Appendix for Availability.
22. Statement of Theo Colborn, Conservation Foundation, before the Subcommittee on Water Resources, Committee on Public Works and Transportation, U.S. House of Representatives, May, 1990.
23. "The Great Lakes Basin: A Regional Focus on the Environment and Human Health," *Conference Proceedings* (September 1989), p.28.

CHAPTER 3
The Costs of Toxic Contamination

Toxic contamination of the Great Lakes creates economic costs. These costs are already a huge environmental debt that we will pass on to future generations.

All costs from toxic contamination should be borne by polluters. But many costs are shifted to society at large. For example, we are forced to treat our water to make it safe to drink or fit to use in manufacturing processes because of toxic contamination. Canadian taxpayers are paying for a pipeline from Lake Huron to Walpole Island so that people will not have to drink water downstream from Canada's Chemical Valley in Sarnia, Ontario.

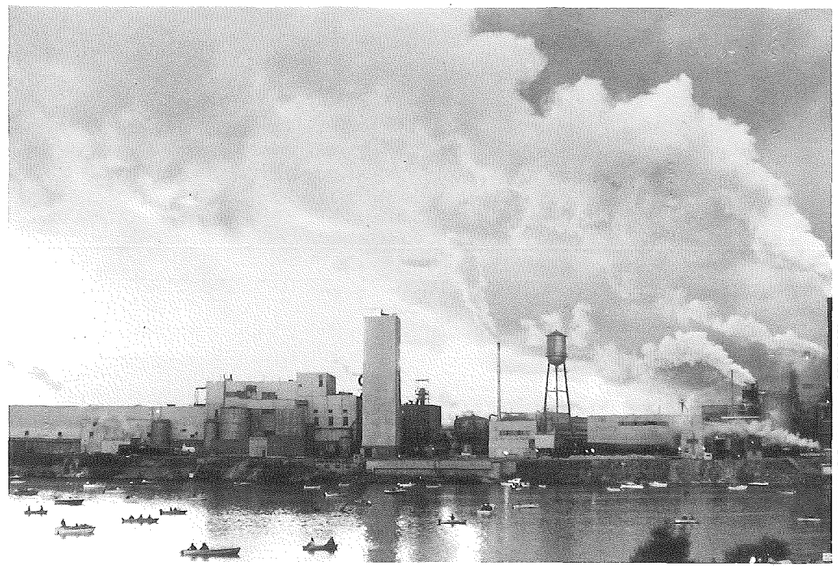
The costs of buying alternative sources of water and food because of contamination are more difficult to tally. Native people disproportionately bear these costs. Wildlife and fish are their historic food supply. Now, native people must purchase a greater percentage of their food because of toxic contamination. Unfortunately, they often can least afford the additional costs.

The costs to industry of trying to remove and treat pollutants before they are released into the environment are increasing rapidly. So are liability costs. These costs will continue to escalate as increased concern about contamination results in tougher regulations. More stringent regulations mean that it is becoming cheaper for industry to reduce their use of toxics rather than capture and treat wastes.

The costs of cleaning up the most severely contaminated parts of the Great Lakes are very high. For example, one group, the Washington, D.C.-based Northeast-Midwest Institute, estimated that it will cost between $2.9 billion and $3.4 billion dollars for a partial cleanup of only ten of the 42 areas designated by the International Joint Commission as toxic hot spots.[1]

Similarly, the U.S. General Accounting Office estimated that it will cost at least $1.8 billion to clean up Michigan's Rouge River to public health standards by the year 2005.[2]

Government scientists from the Canada Centre for Inland Waters estimated that it will cost $6 billion over the next thirty years and $19 billion over the next one hundred years to contain, maintain, monitor and clean up four of the largest leaking dumps on the U.S. side of the Niagara River.[3]



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The health problems caused by chemical contamination are expensive for individuals and governments. The Province of Ontario already spends nearly one-third of its budget on health care. In the U.S., almost one-tenth of the GNP is spent on health costs.

The virtual closing of the commercial fishery in many parts of the Great Lakes has had substantial economic impacts on individuals and fishing communities. These economic setbacks have resulted in part from prohibitions against selling fish contaminated by toxics.

Other parts of the economy that are affected by toxic contamination include food production, sports fishing and other recreational activities. The U.S. Fish and Wildlife Service estimated that anglers in the Great Lakes States spent over $28 billion on fishing and trip-related expenditures in 1985. This figure might be even higher if warnings about the safety of eating Great Lakes fish could be removed.

There are other subtle but significant costs from pollution, such as:

- Human potential may be decreased because of the effect of toxics on the development of this and future generations.
- Ways of life are being destroyed. Native people, for example, can no longer live in their traditional ways.
- The joy and inspiration that the Great Lakes bring us are diminished.

We must stop accumulating this environmental debt for future generations. Polluters must shoulder their fair share of these costs. And all of us must shoulder the burden of restoring and protecting the Great Lakes by adopting drastic and sometimes expensive measures to prevent future pollution and clean up existing contamination.

NOTES

1. *Cleaning up Great Lakes Areas of Concern: How Much Will It Cost?* (August 1989), p. 1.
2. *Improved Coordination Needed to Clean Up the Great Lakes* (September 1990), p. 33.
3. A. Sudar, et al., "Costs and Consequences of Uncontrolled Toxic Waste Sites Along the Niagara River," *Water Resources Journal of Canada* 24, no. 2, (1989) 279-97.

CHAPTER 4
The Failure of the Pollution Control Approach

Despite government actions aimed at controlling toxic pollution, in 1988 over 1.6 billion pounds of toxic chemicals were released into the environment or transferred off-site by U.S. industries located in the Great Lakes States. That is approximately 4.5 million pounds each day. Canadian pollution cannot even be estimated since data on cumulative toxic releases is not gathered.

These estimates understate the total releases of toxic contaminants. The U.S. data do not include small industries and commercial operations that use toxic chemicals. The figures do not reflect releases from pesticide use, run-off from farm lands and urban streets, and from leaking dumps and contaminated sediments. Nor do the reporting requirements cover all of the chemicals known to contaminate the Great Lakes.

These estimates do confirm, however, that despite all our laws, all our efforts and all our expenditures, massive amounts of toxic pollutants continue to be dumped into the environment every day. The current regulatory approach is not working.

Flaws in the Pollution Control Approach

The current regulatory approach focusses on the discharge of toxic substances. On a case-by-case basis, government agencies issue permits that, at best, require modest, incremental reductions in the concentration of a limited number of toxics being dumped into the environment.

This pollution control approach has several flaws:

1. The burden of proof is on the person trying to prevent the pollution:

In the pollution control approach, community residents, or government agencies trying to protect the environment, or workers trying to protect their health must prove that the contaminants will cause serious harm. If they cannot, the polluter is allowed to proceed.

This assumption that chemicals and discharges are innocent until proven guilty puts citizens, workers and the environment at considerable risk. It means that chemicals may be in use for many years before their dangerous impacts are known. By then it may be too late. Massive quantities of toxics have irretrievably contaminated the environment.

2. Reductions in total discharges are not required:

Attention is focussed on assessing each individual source of pollution in isolation, rather than determining the combined impacts of pollutants discharged into all parts of the environment from all sources.

In focussing on each discharge, government agencies fail to adequately assess:

(i) the current condition of the environment and society's goals for protecting or improving the overall environment;
(ii) the combined impact of discharges from other polluters, including other discharges from the same factory into the air or water; and
(iii) pollution from other kinds of sources, such as past dumping, leaking landfills, contaminated sediments and toxic fallout from the air.

As a result, total discharges of contaminants into the environment may increase, even though an individual discharge may appear insignificant.

3. Dilution is not the solution to pollution:

The pollution control approach still accepts the outdated dilution solution to meet environmental standards for toxics. Discharge permit limits are based on the *concentration* of pollutants instead of on the total amount of pollutants being discharged.

Frequently, polluters are allowed to dump massive amounts of a toxic chemical so long as it is mixed with enough water to dilute the concentration. Toxics may be diluted either by the flow of water through the plant or by discharging into a stream that has a high flow rate. Similar situations occur with air releases that are dispersed over a broad area.

The dilution approach is myopic: while it may ensure that discharges won't immediately kill fish near the end of a pipe, it fails to consider the long-term build-up of contaminants in the environment.

Chemical Waste Releases and Transfers in the Eight Great Lakes States[1]

1988 Toxics Release Inventory Data* (in millions of pounds)		
State	No. of Generators	Total**
Ohio	1360	375
Indiana	756	276
Illinois	1229	250
Michigan	790	233
Pennsylvania	1030	201
New York	816	176
Minnesota	330	65
Wisconsin	664	105
TOTAL	6975	1681

* Plants required to report their chemical discharges in 1988 included those that manufacture at least 50,000 pounds per year or use at least 10,000 pounds per year of one or more of the chemicals on the U.S. Toxics Release Inventory list.
** Including wastes released on site and transferred to publicly-owned sewage treatment plants or other off-site facilities.

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4. Pollution control focuses on end-of-the-pipe solutions:

The pollution control approach tries to trap contaminants after they are produced in the factory, but before they are released into the environment. This end-of-the-pipe approach has two fatal flaws:

(i) *Inevitably, some of the contaminants are released into the environment through the stack or pipe.* Once the toxics are created it is impossible to capture all of them. Therefore, existing pollution control regulations focus on determining acceptable levels of discharges.

This approach assumes that there is a safe or acceptable level for chemicals in the environment. Even if this were true, there is inadequate information to determine acceptable levels for all chemicals being discharged, let alone acceptable levels of multiple contaminants. The vast majority of the chemicals in use have never been tested for toxicological effects.[1]

The end-of-the-pipe approach presumes continued use of toxic chemicals. It assumes that most of the toxic substances created can be captured and that the environment can tolerate the ones that are not.

(ii) *The end-of-the-pipe approach amounts to a "toxic shell game."*

End-of-pipe technologies often prevent pollutants from getting into one part of the environment by putting them into another. For example, wastewater treatment systems collect and concentrate pollutants into a sludge. This sludge is incinerated, buried in a landfill or spread on land. Sludge disposal by these means causes pollution of the air or of ground or surface water. This transfer from one environmental medium to another is a self-defeating effort; overall pollution is not necessarily reduced.

Because most government environmental agencies have different branches controlling air, water, waste disposal, pesticides and toxic substances, requirements may vary substantially. This promotes a "toxic shell game" in which polluters merely shift wastes to the least strictly regulated discharge point.[2]

The Pollution Control Approach in the Great Lakes

The Great Lakes are particularly vulnerable to the flaws in the traditional pollution control approach.

Unlike rivers or shallow lakes that flush out fairly quickly, water stays in the Great Lakes a long time. Less than one percent of the water in the Great Lakes flows through the St. Lawrence River to the ocean each year. On average, a molecule of water stays in Lake Superior for 200 years, in Lake Michigan for 100 years, and in Lake Huron for 25 years.

In effect, the Great Lakes are giant sinks with a stopper in the drain. Toxic substances dumped into them do not quickly flush away. So the total amounts of toxics discharged to the Lakes is critical, not just the concentration.

The chemicals that create the greatest problems in the Great Lakes are those that persist a long time before breaking down and which dissolve easily in fats. These include dioxins, PCBs, and pesticides such as DDT, chlordane, dieldrin, toxaphene and mirex.

When these fat-soluble chemicals enter the Great Lakes, they are stored in the tissue of fish and other living organisms in the Lakes, instead of remaining dissolved in the water. The fish and organisms are, in turn, eaten by people and animals. The chemicals that were in the fish are then absorbed in the tissues of those who ate the fish. During this process, the chemicals become ever more concentrated. These processes are called "biomagnification."

Biomagnification can result in chemical concentrations millions of times greater in animals than in Great Lakes water. For example, the levels of PCBs in the body of a herring gull will be at least 30 million times higher than in the water inhabited by the fish that the gull ate. Seemingly harmless levels of chemicals in discharges, therefore, can become extremely dangerous to the health of wildlife and humans.

The pollution control approach to regulating discharges of chemicals largely ignores these fundamental characteristics of the Great Lakes. It cannot, therefore, achieve our vision of a healthy Great Lakes ecosystem.

Jack Vallentyne, a Canadian scientist, has enriched thousands of people, young and old, with his lessons about Great Lakes ecology. He tells this story to school children:

One hot summer day in 1890, my Grandad was fishing in Lake Superior. The hard work from rowing his boat made him sweat, so he jumped in the Lake to cool off. The salt from my Grandad's back spread throughout the Lake.

The last time you were in Toronto, did you drink a glass of water? If you did, salt ions from my Grandad were in the water you drank from Lake Ontario.

NOTES

1. Adapted from Presentation of Joanna D. Underwood, President, Inform, Inc. at a workshop entitled "Pollution Prevention/ Business Modernization Linkages," (Chicago, September 18, 1990).
2. The Conservation Foundation, *State of the Environment: An Assessment at Mid-Decade* (Washington, D.C., 1984), pp. 39-40; and Ross Hume Hall, "Why the EPA Won't Work," Probe Post (Spring 1987), p. 29.
3. M. L'Ecuyer et al., *Toxic Use Reduction: From Pollution Control to Pollution Prevention* (Boston, Mass: 1988), pp. 9-10.
4. Adapted from T. Clark, et al., "Wildlife monitoring, modeling, and fugacity," *Environmental Science and Technology* 22, no. 2 (1988): 120-127.

EXAMPLES OF BIOMAGNIFICATION RATES FROM WATER TO HERRING GULLS[4]

Hexachlorobenzene: *2.1 million to 18 million times higher in Gull than in water.*

DDT: *half a million to one million times higher.*

DDE: *140 million to 300 million times higher.*

Dieldrin: *700,000 to 850,000 times higher.*

PCBs: *33 million to 333 million times higher.*

This is based on chemicals in water moving up the food chain through smelt and alewives, which are eaten by herring gulls.

INTERNATIONAL JOINT COMMISSION

CHAPTER 5
Summary: A New Strategy

If we are to achieve the healthy ecosystem of our vision, we must overcome the limitations of the pollution control approach and eliminate the most harmful substances from the Great Lakes ecosystem. Our strategy for achieving this objective is two-pronged:

1) **Stop all future discharges of the most harmful pollutants through a zero discharge program and substantially reduce the discharge of all other chemicals; and**
2) **Clean up those contaminants that have been released into the Great Lakes.**

The Zero Discharge Strategy

As a first step, government agencies must immediately institute a "toxics freeze" to prevent ***new or increased discharges*** of harmful substances into the Great Lakes ecosystem.

Second, the total quantities of those substances already being discharged from all sources must be eliminated or substantially reduced. The only way to achieve this objective is by focussing on the ***use*** of toxic substances.

Use of the most hazardous chemicals must be immediately banned or phased out as quickly as possible. The introduction of new chemicals that may harm the health of the Great Lakes must be strictly prohibited. The burden of proof must be shifted to those who want to use a substance to demonstrate that it is harmless.

For those chemicals that are not banned, dramatic reductions in their use must be required. Plans to eliminate or minimize the use of toxics in industries, cities, agriculture and other sectors of society should be developed and implemented.

Residents and workers should be involved in making decisions concerning the use of toxic substances in their communities and workplaces.

The zero discharge strategy is detailed in Part II of this report.

The Clean-Up Strategy

Even if current discharges of toxic substances were stopped immediately, the health of the Great Lakes ecosystem would not be restored. The massive amounts of toxics dumped in the past must first be cleaned up before we can achieve our vision.

As a first step in a comprehensive clean-up program, uniform standards must be set to protect women and their infants, wildlife and the other sensitive indicators of toxic contamination. Then, governments must determine the total reduction in the amounts of toxics needed to restore the Great Lakes to health. A timetable for achieving these reductions must then be adopted.

The sources of the toxics now entering the Lakes must be identified, including contaminated sediments, abandoned dump sites, the air, runoff from land and discharges from pipes. Detailed, enforceable plans for cleaning up these sources of contamination must be developed and implemented.

Comprehensive clean-up plans will require the commitment of substantial resources and cooperation between government agencies, industry, agriculture, local governments and citizens' groups. Current efforts to develop Remedial Action Plans and Lakewide Management Plans, as required by the Great Lakes Water Quality Agreement, can be the basis for this part of our strategy.

Part IV of this report details our strategy for cleaning up the Great Lakes.

Our two-part strategy is a concrete plan for achieving a healthy Great Lakes ecosystem; it is a roadmap for making our vision for the future of the Great Lakes become a reality.

We are confident that if our prescription of eliminating and reducing the use of toxics and cleaning up contamination is carefully followed, the Great Lakes will be restored to health. Some people may disagree with parts of this strategy. The challenge is for them to reveal their vision and to disclose their strategy for the future.

PART II
THE ZERO DISCHARGE STRATEGY

CHAPTER 6
The Call for Zero Discharge

The Basis of the Zero Discharge Strategy

How far have we progressed toward the goal of restoring the quality of the environment?

The answer is in fact embarrassing. Apart from a few notable exceptions, environmental quality has improved only slightly, and in some cases has become worse.

These few successes explain the far more common failures. Each of these pollutants has been effectively controlled not by high-tech devices, but by simply stopping its production or use.

The lesson of both the few successes and the far more numerous failures is the same: environmental pollution is a nearly incurable disease: but it can be prevented.

—Barry Commoner[1]

A zero discharge strategy must be based on five fundamental principles:

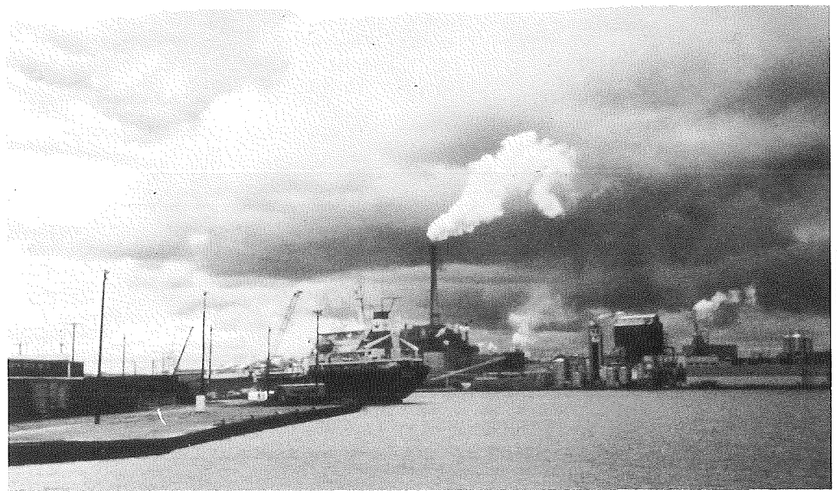
1. Eliminate the Use of Toxics:
Instead of focussing on reducing and treating wastes, polluters must eliminate the use of toxics to avoid creating the wastes in the first place.

2. Decrease Total Quantities of Toxics in the Environment:
The ***total amounts*** of toxics entering the Great Lakes ecosystem must be substantially reduced according to a strict timetable.

3. Address All Sources of Pollution:
All sources of toxics must be controlled, including discharges from municipal sewage treatment plants and industries, and agricultural and urban run-off. These sources must be addressed regardless of whether the initial release of toxics is into water, air or on to land.

4. Enforce the "No Right to Pollute" Principle:
No one has the right to pollute. Permits that have been granted that allow pollution are only temporary concessions and must be phased out as quickly as possible.[2]

5. Institute a Reverse Onus Requirement:
The user or discharger of a possibly toxic substance must prove that the substance will not harm the environment. A chemical should be assumed to be harmful unless proven otherwise. The International Joint Commission called for this principle in its most recent report to the U.S. and Canada.[3]



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Government Commitments to Zero Discharge

Despite the significance of the Great Lakes and our collective rhetoric to restore and enhance them, we as a society continue to mortgage their future by poisoning, suffocating and otherwise threatening them because of insufficient knowledge, other priorities and short-sightedness.

—International Joint Commission, Fifth Biennial Report on Great Lakes Water Quality.

In 1972, the U.S. and Canadian Federal Governments signed the *Great Lakes Water Quality Agreement* in which they promised to work together to clean up and protect the Great Lakes. The Agreement, as revised in 1978, is based on two guiding principles: an ecosystem approach and zero discharge of persistent toxic substances.

The U.S. and Canadian Governments promised to "eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes System." They made an even more stringent commitment regarding the discharge of persistent toxic substances. The discharge of all persistent toxic substances is to be "virtually eliminated."

In order to achieve this goal, the Agreement states that all present and future discharges must be stopped. According to Annex 12, "The philosophy adopted for control of inputs of persistent toxic substances *shall be zero discharge*." Actions that are inconsistent with the zero discharge strategy are described in the Agreement as "interim."

The two Federal Governments realized that the key to achieving the Agreement's goal of restoring ecosystem health is applying a zero discharge strategy to all sources of toxics. The Agreement requires controls of industrial and municipal "point" sources of contamination as well as "non-point" sources such as poison runoff from urban and agricultural land, contaminated sediments, airborne toxic substances, and pollution from contaminated groundwaters.[4]

Governments in the Great Lakes Basin have made similar commitments in several other pieces of legislation or agreements. Section 101 of the U.S. *Clean Water Act* of 1972 states that "it is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985." Section 118 of this Act directs the U.S. to "seek to attain the goals embodied in the *Great Lakes Water Quality Agreement* of 1978 . . . with particular emphasis on goals related to toxic pollutants."

In the 1986 *Great Lakes Toxic Substances Control Agreement*, the eight Great Lakes States and the Provinces of Ontario and Quebec promise to act consistently with the *Great Lakes Water Quality Agreement*. Principle IV states:

> The signatory States commit to continue reducing toxics in the Great Lakes Basin to the maximum extent possible. Such actions shall be consistent with the *Federal Clean Water Act* goal of prohibiting the discharge of toxic pollutants in toxic amounts, as well as the *Great Lakes Water Quality Agreement's* aim to "virtually eliminate" the discharge of all persistent toxic substances.

Ontario's Municipal-Industrial Strategy for Abatement (MISA) and its Clean Air Program (CAP) both state as their aims the virtual elimination of persistent toxic substances.

Despite these many promises of zero discharge, the Governments in the Great Lakes Basin have failed to develop and implement a zero discharge strategy.

In its 1990 report to the Canadian and U.S. Federal Governments, the International Joint Commission concluded its assessment of government progress by saying:

> The Agreement's zero discharge philosophy must become a reality as soon as technologically possible. While the Parties' strategy to regulate producers is required to ensure action by the primary sources of persistent toxic substances, it will not be a sufficient plan to achieve zero discharge. A much more comprehensive and systematic strategy is required.[5]

Substances to Which the Zero Discharge Goal Applies

In the *Great Lakes Water Quality Agreement*, the zero discharge philosophy applies to persistent toxic substances. The Agreement defines persistence as a half-life in water greater than eight weeks. Attention is focussed on persistent toxic substances because this class includes those chemicals that biomagnify in living organisms where they can cause serious health impacts.

However, non-persistent toxics should not be excluded from the zero discharge strategy. Some chemicals that are not persistent or that do not biomagnify at high rates can, nevertheless, have serious health effects. Benzene, for example, does not biomagnify; it does, however, cause cancer. The U.S. *Clean Water Act*'s zero discharge goal applies to all discharges, regardless of whether they persist or biomagnify.

The zero discharge strategy outlined in this report places top priority on persistent toxic substances. But, the same basic principles should be extended to all toxic substances.

Differing Definitions of Zero Discharge

"Zero discharge" is sometimes defined in ways that limit its implications. To implement a zero discharge strategy it is first necessary to understand what it does, and does not mean.

"Zero discharge" is not the same as "virtual elimination":

Some people who wish to weaken zero discharge programs argue that we cannot totally eliminate discharges of toxics; the best we can do, they say, is to almost or virtually eliminate them. These people sometimes use the *Great Lakes Water Quality Agreement* to defend their position. This argument misinterprets the zero discharge objective.

The Agreement recognizes that it is impossible to totally eliminate persistent toxic substances from the Great Lakes ecosystem because we cannot completely clean up or recapture those contaminants already released. Also, some toxics occur naturally. Therefore, we can only virtually eliminate the presence of persistent toxic substances in the Great Lakes Basin.

The objective of the zero discharge strategy outlined in this report is to virtually eliminate the presence of toxics in the Great Lakes ecosystem. Because of the large amounts of these substances already in the Great Lakes, virtual elimination can only be achieved by preventing any additional discharge of these substances (i.e., by implementing a zero discharge strategy), and by cleaning up to the maximum extent possible those contaminants we have already released.

"Zero discharge" does not mean reducing discharges to a level where no impacts can be demonstrated:

There is not enough information to predict all impacts of toxics on the Great Lakes ecosystem. Nor do we have the ability to measure adequately all impacts when they do occur. Most effects from persistent toxic substances do not show up for many years. An extremely hazardous substance could be discharged for decades before its effects on wildlife and human health are apparent.

"Zero discharge" does not mean lower levels than can be measured with current monitoring techniques:

Many pollutants cause harm by accumulating in the environment—including in fish, wildlife and people—over time. Dangerous levels of these toxics can accumulate even though their concentrations are so diluted that they cannot be measured ***in water*** with current monitoring techniques. Interpreting "zero discharge" to mean "zero measured" or "non-detectable" in water could allow continued dumping of toxics that bioaccumulate to dangerous levels.

For this reason, the *Great Lakes Water Quality Agreement* defines the "absence" of persistent toxic chemicals to mean that they are not found in biological indicators such as fish, wildlife or people. A true zero discharge strategy prevents the use and generation of dangerous toxic chemicals, and makes irrelevant the argument that discharge levels that cannot be detected satisfy the zero discharge mandate. If use of a toxic chemical is prevented, it can not be discharged or become available to biomagnify.

"Zero discharge" does not mean best available technology to reduce toxic discharges:

It is not sufficient to control discharges of persistent toxic chemicals only to the extent that some treatment technology currently exists. Changes in processes and products to

A Citizen's Definition of Zero Discharge

For us "zero" means zero. Pollution must be prevented before it is generated. Production processes (including agriculture) must be reformulated so that these toxic substances are not used, produced or discharged. "Zero" does not mean reducing discharges beneath some arbitrary level or even beneath the level of detection. Zero means none.

The use of the term "discharge" is not limited to a single environmental medium. It applies to toxic discharges into water, air, landfill, product, etc. Nor can persistent toxics be eliminated by shifting them from one medium to another or by attempting to recycle them after they have been produced.

—Statement of Principles by the Zero Discharge Alliance, a grassroots network of concerned activists throughout the Great Lakes Basin.

avoid the use of toxics are the preferred methods. We may not be able to achieve zero discharge overnight, but, unless there are measures to force new and innovative clean technologies, polluters will continue to go about business as usual.

Achieving Zero Discharge

A zero discharge strategy means making society less dependent on the ***use*** of toxic chemicals. "Zero discharge" means maximum use of all of the following techniques:

- Replacing toxic products or activities with non-toxic products and methods; for example, using environmentally benign pest control methods instead of chemical pesticides, and using chemicals other than chloroflorocarbons for coolants;
- Using raw materials in production processes that are less hazardous; for example, replacing lead or mercury in paint with less toxic constituents, and substituting water-based inks for solvent-based ones;
- Redesigning products so they don't require the use of hazardous materials in their production; for example, using unbleached paper so that chlorine does not have to be used in pulp and paper mills;
- Changing production processes; for example, replacing organic solvents for cleaning machinery with mechanical processes;
- Reusing toxic raw materials instead of throwing them away; for example, recycling and reusing inks in a printing shop; and
- Instituting better operating practices; for example, using more efficient equipment, preventive maintenance, employee training or good housekeeping to ensure optimal process conditions and minimal leakage.

Pollution Prevention and Toxic Use Reduction

"Pollution prevention" means avoiding the generation of toxic pollutants by reducing their use, rather than capturing pollutants at the end-of-the pipe. Pollution prevention programs require an examination of why the chemicals are being used or generated. Because of this focus on the ***use*** of toxic chemicals, the term "toxics use reduction" is preferred.

When referring to "pollution prevention," the emphasis must always be prevention of the use and generation of pollutants. Hence, the term does not mean efforts to treat or recycle wastes.

Steps in a Zero Discharge Strategy

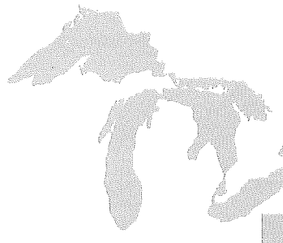
The zero discharge strategy for the Great Lakes includes the following steps:

Step 1: Prohibit new or increased discharges of toxics into the Great Lakes ecosystem.
Step 2: Ban the use of the most harmful persistent toxic substances.
Step 3: Eliminate and reduce the use, generation and disposal of all toxic chemicals through the enactment of model toxics use reduction provisions in each Great Lakes jurisdiction.

Each of these steps is described in detail in the next three chapters of this report.

NOTES

1. B. Commoner, "Failure of the Environmental Effort," *Environmental Law Reporter,* 18 (1988): p. 10195.
2. "In declaring that '[t]he use of any river, lake, stream or ocean as a waste treatment system is unacceptable', Congress made a basic legislative finding that any pollutant discharge into national waters was simply too much. The 1972 Amendments expressly negate any claim of right to pollute the nation's waters." Van Putten and Jackson, "The Dilution of the Clean Water Act," *Journal of Law Reform* 19 (1986): p. 868-869.
3. *Fifth Biennial Report on Great Lakes Water Quality,* Part II, (1990) p. 21.
4. For information on the Agreement, request a copy of "*A Citizens' Guide to the Great Lakes Water Quality Agreement,*" from Great Lakes United, Cassety Hall, 1300 Elmwood Avenue, Buffalo, New York, 14222, (716) 886-0142.
   To receive a copy of the Agreement, contact the International Joint Commission, 100 Ouellette Avenue, Windsor, Ontario, N9A, 6T3, (519) 256-7821.
5. Op. cit. p. 17.



CHAPTER 7
The Toxics Freeze

The Commission endorses the principle of reverse onus . . . . . that is, when approval is sought for the manufacture, use of discharge of any substance which will or may enter the environment, the applicant must prove, as a general rule, that the substance is not harmful to the environment or human health.

—International Joint Commission, Fifth Biennial Report.

All new or increased discharges of the most harmful toxic substances should immediately be prohibited. This Toxics Freeze will ensure that pollution does not keep escalating while the zero discharge strategy is being implemented. The patient should not be exposed to increasing levels of toxics before the cure is fully administered.

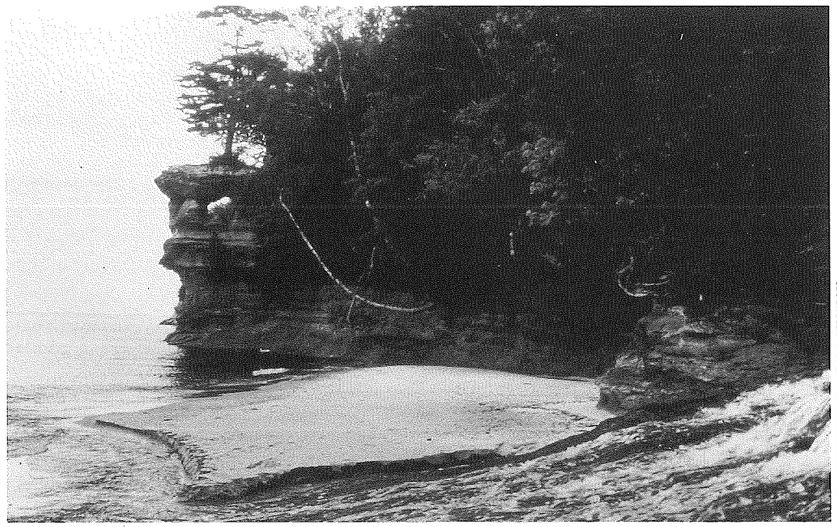
In 1986, scientists with the International Joint Commission's Great Lakes Water Quality Board identified 362 contaminants in the Great Lakes that may threaten human health or wildlife.[1] This list includes: toxic organics such as chlorinated benzenes, dioxins and furans; toxic metals such as chromium, lead and mercury; and pesticides such as chlordane, lindane and alachlor.

Despite the identification of these chemicals of concern, existing government programs still allow new and increased discharges of them into the Great Lakes watershed by industries and municipal sewage treatment plants. No additional discharges of these chemicals should be allowed unless the potential discharger can prove that the toxics will do no further harm to the environment.

RECOMMENDATION: No government in the Great Lakes Basin should issue or reissue a discharge permit that would allow any increase in the amount released of any of the 362 chemicals on the Water Quality Board's "1986 Working List of Chemicals in the Great Lakes Basin," unless the applicant for the permit demonstrates that the discharge will not result in additional accumulation of the chemical in the Lakes or harm to the ecosystem.

In the U.S., the Toxics Freeze can be implemented under the *Clean Water Act*. This Act requires each state to adopt an antidegradation policy to prevent high quality waters from becoming polluted.[2] Similarly, states are supposed to prohibit new or increased discharges to waters that are already polluted to the point that minimum Water Quality Standards are exceeded.[3] The Toxics Freeze must be enforced through implementation of these existing policies.

Canada should adopt the Toxics Freeze policy as part of Environment Canada's Great Lakes pollution prevention plan. As currently drafted, Ontario's procedures for determining acceptable discharges allow increases in pollution levels if the water is not already badly contaminated. Ontario should rewrite its "Implementation Procedures" for the development and application of Provincial Water Quality Objectives to prohibit further degradation



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of water quality. Ontario should implement the Toxics Freeze through its "Municipal and Industrial Strategy For Abatement" and its "Clean Air Program."

The Toxics Freeze is an essential first step to prevent contamination from getting worse. However, this stop-gap measure will not restore the Great Lakes to health on its own. It does not remove the need to implement toxics use elimination and reduction measures. The Toxics Freeze is only an interim measure to hold back the tide of toxics while other measures are implemented.

Lake Superior: Zero Discharge Demonstration Zone

Lake Superior is less polluted by toxic chemicals than any of the other Great Lakes. Lake trout still reproduce in it naturally; bald eagle productivity is higher along its shores than near other Lakes; native people depend on its commercial and subsistence fisheries; and thousands of people visit each year to relish its relatively pristine waters.

But, Lake Superior is under siege. The chlorine-using pulp and paper mills that ring the Lake dump thousands of tons of dioxins, furans and other toxic pollutants into it each year. Despite the availability of new ways to make paper without using chlorine,* new or expanded chlorine-using mills have been proposed for the Lake Superior watershed in Michigan, Wisconsin, Minnesota and Ontario.

Pulp and paper mills are not the only threats to Lake Superior. Widespread logging of Canada's "snow forest" on the north shore is increasing erosion, which carries pesticides and herbicides into the Lake. Condominium developments and vacation homes are cluttering the once vacant and peaceful shoreline.

To meet these threats, the IJC recommended in 1990 that "the Parties designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance will be permitted."[4] The U.S. and Canadian Governments have not yet responded to this recommendation.

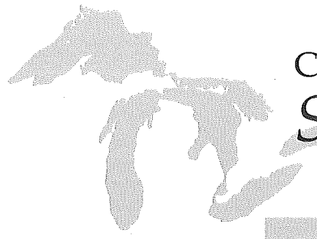
RECOMMENDATION: The U.S. and Canada should immediately implement a zero discharge strategy for Lake Superior. The strategy should include:

1. **Designation of Lake Superior as "outstanding national resource waters" under the U.S. Clean Water Act and a similar designation in Canada;**
2. **A freeze on building new or expanding existing pulp and paper mills that use chlorine;**
3. **A phase-out of the use of chlorine and the discharge of all persistent toxic chemicals at existing pulp and paper mills;**
4. **An independent environmental review in Canada of the impacts of logging and forest management practices on Lake Superior; and**
5. **An inventory of undeveloped Lake Superior shoreline and preparation by the U.S. and Canada of a joint plan for protecting sensitive and undeveloped areas.**

*These other methods of producing paper are described in Chapter 10.

NOTES

1. "1986 Working List of Chemicals in the Great Lakes Basin," reprinted in *1987 Report on Great Lakes Water Quality,* pp. 225-233.
2. A detailed proposal for implementing the Toxics Freeze has been developed by our researchers and can be ordered by using the form in the Appendix.
3. *Oklahoma v. U.S. EPA,* ____ F.2d ____ (slip opinion), reprinted at, 31 Environment Reporter Cases, (BNA), 1741, (10th Cir. 1990).
4. *Fifth Biennial Report on Great Lakes Water Quality,* Part II, (1990) p. 24.



CHAPTER 8
Sunsetting Toxic Chemicals

The production and use of between 65 and 70 of the 70,000 chemicals now in commercial use in the Great Lakes Basin should be banned immediately to prevent further damage to the health of people and wildlife in the Great Lakes ecosystem.

This chapter outlines a process for banning chemicals already in use and for preventing new dangerous chemicals from being put into use.

The banning process is sometimes referred to as "sunsetting". Sunsetting is a systematic process to ban the production and use of toxic chemicals, processes that create toxic by-products, and products that are toxic or contain toxic material.

The banning of a chemical may be immediate or it may be phased in over a number of years. The phasing-out approach often involves the banning of uses one-by-one. For example, a ban on mercury could begin with a prohibition against its use in batteries or paint.

The Sunset List

> *It appears that the only chemicals to have declined significantly in the Great Lakes ecosystem are those whose production and use have been prohibited outright or severely restricted.*
>
> —U.S. Council on Environmental Quality[1]

Types of Chemicals to be Sunset

1. Chemicals that Persist or Bioaccumulate:

The chemicals causing the most damage to the health of wildlife and humans in the Great Lakes Basin are those that persist and biomagnify in the food chain, becoming more concentrated in the bodies of fish, wildlife and people.

There are simple and inexpensive laboratory tests to identify chemicals that are likely to biomagnify in the Great Lakes ecosystem. Using these tests, each chemical can be assigned a bioconcentration factor (or BCF); chemicals with a higher BCF will likely bioaccumulate to more dangerous levels in fish, wildlife and people.

RECOMMENDATION: Toxic chemicals with very high bioconcentration factors should immediately be banned from further use or manufacture anywhere in the Great Lakes Basin, even if there is little evidence of specific toxic effects.

A review of a 1986 list of toxic chemicals and their bioconcentration factors prepared by Michigan officials indicates that an immediate ban of chemicals with a BCF greater than 250 would include approximately 70 toxics.* *This represents just one-tenth of one percent of the toxic chemicals currently in commercial use in the Great Lakes region.* It would include notorious toxics such as: PCBs (already partially banned), dioxins, heptachlor, benzo(a)pyrene, pentachlorophenol, fluorene, diazinon and captan.

2. Substances with Specified Hazardous Properties:

Other properties that justify sunsetting chemicals include whether the substances are carcinogenic, mutagenic, teratogenic or hazardous to the environment. These criteria should take into account both short-term and long-term impacts and the effects of the chemical when combined with other chemicals in the environment.

3. Chemicals for which Substitutes are Available:

If a safer substitute is available for a toxic chemical, it should be placed on the sunset list to avoid unnecessary risks. Because of the highly indefinite nature of risk assessments for chemicals, actual risks may be much higher than predicted. The case studies in Chapter 10 demonstrate readily available alternatives to harmful substances now commonly used in the petroleum refining and pulp and paper industries.

Developing the Sunset List

The Canadian and U.S. Governments should set up a task force to:

- adopt criteria for placing a chemical on the sunset list;
- determine methods to measure chemicals using these criteria; and
- list the chemicals to be sunset.

* Michigan officials reviewed all of the toxics contained in the Michigan database. The list should be updated to include additional chemicals and new data on bioconcentration factors.

Chemicals with known bioconcentration factors greater than 250 should immediately be sunset without waiting for this task force's work to be carried out. The task force should, however, include in its work an assessment of whether the bioconcentration factor should be set at a lower cutoff point and of the methods for calculating bioconcentration factors.

The public should be included in all aspects of this task force's work.

RECOMMENDATION: The U.S and Canadian Federal Governments should set up a joint sunset task force. The public should be consulted in all aspects of this task force's work. The task force should submit its recommendations to the U.S. and Canadian Governments by the September, 1993, biennial meeting of the IJC.

The Sunrise

No new chemicals should be allowed to be produced or used unless they have gone through a screening process in which the chemicals are demonstrated not to bioaccumulate or threaten the health of fish, wildlife or people. This screening process is sometimes referred to as the "sunrise" process. The sunrise process should be based on the same criteria that are used in deciding to sunset existing chemicals.

The person wishing to use or produce a new chemical should have the burden for proving that the sunrise criteria are met. The public and government agencies should not be required to prove that the chemical will cause harm.

RECOMMENDATION: The U.S. and Canadian Federal Governments should use the criteria for banning chemicals developed by the sunset task force to screen the use or production of new chemicals in the Great Lakes Basin.

The Sunset Timetable

For toxic chemicals with high bioaccumulation potential, that pose serious danger to the environment, or for which an alternative is readily available, an immediate ban should be implemented.

In other cases, a specific timetable for the phase-out should be set. This will force industry to develop low-risk alternatives and technologies. Quantifiable interim reduction targets should be set and annual reports should be required to prove progress in achieving the phase-out. Phase-out requirements should be put into individual permits for the use or discharge of chemicals being phased out.

RECOMMENDATION: The two Federal Governments should set specific timetables for phasing out of all chemicals not subject to an immediate ban. These timetables should be set by September of 1994, one year after the task force's recommendations are issued.

Legal Authority to Sunset Chemicals

Legal authority to ban and phase out chemicals currently exists in Canada and the United States.

The Canadian Federal Government has the power to sunset a chemical under the *Canadian Environmental Protection Act*. So far, this act has been used to control only a half dozen substances.[2]

The Province of Ontario could also sunset chemicals. This would repeat the regulatory route it used to phase-out the use of CFCs in certain products.

The U.S.'s *Toxic Substances Control Act* authorizes the banning of substances and products if "there is a reasonable basis to conclude" that a certain chemical may present "an unreasonable risk of injury to health or the environment." This legislation has been used to control PCBs and asbestos.

A Role for the International Joint Commission

The IJC should play an important role as a catalyst and coordinator in the development and implementation of a sunset/sunrise process.

RECOMMENDATION: The Canadian and U.S. Governments should issue a sunset reference to the International Joint Commission. This reference should be announced by the September 1991 meeting of the IJC.

The IJC should be asked to:

1) Assist in the development of sunset list criteria, by:
   - developing bioconcentration factor methodology common to all jurisdictions in the basin;
   - assisting in determining hazardous properties that lead to sunsetting;
   - identifying alternatives to chemicals or processes.
2) Establish a data bank on sunsetting information in all jurisdictions, including a catalogue and report on the chemicals that have been sunset in other jurisdictions.

A Global Sunset

Sunsetting toxic chemicals in the Great Lakes Basin will not absolutely prevent these chemicals from contaminating the Lakes. As long as they are used in other parts of the world, they may be deposited in the Lakes as toxic air pollution.

The Great Lakes are particularly vulnerable to pollution from distant sources. Contaminants carried through the air from thousands of miles away are deposited on the large surface areas of the Great Lakes. For example, the International Joint Commission estimates that 90 percent of the PCBs in Lake Superior come from the air. Over half of the PCBs in Lakes Michigan and Huron are estimated to come from the air.

The Organization for Economic Cooperation and Development is now examining the sunsetting concept.[3] The Canadian and U.S. Governments should become part of international efforts to sunset chemicals on a global scale and should set as a priority toxic chemicals contaminating the Great Lakes from long-range atmospheric deposition. Action in banning chemicals within the Great Lakes Basin should not, however, wait for the successful negotiation of international sunsetting agreements.

NOTES

1. "Environmental Quality: Twentieth Annual Report," *The U.S. Council on Environmental Quality,* Executive Office of the President, (1990) p. 363.

2. The chemicals regulated under the Act include: PCBs, mirex, polybrominated biphenyls (PBBs), polychlorinated terphenyls (PCTs), and chloroflorocarbons (CFCs). A number of industrial sectors are regulated under the air pollution provisions under Part II of the Act.

3. In late 1989, the Swedish delegation made a proposal for the development of a sunset chemical list at the 13th joint meeting of the OECD Chemicals Group in Paris, France. The basics of the proposal is outlined in Bo Wahlstrom, "Sunset for Dangerous Chemicals," *Nature* 341, (28 September, 1989): p. 276.

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- estimates of present and projected toxics use, waste generation and emissions;
- descriptions of technologies and procedures for reducing use of toxics; and
- an implementation schedule.

RECOMMENDATION: Governments in the Great Lakes Basin should require that each industry and each sector of users of toxic chemicals develop toxics use reduction plans by 1994 that will achieve the overall goals of 50% reduction in use of toxics by 1996 and 75% reduction by 2000.

Industries are not the only source of toxics contaminating the Great Lakes. Cities, agriculture, forestry, mining, and, even households use and discard dangerous chemicals. To reduce use of toxics in these activities, each government should develop a toxic use reduction plan for each activity. In the case of cities, agriculture and forestry, the plans should require use of non-toxic alternatives to herbicides and pesticides. For households, it should include educational campaigns on reducing use of toxics and promotion of non-toxic alternative products.[5]

Toxics Use Reduction Permitting

Discharge permits already issued to industries and municipalities can be important regulatory tools for reducing the use of toxic chemicals. The permitting process should be revised in the following ways to fulfil its potential:

1. Permits should include sunset timetables:
Every permit in the basin should incorporate sunset dates for chemicals to be phased out.

2. Permits should be for entire facilities:
Permits for all discharges to air, water and land from each facility should be integrated into a single document. This will ensure that a multi-media approach is taken and that permitting decisions are made on the basis of total discharges from a plant. This approach will encourage toxics use reduction to reduce discharges.

Survey of Toxic Use Reduction Initiatives by Governments in the Great Lakes Basin[4]

	1. Reduction Targets	2. Sunsets/ Bans	3. T.U.R. Plans	4. Technical Assistance	5. Regulatory Integration	6. Institutions
US[a]				x		x
CDA						
Mass.	x		x	x	x	x
Ill.[b]				x		
Ind.[c]				x		x
Mich.						
Minn.[d]			x	x		x
NY.						
Ohio						x
Ont.						
Penn.						
Wis.						x

[a] U.S. EPA Policy Statement, Jan. 1989. The Policy Statement has not been incorporated into legislation.
[b] *Ill. Toxic Pollution Prevention Act*, 1990. This statute provides for voluntary toxics use reduction laws.
[c] *Ind. Pollution Prevention and Safe Material Act*, 1990. As of the fall of the 1990, the law, while creating various technical assistance packages and institutions, has no appropriations to implement the statute.
[d] *Minnesota Toxic Pollution Prevention Act*, 1990.

1. "Reduction Targets" are targets that aim at the overall reduction in the use of toxic chemicals by industry.
2. "Sunsets" pertains to a comprehensive and systematic program to phase out various chemicals.
3. "T.U.R." refers to mandatory toxics use reduction planning provisions with mandatory toxic inventories and audits.
4. "Technical Assistance" refers to financial, educational, and technical assistance given by agencies for toxics use reduction.
5. "Regulatory Integration" refers to the extent to which toxics use reduction provisions are integrated into the regulatory framework of the jurisdiction, such as standard-setting and permit-issuing procedures.
6. "Institutions" refers to the extent to which the jurisdiction has reformed their institutions to better implement toxics use reduction measures, such as ensuring a multi-media focus.


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3. Permits should include a toxics use reduction plan:
Toxics use reduction plans should be required in order to obtain or renew a permit. Implementation of approved toxics use reduction plans should be required as a condition of any permit to discharge, and no renewals should be allowed unless these plans have been implemented on schedule.

Technical Assistance Programs

Governments should set up technical assistance programs to help all toxics users learn how to reduce their use of toxics. These programs should include:

- a pollution prevention clearinghouse, which would catalogue information on ways to reduce use of toxics;
- pollution prevention research programs, which would conduct or fund demonstration projects;
- education programs, including workshops and training courses, to educate toxics users and government agency personnel;
- on-site consultations to help users reduce their use of toxics; and
- grants and loans for capital expenditures.

Community and Worker Right to Act

Workers and community residents should be able to ensure that industries are safely handling and reducing their use of toxic chemicals.[6] Governments should give community residents and workers the following legal rights:

1. The Right to Information and to Inspect:
All industries should be required to make information on their use of toxics available to workers and community residents. This information should include all permits and approvals, toxics use reduction plan summaries, and monitoring and release data. Representatives of community residents and workers should also have the right to inspect industrial plants to ensure that chemicals are being properly handled.

2. Worker Right to Refuse Unsafe Work:
All workers should have the legal right to refuse unsafe work. Each workplace should have a joint labor-management safety and health committee, which has the right to close down a workplace in the event of unsafe work conditions.

3. Worker Right to Report Pollution:
Workers should have the right to report publicly and to government agencies on situations in their workplace that may pollute the environment. Governments must create legal safeguards to protect workers who exercise these rights.

4. Right to Sue:
Citizens should be given the right to sue polluters to prevent them from harming the environment even if they are not personally directly damaged by the pollution. Citizens

should also have the right to sue their government to force them to enforce their legislation and regulations.

Governments should also encourage "good neighbor agreements." These are agreements between a company and neighborhood residents to reduce toxics use and toxics emissions, and to allow inspections of facilities. Governments should promote these agreements with technical assistance grants to citizens similar to those available under the U.S. Superfund law.

RECOMMENDATION: Each Government in the Great Lakes Basin should pass legislation encouraging good neighbor agreements, and giving all community residents and workers the following rights:

1. The right to information and inspection;
2. Worker right to refuse unsafe work;
3. Worker right to report pollution, and
4. The right to sue

Multi-Media Decision-Making

Most environmental agencies are organized in different branches to address pollutants discharged into the air, water or onto land. This media-specific organization means that toxics use reduction is not stressed by those making critical day-to-day decisions about toxics control.

Each government level should reorganize its environmental agencies to reflect a multi-media and toxics use reduction focus. This reorganization should result in coordinated multi-media standard-setting and integrated permitting procedures. This reorganization should ensure that toxics use reduction principles are the primary basis upon which decisions are made by all environmental agencies.

Toxics Use Reduction Standards

The regulatory framework governing water quality in both Canada and the U.S. requires the development of effluent limits based on how low a discharge level can be achieved using the "Best Available Technology" (BAT). Once the BAT has been selected for an industrial sector, each plant within that sector must achieve the effluent limit that could be met by the BAT.

These BAT standards are usually developed based on the use of end-of-the-pipe technologies rather than on toxics use reduction techniques. Our case studies in Chapter 10 on various ways to reduce discharges from the petroleum refining and pulp and paper industries demonstrate the dramatic improvements achievable by using toxics use reduction techniques instead of pollution control techniques.

RECOMMENDATION: Governments should revise their technology-based effluent standards to ensure that they are based on the best available toxics use reduction methods.

Effect of the Zero Discharge Strategy

The combined strategy of an immediate toxics freeze, sunsetting of the most harmful chemicals and reductions in the use of all toxic chemicals is a necessary step forward in restoring the health of the Great Lakes ecosystem. On its own, however, this strategy will not be enough. A zero discharge strategy must also include a clean-up strategy for past pollution. The recommended clean-up strategy is described in Part IV of this report.

NOTES

1. States that have passed toxics use reduction laws include Massachusetts, Oregon, Texas, Maine, Washington and Minnesota. Illinois and Indiana also have such laws, but most of the toxics use planning requirements are voluntary.
2. J. Underwood, "Managing Hazardous Wastes is not Enough," *Industry and Environment*, United Nations Environment Programme, p. 29-31.
3. *Pollution Prevention in the Great Lakes: A Survey of Current Efforts and an Agenda for Reform*, (Canadian Institute for Environmental Law and Policy, 1991.) See Appendix of this report to obtain a copy.
4. Ibid.
5. See, for example, "Do You Have a Zero Discharge Home?" *Canadian Institute For Environmental Law and Policy*, (1989). See Appendix of this report to obtain a copy.
6. For a discussion of these rights, see Scott Tobey, "Taking Control: Workers and Communities Demand the Right to Act," *Multinational Monitor* (June 1990), pp. 3-5.

CHAPTER 10
Zero Discharge in Practice: Two Case Studies

Program for Zero Discharge researchers carried out case studies of the petroleum refining and pulp and paper industries to illustrate the effectiveness of using the zero discharge strategy described in Part II of this report. These studies contrast the zero discharge strategy with the current pollution control regulatory approach.

Using the new strategy to control chromium, ***Great Lakes refineries could reduce total discharges of chromium to water from the 9,000 kilograms* now released each year to zero.*** Chromium is a persistent toxic pollutant in the effluent of the 13 petroleum refineries located in the Great Lakes Basin.

This reduction could be achieved by combining three techniques:

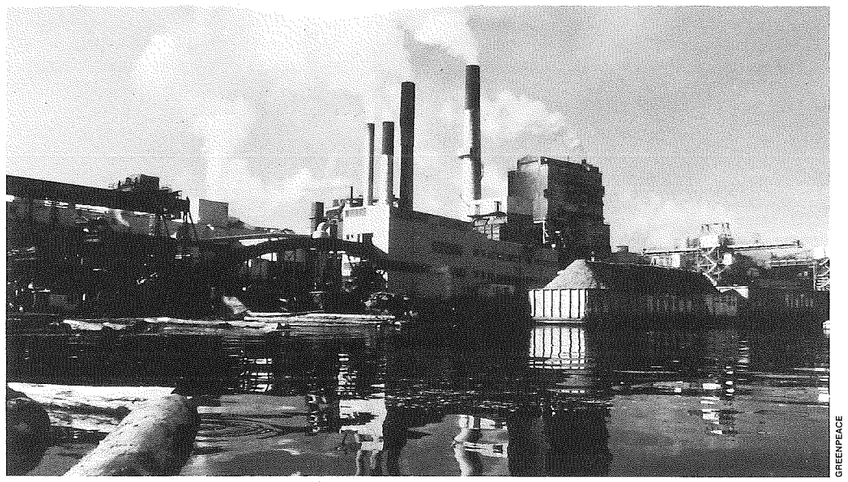
- **substituting** phosphate-based chemicals for the zinc chromate now used as an additive in cooling waters;
- **reducing** the amount of cooling water used and discharged by conserving and recycling water; and
- **employing** more advanced pollution control techniques.

Some chromium occurs naturally in crude oil. Thus, some chromium would remain in sludges. This creates the possibility of pollution from landfilling or incinerating the sludges; so, this is not a complete zero discharge solution. Nevertheless, current releases of chromium could be substantially reduced.

In our case study of the pulp and paper industry, we focussed on releases of adsorbable organo halides (AOX), which include persistent toxic substances such as dioxins and furans, by the 20 bleached kraft mills in the Great Lakes Basin. ***Great Lakes bleached kraft mills could reduce their current discharges of 13,000 tonnes of AOX each year to zero.*** This could be achieved by changing production processes so that no chlorine is used in the bleaching or delignification processes.

Government pollution control programs do not require industries to use these available techniques to achieve the zero discharge objective. The regulatory mechanisms described in Chapters 7 to 9 of this report would force the petroleum refining and pulp and paper industries to use these zero discharge techniques.

*A kilogram is equal to 2.205 pounds. A metric tonne is 1,000 kilograms, or 2,205 pounds. 9,000 kilograms of chromium are equal to 19,800 pounds. 13,000 tonnes of AOX are equal to 14,332 tons of AOX.



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Petroleum Refinery Case Study: Reducing Discharges Through Chemical Substitution[1]

Wastewater discharges from the 13 petroleum refining facilities in the Great Lakes Basin (7 in Ontario and 8 in the U.S.) total approximately 253 million gallons each day. During a 12-month period of monitoring of Ontario facilities in 1988-1989, over 60 toxic pollutants were detected in the discharge waters of the petroleum refining plants.[2]

One of the pollutants consistently found in relatively high concentrations was chromium. Chromium is a persistent, possibly bioaccumulative element, which is a potential carcinogen. Chronic exposure to chromium is harmful to aquatic life, even in very low concentrations. Refineries dump over 9,000 kilograms of chromium into the Great Lakes each year.

End-of-the-pipe pollution control technologies are the most commonly used methods to reduce chromium discharges. The first phase of wastewater treatment typically consists of gravity separators or corrugated plate interceptors, which allow the oil residue to be skimmed off into settling lagoons. Refineries also have secondary treatment, which uses biological processes to remove dissolved organics. Some facilities also have tertiary treatment, which includes techniques such as filtration and carbon absorption to catch more pollutants.

Project researchers examined alternative technologies and techniques based both on reducing the use of toxic chemicals and on end-of-the-pipe technologies. First, an audit of a typical facility was conducted to find sources of chromium. About 90% of the chromium from petroleum refineries comes from a zinc chromate additive to the cooling tower waters, which acts as an anti-corrosive and anti-slime agent. Chromium is also detected in very low concentrations in the crude oil itself.

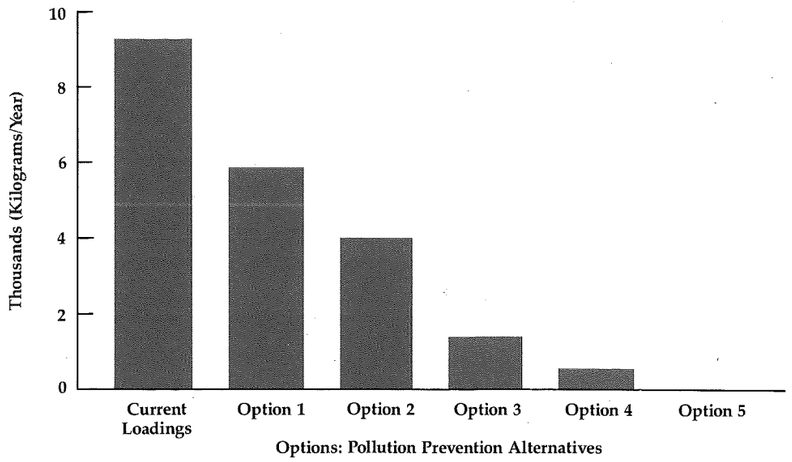
The project team identified five options for reducing chromium discharges. Each successive option includes applying the features in each preceding option.

Option 1: Employ End-of-the-Pipe Technologies:

In this option, end-of-the-pipe filtration systems are installed in cooling towers so that recycling of cooling water can replace the once-through systems. Water conservation measures are also used to reduce the volume of wastewater effluent per unit of production; this produces less chromium discharge because the more water that is used, the more chromium that is needed as an additive.

This option is the best available technology (BAT) for petroleum refineries as now defined under the U.S. *Clean Water Act*. Seven of the 13 refineries in the Great Lakes now use these or equivalent technologies.

Loadings of Chromium from Petroleum Refineries in the Great Lakes



If all of the petroleum refineries in the Great Lakes region adopted this option, annual discharges of chromium would be reduced from approximately 9,000 kilograms to just over 6,000 kilograms.

Option 2: Employ More Advanced End-of-the-Pipe Technologies:

The installation of granular activated carbon adsorption systems would reduce the residual solids and organic compounds in wastewaters. In addition, 25% air cooling systems are installed to further reduce and concentrate wastewater discharges. Air cooling systems require no additives. Granular activated carbon adsorption technology is currently used in only one Ontario facility. A number of U.S. facilities outside of the Great Lakes use this technology, but none within the Basin. The U.S. EPA lists this as a proven technology.

This option would *further* reduce annual discharges of chromium by 2,000 kilograms to approximately 4,000 kilograms.

Option 3: Toxics Use Reduction through Replacement of Chromium:

This option focusses on process changes. Zinc chromate is replaced by non-metallic, anti-corrosive substances, such as phosphate-based chemicals.[3] This option removes all chromium as an additive from cooling water; the only chromium left is from the crude oil itself. Fifty percent air cooling to further reduce water usage is also employed in this option.

By 1989, only two facilities in the Great Lakes Basin had replaced chromium in all production processes. In 1990, three more facilities followed suit. If all Great Lakes refineries used this option in conjunction with Options 1 and 2, the loading of chromium from this sector would be reduced to approximately 1,200 kilograms each year. There are no major cost implications of replacing chromium with other additives.

Option 4: The "Best Performer" Option:

This option employs the technology of the best performing facility in the Great Lakes. The Esso Petroleum refinery at Nanticoke, Ontario uses all the components of Options 1, 2, and 3; in addition, 85% of its water is air-cooled. Important components of this option are comprehensive best management practices that incorporate good housekeeping and spill prevention provisions.

Use of this option, along with Options 1, 2, and 3, would reduce chromium discharges from all refineries in the Great Lakes Basin to a total of 900 kilograms each year.

Option 5: Zero Discharge Option:

A zero discharge facility would combine the above options with comprehensive in-plant recycling. This option would result in ***no discharges*** of chromium in refinery wastewaters. While no effluent will be discharged into receiving waters, there would still be chromium in the residual sludges from the tertiary treatment processes that would have to be contained in a landfill or otherwise disposed of. No facility in the Great Lakes uses a zero effluent option.

While use of the options outlined above would protect the Great Lakes from chromium in the petroleum refining process, there will still be residues. This is inevitable because of contaminants that occur in crude oil. The only way to completely eliminate chromium from this industry is to develop alternative fuels and alternatives to the internal combustion engine. Nevertheless, it is possible, as the case-study demonstrates, to effectively eliminate chromium discharges.

RECOMMENDATION: Option 5 should be required immediately for new or proposed refineries and Option 4 should be required immediately for existing facilities. In the next round of review, all facilities should be required to implement Option 5.

Pulp and Paper Case Study: Zero Discharge Through Process Change[4]

Twenty of the 77 pulp and paper mills in the Great Lakes Basin are bleached kraft mills. These mills bleach their pulp with chlorine gas or chlorine dioxide to increase the whiteness of their paper products. Kraft mills discharge chlorinated organic substances that can be measured as AOX (adsorbable organo halides). These compounds, which include dioxins and furans, are persistent and bioaccumulative. Some cause cancer and birth defects and "might have large-scale, long-range environmental effects."[5] Swedish studies comparing fish living near bleached kraft mills with those near non-bleached kraft mills found that near the bleached kraft mills there were fewer fish, greater failures of sexual maturation, more fin erosion, more deformed skulls and increased disturbances of biochemical and physiological functions.[6] Similar effects are known or suspected in the Great Lakes Basin.[7]

Adequate monitoring data for AOX discharges into the Great Lakes are not available in either Canada or the U.S.[8] Project researchers estimated loadings of AOX by multiplying the amount of AOX produced per tonne of pulp by the production rate for each mill. This resulted in an estimate of 13,000 tonnes of AOX discharged into the Great Lakes each year.

The U.S. EPA's Best Available Technology guidelines for this industry, set in 1982, require aerated lagoons, which allow some pollutants to settle. In Ontario, most facilities use only settling ponds and filtration, which are not as effective as aerated lagoons.

Project researchers identified five options for reducing AOX discharges from bleached kraft pulp and paper mills to the Great Lakes. Most of these are based on changes in the bleaching process. Each successive option includes the features in the preceding options.

Option 1: Application of U.S. BAT to All Pulp and Paper Mills in the Great Lakes:

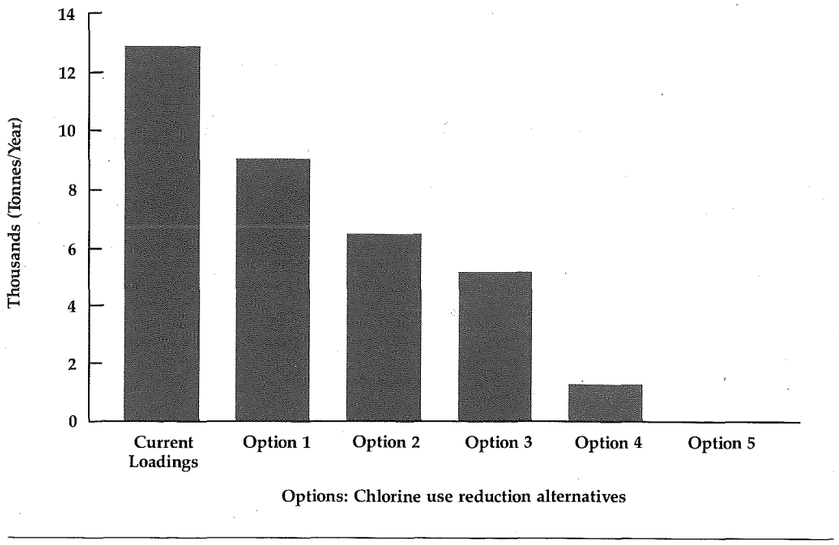
This option would require all facilities in both Canada and the U.S. to meet the U.S. Best Available Technology effluent limits. While all U.S. facilities meet these limits, only two of the eight facilities in Ontario use these technologies.

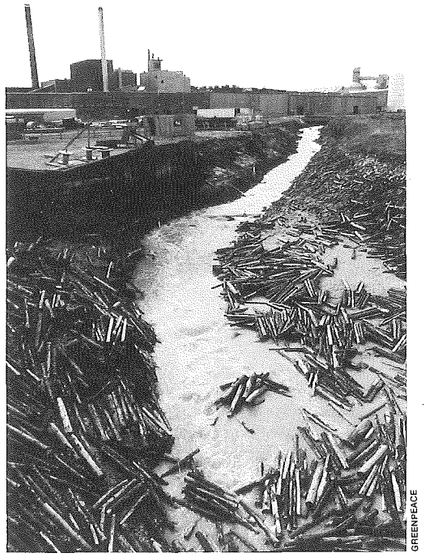
Adoption of this option would decrease loadings to the Great Lakes of AOX from approximately 13,000 tonnes to approximately 9,000 tonnes each year.

Option 2: Oxygen Delignification:

In this option, the use of chlorine is reduced by using oxygen gas as a bleaching agent. To accomplish this, an in-process change, oxygen delignification, is required. Oxygen delignification allows the facility to use a broader range of bleaching agents. Only the Champion mill in Quinnessec, Michigan, and the E.B. Eddy mill in Espanola, Ontario,

Loadings of Adsorbable Organo Halides (AOX) From Great Lakes Pulp and Paper Mills





now use this process. In Sweden, thirteen of the country's bleached kraft mills now use or are in the process of introducing oxygen bleaching.

This option would reduce the loadings to the Great Lakes from 9,000 tonnes per year to approximately 6,400 tonnes each year.

Option 3: Oxygen Delignification with Chlorine Dioxide Bleaching:

In this option, the pulp is bleached by a combination of chlorine gas and chlorine dioxide to reach desired brightness. To be more cost effective, mills often mix chlorine with chlorine dioxide.

Switching to the oxygen delignification process saves money. Chlorine costs approximately $275 per tonne of pulp, while oxygen costs $150 per tonne if the oxygen has to be purchased or $80 per tonne if it is manufactured on site.[9] However, oxygen delignification still requires use of a whitening agent. Chlorine dioxide can be used, which produces less AOX than chlorine. However, it is expensive; $1000 per tonne as compared to $275 per tonne for chlorine.

The AOX discharges into the Great Lakes after application of Option 3 would be reduced to approximately 5,000 tonnes per year.

Option 4: Oxygen Delignification, High Chlorine Dioxide Substitution, with Extended Cooking and Nitrogen Dioxide Pretreatment:

In this option, extended cooking and nitrogen dioxide treatment is used to lower the lignin content of pulp before bleaching by oxygen and chlorine dioxide.

Application of Option 4 would reduce AOX discharges to approximately 1,200 tonnes per year.

Option 5: Oxygen Delignification, Ozone Bleaching, with Hydrogen Peroxide and Sodium Hydrosulphite Brightening:

This option requires both a process change and chemical substitution. Oxygen and ozone are used to delignify the pulp; peroxide and hydrosulphite are used to brighten the pulp.

Option 5 is the zero discharge solution. Since the use of chlorine-based compounds is eliminated, chlorinated organic substances are not produced. In addition, substantial reduction in Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) is achieved, and very bright paper is produced. The end products are similar to conventional bleached paper, with 90.1% brightness compared to 90.6% brightness for chlorine bleached paper.

RECOMMENDATION: Option 5 should be selected as the preferred BAT limit throughout the Great Lakes region. This would remove AOX pollution, one of the most troubling categories of pollution in the Great Lakes.

NOTES

1. S. Sang, *Developing Options for Technology-Based Standards for the Petroleum Refining Sector in the Great Lakes*, (Canadian Institute for Environmental Law and Policy, 1990.) See appendix of this report to obtain a copy.
2. 'Second Report on Monitoring Data for the Petroleum Refining Sector,'' *Environment Ontario*, July, 1990.
3. The use of phosphate-based substitutes may have some environmental trade-offs. However, phosphate-based substitutes are not persistent and can be more efficiently treated, if not completely eliminated, with traditional pollution control technology.
4. S. Sang, *Developing Options for Technology-Based Standards for the Pulp and Paper Sector in the Great Lakes*, (Canadian Institute for Environmental Law and Policy, 1990.) See Appendix of this report to obtain a copy.
5. International Joint Commission, *1989 Report on Great Lakes Water Quality*, Great Lakes Water Quality Board, (Windsor, Ontario, 1989): p. 26.
6. B. Bengtsson, ''Effects of Pulp Mill Effluent on Skeleton Parameters in Fish: A Progress Report,'' *Proceedings of Second IAWPRC Symposium on Forest Industry Waste Waters*, June 9-12, 1987, Tampere, Finland.
7. J. Sprague, et al., *Toxicity to Aquatic Organisms of Organochlorine Substances in Kraft Mill Effluent*, Background Report for Renewable Resources Extraction and Processing Division, Industrial Program Branch, Conservation and Protection, Environment Canada. (1989) pp. 27-28.
8. The pulp and paper industry in Ontario has just completed a year of monitoring. The results from the first six months of this monitoring period is expected to be released in early 1991.
9. N. Bonsar, et al., *Kraft Mill Effluent in Ontario* (prepared for Environment Ontario, 1988).

PART III
WATER QUALITY STANDARDS

CHAPTER 11
Their Purpose

In Chapter 1, we described three indicators of ecosystem health:

- Whether women can eat Great Lakes fish without affecting the development of their babies;
- Whether wildlife that eat Great Lakes fish and other aquatic life thrive in the Great Lakes Basin; and
- Whether people can eat Great Lakes fish without increasing their risk of getting cancer.

Use of these indicators poses two problems:

1) Measuring these indicators requires very extensive, sophisticated epidemiological and field studies. These studies require considerable time and money. Also, they often do not give very clear results.
2) It may take years or even decades before the health effects of the zero discharge strategy and of clean-up programs are measurable.

Therefore, we need ways to quickly and easily measure progress toward the goal of a healthy Great Lakes ecosystem. These indicators must be translated into numerical Water Quality Standards to help make these measurements. Water Quality Standards include chemical-specific concentrations that represent the highest level of a toxic in water that can occur without likely causing adverse health or environmental effects. For example, a Water Quality Standard for PCBs might provide that no more than 0.079 parts per trillion can be present in water without causing unacceptable increased cancer risks for people eating Great Lakes fish.

Water Quality Standards serve two purposes in our strategy:

- They provide a benchmark for evaluating progress in implementing the zero discharge strategy; and
- They provide a basis for determining what clean-up actions are needed to achieve our vision of a healthy Great Lakes ecosystem.

Both the U.S. and Canada already use Water Quality Standards. In the U.S., each state is required to develop Water Quality Standards, sometimes referred to as ''numeric criteria.'' Each state must submit its Water Quality Standards to the U.S. Environmental Protection Agency for review. If a state fails to do so or if the standards do not satisfy EPA's regulations, the EPA can adopt Federal Water Quality Standards to apply in that state.

Ontario's Water Quality Standards are called ''Water Quality Objectives.'' These are adopted independently of the Canadian Federal Government.

Governments in the Great Lakes Basin use their Water Quality Standards as the basis for developing permits which limit wastewater discharges of toxic pollutants by industries and municipalities. They also use these standards to assess whether additional control measures are needed to protect a body of water or whether clean-up actions are needed. For example, standards may be used to decide whether it is necessary to control run-off of pesticides and fertilizers from agricultural lands in a particular water course.

The Water Quality Standards now used by the Governments in the Great Lakes Basin are inadequate in the following ways:

- None of the Governments in the Great Lakes Basin have Water Quality Standards based on protecting babies from developmental harm;
- Only Minnesota, New York and Wisconsin have standards based on protecting bald eagles, cormorants, mink, otter and other fish-eating wildlife; even these standards are incomplete and inadequate;
- Existing Water Quality Standards for cancer-causing chemicals ignore the increased cancer risks faced by people who eat more Great Lakes fish than the average resident of the Great Lakes Basin. This includes native people, anglers and the poor;
- Existing standards ignore the cumulative effects of the numerous different toxic chemicals found in the Great Lakes;

- In implementing standards, Governments in the Great Lakes Basin allow polluters to dilute the toxic chemicals they dump, ignoring the significance of persistence and biomagnification; and
- Existing standards for the same substance vary substantially from one jurisdiction to another, even though the Great Lakes Basin is one ecosystem.

RECOMMENDATION: By June 30, 1994, all Governments in the Great Lakes Basin should adopt uniform Water Quality Standards based on fish being safe to eat by all wildlife and humans.

The U.S. Congress recently enacted the *Great Lakes Critical Programs Act of 1990*, which requires the States to adopt uniform Water Quality Standards, antidegradation policies and implementing procedures for the Great Lakes by June 30, 1994.

Water Quality Standards are frequently interpreted as specifying a "safe" or "acceptable" level of pollution. This fallacy results in standards being misunderstood as the ultimate objective for reducing pollution levels. But, scientific knowledge is inadequate to determine safe levels of persistent, bioaccumulative chemicals in the Great Lakes. Too little is known about the specific chemicals or the ecosystem. By the time science begins to provide the answers, the damage is done.

For persistent, bioaccumulative toxic chemicals, no level of pollution is acceptable. Therefore, Water Quality Standards are, according to the *Great Lakes Water Quality Agreement* and the U.S. *Clean Water Act*, only interim milestones on the way to zero discharge.

RECOMMENDATION: Legislation and regulations should state that Water Quality Standards are only interim and that the standard for all persistent toxic substances will be changed to "virtually eliminated."

ECOLOGICAL SERVICES, INC.

Deformed Caspian Tern

CHAPTER 12
The Basis for New Water Quality Standards

Water Quality Standards must be reformed to better protect human health and wildlife. To address the flaws in existing standards described in Chapter 11, project researchers for the **Program for Zero Discharge** developed model procedures for developing Water Quality Standards.

Three model procedures were developed; one for each of the three measures of Great Lakes health already outlined: protecting babies from developmental damage, protecting wildlife and protecting people from cumulative cancer risks.

Consumption of fish from the Great Lakes is central to each of these indicators because people and wildlife who eat contaminated fish have a much higher exposure to persistent, bioaccumulative chemicals than do those who don't eat Great Lakes fish. This is because these chemicals are highly soluble in fish tissue and, thus, bioconcentrate to much higher levels in the fish than they occur in water or air.

Protecting Children from Developmental Damage[2]

The average non-urban resident in the Great Lakes Basin could breathe the air and drink the water for 58 years before absorbing as much PCBs as they would receive from eating one half-pound meal of fish contaminated at 2 parts per million.

—Wayland Swain, *Program For Zero Discharge* researcher.[1]

Toxic chemicals in the Great Lakes have already damaged the learning abilities of hundreds, if not thousands, of children in the Basin. These children were accidentally poisoned before birth, when they were most sensitive to long-term neurological damage. The chemicals most likely responsible for this damage, PCBs, were passed on to them from their mothers, who had eaten Lake Michigan sport fish. These effects were described in more detail in Chapter 2.

Program For Zero Discharge researchers have determined that PCB levels in water should not be higher than one part per quadrillion (ppq) to enable women to eat fish without risking developmental damage to their babies.

This level contrasts sharply with Water Quality Standards for PCBs now in use in the Great Lakes: 1,000 ppq in Ontario and New York State, 790 ppq in Indiana and Ohio, 150 ppq in Wisconsin, 80 ppq in Pennsylvania, 20 ppq in Michigan and 14 ppq in Minnesota. The U.S. Environmental Protection Agency's standard for PCBs is 79 ppq. It is likely that the Water Quality Standards for many other chemicals would differ just as substantially if they were derived by the techniques used by our researchers.

RECOMMENDATION: By June 30, 1994, Great Lakes Governments should revise their Water Quality Standard for PCBs so that it is no higher than one part per quadrillion.

Our proposed Water Quality Standard for PCBs differs so sharply from the standards adopted by Great Lakes Governments because agencies assume that a standard that protects people from cancer will also protect them from all other health problems. Our research shows that this assumption is wrong.

After reviewing scientific studies on the developmental harm caused by PCBs in children of women who ate Great Lakes fish, our researchers used a four-step process to arrive at a Water Quality Standard for PCBs:

1. Based on the relationship between levels of PCBs in umbilical cord blood and the results of developmental tests, we determined a level of PCBs below which behavioral or learning problems were not likely to occur.
2. We determined the amount of PCBs a woman could take into her body on a daily basis without exceeding that level of PCBs in her umbilical cord.
3. Assuming she ate nearly 7 meals of fish a month, we determined the level of PCBs that could be in fish before a woman took in the unacceptable level of PCBs.
4. Finally, we determined the level of PCBs that could be in the water before fish would bioconcentrate the substance to the excess level. This level becomes the Water Quality Standard for PCBs.

This same process could be used to develop Water Quality Standards for any chemical affecting fetal development.

The features of this method for calculating Water Quality Standards that differ from methods now commonly in use are:

- Our method is based on documented non-cancer effects in people, rather than on studies of cancer in laboratory animals;

Fish Consumption Rates: Who Should Be Protected By Water Quality Standards?

Water Quality Standards should protect the people who face the highest risks from the toxic effects of chemicals.

The U.S. EPA's national guidelines for Water Quality Standards are based on protecting the average person in the U.S. who eats fish only occasionally, and whose fish do not frequently come from contaminated waters. EPA's guidelines are based on consumption of 6.5 grams of fish each day, which equals roughly one half-pound meal of fish every five-and-one-half weeks.

Many people in the Great Lakes Basin, including sport anglers and native people, eat fish far more often. And, the fish they eat may always come from the same contaminated body of water.

Therefore, we recommend that Water Quality Standards be based on a fish consumption rate of 50 grams per day. This is equal to just under seven half-pounds meals of fish a month.

Our 50-gram-per-day estimate is higher than any rate now used in the Great Lakes Basin. The U.S. EPA, Indiana, Michigan and Ohio all use a consumption rate of 6.5 grams each day. Wisconsin's rate is 20 grams, Minnesota's is 30 grams and New York's is 33 grams.

Our recommendation is based on the following considerations:

- Five percent of the people surveyed in Wisconsin eat 63.4 grams or more each day.
- People might eat higher amounts of fish if there weren't advisories warning them that eating fish poses serious health risks.
- Water Quality Standards should protect native people, low income groups, anglers and other people who eat fish more frequently than the average North American.
- A vision of a future healthy Great Lakes ecosystem where people can safely eat as much fish as they wish.

Protecting Humans from Cumulative Cancer Risks[4]

Most existing Water Quality Standards in the Great Lakes Basin are based on avoiding increased risks of cancer to a person eating fish from the Great Lakes. Indiana, Michigan, Ohio and Wisconsin have prohibited an increased cancer risk of over one-in-one hundred thousand; the U.S. Environmental Protection Agency, Minnesota, New York and Pennsylvania prohibit an increased cancer risk of over one-in-one million.

The U.S. Environmental Protection Agency recommends that regulations for mixtures of carcinogens assume that the combined cancer risks of more than one chemical are additive. But, Basin Governments' existing cancer standards fail to take into account the fact that the Great Lakes are contaminated by hundreds of toxic chemicals, many of which are likely to cause cancer. Current standards assume exposure to only one cancer-causing chemical at a time.

Following EPA's recommendation for assessing the cancer risk of chemical mixtures, our researchers calculated Water Quality Standards for PCBs, DDT, dieldrin and chlordane at a one-in-one million risk level. All four of these chemicals have been routinely monitored in Lake Michigan fish, and our researchers used these monitoring data. They assumed that a 150-pound person ate a half-pound meal of fish approximately seven times a month.

Our model procedures for calculating cancer-based Water Quality Standards have the following steps:

1. Calculate the level of each of the four chemicals in water that results in contamination levels in fish creating an increased cancer risk of one-in-one million. This would be the Water Quality Standard for each chemical *if no other chemicals* were present.
2. Determine actual concentrations of each chemical in fish fillets based on state monitoring data, and determine the percentage of contamination coming from each of the four chemicals measured.
3. Reduce the standard arrived at for each chemical in step 1 by the percent of contamination in the fish coming from that chemical. This becomes the new Water Quality Standards for each chemical based on additive cancer risks.

NWF Model Water Quality Standards Compared to Current Great Lakes Standards

Chemical	NWF	U.S. EPA	IN	MI	MN	NY	PA	OH	WI	Ontario
Dioxin (2378 TCDD) ppq	0.0067	0.013	0.1	0.14	—	—	0.01	0.14	0.03	—
PCBs ppq	1.0	79.0	790	20	14	1,000	80.0	790	150	1,000
DDT ppt	0.001	0.59	0.24	0.23	0.11	10	0.02	0.24	0.043	3.0
Chlordane ppt	0.0003	0.46	0.48	0.52	0.073	100	—	0.48	1.3	60.0
Dieldrin ppt	0.01	71	760	31	6.5	900	70	760	170	1000

Values in parts per quadrillion (ppq) or parts per trillion (ppt).

- NWF's standard for 2,3,7,8 dioxin is based on protecting wildlife.
- NWF's standard for PCBs is based on protecting infants and their mothers.
- NWF's standards for DDT, chlordane and dieldrin are based on protecting people from cumulative cancer risks of PCBs, DDT, chlordane and dieldrin.
- All values shown are the jurisdiction's lowest standard for the chemical listed. Most are based on cancer risk.
- EPA, Minnesota, New York and Pennsylvania base their standards on a one-in-one million cancer risk level.
- Indiana, Michigan, Ohio and Wisconsin base their standards on a one-in-one hundred thousand cancer risk level.
- Illinois does not have numeric Water Quality Standards for these chemicals.

For example, in our study of PCBs, DDT, dieldrin and chlordane in Lake Michigan lake trout, PCBs made up about 73% of the total contaminant load of the four chemicals. In step 3 of the process, the PCB standard would become 73% of what it was at step 1 when it was calculated as though the other chemicals were not present.

The objective in following these three steps is to ensure that the ***total risk*** of developing cancer from eating Great Lakes fish will not increase by more than one-in-one million.

Using this method, we arrived at Water Quality Standards of 1.1 parts per quadrillion (ppq) for DDT, 0.01 ppq for dieldrin, 0.3 ppq for chlordane and 0.6 ppq for PCBs. These standards are all substantially lower than those currently in place in the Great Lakes Basin.

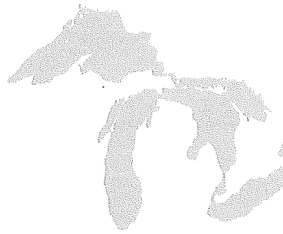
RECOMMENDATION: By June 30, 1994, uniform Water Quality Standards should be adopted by all Great Lakes Governments that prevent an increased risk of cancer in humans using an additive process to take into account the mixtures of cancer-causing chemicals in fish.

Choosing Between Water Quality Standards

In this chapter, we recommend developing Water Quality Standards based on three different environmental health indicators. A standard should be calculated for each chemical based on each of these three model procedures. The most stringent standard of the three should then be applied as the legally enforceable Water Quality Standard.

NOTES

1. W. Swain, *Model Water Quality Standards To Protect Human Health From Reproductive and Developmental Toxicants*, (National Wildlife Federation, 1990). See Appendix of this report to obtain a copy.
2. Ibid.
3. D. Zaber, *Model Water Quality Standards For Wildlife*, (National Wildlife Federation, 1991). See Appendix of this report to obtain a copy.
4. These procedures are based on two documents: J. Foran, *Model Water Quality Standards To Protect Human Health For Multiple Carcinogens*, (National Wildlife Federation, 1990); and B Glenn, et al., *Lake Michigan Sport Fish: Should You Eat Your Catch?*, (National Wildlife Federation, 1989). Both can be obtained by using the order form in the Appendix.



CHAPTER 13
Using Water Quality Standards

Water Quality Standards are often misused in ways that undermine progress in implementing a zero discharge strategy. Two major ways in which Water Quality Standards are misused are:

1. Governments allow polluters to dilute toxic discharges to comply with Water Quality Standards. This relieves polluters from reducing their use of toxics; and
2. Governments use Water Quality Standards to allow new or increased discharges of toxic pollutants into the Great Lakes ecosystem.

Dilution

Government agencies condone the use of dilution as a substitute for removal, reduction or treatment of toxics in discharges. Governments allow polluters to dilute toxic wastes with water already in the lake or stream before complying with standards, resulting in the dumping of greater quantities of toxic chemicals than would otherwise be allowed.

This dilution solution ignores the fundamental characteristics of the Great Lakes that make them especially sensitive to toxic pollution. Due to the slow rate at which water flushes out of the Great Lakes, toxics are accumulated and stored for tens, if not hundreds, of years. This reservoir of toxics is a constant source of exposure to aquatic life and fish. These organisms, in turn, accumulate the toxics and pass them on to people and wildlife. ***For persistent toxic substances, the total amount entering the Great Lakes ecosystem must be controlled, not just the concentrations of pollutants immediately downstream from each source.***

All Great Lakes Governments allow dilution. But, different methods are used to calculate allowable dilution. For example, the Great Lakes States use different statistical procedures to determine the amount of water available in a stream for dilution; the more water assumed to be present, the greater the amount of toxics that can be dumped.

The following scenario illustrates the significance of these different procedures. We assumed that a paper mill recycles waste paper and its effluent is contaminated with PCBs from the de-inking process. This hypothetical paper mill is on a river one-quarter of a mile upstream from its mouth where it empties into Lake Michigan. We also assumed that the state's Water Quality Standard for PCBs to protect against human cancer is 0.80 parts per trillion. We then calculated the total amount of PCBs that could legally be dumped into the river.

In the "no dilution" option, only 0.006 kilograms of PCBs could legally be dumped each year. However, using the Great Lakes States' differing statistical procedures for calculating dilution, the authorized amount of PCB dumping would be: in Michigan, 0.02 kilograms; in Ohio, 0.23 kilograms, and in Wisconsin, 0.93 kilograms. Wisconsin's approach would allow 150 times the amount of PCBs to be dumped as under the "no dilution" option.

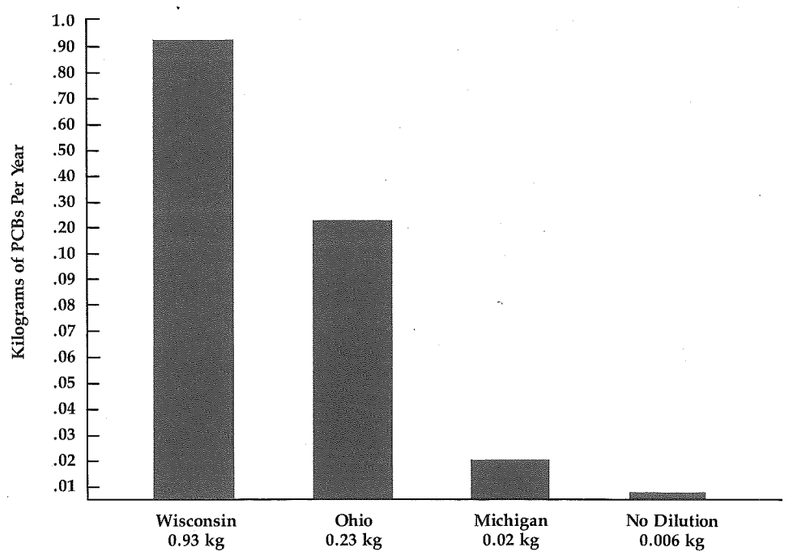
Great Lakes Governments also allow dilution by routinely designating mixing zones; areas of public waters adjacent to discharge locations where weaker Water Quality Standards apply. In some mixing zones, called "zones of intitial dilution" or, "ZIDs," *no* Water Quality Standards apply. Some environmentalists have dubbed these "Zones of Instant Death."

The larger the mixing zone or ZID, the greater the amount of toxics that can be dumped. Although the use of mixing zones has never been authorized by the U.S. Clean *Water Act*, EPA condones the practice.

Mixing zones and other dilution solutions are allowed even where toxics use reduction strategies like those described in Chapters 9 and 10 are available to eliminate or reduce toxic discharges. As long as polluters are allowed to dilute toxics, new, clean technologies will not aggressively be pursued. Thus, dilution undermines implementation of a zero discharge strategy.

RECOMMENDATION: By June 30, 1994, all Great Lakes Governments should eliminate dilution provisions in existing regulatory programs.

Effect of Dilution Factors on PCB Dumping, Assuming Equal PCB Cancer Standards



Anti-Degradation

When water quality in a Great Lakes tributary is better than required by standards, polluters frequently pressure governments to relax their pollution control regulations to allow new or expanded pollution. By misinterpreting Water Quality Standards as the ultimate goals (instead of interim benchmarks on the way to zero discharge) polluters argue that these streams are "too clean." Because existing regulatory programs have not integrated Water Quality Standards into a comprehensive zero discharge strategy, increased toxic pollution of the Great Lakes is frequently allowed in these circumstances.

The U.S., Canada, the States and Ontario all have anti-degradation policies that are supposed to prevent further pollution from *new* ***or*** *increased* pollution sources. The purpose of these policies is to preserve hard-won gains in improving Great Lakes water quality. According to these polices, high quality waters resulting from control efforts or natural processes are to be degraded only upon a compelling demonstration of need, countervailing public benefit and no environmental impact.

But, existing anti-degradation policies in the Great Lakes Basin are not effective. For example, the policies are not applied to all sources, including poisoned runoff. Our researchers developed a model anti-degradation policy for the Great Lakes that focusses on persistent, bioaccumulative toxics.[1] It has the following key elements:

- Anti-degradation review should be triggered by any proposed increase in actual toxic releases, however small, and regardless of the resulting concentration downstream from the discharger.
- It should apply to all sources of persistent toxic pollutants dumped into the Great Lakes ***watershed***, not just directly into the Great Lakes.
- It should apply to all sources, including urban and rural runoff of heavy metals, herbicides, pesticides and other toxic pollutants. Any changes in process, production rates, treatment practices, service area, land management practices, etc., that could reasonably be expected to increase loads of persistent toxic pollutants from these sources should be subject to review.
- No new or increased pollution should be allowed unless the proponent demonstrates all four of the following criteria: (1) that all toxics use reduction and pollution prevention measures have been employed to avoid the increased pollution, (2) that the increase will not have adverse effects on human health or the environment, (3) that widespread economic and social benefits warrant the increase, and (4) that there is no available opportunity for reducing loadings of the same pollutants from other sources.
- Basin-wide public notice and public participation should be required for any proposed decision to allow increased loadings of persistent toxic pollutants into the Great Lakes watershed.

This model anti-degradation policy makes zero discharge its centerpoint. This policy would send a message that business as usual is not acceptable and that preventing pollution and reducing the use of toxics must be the central part of any planning for new industrial developments, municipal expansions, changes in agricultural or forestry practices, or land uses.

RECOMMENDATION: By June 30, 1994, all Great Lakes Governments should adopt uniform anti-degradation policies that emphasize a zero discharge approach.

Water Quality Standards in Perspective

If properly developed and used, Water Quality Standards can play an important role in protecting and restoring the health of the Great Lakes ecosystem. Our recommended model standards and development procedures demonstrate how the indicators of our vision of a healthy Great Lakes ecosystem can be translated into Water Quality Standards.

Unfortunately, as this Chapter describes, Water Quality Standards are often misused to tolerate existing pollution and even authorize more. The recommendations in this Chapter, if adopted, would make Water Quality Standards effective tools in a zero discharge strategy. They must be used to force reduction and elimination of the use of toxic substances. As Part IV describes, Water Quality Standards also must be used to develop and implement strategies to clean up areas of historic contamination.

NOTES

1. This proposal is described in correspondence from M. Van Putten, *National Wildlife Federation*, to B. Vaughn ,U.S. EPA and A. Bamberg, *New York Department of Environmental Conservation*, (8 June, 1990) pp. 11. See Appendix of this report to obtain a copy.

Program For Zero Discharge researchers have adopted a mass balance model for our project that was originally developed and tested by other scientists.[2] In our strategy, the mass balance model serves two purposes:

1) It helps describe the relationship between annual loads and ambient concentrations. In other words, the model determines the total amount of the chemical currently entering the Lake on an annual basis that causes the Water Quality Standard to be exceeded.
2) The model predicts the Lake's response time under different load reduction scenarios. For example, we can ask the model, "If loading rates are reduced by 10% per year, how long will it take for concentrations to reach Water Quality Standards?" This information is critical in developing a clean-up timetable and setting interim targets.

Great Lakes scientists have developed several mass balance models, each of which varies in complexity. However, clean-up strategies should use a relatively simple model. Because data on loadings and sources of contaminants are limited, it does not make sense to develop and use complex models. Moreover, the results from relatively simple models appear not to be significantly different than those from complex models.

Mass balance models must not become ends in themselves. They are only tools in a virtual elimination strategy. Therefore, it is unnecessary to spend valuable time and resources developing complex models that could better be spent reducing contamination.

RECOMMENDATION: Comprehensive clean-up plans based on the strategy outlined above should be developed for each of the Great Lakes by January 1993.

NOTES

1. L. Fink, et al., *Target Load Reductions For Toxic Substance in the Great Lakes*, (National Wildlife Federation, 1991). See Appendix of this report to obtain a copy.
2. R. Thomman, et al., "Physico-Chemical Model of Toxic Substances in the Great Lakes," *Journal of Great Lakes Research* 9, no. 4 (1983): pp. 474-496.

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

CHAPTER 15
Cleaning Up PCBs in Lakes Ontario and Michigan

PCBs are known to be causing many of the health effects in wildlife and humans described earlier in this report. Therefore, we used the six-step clean-up strategy described in Chapter 14 to develop a PCB clean-up plan for Lakes Ontario and Michigan.[1] We chose PCBs in these two Lakes for our example because they are more highly contaminated than the other Lakes, and because there are more data available on sources of PCBs in these two Lakes than in the other three.

According to the most recent data, PCB concentrations in Lakes Michigan[2] and Ontario[3] are nearly 1,000 times greater than required to achieve Water Quality Standards. The PCB standard we proposed in Chapter 12 to protect infants from developmental problems caused by their mothers eating fish is 1 part per quadrillion (ppq).

Even using the Great Lakes Governments' current PCB standards, levels of PCBs in Lakes Michigan and Ontario are 10 to 100 times too high. Since PCB standards are being exceeded, our recommended six-point strategy should be applied.

Step 1: Determine the Current Total Load: The results of our model and survey of sources show that 1,535 kilograms* of PCBs enter Lake Michigan[4] each year and 952 kilograms enter Lake Ontario.

Step 2: Determine the Reductions in Loads Needed to Reach the Water Quality Standard: To protect infants and their mothers, an interim PCB Water Quality Standard of no greater than 1 part per quadrillion must be reached. Because of their persistence, all sources of PCBs to the Lakes must be cut off to reach this level. Figure A shows the rate at which PCB levels in water would drop under different clean-up time scenarios.

According to our mass balance model, if all sources of PCBs are stopped within the next 10 years, it would take until 2021 to achieve the model Water Quality Standard in Lake Michigan and until 2025 to achieve it in Lake Ontario. If we wait 25 years to stop all sources of PCBs, the model standard will be achieved in Lake Michigan in 2031, and in Lake Ontario in 2030.

The major difference between the 10-year and 25-year clean-up scenarios is the improvement that will occur in the interim. Reductions were calculated assuming that cleanup occurs at a constant rate each year. For example, one twenty-fifth of the sources of PCBs would be cleaned up each year in the 25-year plan. Under the 25-year plan, conditions would not improve significantly by 2000. But, under the 10-year clean-up plan, PCB levels would be substantially lower in 2000.

Step 3: Identify the Current Sources, Pathways, and the Loading Rates for Each Pathway: We surveyed all available information on the sources of PCBs entering Lake Michigan.

Tributaries: PCB loadings from tributaries into Lake Michigan are estimated to contribute 75% of the total load. To reduce loadings from these sources as quickly as possible, our data suggest that clean-up efforts should focus on the Fox River in Wisconsin, the Grand Cal in Indiana, the Kalamazoo River in Michigan and Waukegan Harbor in Illinois. Sediments in each of these waterways are known to be heavily contaminated with PCBs. (Sheboygan Harbor, another waterway with known PCB-contaminated sediments, has been omitted from this list because of clean-up activities already underway.) Even though

Concentrations of PCBs

(Values in Parts Per Quadrillion)

Lake Michigan	Lake Ontario	Proposed WQS
800	900	1

Predicted PCB Concentrations in the Year 2000

(Values in Parts Per Quadrillion)

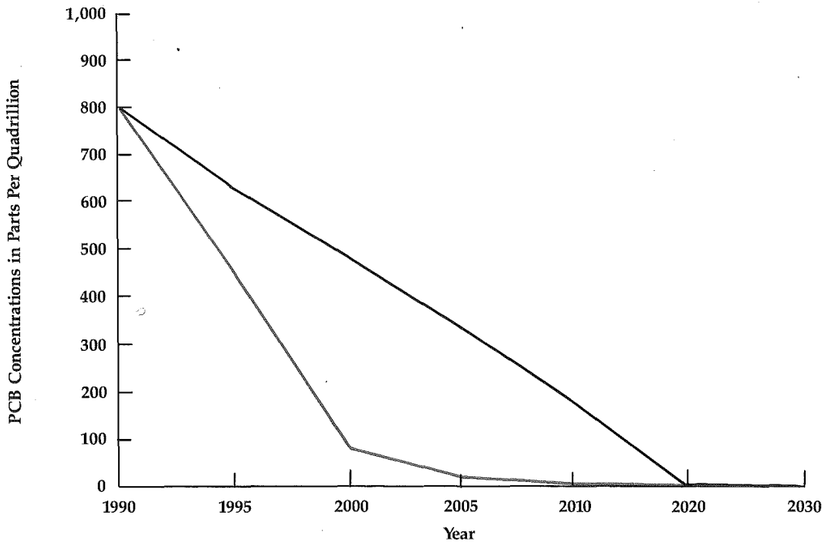
	10-Year Plan	25-Year Plan	Model Standard
Lake Michigan	80	480	1
Lake Ontario	60	560	1

Total Loads of PCBs into Lake Michigan

Pathways	Kilograms/ Year	Percent of Total
Tributaries (Includes sediment releases and direct dumping.)	1150	75
Atmospheric	380	24.7
Direct Discharges to the Lake	5	0.3
Total	1535	100%

Figure A

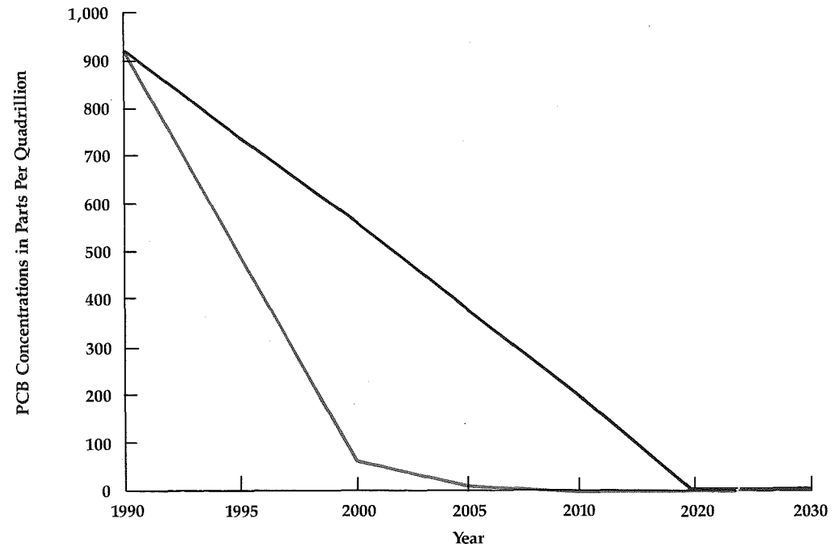
Lake Michigan Water Concentration of PCBs: Reduce all loads to Zero in 10 or 25 years



—— = Load Reduced to Zero in 10 Years. Target Water Quality Standard of 1 Part Per Quadrillion met in 2021.

—— = Load Reduced to Zero in 25 Years. Target Water Quality Standard of 1 Part Per Quadrillion met in 2031.

Lake Ontario Water Concentration of PCBs: Reduce all loads to Zero in 10 or 25 years



—— = Load Reduced to Zero in 10 Years. Target Water Quality Standard of 1 Part Per Quadrillion met in 2025.

—— = Load Reduced to Zero in 25 years. Target Water Quality Standard of 1 Part Per Quadrillion met in 2030.

Lake Michigan Tributary Loads

Waterway	Kilograms/Year	Percent of Total From All Tribs
Fox	520	38
Grand Cal	191	14
Kalamazoo	114	8.4
Waukegan	20	1.5
Total	845	62%*

*This percent does not match up to the 1535 kilograms total lake loadings (above) because the model recognizes that part of the load from the Fox River becomes "trapped" by Green Bay and never reaches Lake Michigan.

most of the current loading is from sediments, there are also point sources of PCBs on these waterways.

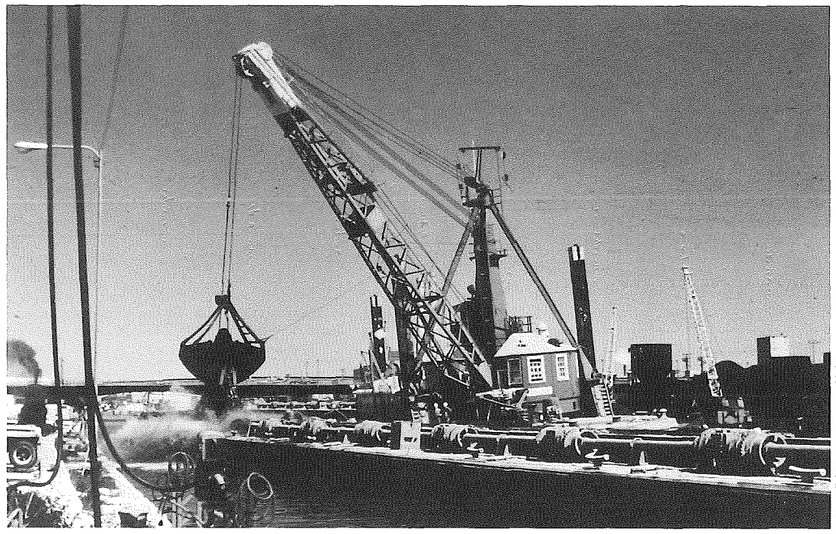
Atmospheric Sources: We made an intensive effort to identify the sources of PCBs that enter Lake Michigan from air pollution. Unfortunately, data are inadequate to construct a complete picture. There is inadequate monitoring of air sources of PCBs within the region, and other PCBs blow into the area from beyond the Great Lakes States.

However, our survey suggests that the most likely atmospheric sources of PCBs are leaking electrical equipment, including transformers and capacitors, and the combustion of PCB-contaminated oil and hydraulic fluids. Regulations under the U.S. *Toxic Substances Control Act* currently allow oils, fluids and equipment containing less than 50 parts per million of PCBs to be reused or burned in low-temperature boilers and incinerators, which spew PCBs into the sky. Given the huge volume of PCBs that were produced and are still in circulation, this legal loophole provides an ongoing source of PCB-contamination to the atmosphere.

Direct Discharges: Permitted wastewater discharges of PCBs into the Lake Michigan watershed make up only a small fraction of the total load. However, this conclusion is limited to Lake Michigan and does not mean that cities and industries are not important sources of PCBs to the other Great Lakes. For example, the City of Detroit's Waste Water Treatment Plant is the largest source of PCBs into Lake Erie,[5] which, in turn, is the largest source of PCBs to Lake Ontario.

Step 4: Establish a Timetable for Achieving Reductions in Total Loadings. We used the mass balance model to forecast the effect on Lake Michigan of different clean-up scenarios.

Clean-up Scenario 1: *Clean up the four areas with the most polluted sediments, the Grand Cal, Fox, Kalamazoo and Waukegan Harbor, first. This would eliminate 62% of the total load coming from tributaries.*



INTERNATIONAL JOINT COMMISSION

Clean-up Scenario 2: *Clean up half of the atmospheric sources of PCBs by the Year 2000 at the same time as the four polluted tributaries in Scenario 1 are cleaned up. This would reduce the amount of PCBs falling on the Lake and increase the rate at which PCBs leave the Lake through volatilization.*

The graph in Figure B shows the drop in concentration of PCBs that would occur if the loadings from these four areas were totally eliminated by the Year 2000 in contrast with the "do nothing" alternative. Figure B also illustrates the effect of cutting atmospheric pollution in half.

The clean-up activities in both scenarios should begin immediately. But, Figure B shows that neither clean-up scenarios would not be enough to reach the Water Quality Standard. An even greater effort will be required to achieve the model PCB standard of 1 part per quadrillion. Based on what is known about sources, cleaning up the four polluted waterways and cutting atmospheric sources in half are the most important first steps.

Step 5: Allocate a Portion of the Required Reduction in Total Loadings Back to Each Jurisdiction. To ensure that the necessary clean-up activities occur, it is important to hold specific government agencies accountable for achieving the load reductions. The pie-chart in Figure C illustrates a proposed Lake Michigan load reduction allocation scheme. Allocations were made primarily on the current tributary loadings of PCBs from all Lake Michigan tributaries in each State. Illinois' share was adjusted upward because it likely is contributing a disproportionate amount of PCBs from atmospheric sources in the Chicago area.

This reduction of 845 kilograms alone would not achieve the Water Quality Standard. In addition, half of the atmospheric loading must be reduced. Allocating this to the States is more complicated because less is known about atmospheric sources of PCBs. Illinois' share of the tributary load reduction allocation has already been increased to take into account air pollution. All four States and the Federal Government must take responsibility for stopping atmospheric sources.

Figure B

Lake Michigan Water Concentrations of PCBs: Clean-Up Options

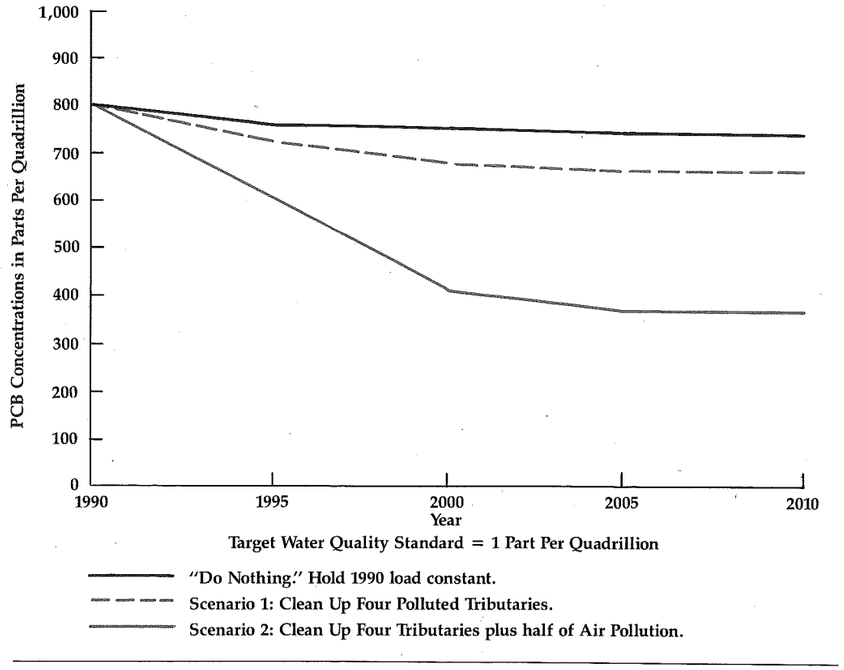
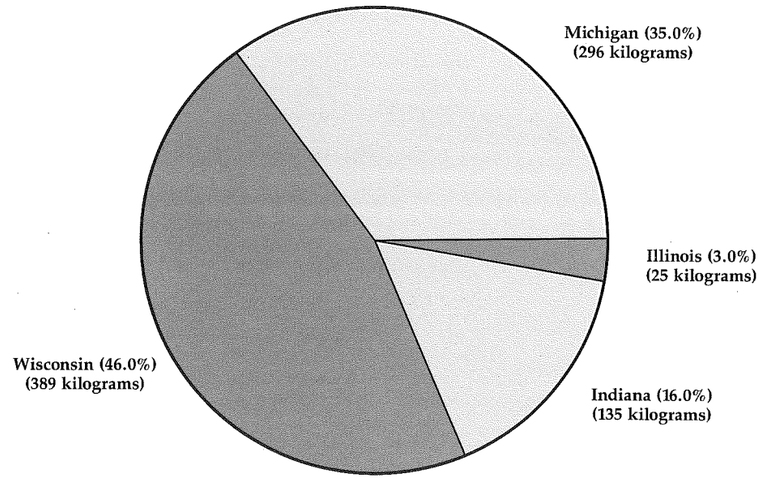


Figure C

State Shares of Lake Michigan Load Reduction* Kilograms of PCBs Per Year



***Based on Current Tributary Loading Rates.**
One kilogram equals 2.205 pounds. 296 kilograms equals 653 pounds.

Two actions should be taken immediately to reduce atmospheric sources of PCB pollution:

1. Correct the loophole in the *Toxic Substances Control Act* that allows burning or reuse of fluids contaminated with less than 50 parts per million of PCBs.
2. Accelerate the decommissioning and proper disposal of PCB-contaminated electrical equipment.

The allocation of load reductions will be difficult. But this step is crucial. There must be a precise assignment of each State's responsibility for meeting load reduction targets by the Year 2000.

RECOMMENDATION: By January 1, 1993, U.S. EPA, Illinois, Indiana, Michigan and Wisconsin should adopt the strategy for cleaning up PCB pollution in Lake Michigan proposed in this Chapter. The first actions required in the strategy should be to clean up contaminated sediments in Waukegan Harbor and the Fox, Kalamazoo and Grand Cal Rivers; and elimination of at least half of the atmospheric sources of PCB pollution by the Year 2000. Allocation to the four States of the responsibility for meeting load reduction targets should be based primarily on current tributary loadings.

Step 6: Enforce Load Reductions and Monitor Progress. One of the most important elements of the clean-up strategy is to enforce the timetable of load reductions and clean-up activities. Our recommendations for accomplishing this are described in Chapter 16.

Tributary Load Reduction by the Year 2000: States' Shares

State	Load Reduction Kilograms	Percent of Total Reductions Required
Wisconsin	389	46
Michigan	296	35
Indiana	135	16
Illinois	25	3
Total	845	100

*One kilogram equals 2.205 pounds. 1535 kilograms equals 3,385 pounds.

cisions have held that when the states fail to set these total load reduction plans, the responsibility lies with EPA.

Meeting load reduction targets for cleaning up the Great Lakes must be included in each Great Lakes State's or Province's annual requirements. For example, U.S. EPA currently negotiates an agreement with each state on the programs and activities that will be undertaken each year, in exchange for grant funding under the *Clean Water Act*. The states' annual plans must spell out what clean-up activities will take place and the load reductions to be achieved. A similar negotiation process occurs between Environment Canada and Ontario under the *Canada-Ontario Agreement Respecting Great Lakes Water Quality.* In exchange for this grant funding, EPA and Environment Canada should require that load reduction targets in the timetable be achieved.

RECOMMENDATION: By January, 1993, U.S. EPA and Environment Canada should enforce load reduction targets and timetables for lakewide clean-up strategies by using the tools available under the U.S. *Clean Water Act* and the *Canada-Ontario Agreement Respecting Great Lakes Water Quality*.

Permits

Governments must not issue discharge permits to any source in the watershed for pollutants that already exceed Water Quality Standards in the open waters of the Lake. Before any permit limits can be set, there must be a timetable of load reductions, an allocation of responsibility back to each jurisdiction, and a guarantee by the agency proposing to issue the permit that the permit is consistent with load reduction requirements.

The Combined Strategy

The recommendations in this report prescribe the reforms needed to protect and restore the health of the Great Lakes. The strategy we recommend requires fundamental changes in the way society uses and manages toxic chemicals. And it requires aggressive action to clean up the pollution already in the Lakes.

If our visions for the future of the Great Lakes are to become reality, governments, users of toxic chemicals and citizens must make critical choices. For example, governments must move aggressively to clean up PCBs. Industry, agriculture and other users of toxic chemicals must dramatically reduce their use of toxic chemicals and find substitutes for those practices that create toxic wastes. The residents of the Great Lakes region must change our lifestyles to reduce the demand for products that require the use of toxic chemicals.

We all must articulate our visions for the future. Our collective voices must be the driving force that demands the changes necessary to turn those dreams into reality. The next Chapter describes several forums available for citizens to push for those changes.

Part V
Conclusion

Chapter 17
Opportunities for Action

Citizen action to protect these magnificent Lakes has proven effective in the past. This is even more essential in the future because dramatic changes in government programs, industrial and agricultural practices and individual lifestyles are required to implement the zero discharge strategy outlined in this report.

Informed citizens have many opportunities to participate in formulating and implementing the zero discharge strategy. Some of the most important opportunities on the horizon are described in this Chapter. They are categorized as basin-wide activities, opportunities in the U.S. and opportunities in Canada. Addresses for more information are listed in the Appendix.

Effective participation by citizens often requires access to technical, policy and legal expertise. With the release of this report, the **Program For Zero Discharge** enters Phase II. In the coming months, the National Wildlife Federation and the Canadian Institute For Environmental Law and Policy, together with Great Lakes United and Pollution Probe, will provide such expertise by conducting citizen-education programs, providing information, and working with other citizens' group for zero discharge reforms.

Basin-Wide Opportunities

The International Joint Commission's Virtual Elimination Task Force: The IJC has established the Virtual Elimination Task Force to prepare recommendations for a comprehensive zero discharge strategy. In April 1991, the Task Force will hold public meetings to hear reactions to its preliminary recommendations. Information on the Task Force is available from the IJC's Great Lakes Regional Office.

The IJC's Great Lakes Biennial Meeting: In September, 1991, in Traverse City, Michigan, the IJC will hold its Sixth Biennial Meeting on Great Lakes Water Quality. At its last meeting, held in Hamilton, Ontario, hundreds of citizens from around the Basin forcefully presented their views on the problems and solutions facing the Great Lakes. This led the Commission to come out with strong recommendations in its *Fifth Biennial Report on Great Lakes Water Quality.*

At the 1991 meeting, citizens can urge the IJC to continue to hold the Governments accountable for keeping the zero discharge promise. Information on the meeting schedule and copies of IJC reports are available from the IJC Regional Office.

IJC Roundtables on Zero Discharge: The IJC is holding a series of "roundtable" discussions on zero discharge issues, with a particular emphasis on protecting Lake Superior. One roundtable is to be held in May, 1991. Citizens can learn more about these roundtables by contacting the IJC Regional Office.

Lakewide Management Plans: Lakewide Management Plans are important tools for developing and implementing the comprehensive, lakewide clean-up strategies described in Part IV of this report. Plans for Lake Michigan and Lake Ontario are to be completed by 1992. Citizens interested in participating in developing these plans should contact the U.S. EPA or Environment Canada offices listed in the Appendix. The Lake Michigan Federation, a citizens' group based in Chicago, is playing a lead role in the development of the Lake Michigan plan; they can provide citizens with information on that plan.

Remedial Action Plans: Remedial Action Plans are being developed for each of the Great Lakes' 42 Areas of Concern identified by the IJC. These can be an important part of the strategy in Part IV of this report. To determine the status of the plan in your area and to participate in its development, contact the IJC Regional Office in Windsor, or the U.S. EPA or Environment Canada.

Opportunities in the United States

Re-authorization of the Clean Water Act: In 1991, the U.S. *Clean Water Act* is scheduled to be reconsidered by Congress. This provides an opportunity to require that the Act's zero discharge goal be implemented through sunset chemical programs, toxics use reduction.

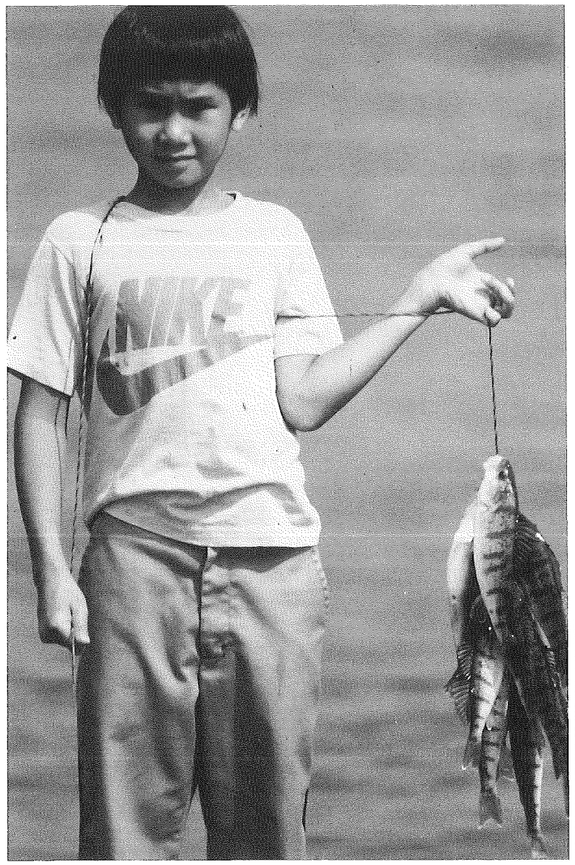
provisions and other elements of a zero discharge strategy. Citizens' organizations have developed an informal network to share information and coordinate lobbying efforts during re-authorization. To learn more about this network, contact the National Wildlife Federation or the Natural Resources Defense Council.

Great Lakes Water Quality Initiative: In 1989, the U.S. EPA began a cooperative process with the Great Lakes States to develop uniform Water Quality Standards for the Great Lakes.

The *Great Lakes Critical Programs Act of 1990* formalized this process and established a statutory timetable requiring completion by June, 1992. The Initiative provides an opportunity to reform Water Quality Standards along the lines of the recommendations in Part III of this report.

The standards developed by the Great Lakes Initiative will be published in draft form in the *Federal Register* in June, 1991. Citizens will have an opportunity to comment on these proposals before they are finalized. For further information, contact U.S. EPA's Water Division in Chicago.

EPA Review of Technology-Based Standards: In January, 1990, the EPA announced plans to review and revise its technology-based effluent limitations guidelines, which define Best Available Technologies for a given industrial sector. Among the industrial categories scheduled for new standards is the pulp and paper sector. Chapter 10 of this report describes toxics use reduction strategies to eliminate chlorinated poisons from this industry.



MICHIGAN DEPARTMENT OF NATURAL RESOURCES

The revision of these EPA guidelines is an opportunity to build the toxics use reduction techniques of Part II of this report into wastewater discharge permits. EPA's revisions will be released for public comment in draft form before they are finalized. To receive copies of the proposed new guidelines contact U.S. EPA in Washington.

Triennial Review of Water Quality Standards: Every three years, Great Lakes States must review their Water Quality Standards. Once the EPA Water Quality Initiative is completed, state Water Quality Standards must be changed to meet the new Federal guidelines. This process is the means for implementing the model Water Quality Standards recommended in Part III of this report. According to the law, public participation is required during these reviews. For further information, contact the Water Quality Standards section of the environmental protection agency in your state.

Permitting Procedures: Citizens can request copies of existing and proposed new discharge permits for polluters in your area. Citizens can urge that these permits include plans for reducing the use of toxics and dates for sunsetting dangerous chemicals. Information on permits can be obtained from your state agency.

Opportunities in Canada

The Great Lakes Pollution Prevention Strategy: In July, 1990, the Canadian Government announced plans to develop a pollution prevention strategy for the Great Lakes. This initiative provides an opportunity to institute a Toxics Freeze for Canadian waters of the Great Lakes and to initiate a Sunsetting Process. (See Chapters 7 and 8.) To receive a copy of this strategy and to become involved in its development, contact Environment Canada.

Renegotiation of the Canada-Ontario Agreement: In 1991, Federal and Provincial authorities will negotiate revisions to the *Canada-Ontario Agreement to implement the Great Lakes Water Quality Agreement*. This agreement should detail Ontario's and Canada's responsibilities for implementing the zero discharge strategy. It should include, for example, load reduction targets for the lakewide clean-up plans described in Part IV. To obtain information on this review process, contact Environment Canada.

Municipal-Industrial Strategy for Abatement (MISA): Ontario's water quality laws are currently being rewritten under the MISA program. MISA is focussing on the development of technology-based standards. In 1991, draft regulations for wastewater discharges to the Lakes will be developed and circulated for review. These effluent limitations are an opportunity to incorporate the toxics use reduction standards (described in Chapters 9 and 10) and to adopt uniform Water Quality Standards (see Chapters 11-13). To learn more about MISA, contact the Ontario Ministry of Environment.

Discharge Approvals: Citizens should ask the Ontario Ministry of Environment for copies of the Certificates of Approval for polluters in their community. These certificates are the permits that allow toxic discharges. These provide useful, though limited, information on contaminants that can legally be dumped. Citizens can use this information to push polluters and the Government to use many of the zero discharge strategies in Part II of this report.

Don't Wait for Government—Make Your Own Opportunities

Citizens don't always have to wait to respond to government. A number of recommendations in this report are aimed at directly involving you in reducing the use and discharge of toxic chemicals. For example, neighborhood residents can develop "good neighbor" agreements as described in Chapter 9.

Several Great Lakes citizens' groups are pushing for zero discharge in addition to the National Wildlife Federation and the Canadian Institute For Environmental Law and Policy. These include state affiliates of the National Wildlife Federation, Great Lakes United, Pollution Probe, Greenpeace and the Zero Discharge Alliance, a basin-wide network of individual and groups.

Join these groups and help campaign for zero discharge!

It is also crucial to adopt a zero discharge strategy in our own homes and workplaces. By refusing to buy bleached paper products, by using toxic chemical-free cleaning and household products, and by becoming aware of how our lifestyles and work activities affect the environment, each of us can make a meaningful contribution to a healthy Great Lakes ecosystem.

Each of us must fulfill our responsibility to carry out the prescription outlined in this report for restoring the health of the Great Lakes ecosystem.

CHAPTER 18
Summary of Recommendations

A Vision For the Future of the Great Lakes

Government strategies to protect and clean up the Great Lakes must be guided by a vision of a future, healthy Great Lakes ecosystem. In this report, we offer our prescription for a healthy Great Lakes. It is based on three measures of the Lakes' health:

- Whether women can eat Great Lakes fish without affecting the development of their babies;
- Whether wildlife that eat Great Lakes fish and other aquatic life thrive in the Great Lakes Basin; and
- Whether people can eat Great Lakes fish without increasing their risk of getting cancer.

Other visions may be just as valid as ours, so long as they provide clear direction for the problems that must be addressed and provide clear direction for the actions that must be taken by the responsible parties. **(Chapter 1)**

A New Strategy To Protect and Clean Up the Great Lakes

If we are to achieve the healthy ecosystem of our visions, we must overcome the limitations of the pollution control approach and eliminate the most harmful substances damaging life in the Great Lakes ecosystem. Our strategy for achieving this objective is two-pronged:

1) Stop all future discharges of the most harmful pollutants through a zero discharge program and substantially reduce the discharge of all other chemicals; and
2) Clean up those contaminants that have been released into the Great Lakes. **(Chapter 5)**

The specific recommendations for reforming existing programs and adopting new programs are described below. Included with each recommendation is the timeframe within which each can be accomplished and the government agency (or agencies) responsible. The Chapter of this report where these recommendations are described in depth is also listed.

The Zero Discharge Strategy

Immediately Freeze Toxic Dumping.

No government in the Great Lakes Basin should issue or reissue a discharge permit that would allow any increase in the amount released of any of the 362 chemicals on the Water Quality Board's "1986 Working List of Chemicals in the Great Lakes Basin," unless the applicant for the permit demonstrates that the discharge will not result in additional accumulation of the chemical in the Lakes or harm to the ecosystem. **(Chapter 7)**

Sunset the Most Dangerous Toxic Chemicals.

Toxic chemicals with very high bioconcentration factors should immediately be banned from further use or manufacture anywhere in the Great Lakes Basin, even if there is little evidence of specific toxic effects. **(Chapter 8)**

The U.S and Canadian Federal Governments should set up a joint sunset task force. The public should be consulted in all aspects of this task force's work. The task force should submit its recommendations to the U.S. and Canadian Governments by the September, 1993, biennial meeting of the IJC.

The task force should:

- adopt criteria for placing a chemical on the sunset list;
- determine methods to measure chemicals using these criteria; and
- list the chemicals to be sunset. **(Chapter 8)**

The U.S. and Canadian Federal Governments should use the criteria for banning chemicals developed by the sunset task force to screen the use or production of new chemicals in the Great Lakes Basin. **(Chapter 8)**

The two Federal Governments should set specific timetables for phasing out all chemicals not subject to an immediate ban. These timetables should be set by September of 1994, one year after the task force's recommendations are issued. **(Chapter 8)**

The Canadian and U.S. Governments should issue a sunset reference to the International Joint Commission. This reference should be announced by the September, 1991 meeting of the IJC. **(Chapter 8)**

PAUL T. SCHNELL

Reduce Use of Toxics.

Each Government in the Great Lakes Basin should implement comprehensive toxics use reduction programs that include:

1. Clearly specified toxics use reduction goals and objectives;
2. The gathering of inventories and audits of toxics use;
3. Toxics use reduction planning by each industrial sector using toxics;
4. Technical assistance programs;
5. Community and worker right-to-act provisions;
6. Reorganization of government agencies on a multi-media basis;
7. Toxics use reduction standards; and
8. Toxics use reduction permitting procedures. **(Chapter 9)**

Each Government in the Great Lakes Basin should set a goal of 50% reduction in the total use of toxic chemicals by 1996 and 75% reduction by 2000. **(Chapter 9)**

Governments in the Great Lakes Basin should require that each industry and each sector of users of toxic chemicals develop toxics use reduction plans by 1994 that will achieve the overall goals of 50% reduction in use of toxics by 1996 and 75% reduction by 2000. **(Chapter 9)**

Each Government in the Great Lakes Basin should pass legislation encouraging good neighbor agreements and giving all community residents and workers the following rights:

1. The right to information and inspection;
2. Worker right to refuse unsafe work;
3. Worker right to report pollution, and
4. The right to sue. **(Chapter 9)**

Adopt Zero Discharge Technologies.

Governments should immediately revise their technology-based effluent standards to ensure that they are based on the best available toxics use reduction methods. **(Chapter 10)**

Great Lakes petroleum refineries should reduce total discharges of chromium to water from the 9,000 kilograms now released each year to zero.

This reduction could be achieved by combining three techniques:

- **substituting** phosphate-based chemicals for the zinc chromate now used as an additive in cooling waters;
- **reducing** the amount of cooling water used and discharged by conserving and recycling water; and
- **employing** more advanced pollution control techniques.

Great Lakes bleached kraft mills should reduce their current discharges of 13,000 tonnes of AOX each year to zero. This could be achieved by changing production processes so that no chlorine is used in the bleaching or delignification processes. **(Chapter 10)**

The Clean-Up Strategy

Protect Lake Superior.

The U.S. and Canada should immediately implement a zero discharge strategy for Lake Superior. The strategy should include:

1. Designation of Lake Superior as "outstanding national resource waters" under the U.S. *Clean Water Act* and a similar designation in Canada;
2. A freeze on building new or expanding existing pulp and paper mills that use chlorine;
3. A phase-out of the use of chlorine and the discharge of all persistent toxic chemicals at existing pulp and paper mills;
4. An independent environmental review in Canada of the impacts of logging and forest management practices on Lake Superior; and
5. An inventory of undeveloped Lake Superior shoreline, and preparation by the U.S. and Canada of a joint plan for protecting sensitive and undeveloped areas. **(Chapter 7)**

Reform Water Quality Standards.

By June 30, 1994, all Governments in the Great Lakes Basin should adopt uniform Water Quality Standards based on fish being safe to eat by all wildlife and humans. **(Chapter 11)**

Legislation and regulations should state that Water Quality Standards are only interim and that the standard for all persistent toxic substances will be changed to "virtually eliminated." **(Chapter 11)**

By June 30, 1994, Governments in the Great Lakes Basin should adopt new Water Quality Standards to protect babies from developmental problems. These Standards should use the model procedures in Chapter 12 and protect a 120-pound woman eating an average of 50 grams of fish each day. **(Chapter 12)**

By June 30, 1994, Great Lakes Governments should revise their Water Quality Standard for PCBs so that it is no higher than one part per quadrillion. **(Chapter 12)**

By June 30, 1994, uniform Water Quality Standards that protect wildlife should be adopted by all Great Lakes Governments. These standards should take into account bioaccumulation factors, the limitations of field data, protection of the most sensitive species and the combined effects of contaminants in the Great Lakes. **(Chapter 12)**

By June 30, 1994, Governments in the Great Lakes Basin should adopt new Water Quality Standards for dioxin (2,3,7,8 TCDD) of no higher than 0.0067 parts per quadrillion to protect wildlife. **(Chapter 12)**

By June 30, 1994, uniform Water Quality Standards should be adopted by all Great Lakes Governments that prevent an increased risk of cancer in humans by using an additive process to take into account the mixtures of cancer-causing chemicals in fish. **(Chapter 12)**

By June 30, 1994, all Great Lakes Governments should eliminate dilution provisions in existing regulatory programs. **(Chapter 13)**

By June 30, 1994, all Great Lakes Governments should adopt uniform anti-degradation policies that emphasize a zero discharge approach. **(Chapter 13)**

Develop and Enforce Lakewide Clean-up Strategies.

Comprehensive clean-up plans based on the six-step strategy outlined in Chapter 14 should be developed for each of the Great Lakes by January 1993. **(Chapter 14)**

By January 1, 1993, U.S. EPA, Illinois, Indiana, Michigan and Wisconsin should adopt the strategy for cleaning up PCB pollution in Lake Michigan proposed in Chapter 15. The first actions required in the strategy should be to clean up contaminated sediments in Waukegan Harbor and the Fox, Kalamazoo and Grand Cal Rivers; and elimination of at least half of the atmospheric sources of PCB pollution by the Year 2000. Allocation to the four States of the responsibility for meeting load reduction targets should be based primarily on current tributary loadings. **(Chapter 15)**

The Governments in the Great Lakes Basin should immediately intensify efforts to monitor likely sources and loadings of PCBs and other persistent toxic chemicals. **(Chapter 15)**

By January, 1993, U.S. EPA and Environment Canada should enforce load reduction targets and timetables for lakewide clean-up strategies by using the tools available under the U.S. *Clean Water Act* and the *Canada-Ontario Agreement Respecting Great Lakes Water Quality.* **(Chapter 16)**

APPENDIX
Resources for More Information

For more information on the research methods and conclusions summarized in this report, please use the order form to request copies of the documents listed below. Costs listed are to cover the expenses of copying and postage.

Following this section are addresses of organizations described in Chapter 17.

From NWF

Model Water Quality Standards to Protect Human Health From Reproductive and Developmental Toxicants. By Wayland Swain, Ph.D., 175 pages. ($10.00 U.S.)

Model Water Quality Standards to Protect Wildlife. By David Zaber, M.S., 50 pages. ($5.00 U.S.)

Model Water Quality Standards to Protect Human Health From Multiple Carcinogens. By Jeffery Foran, Ph.D., 20 pages. ($3.00 U.S.)

Lake Michigan Sport Fish: Should You Eat Your Catch? By Barbara Glenn, M.S. and Jeffery Foran, Ph.D., Summary, 16 pages (free). Complete, two-volume Technical Report, 1000 pages ($35.00 U.S.)

Target Load Reductions For Toxic Substances in the Great Lakes: Part 1, The Great Lakes Model; Part 2, Evaluation of Waste Load Allocation Issues. By Larry Fink, M.S. and Michael Penn, 170 pages. ($10.00 U.S.)

Sources of Polychlorinated Biphenyl Loadings To Lake Michigan. By Lorraine Lamey, M.S., 40 pages. ($5.00 U.S.)

A Summary of Mean Fish Tissue Contaminant Levels. By Lorraine Lamey, M.S., 90 pages. ($10.00 U.S.)

A Summary of Fish Consumption Rate Surveys. By Lorraine Lamey, M.S., 15 pages. ($2.00 U.S.)

Proposed Great Lakes Antidegradation Policy. By Mark Van Putten, J.D., 12 pages. ($2.00 U.S.)

From CIELAP

Zero Discharge: A Strategy for the Regulation of Toxic Substances in the Great Lakes Ecosystem. By Paul Muldoon and Marcia Valiante, 79 pages ($30.00 Cdn.)

Pollution Prevention in the Great Lakes: A Survey of Current Efforts and an Agenda for Reform. By Marcia Valiante and Paul Muldoon, 140 pp. ($40.00 Cdn.)

Developing Options for Technology-Based Standards for the Petroleum Refining Sector in the Great Lakes. By Susan Sang, Ph.D., ($30.00 Cdn.)

Developing Options for Technology-Based Standards for the Pulp and Paper Sector in the Great Lakes. By Susan Sang, Ph.D., ($30.00 Cdn.)

Still Going to B.A.T. for Water Quality? A Four-Year Review of the Ontario Municipal-Industrial Strategy for Abatement. By Burkhard Mausberg ($10.00 Cdn.)

Do You Have a Zero Discharge Home? By CIELAP, ($1.00 Cdn.)

Organizations and Agencies

The following list includes many of the citizens' organizations working on water quality issues and many of the government agencies making decisions affecting the Great Lakes. These groups and agencies are referred to in Chapter 17, ***Opportunities For Action***. Contact any of these groups to find out more about the Great Lakes and how you can help protect them. Contact NWF for the state affiliate in your state.

Citizens' Groups:

National Wildlife Federation
Great Lakes Natural Resource Center
802 Monroe Street
Ann Arbor, Michigan 48104
(313) 769-3351

Canadian Institute For Environmental Law and Policy
517 College Street, Suite 400
Toronto, Ontario M6G 4A2
(416) 923-3529

Great Lakes United
State University College
Cassety Hall
1300 Elmwood Avenue
Buffalo, New York 14222
(716) 886-0142

Pollution Probe
12 Madison Avenue
Toronto, Ontario M5R 2S1
(416) 926-9876

Agencies:

International Joint Commission
Great Lakes Regional Office
100 Ouellette Avenue
Windsor, Ontario N9A 6T3
(519) 256-7821
or,
P.O. Box 32869
Detroit, Michigan 48232
(313) 226-2170

U.S. Environmental Protection Agency
Great Lakes National Program Office
111 West Jackson, 10th Floor
Chicago, Illinois 60604
(312) 353-2117

U.S. EPA, Region V Water Division
230 South Dearborn
Chicago, Illinois 60604
(312) 353-2147

U.S. EPA, Office of Water Regulations and Standards
401 M Street, S.W.
Washington, D.C. 20460
(202) 382-5400

Environment Canada
Great Lakes Environment Office
25 St. Clair Avenue East
Toronto, Ontario M4T 1M2
(416) 973-8632

Ontario Ministry of the Environment
Municipal-Industrial Strategy For Abatement
135 St. Clair Avenue West
Toronto, Ontario M4V 1P5

Lake Michigan Federation
59 East Van Buren Street, Suite 2215
Chicago, Illinois 60605
(312) 939-0838

Sierra Club
214 North Henry Street
Suite 203
Madison, Wisconsin 53703
(608) 257-4494

Natural Resources Defense Council
1350 New York Avenue, N.W.
Suite 300
Washington, D.C. 20005
(202) 783-7800

Zero Discharge Alliance c/o Greenpeace, Great Lakes
1017 West Jackson
Chicago, Illinois 60607
(312) 666-3305

Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62794

Indiana Department of Environmental Management
105 South Meridian Street
Indianapolis, Indiana 46225

Michigan Department of Natural Resources
Surface Water Quality Division
P.O. Box 30028
Lansing, Michigan 48909

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, Minnesota 55155

New York Department of Environmental Conservation
Division of Water
50 Wolf Road
Albany, New York 12233

Pennsylvania Department of Environmental Resources
P.O. Box 2063
Harrisburg, Pennsylvania 17120

Ohio Environmental Protection Agency
P.O. Box 1049
1800 Watermark Drive
Columbus, Ohio 43266

Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, Wisconsin 53707

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NWF
802 Monroe Street
Ann Arbor, Michigan 48104,
or
CIELAP
517 College Street, Suite 400
Toronto, Ontario M6G 4A2

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