

Chapter 1. Background and Methods

The Great Lakes Water Quality Agreement (GLWQA) was first signed by the United States and Canada in 1972 and renewed in 1978 and 1983. It commits the two nations to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem. The entire GLWQA, which includes general and specific objectives to achieve these goals, is available at <http://www.epa.gov/glnpo/glwqa/1978/annex.html#ANNEX%2012>.

The GLWQA objectives emphasize human health protection. For example, Annex 12, “Persistent Toxic Substances,” calls for the two countries to “establish action levels to protect human health based on multimedia exposure and on the interactive effects of toxic substances.” That same section suggests research on the “pathways, fate and effects of toxic substances aimed at the protection of human health . . .,” and in particular on research to determine “the significance of effects of persistent toxic substances on human health and aquatic life.” Similarly, Annex 2, Remedial Action Plans and Lake-wide Management Plans, proposes Lake-wide Management Plans for Critical Pollutants, including “a definition of the threat to human health or aquatic life posed by Critical Pollutants, singly or in synergistic or additive combinations with another substance. . .”

1.1. Geographic Focus

The geographic focus of this report is on “Areas of Concern” (AOC) defined by Annex 2 of the GLWQA as

a geographic area that fails to meet the General or Specific Objectives of the Agreement where such failure has caused, or is likely to cause impairment of beneficial use or of the area’s ability to support aquatic life.

The “impairment of beneficial use,” in turn, is defined as any of 14 possible changes in “the chemical, physical or biological integrity of the Great Lakes System.” These changes are

- Restrictions on fish and wildlife consumption,
- Tainting of fish and wildlife flavor,
- Degradation of fish and wildlife populations,
- Fish tumors or other deformities,
- Bird or animal deformities or reproduction problems,
- Degradation of benthos,
- Restrictions on dredging activities,
- Eutrophication or undesirable algae,
- Restrictions on drinking water, consumption, or taste and odor problems,
- Beach closings,
- Degradation of aesthetics,
- Added costs to agriculture or industry,
- Degradation of phytoplankton and zooplankton populations, and
- Loss of fish and wildlife habitat.

Figure 1. 1. United States and Binational Great Lakes Areas of Concern



The U. S. and Canadian governments have identified a total of 43 Great Lakes AOCs: 26 in the United States, 12 in Canada, and 5 shared on connecting river systems (binational AOCs). See <http://www.epa.gov/glnpo/aoc/>. This report provides data on the 26 U.S. AOCs defined by the U.S. EPA, organized geographically by lake from east to west, around the lake shorelines. Lake Ontario AOCs are discussed in Chapter 2, Lake Erie AOCs in Chapter 3, Lake Huron AOCs in Chapter 4, Lake Michigan AOCs in Chapter 5, and Lake Superior AOCs in Chapter 6. The map (Figure 1.1) shows the locations of the U.S. (and binational) AOCs. The binational AOCs are addressed in the Canadian report.¹

The locations and approximate boundaries of the AOCs are based on information provided by U.S. EPA at <http://www.epa.gov/glnpo/aoc/>.

¹ Elliot, SJ, Eyles J, DeLuca P. 2001. Mapping health in the Great Lakes Areas of Concern : a user-friendly tool for policy and decision makers. *Environ Health Perspect* 109(6):817–19.

1.2. Contaminant Focus

As defined by IJC, critical pollutants are chemicals that persist in the environment, bioaccumulate in fish and wildlife, and poison humans and animals. The IJC has identified critical pollutants as the focus for efforts to reduce pollutants in the Great Lakes. Because of their toxicity, the Great Lakes Binational Toxics Strategy identifies them as requiring immediate priority and targets them for virtual elimination (<http://www.epa.gov/bns/>). Table 1.2 lists these pollutants. This report includes relevant information on critical pollutants where that information is available from the existing data sources included in this report. We recognize that the IJC's interest is primarily focused on the 11 critical pollutants listed below. However, because this report will have a number of audiences in addition to the IJC, we have also provided information on other pollutants if it was available in the sources we have included.

Table 1.2. International Joint Commission (IJC) Great Lakes 11 Critical Pollutants

<i>IJC Tracking Number*</i>	<i>Critical Pollutant, Synonyms, Relevant Contaminants in TRI and NPDES</i>
1	PCBs (polychlorinated biphenyls), Aroclors
2	Dioxins, PCDDs (polychlorinated dibenzo-p-dioxins), TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), other polychlorinated dioxin congeners
3	Furans, PCDFs (polychlorinated dibenzofurans), TCDF (2,3,7,8-tetrachlorodibenzofuran), other polychlorinated dibenzofuran congeners
2 & 3	Dioxins and dioxin-like compounds
4	B(a)P [benzo(a)pyrene]; carcinogenic PAHs (polyaromatic hydrocarbons)
5	DDT (dichlorodiphenyltrichloroethane) and metabolites, p,p'- and o,p'-DDT, DDE
6	Aldrin/dieldrin
7	Mirex
8	Alkyl-lead, alkylated lead, tetraethyl lead, lead, lead compounds
9	Mercury, methyl mercury, mercury compounds
10	Toxaphene
11	Hexachlorobenzene

* ATSDR assigned these numbers to the pollutants to enable tracking of those TRI and NPDES records that provide data relevant to each pollutant. The number does not reflect priority.

1.3. Methods and Data

Among other things, the GLWQA calls on the two nations to define “the threat to human health from critical pollutants” found in the Great Lakes region. In its December 2001 request, the IJC asked ATSDR to review those health assessments it conducted on hazardous waste sites within AOCs on the United States side of the Great Lakes region. The IJC stated further that

It would be most helpful if ATSDR could identify evaluated sites within each AOC, the Hazard Category assigned to each site, any relevant demographic information available to ATSDR concerning the populations at risk, completed exposure pathways identified, and the priority substances following these pathways.

This request was more complex than it appeared. AOCs do not correlate well geographically with waste sites that ATSDR has evaluated. Some waste sites occupy small parts of an AOC while others may be only partly contained within the AOC. Sources of contamination may lie close to but not within an AOC while still contributing to environmental pollution within the AOC. Many sources of contamination exist that are not ATSDR-evaluated sites. Finally, many sites that have been evaluated by ATSDR have since been remediated and thus do not provide current information environmental contamination in the AOCs. Therefore, in assembling this report, ATSDR scientists considered whether additional data sources might be useful in answering the request. We surveyed many sources of data on environmental exposures and human health (see Appendix 3 for the environmental and health data that were considered).

At the core of the final report are the ATSDR site assessment/public health assessment data from hazardous waste sites in the AOCs or in counties that are in close proximity to AOCs. This report compiles previously published public health assessment documents for the 26 U.S. AOCs and for 54 counties in geographic proximity to those AOCs. We have updated those assessments with additional information from the U.S. EPA and other sources to reflect remediation efforts since the time of the initial assessment.

In addition, to provide a more complete and holistic picture of ongoing chemical inputs into the Great Lakes AOCs and add value to the final report, ATSDR provided examples of data from three other major U.S. EPA data sources, including U.S. EPA 2001 chemical release data from its Toxic Release Inventory (TRI), U.S. EPA 2004 data on pollutant discharges into water, from its National Pollutant Discharge Elimination System (NPDES), and data on “beneficial use impairments,” such as wildlife and drinking water advisories, from each of the Great Lakes states.

These data are presented in three ways: text, tables, and Geographic Information System-based (GIS) maps created by ATSDR for each of the 26 U.S. AOCs and the 54 AOC counties that lie within or in close proximity to the AOCs (the specific included counties are shown on the individual AOC maps).

We selected datasets to include in the report that we believed were responsive to the request, for which we were able to assure scientific quality, and which we could assess and summarize with the time and resources that were available for this project. The list is not all-inclusive. It does not include all datasets that we could conceivably have included (Appendix 3 provides a list of those that were considered) and also does not include recognized but less well-defined contamination sources such as atmospheric deposition and urban/agricultural runoff that are not well represented in currently available data sources. The datasets do, however, provide a somewhat more inclusive picture of chemical inputs into the Great Lakes region than would a report limited only to ATSDR-evaluated sites.

ATSDR site assessment data are complete as of this report’s release date. The specific year(s) in the databases are discussed in the description of each dataset. The specific databases included are discussed further in the sections that follow.

1.3.1. ATSDR Hazardous Waste Site Assessment Data

In 1980, Congress created ATSDR to implement the health-related sections of federal laws that protect the public from hazardous wastes and from releases of hazardous substances into the environment. The Comprehensive Environmental Response, Compensation, and Liability Act of

1980 (CERCLA), commonly known as the “Superfund” Act, includes a Congressional mandate to remove or to clean up abandoned and inactive hazardous waste sites and to provide federal assistance in responding to toxic releases (<http://www.atsdr.cdc.gov/congress.html>). As the lead agency for implementing CERCLA’s health-related provisions, ATSDR’s responsibilities include assessing the presence and nature of health hazards at Superfund sites; sometimes directly and sometimes by providing funds to states. ATSDR’s reports on hazardous waste sites therefore represent a valuable data source for potential exposure to pollutants.

Sites investigated by ATSDR include CERCLA (Superfund) sites, National Priorities List (NPL) sites (EPA’s list of the most serious CERCLA sites), and petitioned sites, where assessment activity begins as a result of a citizen or public official contacting ATSDR in writing to investigate a site or a sudden occurrence such as an explosion or spill. Specific and more complete definitions for CERCLA and NPL sites are provided in the Glossary of Terms in Appendix 1 of this report.

ATSDR investigations draw on available information from U.S. EPA and local governments. Such information can include physical features of the site, environmental sampling data, biota sampling data, health data, and community health concerns. ATSDR health assessors use comparison values such as ATSDR minimal risk levels (MRLs) and U.S. EPA reference doses (RfDs) to identify chemicals that might require further evaluation for their effect on human health under site-specific conditions. As part of their investigation, ATSDR health assessors identify points of exposure, concentrations of contaminants at exposure points, and potentially exposed populations. A completed exposure pathway must include all five of the following elements:

1. Contaminant source or release—examples include drums and landfills.
2. Environmental media and transport—this involves the movement of the contaminant through various media (i.e., air, soil, and water) and includes the degradation of the contaminant.
3. Exposure point. The specific location(s) where the population might come into contact with the contaminated media.
4. Exposure route. This includes the means by which contact is made by the population at the exposure point (e.g., inhalation, ingestion, or dermal contact).
5. Population potentially or actually exposed.

The confirmation of a completed exposure pathway does not necessarily mean the presence of a public health hazard. Specific conditions require examination (i.e., route of exposure and the magnitude, frequency, and duration of exposure) to evaluate the possible health implications resulting from exposures. ATSDR uses standard language to describe the level of hazard at sites (ATSDR public health assessment guidance manual 2005). These Hazard Categories are shown in Table 1. 3.

Table 1. 3. ATSDR Public Health Hazard Categories

<i>Hazard Category</i>	<i>Definition</i>
1. Urgent Public Health Hazard	Sites where short-term exposures (<1 year) to hazardous substances or conditions could result in adverse health effects requiring immediate action or intervention.
2. Public Health Hazard	Sites where long-term exposures (>1 year) to hazardous substances or conditions could result in adverse health effects requiring one or more public health interventions.
3. Indeterminate Public Health Hazard	Sites where a professional judgment on the level of health hazard cannot be made due to the lack of critical information about the extent of exposure or toxicologic properties at estimated exposure levels.
4. No Apparent Public Health Hazard	Sites where human exposure to contaminated media may be occurring, may have occurred in the past, or may occur in the future, but the exposure is not expected to cause adverse health effects.
5. No Public Health Hazard	Sites that because of the absence of exposure do not pose a public health hazard.

ATSDR investigations can produce several public health documents, including but not limited to public health assessments, health consultations, exposure investigations, site reviews, and updates. The three principal public health documents are

- A public health assessment (PHA) is a complete evaluation of hazardous substances, health outcomes, and community concerns at a site. A PHA is intended to determine whether people could be harmed by coming into contact with hazardous substances, and contains recommendations to protect public health.
- A health consultation (HC) is a more limited, specific-exposure, issue review of available or, in rare instances, newly collected data to respond to a particular health question or to a request for information about a potential environmental hazard.
- An exposure investigation (EI) collects and analyzes site-specific information and, when appropriate, tests on biologic samples to determine whether people have in fact been exposed to hazardous substances.

This report includes summaries of ATSDR's assessment of site-related exposures and, where available, associated health effects from 146 site narratives written between 1982 and 2007. Because the site narratives included here were based on health and environmental information provided by a variety of federal, state, and local environmental and health agencies; and because they were collected over a long time period during which ATSDR's processes and procedures were evolving, the included data and the descriptions can vary considerably from site to site.

Site narratives were abstracted from all three of the ATSDR public health document types. Results are summarized for sites categorized as either an urgent public health hazard, a public health hazard, or an indeterminate public health hazard, which represent approximately 60 per cent of ATSDR public health assessment investigations conducted at the AOC sites. A list of all the included sites is shown in Appendix 5. Most of the sites are not located within an AOC but are found elsewhere in within counties that include part of an AOC.

For NPL sites remediated subsequent to ATSDR's evaluation, current site status was obtained from U.S. EPA NPL Fact Sheets (<http://www.epa.gov/epahome/wherelive.htm>) from written

comments from U.S. EPA's or other partners, from more recent ATSDR follow-up reports, if available, from relevant state agency updates, and occasionally from other Web sources. In some instances, updated health assessments have resulted in a revised hazard category. Due to ongoing remediation activities, current conditions at a site may differ from those described in the most recent ATSDR site assessment included here. Thus, the last available ATSDR hazard category listed in that assessment may not reflect present conditions.

1.3.2. Toxics Release Inventory 2001 Data

The Emergency Planning and Community Right to Know Act (EPCRA) of 1986 facilitates emergency planning, minimizes the effects of potential toxic chemical accidents, and provides the public with information on releases of toxic chemicals in their communities. Under this authority, the Toxic Release Inventory (TRI) Program collects data on a number of different types of disposal or other releases as reported by certain industries and federal facilities, and on certain waste management and recycling practices.

Facilities must report release information to the TRI if any of approximately 650 chemicals that they manufacture, use, or store at levels above specified thresholds. The list includes 25,000 pounds per year for chemicals manufactured or processed, 10,000 pounds per year for chemicals otherwise used, and far lower levels for a small number of persistent, bioaccumulative, and toxic chemicals. The TRI database is publicly available (<http://www.epa.gov/tri>) and contains information on specified toxic chemical releases to soil, water, and air from the reporting facilities.

What information is included: Information in TRI includes the location of each reporting facility, the specific chemicals manufactured, processed, and used at that facility, and estimated amounts of these chemicals released each year. Facility releases include discharges to air, water, and land. TRI data also include disposal of waste materials into landfills and Class I underground injection wells. Although landfill disposal is recorded as "releases onto land," the amount of chemicals in this category may not represent conditions for human exposure. In fact, disposal in Resource Recovery and Conservation Act (RCRA)-approved landfills equipped with liners, covers, leak-detection systems, and groundwater monitoring systems may reduce potential human exposure compared with the pre-RCRA condition of those same landfills.

What is not included: EPCRA exempts such items as chemicals used in routine janitorial or facility maintenance, chemicals used in foods, drugs, or cosmetics, and chemicals used in motor vehicle maintenance. Facilities with fewer than 10 employees are not required to report, nor are facilities in certain industrial sectors. TRI data do not therefore reflect the totality of chemical releases into a specified environment.

This dataset only lists the amounts, in pounds, of toxic substance released to air, surface water, to soil surface on site, and injected underground. The data also list toxic substances transferred off-site for disposal. Because onsite releases for counties within an AOC are most relevant to exposures in the U.S. Great Lakes AOCs, we report only those data.

This report provides 2001 TRI data as an example because these data were available to us throughout the preparation of this report. They are not a complete representation of TRI data over time. Additional and more recent TRI data are available electronically at <http://www.epa.gov/tri/tridata/tri01/data/index.htm>.

1.3.3. National Pollutant Discharge Elimination System (NPDES) 2004 Data

The Federal Water Pollution Control Act (33 U.S.C. §1251 et seq.), commonly known as the Clean Water Act, created the National Pollutant Discharge Elimination System (NPDES) permit program. NPDES controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Individual homes connected to a municipal system, connected to a septic system, or that have no surface discharge do not need an NPDES permit. Industrial, municipal, and other facilities, however, must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states.

In addition to issuing permits, the program requires permit holders to monitor discharges to ensure compliance with their permits. U.S. EPA collects this information and, together with information about permitted discharges, makes it available to the public through the Permit Compliance System (PCS). Available NPDES reports are available at:

http://www.epa.gov/enviro/html/pcs/pcs_query.html. The NPDES program only records permitted releases; thus the database does not include information about nonpoint sources of chemical releases (e.g., pesticide and fertilizer run-off from agricultural lands, animal feedlots, urban runoff, failing septic systems, illegal dump sites) and unpermitted point sources. The NPDES database does not therefore represent the totality of chemical releases into bodies of water.

1.3.4. Data on Impairments of Beneficial Use

Because of the volume of available information for NPDES-permitted facilities that discharged industrial and municipal effluent within the AOC counties, ATSDR requested that U.S. EPA query the database to identify only those facilities within the 54 U.S. AOC counties that released IJC-critical pollutants. If those facilities also released noncritical pollutants, they are included in this report. Data presented in this report are from 2004. They are presented here because they were available to us through most of the preparation of this report. More recent data for specific facilities are available from http://www.epa.gov/enviro/html/pcs/pcs_query.html.

Of the 14 Impairments of Beneficial Use discussed above, two were considered to represent a potential impact of critical pollutants on human health: restrictions on fish and wildlife consumption and restrictions on water consumption. Accordingly, these findings are summarized for each of the AOCs based on information from the U.S. EPA Web site at <http://www.epa.gov/glnpo/aoc/>. We included information that was current as of the date of this report.

1.3.5. Restrictions on Fish and Wildlife Consumption

Fish-tissue monitoring can determine whether contaminant concentrations exceed state-based human consumption advisories for specific fish species. Each Great Lakes state sets guidelines and advisories for consumption of sport- and subsistence-caught fish. The states may base recommendations on existing U.S. EPA or FDA guidance or develop their own, state-specific recommendations. Fish caught for commercial sale, however, must comply with U.S. FDA contaminant-concentration standards. In 1993, the Great Lakes Sport Fish Advisory Task Force²

² Critical review of a proposed uniform Great Lakes fish advisory protocol (A science report to the Council of Great Lakes Governors). 1995. Prepared by Michigan Environmental Science Board, Council of Great Lakes Governors

created a Great Lakes area-wide standard for fish contaminated with polychlorinated biphenyls (PCBs), and in 2005 created a similar standard for mercury. For PCBs, the Task Force developed a health protection value (HPV) of 0.05 µg/kg/day for PCB residue ingested from fish tissue, with associated recommendations ranging from unrestricted consumption (i.e., fish containing fewer than 0.05 ppm PCB) to “Do-Not-Eat” (i.e., fish containing more than 1.89 ppm PCBs). Every Great Lakes state except New York uses these recommendations for establishing PCB-related fish consumption advisories. The recommendations for mercury established an average dietary ingestion level below 0.1 µg/kg/day for mercury (equating to 7 µg/day for a 70-kg person). All Great Lakes states, with the exception of New York and Pennsylvania, have adopted this recommendation.

1.3.6. Restrictions on Drinking Water Consumption and Standards for Drinking Water Odor and Taste

The Safe Drinking Water Act requires monitoring for contaminants in drinking water supplied by large and intermediate drinking water utilities. This is to determine whether drinking water contains concentrations of contaminants that exceed U.S. EPA’s standards for human consumption. The U.S. EPA’s National Primary Drinking Water Regulations are legally enforceable standards for maximum contaminant levels (MCLs) in drinking water for such contaminants as organic and inorganic chemicals and radionuclides (<http://www.epa.gov/safewater/contaminants/>). If levels of contaminants exceed the MCL, the public water facility must take remedial action to lower the contaminant levels to the MCL. Nonenforceable standards are applicable for odor and taste criteria. The Safe Drinking Water Act does not, however, require small utilities and private well owners to monitor drinking water for contaminants.

1.3.7. Map Data

Using ArcGIS software (ESRI, Redlands, CA), ATSDR produced maps for each of the 26 Areas of Concern (AOC). The same maps are in both Appendix 2 and in the report. Each map shows a single AOC and its associated county or counties (referred to as an AOC county).

The maps in Appendix 2 of the report are 11 by 17 inches, but those same maps in the report itself have been reduced in size; they appear in landscape format after the Beneficial Use Impairment discussion for each AOC. The maps depict the potential sources of contamination in the AOCs, and include

- ATSDR hazardous waste sites—if the site county of record was an AOC county.
- TRI facilities—if the county of record was an AOC county.
- NPDES discharge locations—if the county of record was an AOC county.

In March 2008, we downloaded as digital Global Information System (GIS) files the AOC boundaries for both of these map types from the U.S. EPA Web site (<http://www.epa.gov/greatlakes/aoc/>). In addition to AOC boundaries, some of the maps contain data regarding areas of particular interest to the U.S. EPA: watersheds, source areas of concern, or expanded study areas. Each map also includes basic information such as counties, place

names, primary roads, Interstate highways, and bodies of water. Any errors in the spatial coordinates in the databases are also reflected in the maps.

1.3.8. Health Data

To assess accurately the potential health effects related to AOCs, health data

- should be biologically associated with relevant exposures, and
- should match the environmental data in space and time.

Except as noted in the context of ATSDR health assessment products, ATSDR did not consider currently available health data to meet these needs. As a result, this report does not include other health data. Chapter 7, the bibliography, and Appendices 3 and 4 of this report, however, contain additional health data discussion, as does <http://www.atsdr.cdc.gov/grtlakes/>. ATSDR is committed to improving the availability and relevance of data linking health and environment over time.

1.3.9. Demographic Information

Consistent with the original IJC request, we included—when such information was available—relevant demographic data about populations (e.g., children, women of childbearing age, the elderly) that, if exposed to toxic substances, may experience higher than usual exposures or greater than usual health consequences. We did not provide general demographic data for AOC counties because those data did not allow us to determine which populations might have some risk of exposure to the toxic substances discussed in this report. But for some sites in Chapters 2–6, data are provided regarding numbers of children, women of child bearing age, and elderly persons living in close proximity (i.e., within 1 mile) of that site. Wherever possible, ATSDR has updated demographic information relevant to the specific site health assessments.

1.4. Report Revisions

This report differs in several important ways from earlier working drafts and supersedes all previous versions. Detailed information regarding the changes and the reasons for those changes is available at <http://www.atsdr.cdc.gov/grtlakes/improving-science.html>, and <http://www.atsdr.cdc.gov/grtlakes/>.