

Chapter 1. Background and Methods

The Great Lakes Water Quality Agreement (GLWQA) was first signed in 1972 and renewed in 1978 and 1983. It commits the United States and Canada to the restoration and maintenance of the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem. The entire GLWQA, which includes a number of 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 protecting human health. 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 the interactive effects of toxic substances,” and calls for research on the “pathways, fate and effects of toxic substances aimed at the protection of human health . . .,” and in particular to determine “the significance of effects of persistent toxic substances on human health and aquatic life.” Similarly, Annex 2, on Remedial Action Plans and Lake-wide Management Plans, calls for 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. . .”

This report supports the health objectives of the GLWQA by describing selected sources of chemical releases in the Great Lakes region. It was developed by the Agency for Toxic Substances and Disease Registry (ATSDR) in response to a request from the International Joint Commission (IJC).

This report presents previously published public health assessment products and chemical release information for the 54 counties in geographic proximity to one or more of the 26 U.S. AOCs. These 54 counties have been defined by ATSDR as AOC counties. The data come from publicly available data sets provided by ATSDR and the U.S. EPA.

1.1. Geographic Focus

The geographic focus of this report is on “Areas of Concern” throughout the Great Lakes region. An Area of Concern (AOC) is an ecologically degraded place. The formal definition appears in Annex 2 of the GLWQA:

“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 shown in Table 1.1.

Table 1.1: “Impairments of Beneficial Use” that Define Areas of Concern

- 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
- Loss of fish and wildlife habitat.

Figure 1: Map of Areas of Concern

The U.S. and Canadian governments have identified a total of 43 AOCs: 26 in the U.S., 12 in the Canadian waters, 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, 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 are discussed in Chapter 6. The map (Figure 1-1) shows the locations of the U.S. (and binational) AOCs. USEPA defined the boundaries of the AOCs. The binational AOCs have been left to the Canadian report.¹

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

1.2. Contaminant Focus

Critical pollutants, as defined by IJC, are chemicals that persist in the environment, bioaccumulate in fish and wildlife, and are toxic to humans and animals. The IJC has identified 11 critical pollutants as the focus for efforts to reduce loadings to the Great Lakes. Because of their toxicity, the Great Lakes Bi-national 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, along with the IJC tracking number.

We present available data from our primary sources on each of the IJC critical pollutants.

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 (dichlorodiphenyldichloroethylene), and DDD (dichlorodiphenyldichloroethane)
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

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

*Number assigned to the pollutant(s) by ATSDR to enable tracking of TRI and NPDES records that provide data relevant to that pollutant. The number does not reflect priority.

Consistent with the IJC's interest in synergistic effects, this report is not limited to critical pollutants. Available data bases also provide information on other pollutants, and this information is provided in the pages that follow.

1.3. Methods and Data

This report compiles selected previously published data describing potential chemical exposures in the counties containing the 26 U.S. Areas of Concern (AOCs) that affect the five Great Lakes. The four types of data include:

- Hazardous Waste Site Assessment Data from the Agency for Toxic Substances and Disease Registry (ATSDR)
- Toxics Release Inventory Data from the U.S. Environmental Protection Agency (USEPA)
- National Pollutant Discharge Elimination System Data from the U.S. Environmental Protection Agency (USEPA)
- Data on Impairments of Beneficial Use from the U.S. Environmental Protection Agency (USEPA)

The ATSDR data are complete through the end of 2007. The specific year(s) in the data bases are discussed below in the description of each dataset.

1.4. 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 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. ATSDR's reports on hazardous waste sites therefore represent a valuable data source for potential exposure to pollutants.

Sites investigated by ATSDR include National Priorities List (NPL) sites, CERCLA sites, and petitioned sites. The NPL sites are areas the USEPA deems eligible for long-term cleanup under the Superfund Act. Although a number of factors determine whether a site is listed on the NPL, a major determinant is the probability of human exposure. The ATSDR investigations draw on available information from USEPA and local governments regarding 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 requiring 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 these points, and potentially exposed populations. A completed exposure pathway must include five elements:

- Contaminant source or release. Examples include drums and landfills.
- 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.
- Exposure point. The specific location(s) where the population might come into contact with the contaminated media.
- 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).
- Population potentially or actually exposed.

Even if a completed exposure pathway exists, a public health hazard does not necessarily arise. Specific conditions (i.e., route of exposure and the magnitude, frequency, and duration of exposure) need to be examined to evaluate the possible health implications resulting from exposures. ATSDR uses standard language to describe the level of hazard at sites (*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 and/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, and/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 yield several different public health assessment products, including: public health assessments, health consultations, site reviews and updates, and exposure investigations, and others. A public health assessment (PHA) is a complete evaluation of hazardous substances, health outcomes, and community concerns at a site and is intended to determine whether people could be harmed from coming into contact with hazardous substances. The PHA contains recommendations to protect public health. A health consultation (HC) is a more limited, specific-exposure-issue review of available or (rarely) 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, biologic tests to determine whether people have in fact been exposed to hazardous substances.

This report includes abstracted information from all three types of ATSDR reports at 150 hazardous waste sites and releases within the AOC counties. Of note, most sites are not located within an AOC but are located elsewhere in an AOC county. Results are reported for sites with

Hazard Categories 1, 2 and 3, representing approximately 60 per cent of ATSDR public health assessment products conducted at the AOC sites.

A list of all the sites that ATSDR investigated is included in Appendix 2.

For NPL sites remediated subsequent to ATSDR's evaluation, current site status was obtained from USEPA NPL fact sheets (<http://www.epa.gov/epahome/whereyoulive.htm>), from USEPA's written comments, and from more recent ATSDR follow-up reports, if available. These too are incorporated in this report. In some instances, updated health assessments have resulted in a revised Hazard Category. Thus if conditions at a site differ from those described in the most recent ATSDR site assessment included here, this report's listed hazard category may not reflect current conditions. Many ATSDR assessments include information on health outcomes and demographic information for clearly vulnerable populations. When this information was available, it was included in this report.

1.5. Toxics Release Inventory Data

Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA) of 1986 was enacted to facilitate emergency planning, to minimize the effects of potential toxic chemical accidents, and to provide 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, as well as 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 (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>) containing 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 that have been released each year.

Facility releases include discharges to air, water, and land. TRI data also includes 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 RCRA-approved landfills that have liners, covers, leak-detection systems, and groundwater monitoring systems, may represent an actual reduction in potential human exposure compared to where they may have been previously located in the environment.

What is not included: There are certain exemptions, such as chemicals used in routine janitorial or facility grounds 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. Therefore, TRI data do not reflect the totality of chemical releases into the environment.

TRI onsite 2001 release data from facilities located in the AOC counties are included in this report. These sites are frequently not located in an AOC. This data set contains the amounts, in pounds, of toxic substance released to air, surface water, injected underground, and soil surface on site. The data also consist of toxic substances transferred off-site for disposal. This report focuses on onsite releases within the AOC counties as most relevant to exposures in the U.S. Great Lakes AOCs.

The TRI data reporting year 2001 were obtained from US EPA, which originally released the data in June, 2003. ATSDR obtained the data electronically from <http://www.epa.gov/tri/tridata/tri01/data/index.htm> on March 7, 2008. This snapshot is not a complete view of data over time and additional TRI data are available from the above Web site.

1.6. National Pollutant Discharge Elimination System (NPDES)

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit. Industrial, municipal, and other facilities must, however, 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 also requires permit holders to monitor discharges to ensure compliance with the permit. EPA collects this information and, together with information about permitted discharges, makes it available to the public through the Permit Compliance System (PCS – see http://www.epa.gov/enviro/html/pcs/pcs_query.html). Since the NPDES program only records permitted releases, the database does not include information about non-point 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. Therefore, the NPDES database does not represent the totality of chemical releases into water bodies.

Because of the volume of available information for NPDES-permitted facilities that discharged industrial and municipal effluent within the AOC counties, ATSDR requested that EPA query the database to identify only those facilities releasing IJC-critical pollutants as well as IJC noncritical pollutants. The results were tabulated in the report to provide lists of IJC-critical and non-IJC-critical pollutants. The data from EPA were received October 2004.

1.7. Data on Impairments of Beneficial Use

Of the 14 Impairments of Beneficial Use shown in Table 1-1, two may reflect 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 on the EPA Web site at <http://www.epa.gov/glnpo/aoc/>. This report includes the information reported on the EPA Web site.

1.7.1. Restrictions on fish and wildlife consumption

Fish-tissue monitoring can determine whether concentrations of contaminants exceed state-based advisories for human consumption. Each Great Lakes state sets guidelines and advisories for

consumption of sport- and subsistence-caught fish. The states may base recommendations on existing EPA or FDA guidance or develop state-specific recommendations. Fish caught for commercial sale must comply with U.S. FDA contaminant-concentrations standards. The Great Lakes Sport Fish Advisory Task Force has attempted to create a Great Lakes area-wide standard for fish contaminated with polychlorinated biphenyls (PCBs) (1993) and mercury (2005). 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” (fish containing more than 1.89 ppm PCB). 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). This recommendation has been adopted by all the Great Lakes states except New York and Pennsylvania.

1.7.2. Restrictions on Drinking Water Consumption and Odor and Taste

Monitoring for contaminants in drinking water supplied by large and intermediate drinking water utilities is required under the Safe Drinking Water Act to determine whether drinking water contains concentrations of contaminants that exceed EPA’s standards for human consumption. The EPA 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. Non-enforceable standards are applicable for odor and taste criteria.

The Safe Drinking Water Act does not require monitoring for drinking water contaminants by small utilities and private wells.

1.8. Map Data

ATSDR produced two maps for each of the 26 Areas of Concern (AOC) using ArcGIS software (ESRI, Redlands, CA). Each map shows a single AOC and its associated county or counties (referred to as an AOC county).

The AOC boundaries for these maps were downloaded as a digital GIS file from the U.S. EPA in March 2008 (<http://www.epa.gov/greatlakes/aoc/>). The file is in an ESRI shapefile format (GIS). In addition to AOC boundaries, some of the files contain additional data about areas of interest to the EPA: watersheds, source areas of concern or expanded study areas.

Each map also includes basic map information such as counties, place names, primary roads, interstates, and bodies of water taken from ATSDR’s spatial data engine (SDE). The data sources for this basic information were Teleatlas (Lebanon, NH) and ESRI.

The first type of map is 8 ½ by 11 inches in size. These appear in Chapters 2-6 of this report. The counties designated as AOC counties have a blue border with a white interior. Other counties are in gray.

The second type of map is 11 by 17 inches in size. These maps are located in Appendix 1. These maps depict the potential sources of contamination in the AOCs. In addition to the data from the 8 ½ by 11 inch maps, these maps include:

- ATSDR hazardous waste sites if their county of record was one of the AOC counties.
- TRI facilities if the county of record was one of the AOC counties.
- NPDES discharge locations if the county of record was an AOC county.

The spatial coordinates for ATSDR hazardous waste sites, TRI facilities, and NPDES discharge locations may contain errors, which cause them to appear outside of the AOC counties in the map.

1.9. Health Data

In order to be useful for assessing potential health effects related to AOCs, health data should have the following characteristics:

- biologically associated with relevant exposures
- well-matched to the environmental data in space and time

ATSDR remains committed to improving the availability and relevance of data linking health and environment over time. Except as noted in the context of ATSDR health assessment products, no currently available health data meet these needs; thus this report does not include other health data. Additional health data discussion is in Chapter 7 and of this report and at <http://www.atsdr.cdc.gov/grtlakes/>.

1.10. Demographic Information

We attempted to present relevant demographic information about populations (e.g., children, women of childbearing age, and the elderly) who may be subject to higher than usual exposures or experience greater than usual health consequences if exposed to toxic substances when such information was available. When information about these populations within AOCs was available from ATSDR reports, we included that information here. We did not provide general demographic data for AOC counties because existing data do not allow us to determine which populations might have some risk of exposure to the toxic substances discussed in this report. However data about numbers of children, women of child bearing age and elderly living in closest proximity (within 1 mile) are included in chapters 2-6 for some sites.

1.11. Report Revisions

This report differs in several important ways from earlier working drafts. Detailed information regarding the changes and the reasons for those changes is available in <http://www.atsdr.cdc.gov/grtlakes/>.