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Report to the Chairman, Subcommittee on Health and the Environment, Committee on Energy and Commerce, House of Representatives

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AIR POLLUTION

EPA May Not Fully Achieve Toxic Air Deposition Goals

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GAO
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Resources, Community, and
Economic Development Division

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May 10, 1991

The Honorable Henry A. Waxman
Chairman, Subcommittee on Health and
the Environment
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

As you requested, this report provides information on toxic bioaccumulation and the extent to which air deposition contributes to this problem. It also discusses the Environmental Protection Agency's (EPA) planned approach to addressing the 1990 Clean Air Act Amendments' requirements for reporting on and controlling air deposition to surface waters. Specifically, this report discusses the need for EPA to complete its planning as soon as possible and, if it finds that it cannot fully comply with the amendments' requirements, to inform the Congress of any anticipated delays and suggest possible remedies.

Unless you publicly release its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time we will send copies of the report to appropriate congressional committees; the Administrator, EPA; and other interested parties. We will make copies available to others upon request.

This work was performed under the general direction of Richard L. Hembra, Director, Environmental Protection Issues, who may be reached at (202) 275-6111. Other major contributors to this report are listed in appendix I.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Concern exists about the effect of toxic chemicals released into the environment that accumulate in various animal species (bioaccumulation) and may cause birth deformities and other adverse health effects. The Great Lakes, coastal waters, and other bodies of water are the areas most susceptible to bioaccumulation problems.

The Chairman of the Subcommittee on Health and the Environment, House Committee on Energy and Commerce, asked GAO to provide information on the toxic bioaccumulation problem and on the extent to which toxic air deposition contributes to it, and also to determine the Environmental Protection Agency's (EPA) progress in responding to the 1990 Clean Air Act Amendments' requirements to assess and report on the problem.

Background

Certain chemical compounds, such as polychlorinated biphenyls (PCBs), which break down slowly in the environment and are easily absorbed in living tissue, tend to bioaccumulate in some organisms and can become even more concentrated in predators that consume the organisms. Air deposition of toxic pollutants may significantly contribute to bioaccumulation problems. American industry reported emitting about 2.4 billion pounds of toxic chemicals into the atmosphere in 1988. Toxics also enter the atmosphere from automobiles, pesticides, municipal waste incineration, and other combustion processes. Once in the atmosphere, the toxics can quickly fall to the earth's surface, or they may be carried a great distance, depending on their physical characteristics and on atmospheric conditions.

To reduce toxic emissions that are harmful to human health and the environment, the 1990 Clean Air Act Amendments require EPA to establish pollution control standards for 189 toxic air pollutants. The amendments also require that EPA assess and report on air deposition and, if necessary, take further action to control toxic emissions. The report, due in 3 years, is to include an assessment of the environmental and public health effects of deposition, including bioaccumulation, and is to serve as the basis for developing additional emission standards or regulatory controls within 5 years, if necessary to prevent adverse effects.

Results in Brief

Toxic substances from the air and other sources have had serious environmental impacts. Bioaccumulation of certain toxic substances has been associated with harmful effects in several species of fish and wildlife. The states surrounding the Great Lakes have issued warnings about

the risk to human health of consuming some species of fish in contaminated areas. Moreover, research indicates that significant amounts of some toxics—lead and PCBs, for example—are being deposited in the Great Lakes from the atmosphere and that other toxics are being carried there from distant locations. Bioaccumulation also occurs in the Chesapeake Bay and other waters but is not as widespread, and less is known about the extent of air deposition to those waters.

EPA officials, who are currently planning how to respond to the 1990 Clean Air Act Amendments' requirements to assess and report on the air deposition problem, are concerned that data limitations will make it difficult to develop a comprehensive report in 3 years. Little information exists on the extent of air deposition of the 189 toxic air pollutants identified in the amendments and, although some data exist on their environmental effects, more research is needed. EPA has only recently begun to develop a capability to monitor air deposition, and EPA officials stated that considerable time may be required to plan and conduct the monitoring activities needed to measure air deposition levels and assess the results for a report to the Congress. Further, EPA officials told GAO that it will be difficult to determine the need for and promulgate additional emission standards within 5 years.

Principal Findings

Bioaccumulation Levels Monitored and Some Impacts Identified

Hundreds of toxic substances have been identified in the Great Lakes, and research there has associated the bioaccumulation of dichlorodiphenyl-trichloroethane (DDT) and other chemicals with adverse impacts on fish, birds, and other wildlife. These impacts include population declines, impaired reproduction, tumors, and other behavioral and physiological problems. Data on human health impacts are limited, but Great Lakes states have found it necessary to warn the public of significant health risks associated with eating some species of fish caught in contaminated areas. Moreover, although widespread bioaccumulation problems have not been identified in coastal waters, problems have occurred in some locations, and coastal states have also had to warn the public about fish consumption.

Although research has identified bioaccumulation problems in some areas, national data indicate that certain toxic levels have decreased

overall after control measures have been imposed. Federal environmental monitoring efforts conducted in 47 metropolitan areas by EPA to determine human bioaccumulation and by the U.S. Fish and Wildlife Service at more than 100 sites to determine toxic levels in fish and birds indicate that the levels of PCBs, DDT, and some other harmful toxics have stabilized or are decreasing. High toxic levels persist in some areas, however, and researchers believe other toxics that may bioaccumulate have not yet been identified and/or monitored. Additional measurement of bioaccumulation and its environmental effects is planned as part of new or expanded monitoring programs to be conducted by EPA and other agencies.

Data on Air Deposition Are Limited

Research indicates that air deposition may contribute significantly to bioaccumulation. For example, atmospheric experts estimate that air deposition of lead and PCBs accounts for 90 percent or more of those toxic compounds entering Lake Superior. Some researchers also consider air deposition to be responsible for a significant share of other toxic pollutants entering the Great Lakes and Chesapeake Bay. Further, some researchers believe that harmful toxics, such as the pesticides toxaphene and DDT, were transported hundreds of miles in the atmosphere before being deposited in the Great Lakes.

Although air deposition of most toxic chemicals has not been measured, EPA has monitored certain toxic compounds since 1988 as part of a project in Green Bay, a part of the Great Lakes system. The purpose of the project is to quantify atmospheric deposition, compare its volume to other sources of toxic pollution, and develop a model for estimating the amounts of toxic substances that enter a body of water from the various sources. EPA has also begun to measure deposition in the Chesapeake Bay; plans additional monitoring in the Great Lakes, as required by the 1990 amendments; and is planning a monitoring effort in coastal waters. Nevertheless, completion of monitoring activities is not expected for several years, and the results are uncertain since techniques for measuring air deposition are still unproven.

EPA Needs to Focus Data-Gathering Efforts

To develop information for a report to the Congress, EPA intends to rely primarily on ongoing or planned efforts being conducted by a number of agencies and EPA offices. However, according to EPA officials, determining deposition levels and environmental effects will be difficult in view of data limitations. There is little information on toxic air deposition levels, for example, and its development is uncertain and may take

considerable time. Even if the information were available for a congressional report in 3 years, it is uncertain whether EPA could determine the need for and complete regulatory action in 5 years, as required by the amendments.

Officials of EPA's Office of Air Quality Planning and Standards, which has overall responsibility for responding to the amendments' air deposition requirements, informed GAO that their office will not complete its planning for accomplishing the reporting and other objectives until November 1991. In GAO's opinion, it would be helpful if EPA completed its planning as soon as possible in order to determine what can be accomplished.

Recommendations

If EPA's planning efforts show that EPA cannot fully achieve the 1990 Clean Air Act Amendments' requirements within the required time frames, GAO recommends that the Administrator, EPA, inform the Congress of any anticipated delays and/or problems and suggest possible remedies.

Agency Comments

GAO discussed the information contained in this report with EPA officials, who generally agreed with the facts presented. Their comments have been included where appropriate. However, as requested, GAO did not seek official agency comments on this report.

Contents

Abbreviations

DDT	dichlorodiphenyl-trichloroethane
EMAP	Environmental Monitoring Assessment Program
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FWS	Fish and Wildlife Service
GAO	General Accounting Office
GLNPO	Great Lakes National Program Office
NOAA	National Oceanic and Atmospheric Administration
OAQPS	Office of Air Quality Planning and Standards
PAHs	polycyclic and polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls

Introduction

Over 60,000 chemicals are in commerce in the United States, and approximately 1,000 new chemicals are introduced annually. Although these chemicals have many beneficial uses, some can be toxic to living organisms, including humans. Substances such as polychlorinated biphenyls (PCBs), dioxin, mercury, and others have been associated with adverse health impacts such as reproductive failure, birth defects, or cancer.[1] Despite the known environmental risks, many of these chemicals are released into the environment through the use of pesticides, industrial processes, and combustion of fossil fuels. Moreover, although the amount of toxic air emissions from all sources is unknown, it is significant. For example, American industry reported that 2.4 billion pounds of 322 toxic chemicals were released into the atmosphere in 1988.

Concerns Over Bioaccumulation

The release of toxic chemicals presents a risk to public health and the environment; however, this risk may increase as toxic chemicals accumulate in living tissue—a process referred to as "bioaccumulation." Generally, toxic chemicals that bioaccumulate meet two criteria: (1) they are persistent and do not quickly break down into less harmful substances and (2) they are fat soluble and are therefore easily absorbed and stored in the tissues of living organisms. The bioaccumulative chemicals that an organism consumes or absorbs throughout its lifetime tend to be retained in the tissue of that organism. The amount that bioaccumulates in an individual organism depends on many factors, including the amount of food consumed, the concentration of the chemical in the food, and the length of the organism's life.

The bioaccumulation of toxic substances can be greatly magnified in organisms that are higher up the food chain because the chemicals absorbed by species at lower levels are transferred to other organisms that prey upon them. Consequently, predator species at the end of the food chain—particularly the oldest and largest animals—can accumulate high concentrations of toxic chemicals and can be adversely affected. For example, the bioaccumulation of dichlorodiphenyltrichloroethane (DDT)—a persistent pesticide banned in 1972—was linked to reproductive failure in predatory birds, such as the bald eagle and peregrine falcon. More recently, such unacceptably high concentrations of toxic substances have been found in various species of fish

[1]The glossary briefly describes these chemical substances and others that are discussed later in the report.

throughout the country that 26 states have issued over 2,000 fish-consumption advisories from 1984 to 1987 to inform people of health risks associated with eating contaminated fish.[2]

The Great Lakes, coastal estuaries, and other bodies of water are the areas most susceptible to bioaccumulation problems. Water bodies have been found to act as sinks for toxic substances that may enter them from industrial and municipal discharges, agricultural and urban runoff, underground water migration, or air deposition. After entering the water, substances may settle in the sediments or remain suspended and, if bioaccumulative, can be taken up and magnified through the food chain.

Further, lakes and other water bodies have relatively long food chains through which toxic concentrations can increase to very high levels. For example, the concentration of DDT can increase from .01 in plankton, an organism near the bottom of the Great Lakes food chain, to 6.3 in herring gulls, which prey on fish, a 630-fold increase. Other chemicals may bioaccumulate to even higher levels—thousands of times their concentration in the surrounding water.

Air Deposition of Toxic Chemicals

Toxic substances that bioaccumulate may be released into the environment from a variety of sources. Although some toxics, such as mercury, may be emitted from natural sources, toxic substances entering the water are generally believed to have come from point sources, such as factories and refineries, and from nonpoint sources, such as urban runoff, farming activities, and the air. To reduce the threat to human health and the environment from such releases, controls have been placed on point sources to limit the discharge of toxic substances directly to the water, and efforts have been made to reduce toxic pollution from urban runoff and farming activities.

The amount of toxic air emissions from all sources is unknown, but in response to section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, EPA collects data from industry on air emissions and other releases to the environment for 322 toxic chemicals. For 1988, industry reported total releases of 4.5 billion pounds of these

[2]Advisories issued by states are based on the concentration of contaminants found in fish tissue as compared to state or federal standards. Generally, states consider issuing advisories when contaminant levels found in fish exceed tolerance or action levels established by the Food and Drug Administration (FDA) and EPA. Ten action levels, primarily for pesticide residues, and one tolerance level for PCBs have been established.

chemicals directly to either air, water, land, or underground wells, including 2.4 billion pounds emitted to air. Actual industrial toxic releases are probably larger since EPA acknowledges it does not report on all toxic chemicals of concern.[3] Further, reporting requirements cover manufacturing industries and do not include other businesses, such as warehouses, photographic processing plants, dry cleaners, and mining operations that may also be substantial sources.

Recently, concerns have arisen about the air deposition of toxic chemicals and its contribution to the bioaccumulation problem. EPA, which is responsible for protecting public health and the environment from toxic pollution, has acknowledged that air deposition is an important source of toxic pollutants to the Great Lakes and, although little is known about it, it may also be an important source of pollution in some coastal waters. Moreover, the Science Advisory Board, a public advisory group that provides scientific information and advice to EPA, has identified air deposition of pollutants to surface waters as a high-ranking problem with significant impacts on the health of existing ecosystems.

In November 1990, the Congress passed the Clean Air Act Amendments of 1990 that, in part, direct EPA to address these air deposition concerns. The amendments require that EPA, by the year 2000, establish emission standards to reduce the industrial emissions of 189 toxic air pollutants considered to be among the most harmful to humans and the environment. Further, the amendments require EPA to identify and assess the atmospheric deposition of those pollutants and others (at the Administrator's discretion) to the Great Lakes, Chesapeake Bay, Lake Champlain, and coastal waters. EPA is required to evaluate any adverse effects to public health and the environment, including bioaccumulation; issue a report to the Congress on the air deposition of toxic substances in these water bodies within 3 years; and, if necessary, promulgate further emission standards or control measures to prevent such harmful effects within 5 years.

EPA's Office of Air Quality Planning and Standards (OAQPS), which is part of the agency's Office of Air and Radiation, has the lead responsibility for preparing the required report and promulgating the standards and

[3]Neither EPA, nor the Congress, nor the scientific community has ever created a universally accepted list of toxic chemicals. According to EPA, it is difficult to define a toxic chemical because toxic effects depend not only on the intrinsic properties of a chemical, but also on the conditions in which the environment or people are exposed to it. The Congress created the national reporting list from lists previously developed for similar reporting laws in the states of New Jersey and Maryland, and this list is subject to revision by EPA.

controls that may be needed. However, other agencies and EPA offices also have significant roles. The amendments specify, for example, that EPA's assessment be done in cooperation with the Under Secretary of Commerce responsible for the National Oceanic and Atmospheric Administration (NOAA), which monitors toxic levels in coastal waters. Other EPA offices will help develop the data needed for the air deposition study. These offices include the Office of Research and Development, which is helping to plan and develop EPA's toxic air monitoring capability, and its field laboratories, which are involved in researching air deposition and its environmental impacts. EPA's Great Lakes National Program Office (GLNPO) and Chesapeake Bay Program will also have important roles in assessing air deposition and its impact on the bodies of water with which they are identified.

Other state and federal agencies are developing information that may be useful in assessing air deposition and its effects on health and the environment. For example, Wisconsin and Michigan are participating in an important EPA-sponsored study of toxic pollution sources, including air deposition, to Green Bay, which borders the two states. Three federal agencies collect data on bioaccumulation: (1) the Department of Commerce's NOAA monitors toxic levels in coastal waters and is studying its impact on fish and other marine species, (2) the Department of the Interior's U.S. Fish and Wildlife Service (FWS) monitors the levels of certain pesticides and other toxics in fish and birds, and (3) EPA's Office of Toxic Substances conducts a national program to measure the levels of some pesticides and other toxic substances in humans.

Objectives, Scope, and Methodology

In a February 21, 1990, letter, the Chairman, Subcommittee on Health and the Environment, Committee on Energy and Commerce, asked us to provide information on toxic bioaccumulation resulting from air deposition, among other things. In meetings with the Chairman's office, we subsequently agreed to report on (1) bioaccumulation and the problems resulting from the bioaccumulation of toxic chemicals in the environment, (2) the extent to which the air deposition of toxics contributes to these problems, and (3) EPA's plans for responding to the 1990 Clean Air Act Amendments' requirements for a report and regulations on air deposition to surface waters. We also agreed to obtain information on bioaccumulation and air deposition primarily for the Great Lakes, Chesapeake Bay, and San Francisco Bay.

To address the first two objectives, we discussed toxic bioaccumulation and air deposition issues with officials from EPA's Office of Toxic Substances in Washington, D.C., and from OAQPS and the Atmospheric Research and Exposure Assessment Laboratory, both located in Research Triangle Park, North Carolina. For more specific information on the Great Lakes, we interviewed officials at GLNPO in Chicago, Illinois, and officials from NOAA's Great Lakes Environmental Research Laboratory, from FWS' National Fisheries Research Center, and from the Great Lakes Fishery Commission—all located in Ann Arbor, Michigan. To obtain information on conditions in the Chesapeake Bay, we interviewed officials in the Chesapeake Bay Program in Annapolis, Maryland; the University of Maryland's Chesapeake Bay Biological Laboratory in Solomons, Maryland; and the College of William and Mary's Virginia Institute of Marine Sciences in Gloucester Point, Virginia. Finally, to obtain information on San Francisco Bay, we interviewed officials involved in the San Francisco Estuary Project in Oakland, California, and from the Aquatic Habitat Institute in Richmond, California.

We reviewed data from nationwide monitoring programs on the levels of toxic substances in the tissues of various animal species. We reviewed data on shellfish from NOAA's Office of Oceanography and Marine Assessment and information on fish and birds from FWS' Division of Environmental Contaminants. In addition, we reviewed data on toxic levels in human tissues from EPA's Office of Toxic Substances, which conducts human adipose tissue surveys.

We also reviewed reports and other information provided by representatives of various environmental groups. These included the Conservation Foundation's 1990 report, Great Lakes, Great Legacy?, the Sierra Club's May 1988 report, Sweet Water Bitter Rain, and a July 1989 National Wildlife Federation report addressing the health risks of eating fish caught in Lake Michigan. We also reviewed data from NOAA on fish-consumption advisories issued by states to warn of high toxic levels in finfish, and we discussed such advisories with officials from California, Maryland, and Virginia. Finally, we reviewed the results of selected scientific studies of bioaccumulation in the three regions on which we focused, as well as in the Arctic, where bioaccumulation caused by pollution imported from other regions is now being identified.

To examine the extent to which air deposition contributes to bioaccumulation, we discussed with EPA officials from the Great Lakes and Chesapeake Bay program offices the activities that are being conducted currently or are planned to assess the air deposition of toxic substances

in their regions and reviewed related reports and other data they provided. We also reviewed International Joint Commission reports on air deposition in the Great Lakes and Aquatic Habitat Institute reports on San Francisco Bay pollution sources, including air deposition.

To determine EPA's approach for meeting the amendments' requirements for reporting on and regulating the air deposition of toxics, we spoke with officials from OAQPS. We discussed with them the methodology EPA intends to use to obtain necessary data, the activities needed to complete these efforts and the schedule anticipated for these activities, and the resources to be dedicated to these efforts.

We reviewed the facts in this report with EPA officials, who generally agreed with their accuracy, and we incorporated the officials' comments where appropriate. However, as requested, we did not obtain official agency comments from EPA on this report. We conducted our review from June 1990 through January 1991 in accordance with generally accepted government auditing standards.

Data on Toxic Air Deposition Are Limited

Toxic substances from various sources have accumulated with serious consequences in fish, birds, and other species. The most widespread effects have been documented in the Great Lakes, where the accumulation of DDT and other toxic substances has been associated with impacts on wildlife, including the development of tumors, population declines, and birth deformities. The accumulation of these toxics is also considered a threat to human health. Although the levels of some toxic substances have decreased nationwide with the imposition of regulatory controls, these same toxics are persisting at high levels in some areas and other substances that may bioaccumulate are not being monitored.

Although it is known that toxic substances may be deposited from the air, limited data are available on the contribution of air deposition to toxic pollution and bioaccumulation because little monitoring has been done. EPA recently began to monitor deposition, but much that is known about it is based on earlier research in which sediments were analyzed to identify the toxics that entered the water and the sources of these toxics. Nevertheless, evidence indicates that toxic substances are transported great distances through the atmosphere and contribute significantly to Great Lakes pollution.

Toxic Bioaccumulation and Its Adverse Effects

The accumulation of chemical compounds in humans and other species is well documented in nationwide monitoring programs conducted by EPA and other federal agencies. It is further known that toxic substances enter bodies of water from several sources. In the Great Lakes, these substances have concentrated in and adversely affected some fish and wildlife species and are also considered a threat to human health. Coastal waters are affected by bioaccumulation, too, but widespread impacts have not been identified.

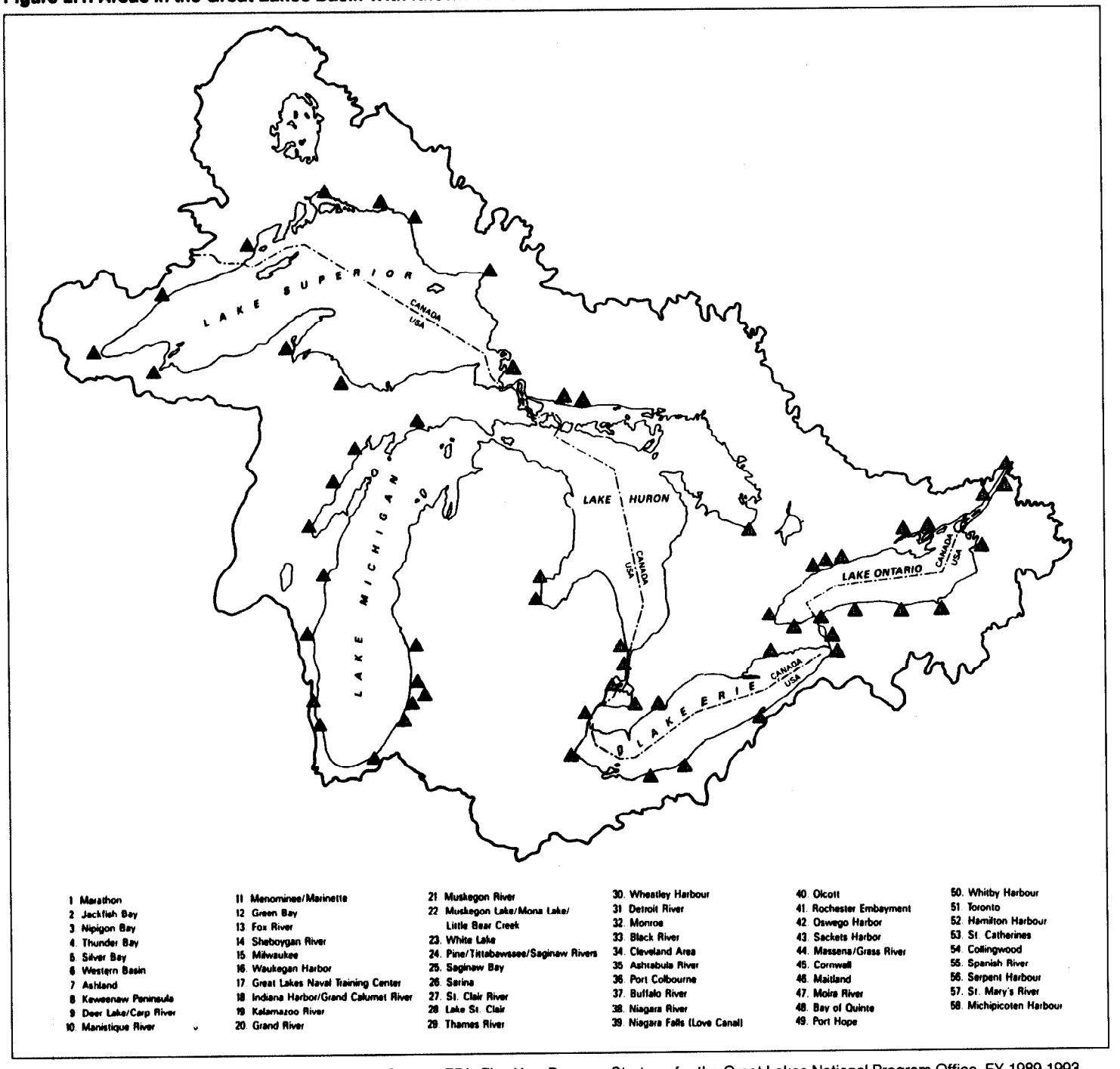
The Great Lakes

Perhaps no area in the country has been as severely affected by toxic pollution and bioaccumulation as the Great Lakes, which contain about 20 percent of the world's fresh water. In part, this condition has arisen because the two upper lakes, Superior and Michigan, require, on average, 100 years or more to fully renew their water. Thus, concentrations of contaminants in the water can remain fairly constant over a long period. Even though the lower lakes have shorter retention times, their water is supplied by the upper lakes, and so they can inherit persistent water quality problems.

Many lake areas have become contaminated with toxics, and many different chemicals contribute to the problem. An EPA report lists 42 "areas of concern" identified by the International Joint Commission within the Great Lakes Basin that do not meet the water quality objectives established in the Great Lakes Water Quality Agreement between the United States and Canada and that cause, or are likely to cause, impairment of beneficial uses identified in that agreement.[1] In 41 of these 42 areas, the Commission has found problems with toxics in the water or in sediments. EPA also has some indications that 17 other areas have toxic pollution concentrations, primarily in sediments. Figure 2.1 shows the 58 areas (41 areas of concern and 17 other areas) with toxic pollution problems.

[1]The International Joint Commission, a permanent binational agency organized to prevent and resolve disputes concerned with the waters along the border between Canada and the United States, is responsible for evaluating progress in implementing the agreement. The agreement identifies several conditions as impairing beneficial uses of the waters, including the degradation of fish and wildlife populations.

Figure 2.1: Areas in the Great Lakes Basin With Known Toxic Pollutant Problems



Source: EPA, Five Year Program Strategy for the Great Lakes National Program Office, FY 1989-1993 (Dec. 1988).

Further, a February 1990 list developed by a binational committee to the Commission identified over 170 substances believed to be present within the water, sediment and aquatic biota (animal and plant life) that, either alone or in combination with other substances, would have acute or chronic toxic effects on aquatic, animal, or human life.[2]

Research in the Great Lakes has associated bioaccumulation of toxic substances with harmful effects on wildlife and, potentially, on humans. According to a 1989 International Joint Commission contractor's report summarizing scientific literature and other information on contamination, toxic chemicals introduced into the Great Lakes environment have affected 17 wildlife species. Some of the effects on these species are summarized below.

- Top predator species in several areas, often birds that prey on lake fish, have exhibited reproductive problems or population declines since the 1950s. Researchers found relatively high concentrations of organochlorine compounds, pesticides, and industrial chemicals in the predator species' tissue and eggs. Recent long-term trend data show that concentrations of selected organochlorine compounds and pesticides have decreased over time, but the reproductive problems of fish-eating birds still occur at specific sites where pollution persists.
- Researchers have identified cancer as a bioaccumulative effect only in fish. In addition, researchers have identified readily visible birth defects and more subtle health effects in other species. These more subtle effects included metabolic, hormonal, and target organ changes manifested by wasting (a loss in body weight and body-organ weight ratio changes), abnormal development, immune suppression, and behavioral changes. Except for behavioral changes, these effects were not generally found in adult animals but were related to their offspring whose compromised health and increased attrition appears to have undermined the exposed wildlife populations.

The report also addressed the effects of these toxic levels on human health. It noted that although information on health impacts is limited, there is no indication that the health of human adults living in the Great Lakes Basin is being compromised. However, according to the report, several studies have identified subtle health effects on the offspring of parents who were exposed to lake resources. One study of women who

[2]The committee has identified hundreds of additional chemicals that are either (1) known to be in the system with the potential to cause toxic effects or (2) known to cause toxic effects but have not yet been found in the system even though they are thought to be discharged.

ate Lake Michigan fish indicated that the women's lifetime fish consumption affected their gestation period as well as their infants' birth weights, subsequent cognitive motor skills, and behavioral development. The report drew parallels between the human and wildlife populations: (1) both humans and wildlife predators are exposed to and accumulate the same toxic substances, (2) cancer does not appear to be a major factor in either, and (3) health effects appear to be manifested in the offspring of both rather than in adults.

On the basis of evidence indicating significant toxic impacts on wildlife and on the offspring of human mothers in the Great Lakes area, the International Joint Commission reported in 1990 that the health of children was threatened as a result of human exposure to persistent toxic substances in the Great Lakes, even at very low levels in the water. The Commission concluded that sufficient data existed to warrant actions to prevent the continued manufacture of, and human exposure to, persistent toxic substances and to promote cleanup of contaminated areas.[3]

To limit human exposure to toxic substances, all of the Great Lakes states have found it necessary to warn the public of the health risks associated with eating certain fish species with high toxic levels. Such fish-consumption advisories were issued in 39 of the 42 Great Lakes areas where beneficial uses are impaired, and similar warnings also were issued for smaller inland lakes. The advisories are based on a few toxic pollutants, such as mercury and DDT, whose levels exceed federal standards that are designed to protect human health. The advisories vary from simple recommendations to avoid eating fish from certain areas to recommendations on amounts that can be safely eaten by different segments of the population, including those at higher risk. For example, the advisories may recommend lower consumption levels for nursing mothers, pregnant women, women who intend to have children, and young children.

Nevertheless, one organization is concerned that the consumption rates suggested in the advisories are too high. The National Wildlife Federation recommends that people restrict their consumption of Lake Michigan sport fish, such as lake trout and coho salmon, even more than is currently recommended by public health agencies. The Federation's Lake Michigan Sport Fish Consumption Advisory Project evaluated the

[3]In a July 1990 report, Water Pollution: Improved Coordination Needed to Clean Up the Great Lakes (GAO/RCED-90-197), we discussed the problem of toxic pollution in the Great Lakes and reported that although firm cost estimates are not available, indications are that the total clean up will cost billions.

threat posed by the consumption of Lake Michigan fish and concluded that the problem of toxic pollution is more serious than previously reported. The Federation's 1989 report on its evaluation states that eating only 11 meals of lake trout (from fish 30 inches or longer) in a lifetime is associated with a 1-in-10,000 risk of cancer.

Coastal Waters

Bioaccumulation also occurs in coastal waters, but the effects found so far have not been as widespread as those in the Great Lakes. According to a NOAA official, this difference may exist because (1) the tides and currents in most coastal waters are generally more effective than lake currents in removing toxic substances, (2) many marine species in coastal waters are migratory and therefore have less exposure to the toxic substances in any one area and (3), in relation to their size, there is a greater concentration of pollution sources around the Great Lakes than around coastal waters.

Nevertheless, toxic levels in coastal waters are being monitored nationally to identify trends and assess the effects of human activities on water quality. Since 1984 NOAA has measured the concentrations of toxic organic compounds and trace metals in bottom-feeding fish, shellfish and sediments at almost 300 locations throughout the United States. In October 1990, NOAA reported, on the basis of results obtained from 6 years of monitoring, that high and biologically significant concentrations appear to be limited primarily to urbanized estuaries and that contaminant levels, in general, have begun to decrease.

The Chief of NOAA's Ocean Assessments Division told us that his office has compared toxic levels from its samples with FDA health standards and has found no violations of these standards. Consequently, he stated, NOAA's monitoring does not currently indicate widespread problems with toxic bioaccumulation in coastal waters. However, because the monitoring program is designed to describe national rather than local contamination distribution, NOAA selects sites representative of large coastal areas and avoids small-scale patches or "hot-spots" of contamination. Therefore, he said that the program probably would not identify those areas in coastal waters with adverse impacts from high levels of toxics.

State and local officials, however, indicated that toxic levels are elevated in certain areas, resulting in adverse impacts or potential impacts such as the following.

- Areas in the Chesapeake Bay near Baltimore, Maryland, and Norfolk, Virginia, have high levels of toxic substances, such as chlordane and metals. A Maryland official told us that chlordane levels exceeded FDA's action level and the state issued advisories against consuming certain bottom-dwelling fish in the Baltimore harbor area. Similarly, a Virginia official reported that there was a ban on taking shellfish from the Elizabeth River near Norfolk because they were contaminated with metals.
- State and local officials told us that they are concerned about toxic levels in the San Francisco Bay. Two toxic substances, mercury and selenium, present at elevated levels in the bay, have accumulated in fish and ducks to the extent that the state has issued warnings about their consumption. State officials also are concerned about the levels of other toxic substances in the tributaries and some areas of the bay, but they said that research on this issue has been limited. Consequently, little evidence currently links toxics to adverse effects on fish or other beneficial uses in these areas.

Monitoring Data on Air Deposition as a Source of Toxic Contamination Are Limited

Air deposition may be a major environmental pathway for the transport of toxic chemicals to surface waters. Research in the Great Lakes indicates that significant amounts of some toxics are deposited in the water from the atmosphere and, in some cases, have been carried there from distant locations. However, air deposition generally has not been monitored, and data indicating the extent of the problem are limited.

Research Indicates Toxic Air Deposition Is Widespread

The toxic substances that enter the Great Lakes and coastal waters and cause bioaccumulation problems come from many sources. Toxics enter the water from municipal and industrial discharges and from various non-point sources, including run-off from the land, underground water migration, and atmospheric deposition. Past efforts to improve water quality have focused on identifying and controlling pollution from point sources, however, and relatively little monitoring has been done to determine the extent of atmospheric deposition of toxic substances to surface waters.

Nevertheless, available research indicates that toxic substances travel great distances in the atmosphere before being deposited and accumulated in different species. Scientists believe that toxic substances originating in other countries have entered the Great Lakes and that even the pristine environment of the Arctic has been contaminated by

airborne toxics. The results of some research efforts are summarized below.

- Toxaphene, a now-banned pesticide used almost exclusively in the southern United States, has been found in the waters and fish of the Great Lakes. Scientists generally believe that toxaphene was carried to the Great Lakes by air and deposited.
- DDT, a pesticide whose use was banned in the United States in 1972, has since entered Siskiwit Lake, a small lake located on a remote island in Lake Superior. Siskiwit Lake is physically isolated from Lake Superior and is in a national park. Some researchers believe that air deposition of DDT was the source of this contamination. The most likely points of origin are Mexico and Central America where DDT is still used.
- Scientists believe that a large number of toxic chemicals reach the Arctic by means of long-range atmospheric transport from North America, Central Europe, and the Soviet Union, and they are increasingly concerned about the impact of these substances. In the Canadian Arctic, for example, evidence is growing that residues of toxic metals and other toxic compounds are reaching unexpectedly high concentrations in marine mammals and fish.

Air deposition is considered to be a significant source of toxic contamination in the Great Lakes. On the basis of estimates, an environmental organization believes that air deposition is responsible for 20 to 25 percent, on average, of the toxic pollution entering the lakes. In 1986, an International Joint Commission-sponsored workshop of experts on atmospheric processes estimated that air deposition was a major, and sometimes the predominant, source of four toxic substances—lead, PCBs, DDT, and benzo(a)pyrene—entering the Great Lakes. Although the workshop participants acknowledged that there were uncertainties, they estimated the amounts of toxics entering each lake and the percentage contributed by air deposition compared to the total amounts from all sources. Table 2.1 shows the workshop's estimates for these four pollutants.

Table 2.1: Estimated Amounts of Four Toxic Substances Entering the Great Lakes Each Year From Air Deposition Compared to All Sources

Amounts in kilograms

Toxic substances and sources	Amounts entering the lakes[a]				
	Superior	Michigan	Huron	Erie	Ontario
Lead					
From air deposition	234,000	540,000	404,000	225,000	216,000
From all sources	241,000	543,000	430,000	567,000	426,000
Percent from the air	97	99	94	40	51
PCBs					
From air deposition	548	394	399	182	143
From all sources	606	685	636	2,520	2,540
Percent from the air	90	58	63	7	6
DDT					
From air deposition	90	64	65	33	26
From all sources	92	65	92	319	111
Percent from the air	98	98	71	10	23
Benzo(a)pyrene					
From air deposition	69	179	183	81	62
From all sources	72	208	290	122	155
Percent from the air	96	86	63	66	40

[a]Additional toxic pollution in Lake Huron, Lake Erie, and Lake Ontario occurs indirectly from air deposition into other lakes. For example, PCBs originally deposited into Lake Superior and Lake Michigan from the air are contained in the water flowing from those lakes into Lake Huron. It is estimated that such indirect deposition is responsible for an additional 15 percent of Lake Huron's PCB pollution.

Source: Estimates from 1986 International Joint Commission workshop.

Although precise data are not available, concerns exist about air deposition of toxics to estuaries and coastal waters, particularly the Chesapeake Bay. A 1988 study by the Environmental Defense Fund concluded that air deposition accounted for 25 percent of the nitrogen (a component of acid rain) derived from human activity that entered Chesapeake Bay. Because atmospheric nitrogen is derived from fossil fuel combustion, which also generates other toxic substances, some researchers are concerned that toxics entering the bay from air deposition may also be significant. A Chesapeake Bay Program official said that, although available data do not identify the amounts of toxics atmospherically deposited in the bay, air deposition is a serious concern.

Available Monitoring Data on Air Deposition Are Limited

Despite evidence that toxic substances travel great distances in the atmosphere and deposition is a serious concern, little monitoring of air deposition levels has taken place. In the Great Lakes, knowledge of deposition comes from analyzing sediment cores and, according to an environmental expert, much of the research there has focused on a few toxics—primarily DDT, toxaphene, PCBs, PAHs, and polychlorinated dioxins and furans. Sediment cores taken from the Great Lakes were analyzed to identify the presence and amounts of toxic substances, and the atmospheric contribution was determined through comparison with cores from nearby peat bogs or from lakes that are remote from pollution sources. For coastal waters, measured data on air deposition of toxic substances are even more limited.

Recently, however, EPA has started to monitor atmospheric deposition to surface waters. In 1988, EPA and the state of Wisconsin began measuring the air deposition of four toxic substances in Green Bay as part of a pilot project to determine the amount of toxic pollution entering the water from various sources—including ground water, runoff, and point source discharges, as well as air deposition. The project is designed to measure the amounts of the four substances—PCBs, dieldrin, cadmium and lead—that (1) enter the bay from the various sources, (2) are present in its sediment, water, and biota and (3) leave the bay. On the basis of the project's results, EPA plans to develop a model that can use data collected for the five Great Lakes to estimate how much toxic pollution enters each lake from each source.

Additionally, EPA has begun a monitoring project in the Chesapeake Bay. Initiated in mid-1990, this project established three monitoring stations in the bay to determine deposition levels of selected toxics to the bay. EPA expects to obtain final results from these monitoring stations by mid-1991.

Emission Controls Should Reduce Toxic Air Deposition and Bioaccumulation, but Concerns Remain

The 1990 Clean Air Act Amendments require EPA to establish emission standards to reduce the emissions of 189 toxic substances, including some substances that contribute to air deposition and bioaccumulate. For example, standards are required to reduce emissions of toxaphene and lead compounds, which have both been identified as contributing to air deposition in the Great Lakes. Moreover, even though EPA's experience in regulating toxic air emissions is limited,[4] evidence suggests that other regulatory actions have effectively reduced the levels of certain harmful pesticides and other toxic substances that are bioaccumulated in humans and other animal species.

EPA and FWS conduct nationwide monitoring programs to determine the levels of pesticides, PCBs, and other harmful toxics in humans and other species. EPA has monitored levels of these substances in the U.S. population since the early 1970s through its National Human Adipose Tissue Survey. This survey, conducted annually in 47 metropolitan statistical areas, examines toxic levels in adipose (fatty) tissue collected from cadavers and persons undergoing elective surgery. FWS has periodically monitored toxic levels in fish and birds since the mid-1960's at more than 100 sites through its National Contaminant Biomonitoring Program.

The results of these monitoring programs indicate that levels of substances now banned or closely controlled—such as DDT, PCBs, and other compounds—have decreased in the environment. For example, in August 1990, EPA reported that its most recent adipose tissue monitoring efforts have shown reductions in the levels of certain compounds, including DDT and PCBs, in human tissue. These reductions coincide with—and, according to EPA, are the result of—restrictions or bans on these compounds. FWS also reports declines in DDT, PCBs, and other pesticides in fish and birds nationally following the ban or severe restriction of these chemicals.

Although such trends indicate that the levels of some harmful toxic substances have decreased nationally, a number of serious concerns remain about toxics in the environment and their effects on the ecosystem. Some areas continue to experience elevated levels of banned toxics that have persisted in the environment long after use of the toxics was prohibited. Furthermore, other persistent contaminants that have not been

[4]The 1970 amendments to the Clean Air Act required EPA, under section 112, to promulgate national emission standards for hazardous air pollutants when the agency determined that a pollutant would result in increased mortality, serious irreversible illness, or incapacitating reversible illness. Since 1970, however, EPA has promulgated national standards for only 7 air toxics.

monitored and analyzed can be bioaccumulated and can adversely affect fish and wildlife.

Conclusions

Research indicates that toxic substances, including some that travel great distances in the atmosphere, enter the water from air deposition, but much of this information is derived from analysis of the toxics in sediments rather than from actual monitoring. Although data on air deposition levels are limited, there is evidence that air deposition can contribute significantly to toxics in water. These toxics can in turn bioaccumulate to much higher concentrations in fish and other species and are sometimes associated with serious adverse effects. To better understand the significance of the problem, the Congress established the requirement in the 1990 amendments that EPA further assess and report on toxic air deposition and its effects.

EPA Planning Efforts Raise Doubts About Fulfilling the Air Deposition Requirements of the Clean Air Act Amendments of 1990

The 1990 Clean Air Act Amendments require EPA to study toxic air deposition and its environmental impacts, report its findings to the Congress, and take actions to control harmful emissions if necessary. An initial report is required in 3 years, and necessary emission standards or control measures are to be promulgated within 5 years. To comply with these requirements, considerable data will have to be developed on air deposition and its effects.

EPA is planning how it will respond to the requirements but does not expect to complete its effort until late 1991. Further, OAQPS, the EPA office responsible for planning and reporting on air deposition, will rely extensively on data developed by other agencies and EPA offices, and OAQPS officials are concerned that the available data may not be sufficient to permit a full response within the established time frames.

Initial Steps to Implement Air Deposition Requirements

The Clean Air Act Amendments of 1990 require EPA to assess the extent of toxic air deposition and its environmental impacts. Specifically, the amendments require EPA, in cooperation with the Under Secretary of Commerce for Oceans and Atmosphere, to identify and assess the extent of toxic air deposition to the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters.[1] The amendments further require EPA, within 3 years and biennially thereafter, to submit reports on these waters to the Congress. At a minimum, these reports must include the following information:

- the contribution of atmospheric deposition to water pollution;
- the environmental and public health effects of any pollution attributable to atmospheric deposition;
- the source or sources of any pollution attributable to atmospheric deposition;
- a determination of whether pollutants cause or contribute to violations of federal drinking water or water quality standards, or the specific objectives of the Great Lakes Water Quality Agreement; and
- a description of any revisions of requirements, standards, or laws needed to protect human health and the environment.

[1] According to an OAQPS official, the role of the Department of Commerce in responding to the amendments' requirements has not been determined but is being discussed with officials of that agency.

As part of its report, EPA is also required to determine whether the amendments' hazardous air pollution provisions, which establish emissions standards for 189 toxic substances, are adequate to prevent serious adverse effects to the public health and serious or widespread environmental effects, including bioaccumulation. On the basis of the report, EPA is required within 5 years of the enactment of the 1990 amendments to promulgate further emission standards or control measures, if necessary, to prevent harmful effects.

In anticipation of the air deposition requirements, OAQPS convened a meeting in July 1990 for representatives of various EPA offices to discuss an implementation strategy. After the enactment of the 1990 amendments on November 15, 1990, OAQPS began planning how EPA will respond to the reporting and regulatory requirements. OAQPS does not expect to complete its planning until November 1991, at which time EPA also intends to complete a comprehensive plan for establishing monitoring networks for measuring air pollution. These networks, which will also measure toxic air deposition, are needed to comply with all of the 1990 amendments' requirements.

Although OAQPS has overall responsibility for responding to the air deposition requirements, its primary role is planning and coordination, and it will rely on others to collect the needed information. Several EPA offices will contribute to the deposition study, including the Office of Research and Development and its laboratories located throughout the country, GLNPO and other headquarters and field offices. OAQPS and GLNPO are working closely with the Office of Research and Development, which is helping to plan and develop EPA's toxic air monitoring capability and whose field laboratories are researching air deposition and its environmental impacts. GLNPO coordinates the activities of other EPA offices and helps to ensure that matters concerning the Great Lakes are considered in policy and program decisions; consequently, it plays an important role in the study of air deposition.

Although OAQPS has not yet completed its planning, it identified possible strategies for complying with the deposition requirements at its July 1990 planning meeting with officials from other EPA offices. In view of the many different federal offices and programs interested in air deposition and its environmental impacts, the officials concluded that a comprehensive review of available information and programs should be conducted for the purpose of integrating them into an overall strategy. Participants also discussed (1) the importance of using data from monitoring now in progress, (2) the possibility of narrowing the study's focus

to a more manageable number from the 191 toxic pollutants that were considered for emission standards in the 1990 amendments,[2] (3) the need to contact a number of other interested agencies and organizations, and (4) the feasibility of obtaining the data needed to report on and regulate toxic substances within required time frames.

EPA Intends to Use Existing Efforts to Assess Air Deposition and Its Effects

Although its planning is not complete, EPA clearly recognizes that it will have to rely on efforts to measure air deposition and the environmental impacts of toxic pollution that were already planned or underway when the 1990 amendments were enacted. These include efforts in the Great Lakes and other areas to be carried out by various EPA offices, NOAA, and FWS. However, while these efforts may eventually provide useful information on the extent of toxic air deposition and its impacts on the environment, including bioaccumulation, such information will probably not be available for several years. This situation raises serious concern about whether adequate data will be available for the initial report to the Congress in 3 years and whether EPA will be in a position to complete regulatory actions within 5 years, as required by the amendments.

Measurement of Air Deposition

EPA was planning monitoring networks for measuring toxic air deposition in both the Great Lakes and in coastal waters before the enactment of the 1990 amendments and has begun measuring some toxics as part of a pilot project in Green Bay, a part of the Great Lakes system. These networks will consist of a number of sites where monitoring equipment is placed to collect air and precipitation samples for measuring toxic air deposition levels.

The air monitoring station established in Green Bay as part of EPA's effort to identify the sources of toxic water pollution (see ch. 2) is the first in the planned Great Lakes toxic monitoring network. A Great Lakes network is required under agreement between the United States and Canada. EPA, which is responsible for implementing the U.S. segment of the joint Canadian-American network, plans to phase in monitoring sites so that a complete network, consisting of a master and several satellite stations on each lake, will be implemented by December 1995. The 1990 amendments, however, require that at least one monitoring facility be established on each lake by December 31, 1991. A

[2]Although 191 toxics were considered in the proposed legislation, the Clean Air Act Amendments of 1990 require EPA to establish emission standards for 189 toxics.

GLNPO official told us that EPA was currently determining a monitoring configuration that would comply with that requirement.

EPA is also developing a plan for monitoring toxic air deposition in coastal waters, but that planning effort is not completed and will rely on the experience gained in the Great Lakes. The draft plan indicates that a 10-year monitoring effort may be needed. Because methods for measuring air deposition are still being developed, the results of both the Great Lakes and coastal water efforts are uncertain. In its March 1990 plan for implementing the Great Lakes network, a joint Canadian-U.S. coordinating committee acknowledged the need for more research and better understanding of the atmospheric pathways and consequences of toxic air deposition. The plan stated that evidence is required to establish whether any toxic substance can routinely be monitored in air and precipitation samples. It also acknowledged that there are several toxic substances—including toxaphene, dioxins, furans, and certain types of PCBs—for which a measurement methodology either does not exist or needs considerable improvement. The initial phase of the planned network will include efforts to overcome these problems, to determine the monitoring equipment to be used, and to establish quality control procedures.

Determining Toxic Impacts

When the 1990 amendments were enacted, EPA and other federal agencies already had efforts under way or were planning new efforts to determine the environmental impacts of toxic pollution from all sources. NOAA was monitoring toxic concentrations and assessing their impacts on fish and biota in selected coastal waters, and FWS was planning to expand its monitoring program to include additional toxic substances. However, EPA was planning the most extensive environmental monitoring program.

NOAA has several studies under way to assess the biological consequences of contamination. Study areas, selected on the basis of contamination levels, include Boston Harbor, the Hudson/Raritan Estuary, Long Island Sound, Tampa Bay, San Francisco Bay, and coastal waters off southern California (Santa Monica, San Pedro, and San Diego). The studies are measuring (1) reproductive impairment, genetic damage to blood cells, and the prevalence of disease in fish; (2) the abundance and variety of bottom-dwelling species; and (3) toxicity in sediment and water. According to a NOAA official, the first study results, a report on San Francisco Bay, will be published in early 1991. NOAA believes the

results of the studies in the areas selected will show a variety of biological responses in different species to toxic contamination.

In response to concerns about inadequate data on the status of the environment, EPA is planning to establish an Environmental Monitoring Assessment Program (EMAP), which should provide information for determining toxic impacts on ecosystems. Under this program, EPA intends to develop indicators for measuring the health of an ecosystem and the likely cause of adverse changes. For example, limited diversity in an ecosystem's fish communities might indicate the presence of toxics in sediments or the bioaccumulation of toxics.

To obtain the data it needs for EMAP, EPA is considering doing field sampling at 3,000 sites across the country. The agency believes that simultaneous monitoring of pollutants and environmental changes at the sites will allow it to identify the likely causes of adverse changes in the nation's ecosystems. As currently designed, EMAP should provide considerable information on environmental conditions, but it is still being planned and will not be fully implemented until 1995.

Achieving the Amendments' Toxic Air Deposition Goals Is Uncertain

EPA officials expressed several concerns about the agency's ability to comply with the 1990 amendments' air deposition requirements. These concerns stem from the breadth and complexity of the toxic air deposition issue, the limited data currently available on deposition amounts and impacts, and the difficulty of developing the required information quickly enough to meet legislative time frames for reporting on air deposition and controlling toxic emissions.

OAQPS officials stated that it is questionable whether EPA can gather the data needed for a comprehensive report to the Congress in 3 years. They cited the following difficulties.

- Existing data on deposition and its effects are not sufficient to address the amendments' study requirements. For example, initial deposition monitoring of four toxic substances is being done in a Green Bay pilot project, but data will be needed on many other toxic substances throughout the Great Lakes and in coastal waters. Related information also will be needed on the effects of these substances on health and the environment. To prepare a comprehensive assessment, EPA will need the deposition and other information that will be gathered from the Great Lakes toxic monitoring network, EMAP, and other programs already

under way or planned. In the short term, these programs may not provide enough data to meet the amendments' requirements.

- Although OAQPS is responsible for planning and reporting, other agencies and EPA offices will develop the data for assessing air deposition and its effects. For example, GLNPO and the Office of Research and Development are working together to establish monitoring stations that will measure air deposition in the Great Lakes, and other agencies such as NOAA and FWS may provide information on environmental impacts, including bioaccumulation. Since OAQPS has no control over the funding and resources supporting these programs, it cannot ensure that these organizations conduct the activities it believes necessary to complete the study requirements.
- Given data limitations and time constraints, the initial report in 3 years may not provide as comprehensive and thorough an analysis of deposition and its impacts as later reports.

Even if adequate data are available for a comprehensive report in 3 years, officials told us that promulgating regulations to control toxic emissions within the 5-year time frame established in the 1990 amendments would be difficult. One difficulty is the length of the regulatory process—promulgating pollution control regulations has typically taken years. And more data will be needed to establish controls because the specific sources of the toxic emissions causing problems will have to be identified in order to be controlled. This identification will require the development of toxic emissions inventories and analysis of their atmospheric transport or another method of source identification. Finally, determining the need for additional controls within 5 years will be difficult because emission standards for all of the 189 toxic air pollutants and other pollution reduction measures required by the 1990 amendments will not be fully implemented and their effectiveness in reducing toxic pollution will not be known.

Conclusions

The Clean Air Act Amendments of 1990 establish requirements for an ambitious program for assessing and controlling the air deposition of toxic substances. The amendments direct EPA to determine the levels of toxics deposited by the air and their environmental impacts, initially report to the Congress within 3 years on the scope of the problem, and act to reduce harmful toxic emissions within 5 years of the amendments' enactment. To accomplish these objectives, the agency must quickly develop a sound strategy for obtaining information on the extent and impact of air deposition.

EPA's planning efforts, however, will not be completed until November 1991, just 2 years before the initial report on air deposition is due to the Congress. Moreover, OAQPS, which is primarily responsible for preparing the report and taking regulatory action, may not have adequate data for these purposes. OAQPS must rely on other agencies and EPA offices to develop the required data, whose nature and usefulness is uncertain. It is uncertain, for example, whether EPA's other offices will be able to develop adequate monitoring data on the extent of air deposition in time for the initial report. Monitoring techniques are unproven and data collection and analysis will take time. Further, even if adequate data are available in 3 years, EPA may not be able to complete regulatory action to control harmful emissions within 5 years. The agency may not be able to determine the effectiveness of emission standards in reducing toxic air pollution, since the time frame for implementing those standards extends beyond the deadline established for regulatory action to control air deposition.

Recommendations

If EPA's planning efforts show that EPA cannot fully achieve the 1990 Clean Air Act Amendments' requirements within the designated time frames, we recommend that the Administrator, EPA, inform the Congress of any anticipated delays and/or problems and suggest possible remedies.

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Glossary

Benzo(a)pyrene	One of the polynuclear aromatic hydrocarbons discussed below. Wood combustion is a significant source of this compound.
Cadmium	Compounds of this metal have various commercial uses, including metal finishing.
Chlordane	An insecticide and fumigant (for termites, etc.) whose use for most purposes was banned in the United States in 1978.
Dichlorodiphenyl-trichloroethane (DDT)	An organochlorine pesticide whose use for most purposes was banned in the United States in 1972.
Dieldrin	An organochlorine pesticide whose use was banned in the United States in 1974.
Dioxins and Furans (Polychlorinated)	Chlorinated dioxins and furans are commonly formed through organic chemical manufacturing, pesticide production, and various forms of combustion.
Lead	Lead emissions originate from modes of transportation and other sources.
Mercury	This metal occurs naturally in rocks and soil and can be emitted as a result of burning fossil fuels, including coal.
Mirex	An organochlorine compound, which has been used as a fire retardant and whose use as a pesticide has been phased out.
Organochlorine Compounds (or Chlorinated Hydrocarbons)	A range of compounds, including some pesticides, which often persist and tend to bioaccumulate.

Polychlorinated Biphenyls (PCBs)	Compounds whose largest application was in the electrical industry. Although domestic U.S. production was halted in 1977 and their use is controlled by federal regulation, PCBs are still present in transformers and capacitors.
Polycyclic and Polynuclear Aromatic Hydrocarbons (PAHs)	Compounds formed primarily through incomplete combustion of organic compounds. Sources of PAHs include fireplaces, industrial processes, and automobiles.
Selenium	A trace element that occurs both naturally and as a result of human activities, such as disposing of drainage water from agricultural fields.
Toxaphene	An organochlorine pesticide used primarily on cotton in the southern U.S.

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