Ohio EPA Ohio Environmental Protection Agency

ASHTABULA RIVER

REMEDIAL ACTION PLAN

STAGE I INVESTIGATION REPORT

DECEMBER 1991

Ashtabula River Remedial Action Plan Advisory Council

ASHTABULA RIVER REMEDIAL ACTION PLAN

STAGE 1 REPORT

BACKGROUND INVESTIGATION

OHIO ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF WATER QUALITY PLANNING & ASSESSMENT

DECEMBER 1991

The Ashtabula River RAP Stage 1 Report is dedicated to the memory of Co-Chairman Jack Phelps, who passed away on November 12, 1991. He was a lifelong resident of Ashtabula whose love and appreciation of the river and Lake Erie were developed at an early age. Long before the RAP process was even an idea in the minds of IJC Water Quality Board members, Jack was providing assistance to U.S. EPA, U.S. Geological Survey, Ohio EPA, Ohio Sea Grant and the U.S. Army Corps of Engineers in sampling and maintenance work on the river. He was a strong advocate of environmental cleanup and restoration. His dedication to improve the status of the Ashtabula River, often in the face of seemingly insurmountable obstacles, never wavered. He will be missed.

The Ashtabula River Remedial Action Plan (RAP) Stage 1 Report was prepared by the Ohio Environmental Protection Agency, Division of Water Quality Planning & Assessment, in cooperation with the Ashtabula River RAP Advisory Council.

<u>Ashtabula River RAP Advisory Council Members</u>

Carl Anderson, Co-Chair, Citizen
Jack Phelps, Co-Chair, Marina Operator

Doug Adams, Ohio American Water Company
Karla Auker, Ohio EPA
Jeanne Bento, Ashtabula County Commissioner
Honorable Robert Boggs, Ohio Senator, ex-officio member
Rick Brewer, RMI Extrusion, Industry
Christina Bruun-Horrigan, City Council President, ex-officio member
Anne DiDonato, representing U.S. Representative Dennis Eckart
Leonard Eames, Citizen
Honorable Dennis Eckart, U.S. Representative, ex-officio member
Pat Helmici, Citizen (moved from area 10/88)
William Holt, Citizen
Bruce Kershner, Great Lakes United
Fred Leitert, Oxychem, Industry
Julie Letterhos, RAP Coordinator, Ohio EPA
Frank Lichtkoppler, Ohio Sea Grant
Ken Malin, Ashtabula County Rod & Reel Association
Eric Marsh, RMI Titanium, Industry
Rick Mason, RMI Titanium, Industry
Clifford McClure, Ashtabula City Manager, ex-officio member
Joseph Rose, Ashtabula Port Authority
Ray Saporito, Ashtabula County Health Department
Mary Ann Smith, Ashtabula Township Trustee
Doug Towner, SCM Corporation, Industry
Steve Tuckerman, Ohio EPA

We would like to acknowledge the substantial contribution and dedication of Joe Holman, RMI Titanium Company, who was very active in the RAP process and committed to negotiating a unified effort to cleanup Fields Brook and the Ashtabula River. Joe passed away in late 1989.

We would also like to acknowledge the Great Lakes National Program Office and U.S. EPA, Region V, for providing partial funding for the development of this report.

Martha Fravel, Jo Hodanbosi and Mary Parman of Ohio EPA, Division of Water Quality Planning and Assessment, assisted in typing, printing and organizing this report.

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GLOSSARY

ACOE - Army Corps of Engineers

ARCS - Assessment and Remediation of Contaminated Sediments (a remediation demonstration program to address contaminated sediments which was authorized in Section 118 of the Clean Water Act as revised in 1987.)

AOC - Area of Concern

BAT - Best available technology

CDF - Confined disposal facility

CEI - Cleveland Electric Illuminating Company

CERCLA - Comprehensive Environmental Response, Compensation and Liability Act (Superfund)

CERCLIS - Comprehensive Environmental Response, Compensation and Liability Information System (list of unregulated hazardous waste disposal sites)

cfs - Cubic feet per second

DO - Dissolved Oxygen

EIS - Environmental Impact Statement

FEIS - Final Environmental Impact Statement

FIT - Field Investigation Team: U.S. EPA team assigned to perform followup inspections at potential Superfund sites.

GLNPO - Great Lakes National Program Office

GLWQA - Great Lakes Water Quality Agreement

GPM - Gallons per minute

IJC - International Joint Commission

LC50 - Median lethal concentration of a substance at which fifty percent of the exposed organisms die.

LEH - Lake Erie Habitat

LOEL - Lowest observed effect level is the lowest concentration of an effluent sample that causes an observed effect on a test organism.

LWD - Low Water Datum

MGD - Million Gallons per Day

mg/l - Milligrams per liter

mg/kg - Milligrams per kilogram

MW - Megawatts

ng/l - Nannograms per liter, parts per trillion

NOEL - No observed effect level is the highest concentration of a sample that causes no observed effect on a test organism

NPDES - National Pollutant Discharge Elimination System

NPL - National Priority List for qualifying hazardous waste sites for cleanup under Superfund.

OCE - Office of the Chief Engineers (Corps of Engineers - Washington, D.C.)

ODH - Ohio Department of Health

ODNR - Ohio Department of Natural Resources

Ohio EPA - Ohio Environmental Protection Agency

PA - Preliminary Assessment (first step in the investigation of a suspected hazardous waste site under CERCLA)

PAH - Polynuclear aromatic hydrocarbon

PCBs - Polychlorinated Biphenyls

PEMSO - Planning and Engineering Data Management System of Ohio

ppb - Parts per billion, equivalent to ug/l

ppm - Parts per million, equivalent to mg/l

PRPs - Potentially Responsible Parties

RAP - Remedial Action Plan

RCRA - Resource Conservation and Recovery Act of 1986

RI/FS - Remedial Investigation/Feasibility Study

RM - River Mile

ROD - Record of Decision

GLOSSARY - Continued

SARA - Superfund Amendments and Reauthorization Act of 1986

SOU - Sediment Operable Unit

SOW - Statement of Work

TRE - Toxicity Reduction Evaluation

TRI - Toxics Release Inventory

TSCA - Toxic Substances Control Act

TSD - Treatment, Storage and Disposal Facility for hazardous waste as identifed under RCRA

ug/l - Micrograms per liter

USEPA - U.S. Environmental Protection Agency

USGS - U.S. Geological Survey

WCC - Woodward Clyde Consultants

WQB - Water Quality Board of the IJC

WQS - Ohio Water Quality Standards

WWH - Warmwater Habitat

WWTP - Wastewater Treatment Plant

CHAPTER 1. INTRODUCTION

This report represents completion of the first stage of development of a Remedial Action Plan (RAP) for the Ashtabula River Area of Concern (AOC). According to the Great Lakes Water Quality Agreement of 1978, as amended by Protocol in 1987 (GLWQA), RAPs are to be submitted to the International Joint Commission (IJC) for review in three stages:

- Stage 1 - When the problems have been identified.
- Stage 2 - When remedial measures have been selected.
- Stage 3 - When surveillance and monitoring indicate all identified impaired uses have been restored.

Since 1973, the Water Quality Board of the IJC has listed "problem areas" in its biennial report on Great Lakes water quality. These areas included locations experiencing violations of water quality standards or degraded environmental conditions, as identified by the states and the province of Ontario. Subsequent Water Quality Board Reports termed these sites Areas of Concern (AOC). The 1985 Water Quality Board Report (IJC 1985) called for the preparation of Remedial Action Plans (RAPs) for each AOC which would provide a focus for developing and implementing remedial options and establish a means for tracking changes in environmental quality. The RAPs must embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in AOCs.

The 1987 Protocol amending the GLWQA formally addressed the development of RAPs stating that:

> "The Parties (Federal Governments) shall cooperate with State and Provincial Governments to ensure that Remedial Action Plans are developed and implemented for Areas of Concern" (Annex 2-4(a)).

The Critical Programs Act of 1990, an amendment to Section 118 of the Clean Water Act, further encouraged development of RAPs by setting deadlines for their completion. The Act states: RAPs should be submitted to U.S. EPA by June 1991; to the IJC by January 1992; and certified in state water quality plans by January 1993. The Act does not specify if these deadlines refer to Stage 1, 2 or 3 Reports. Although the Act raises the profile and priority of RAPs on the national level, it does not provide additional resources to prepare and implement remedial actions.

RAPs are meant to endorse and build upon existing efforts toward restoration of AOCs. Efforts needed to redirect existing programs to embrace a comprehensive ecosystem approach, lengthy negotiations needed to resolve the complicated environmental problems and lack of existing legislation to address the real needs of the AOCs make it doubtful that the deadlines in the Critical Programs Act will be met for the Ashtabula River AOC. However, Ohio remains committed to producing the best RAPs possible and continues to seek the funding and tools to restore its AOCs as quickly as possible.

The main focus of RAPs is on identifying the extent of use impairment. The GLWQA lists fourteen beneficial uses whose impairment could result in designating a site as an AOC. In general, these include: restrictions on consumption of fish, wildlife and drinking water; degraded biological communities; economic and recreational restrictions due to environmental degradation; loss of habitat; and poor aesthetics. A list of the beneficial uses and status of their impairment in the Ashtabula River AOC is presented in Table 1. This Stage 1 Report will concentrate on identifying the sources, causes and extent of impairment of these uses.

The severe pollution problems of the Ashtabula River brought it to the attention of the IJC as a probable source of contaminants to Lake Erie and a candidate for the RAP process. Industrialization of the area in the late 1940s and early 1950s established a concentrated cluster of chemical companies in the Fields Brook area just east of the city of Ashtabula. Unregulated discharge and mismanagement of hazardous wastes left a legacy of toxic and hazardous sediments, contaminated groundwater, degraded biological communities, fish with high tissue concentrations of contaminants and, ultimately, the designation of Fields Brook as a Superfund site. Discharge from Fields Brook, along with that from coalyards, diesel fuel facilities, scrapyards, railyards, combined sewer overflows and possibly tanneries and abandoned hazardous wastes sites polluted the sediments of the Ashtabula River, degraded the biological community and created the need for issuance of a fish consumption advisory. Sediments in the outer harbor are becoming increasingly contaminated as in place pollutants continue to migrate downriver. River discharge and the effluents from the municipal wastewater treatment plant, power plants and industries discharging directly to Lake Erie may be impacting the nearshore. The major pollutants of concern are mercury, chromium, lead, zinc and chlorinated organic compounds, particularly PCBs. PCB concentrations in some sections of the river sediment are high enough to be considered toxic and must be handled under the regulations of the Toxic Substances Control Act (TSCA).

Due to the toxic designation and lack of a disposal site, sediments have not been dredged from the river navigation channel since 1962. The channel has now become a navigation hazard as well as an environmental and potential human health hazard. The situation is critically close to impacting the already depressed local economy as well.

The Ashtabula River RAP will focus on the lower two miles of the Ashtabula River, Ashtabula Harbor and the adjacent Lake Erie nearshore, considering the Fields Brook Superfund investigation and cleanup as a complementary project. The RAP is intended to be used as a guidance document for cleanup of the Ashtabula River AOC. It is to serve as an important step toward virtual elimination of persistent toxic substances and toward restoring and maintaining the chemical, physical and biological integrity of the Great Lakes Basin ecosystem. The resulting recommendations will draw largely on the existing framework of institutional programs, but new rules, regulations and legislation may also be identified and recommended.

Table 1. Summary of use impairments (cited in Annex 2 of the GLWQA) and their significance to the Ashtabula River AOC.

Use Impairment	Impaired in Ashtabula River AOC?
1. Restrictions on fish or wildlife consumption	Yes
2. Tainting of fish and wildlife flavor	Unknown
3. Degraded fish and wildlife population	Yes
4. Fish tumors or other deformities	Yes
5. Bird or animal deformities or reproductive problems	Unknown
6. Degradation of benthos	Yes
7. Restrictions on dredging	Yes
8. Eutrophication or undesirable algae	No
9. Restrictions on drinking water consumption	No
10. Beach closings	No
11. Degradation of aesthetics	No
12. Added costs to agriculture or industry	No
13. Degradation of plankton populations	Unknown
14. Loss of fish and wildlife habitat	Yes

CHAPTER 2. PUBLIC INVOLVEMENT AND DETERMINATION OF GOALS AND OBJECTIVES

The GLWQA requires public involvement at all stages of RAP development since substantial local support is essential to ensure the organization and implementation of a successful RAP. The public participation process provides the opportunity for anyone with a stake in the cleanup of the AOC to become involved. This includes those who will benefit as well as those who will be responsible for cleanup. Early and ongoing involvement ensures greater consensus and political support, enhancing the ability to obtain funding for implementation. The Ohio EPA is responsible for the RAP program in Ohio and is the contact for the IJC, U.S. EPA, other state and federal agencies and the general public.

When Ohio EPA held the first RAP information meeting in Ashtabula in October 1987, the audience was skeptical that this would be just another study of the river. The extent of environmental contamination in the area and the lack of implementation of any cleanup actions had created a cynical local attitude and distrust of the intentions of the government agencies promoting the RAP.

Following that first meeting, Ohio EPA worked with Ohio State Senator Robert Boggs to initiate the public involvement process necessary to develop a successful RAP. Local community leaders were invited to the early organizational meetings to provide insight into the needs and attitudes of the local community and guidance on the best approach to developing the RAP process for Ashtabula. U.S. Representative Dennis Eckart, a strong advocate of environmental cleanup and economic growth in the Ashtabula area, also supported the RAP process. The active participation of these two well-respected politicians was essential in drawing the local community into the RAP process. The emphasis on public involvement at these early meetings convinced a number of people that a RAP would not be just another study of the area's problems.

An Ashtabula River RAP Advisory Council was established in February 1988 with approximately thirty volunteer members representing local, state and federal government agencies, elected officials, industry, business, special interest groups, and nonaffiliated citizens. Bimonthly meetings served as forums to answer questions and explain state and federal regulatory programs. They provided the opportunity for frank discussion, presentation of varying perspectives and coordination toward a common goal. The Ashtabula City Council, Ashtabula Township Trustees and Ashtabula County Commissioners all signed resolutions supporting the RAP process. Several local special interest groups also signed similar resolutions.

Early in the RAP process, council members decided to focus their efforts on cleaning up the river. The Fields Brook site was certainly an important contributor to pollution in the Area of Concern, and itself an environmental hazard, but the complicated technical and legal issues associated with cleanup and the costs of remedial actions already were being addressed under Superfund. However, there was no concerted effort to remove contaminated sediments from the river which was now shallow enough to impede both commercial and recreational navigation. Council members delegated all writing responsibilities to Ohio EPA and formed two committees to address specific technical and communication issues.

Since much of the background information needed to prepare the Stage 1 RAP Report already was available or being collected, most of the public involvement activities focussed more on the Stage 2 implementation process than the Stage 1 Report. At the time the RAP process began, the Buffalo District of the U.S. Army Corps of Engineers was seeking to obtain final approval for its $25 million plan to dredge the river and remove all contaminated sediment from the federal navigation channel. Changes in Corps' policy and budget cuts under the Reagan Administration indicated the Ashtabula project would not be funded. Council members initiated an intensive letter writing campaign to obtain federal support for the project. They hosted a boat tour of the river providing State and federal officials and political leaders a first hand view of the river's problems. This campaign culminated in a meeting with the Office of the Chief Engineers in Washington, D.C. in March 1989, which was arranged by Congressman Eckart. Other attendees included the chief administrators from U.S. EPA-Region V, Ohio EPA and the Buffalo District Corps of Engineers; Senator Boggs; representatives of U.S. Senators John Glenn and Howard Metzenbaum; and a representative of the Director of the Ohio Department of Natural Resources. Council members presented a detailed slide show and accompanying report emphasizing the immediate need for river dredging.

Although the Office of the Chief Engineers did not agree to fund the entire operation, they did agree to consider a scaled down project to alleviate at least the navigation hazard. The local RAP contingency felt they had scored a victory by succeeding in having all the deciding authorities together in one place to collectively discuss a solution. The awareness of the Ashtabula River problem was raised at the federal level, and all parties present agreed to commit as much effort as needed to get the river dredged.

Back on the home front, RAP Council members continued to raise local awareness and support by showing their slide presentation to the City Council and local service organizations. RMI Titanium, one of the local industries, donated its staff expertise in refining the slide show and producing several videos of the river. Prompted by the RAP Council's efforts, the Ashtabula City Council passed an ordinance to tax boat docks and ramps. The law became effective in August 1989, and revenue was designated for river improvements and as local match money to secure funds for the dredging from State or federal sources.

Encouraged by the RAP process, local government officials and RAP Council members met with State officials to seek a State commitment to the river cleanup. These meetings resulted in a State commitment of $7 million dollars toward the total river dredging cleanup project, the release of which is contingent upon receiving federal funds. The State commitment was approved in January 1990.

Council members have publicized the river cleanup effort by ensuring frequent newspaper coverage, interviewing on radio talk shows, sponsoring public service announcements, publishing a newsletter, and distributing information at local festivals and fishing symposiums. They have also participated in career days and health fairs at local schools. Fact sheets have been prepared in association with Ohio EPA, Ohio Sea Grant, Great Lakes United and the Center for Great Lakes. Numerous presentations have been made to area organizations, some of whom have donated money to the RAP effort and incorporated the RAP goals into their own agendas. The RAP Council is now working to attain a local consensus on location of disposal sites for sediment dredged from the river.

Goals and objectives for the Ashtabula River RAP were recommended by the Ashtabula River RAP Advisory Council. These were determined via reference to the GLWQA, the Ohio Water Quality Standards (Chapter 3745-1 of the Ohio Administrative Code), and the results of a river users' survey distributed at local fishing and sport symposiums. According to the GLWQA, the overall goal of a RAP is to restore all beneficial uses to an AOC, prohibit the discharge of toxic substances in toxic amounts, and virtually eliminate the discharge of persistent toxic substances. All of the goals and objectives listed below are directed toward that end.

Goal / Use to be Restored	Objectives
1. Healthy biological community	- eliminate toxic discharge - remove contaminated sediments and/or eliminate biological availability of containments - protect and enhance habitat - reduce contaminant levels in fish so fish consumption advisory can be rescinded - achieve compliance with Ohio Water Quality Standards.
2. Fully attain designated uses listed in Ohio Water Quality Standards	- maintain Ohio Water Quality Standards - control discharge of pollutants - remove contaminated sediments - eliminate toxic discharge - control nonpoint source runoff

3. Provide safe harbor and navigation	- remove contaminated sediments - dredge channels to specified depths - maintain and improve dockage
4. Eliminate possible human health risk.	- eliminate toxic discharge - remove contaminated sediments - achieve Ohio Water Quality Standards for protection of human health - implement air quality controls to restrict release of toxics - monitor public water supply for presence of toxics.
5. Eliminate restrictions on dredging	- remove contaminated sediments - control discharge of pollutants - meet U.S. EPA guidelines for contaminants in sediments
6. Attain pleasing aesthetics	- control debris - regular cleanup of river and shoreline - reduce nonpoint source runoff
7. Cleanup of Fields Brook and removal from National Priorities List (Superfund)	- continue to promote and review Superfund Activities - participate in Superfund public involvement activities - coordinate river dredging with Superfund cleanup to the extent possible
8. Improve status of the local economy	- cleanup/dredging of the river to provide safe navigation and expansion of river related businesses

9. Identify and control additional sources of pollutants and problems not previously realized.

10. Coordinate implementation of remedial actions recommended in the RAP.

It is expected this list of goals and objectives will change as new information becomes available and as uses are restored. Note that dredging of contaminated sediments and elimination or more stringent control of pollutant discharge are repeatedly listed as objectives to achieve the restoration of beneficial uses.

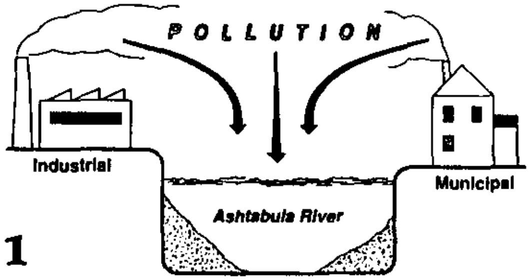
Public input in the RAP process has been invaluable in providing historical background of past river conditions and in establishing common goals and objectives. Involving the public in the RAP process has itself been the most effective means of increasing public awareness. The RAP program has provided an opportunity for the local community to communicate directly with State and federal government agencies and help restore the environmental integrity of the Ashtabula River AOC. Figure 1 summarizes how the local community has cooperated to enhance the cleanup of the Ashtabula River.

Figure 1.

Ashtabula River Cleanup

Enhancement by Citizen, Industry and Government Cooperation

1960s - 1970s
Polluted Sediments Accumulated



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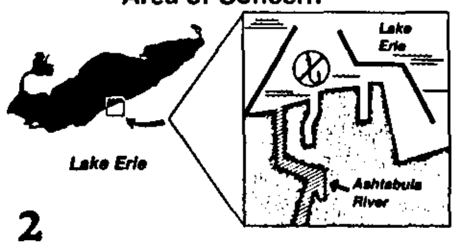
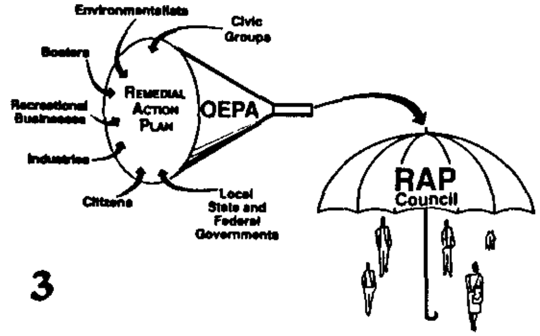
1985
Ashtabula River Listed as an Area of Concern



2

1988
The Ohio EPA (OEPA) Started the Remedial Action Plan (RAP) & Formed the RAP Council



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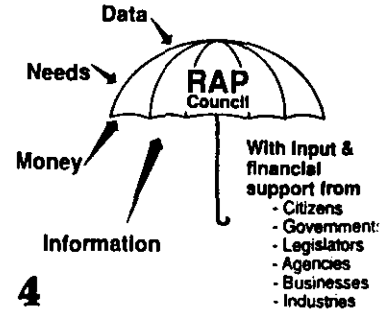
RAP Council Receives Input and Support



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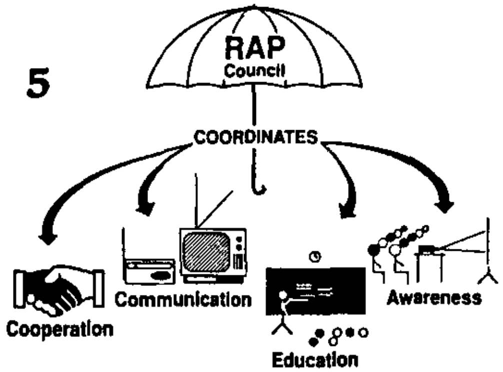
5

Four Areas of Effort



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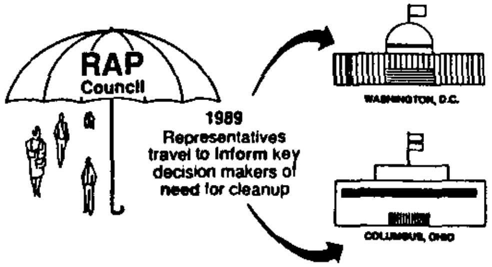
RAP Council Educates Decision Makers



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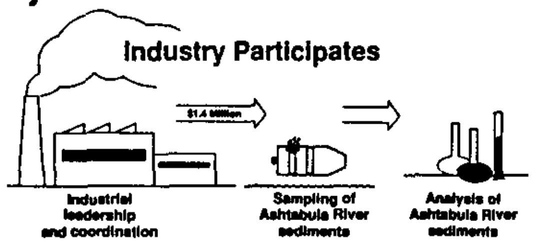

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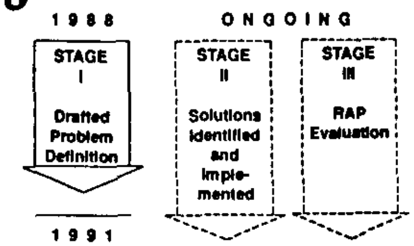
RAP Council Efforts



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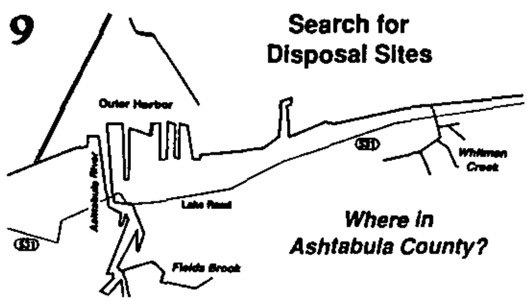
Search for Disposal Sites



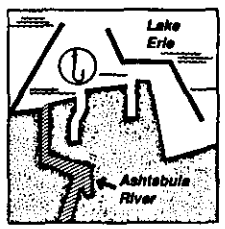
10

Secure Resources for Cleanup

- ➡ Local $
- ➡ State $
- ➡ Federal $

11

The Goal of the RAP Is to Restore Beneficial Uses



Environmental cleanup enhances economic growth potential of Ashtabula area

For Further Information Contact:

Julie Letterhos
Ashtabula RAP Coordinator
Ohio EPA, DWQPA
P.O. Box 1049, 1800 WaterMark Drive
Columbus, OH 43266-0149
614/644-2866

Carl Anderson
Advisory Council Co-Chair
2916 Fairview Drive
Ashtabula, OH 44004
216/998-1969

Prepared by *Frank R. Lichtkoppler*
& Graphics by Suzanne L. Abbati
with the
Ohio Sea Grant College Program
The Ohio State University

Ohio Sea Grant College Program works for the wise use and management of marine and Great Lakes resources for the public benefit through university-based research, education, and outreach.

CHAPTER 3. NATURAL FEATURES AND DESIGNATED USE

The Ashtabula River Area of Concern (AOC) has been identified as the lower two miles of the river from the 24th St. bridge to the mouth, including the outer harbor, Strong Brook, Fields Brook and the adjacent Lake Erie nearshore. This area is highlighted in Figure 2.

To better understand the Ashtabula River AOC and the remedial actions needed to resolve the environmental problems, it is important to be familiar with the physical description of the area. This chapter briefly describes the natural features of the AOC and the Ashtabula River watershed, the existing land and water uses and the uses which legally must be attained as listed in the Ohio Water Quality Standards. This sets the scene for the more technical discussions of problems, causes and remedial actions to follow.

Geography

The Ashtabula River is located in Ashtabula County in extreme northeast Ohio, and flows into Lake Erie's central basin at the city of Ashtabula (Figure 3). The Ashtabula River drainage basin covers an area of approximately 137 square miles, with 8.9 square miles in Pennsylvania. The mainstem is 23 miles long and originates at the confluence of the East and West Branches, which are 10 and 16 miles long, respectively. The major tributaries include Fields Brook, Hubbard Run and Ashtabula Creek. Strong Brook is a minor tributary and is located within the AOC. The drainage basin is predominantly rural and agricultural, with the city of Ashtabula the only significant urbanized area. There is some industrial development in Ashtabula west of the river, but the most concentrated industrial development is around Fields Brook and east of the river mouth.

The mainstem of Fields Brook is 3.5 miles long with five tributaries. It empties into the Ashtabula River from the east bank of the upper turning basin. All but the very upstream segments (east of Cook Rd.) are identified as the Superfund site. It drains a 5.6-square mile basin containing a high concentration of industries and waste disposal sites. Strong Brook drains an area of less than one square mile. Most of the original stream is now an underground stormsewer. However, there are three open sections near the mouth of the stream which are separated by culverts. Strong Brook empties into the Ashtabula River from the west side of the upper turning basin.

The outer harbor covers approximately 185 acres (0.3 square miles) of Lake Erie enclosed by breakwaters. The progressive construction of piers and breakwaters, initially begun in 1826, has ultimately extended the Ashtabula River mouth about 1 mile from the natural mouth. The outer harbor and river areas of the AOC encompass the federal navigation channel. As designated in the Federal River and Harbor Act, the outer harbor is dredged to depths of 21 to 29 feet. The river was originally dredged to 16-18 ft., but has not been maintained due to the decline in commercial shipping on this part of the river. Since the river has not been dredged for almost 30 years, depths in some areas are now less than 2 ft. Details of the harbor are highlighted in Figure 4.

The Ashtabula River AOC lies within the city of Ashtabula and Ashtabula Township. A comparison of 1990 U.S. Census figures with those from 1980 (Table 2) indicates a

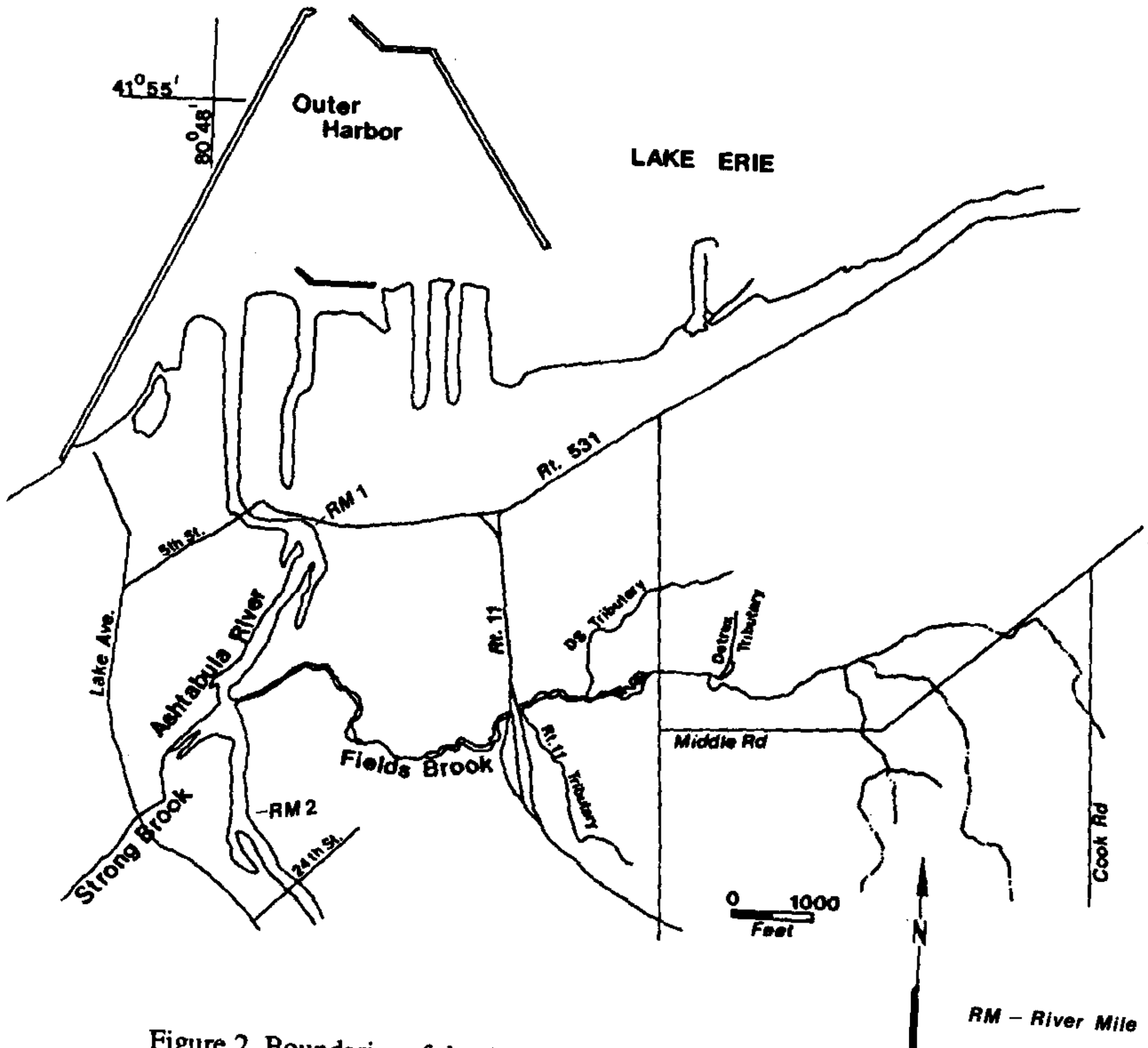


Figure 2. Boundaries of the Ashtabula River Area of Concern.

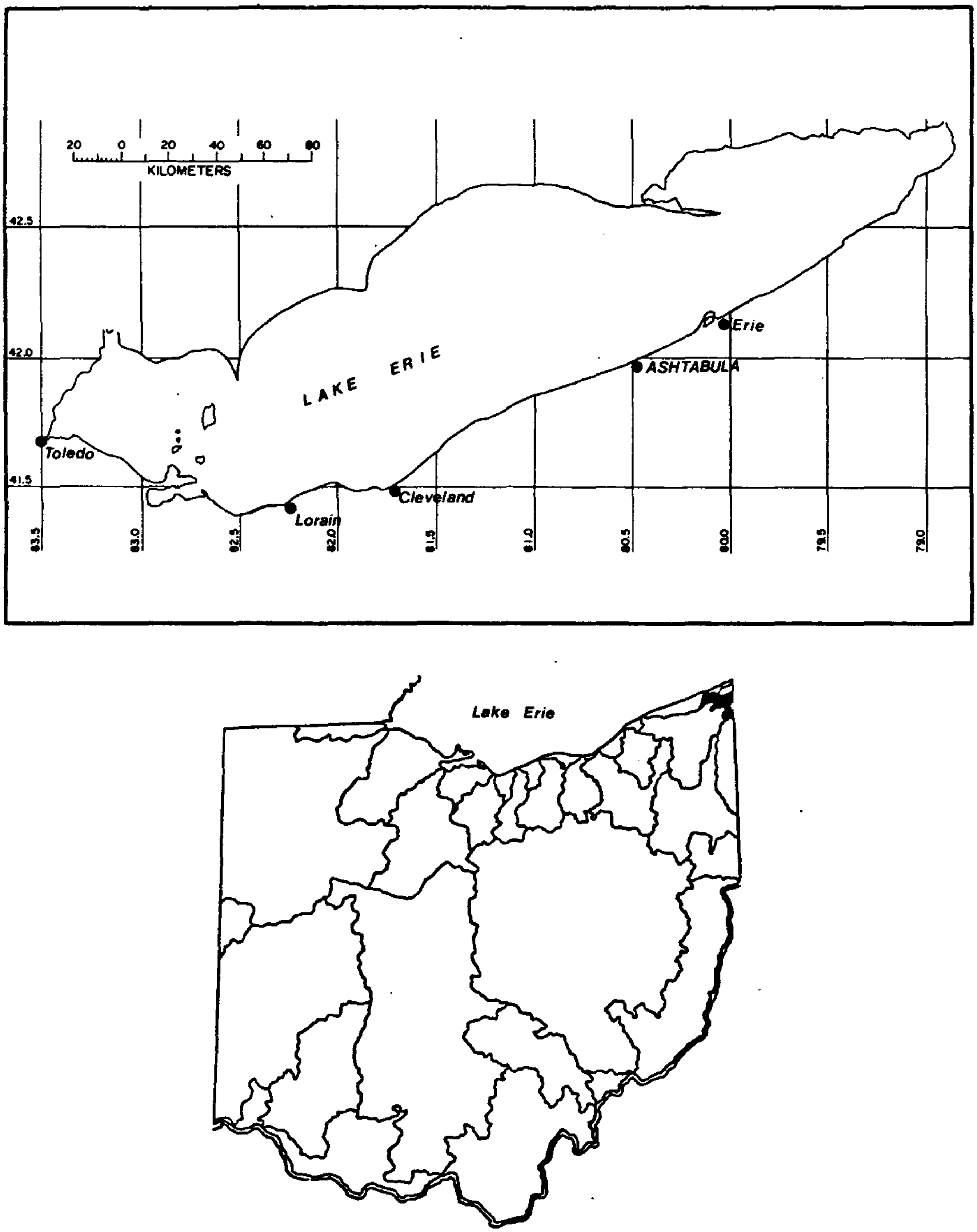


Figure 3. Location of the Ashtabula River Basin in relation to Lake Erie and the State of Ohio.

Table 2. Population figures for the Ashtabula River AOC.

	1980 Census	1990 Census	Change
Ashtabula County	104,215	99,821	-4,394
Ashtabula City	23,449	21,633	-1,816
Ashtabula Township	7,308	6,654	-654

countywide population decline. Approximately 56 percent of the decrease can be attributed to loss of population in the city of Ashtabula and Ashtabula Township.

Topography

The basin topography is characterized by the rolling hills and deep, narrow valleys formed on the glaciated Lake Plains Section of the Central Lowlands Province. Miscellaneous recession beach ridges are scattered throughout the northernmost sector, formed from ancient shoreline depositions of Glacial Lakes Whittlesey and Warren. The AOC lies within a 3 to 5 mile wide band parallel to the present Lake Erie shoreline that was once lake bottom. From an elevation of 1,033 feet above sea level at the source, the river slopes at an average 11.6 feet per mile to lake level at 573 feet above sea level. Gradient in the AOC segment is only 4 feet per mile. The lower course of the river flows through a narrow valley which has been cut in the shale bedrock to a depth of 75 to 100 ft. Steep shale cliffs are exposed along the banks upstream from the AOC. Steep bluffs exist on the west side of the river near the natural mouth. Low clay bluffs highly susceptible to lake erosion line the Lake Erie shoreline east and west of the sand beaches adjacent to the harbor breakwalls.

The AOC lies within the Erie/Ontario Lake Plain ecoregion. The ecoregion concept was developed by U.S. EPA to identify ecologically similar geographical areas around the country. The ecology of a region has a significant impact on the type of biological community that region will support. Knowledge of the ecology of an area allows one to anticipate what type of biological community the area will support. An assessment of the biological community can be compared with the standards for that particular ecoregion to evaluate whether or not the area is impacted by pollution. The Erie/Ontario Lake Plain ecoregion is characterized by the rolling glacial topography described above (U.S. EPA 1988c).

Hydrology

Average flow for the Ashtabula River is approximately 160 cubic feet per second (cfs). Dry weather flow is typically around 10 cfs and occasionally decreases to zero. Mean monthly flows measured at the USGS gauging station at RM 5.5 from 1970 to 1980 are presented in Table 3. The minimum annual flow typically occurred during the summer months. Data collection at this site was discontinued in 1980.

Table 3. Mean flow in cubic feet per second (cfs) for the Ashtabula River near Ashtabula. (U.S.G.S. gage at River Mile 5.5)

Water Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	7.86	117	154	164	319	282	150	137	76.1	14.6	14.7	151
1971	230	383	249	121	514	267	85.3	37.1	55.4	4.09	2.57	7.80
1972	19.8	130	428	210	277	746	286	105	395	117	24.2	56.5
1973	73.7	289	324	149	137	486	317	235	121	3.81	17.5	2.10
1974	37.3	229	266	205	163	444	323	230	33.9	164	6.20	7.02
1975	31.8	442	328	323	373	393	106	26.5	180	1.72	75.6	53.8
1976	43.3	57.6	376	369	638	366	143	49.0	4.23	96.0	28.1	81.5
1977	126	190	281	48.4	393	519	340	28.6	5.46	193	222	260
1978	120	410	672	170	89.8	432	218	211	7.25	1.03	1.42	2.89
1979	21.4	13.6	166	295	231	466	333	120	18.9	17.2	33.2	272
1980	412	314	568									

U.S. Geological Survey, Water Resources Data for Ohio 1970-1979.
Streamflow data collection was discontinued in 1980.

Flow duration data presented in Table 4 indicate low flow conditions prevail 90 percent of the time. The Ashtabula River has the smallest drainage basin of all the major Ohio tributaries to Lake Erie, and this is reflected in the low average flow.

Table 4. Ashtabula River and Fields Brook Flow-Duration Data.

	Percent of Time Indicated Discharge is Equaled or Exceeded							
Water Body	0.1	1	5	10	25	50	75	90
Ashtabula River[a] Discharge (cfs)	4000	1600	680	410	150	39	4.7	0.50
Fields Brook[b] Discharge (cfs)	193	77	33	20	7.3	1.9	0.23	0.02
Fields Brook[c] Discharge (cfs)	209	93	49	36	24	18	16.5	16.3

[a] From U.S. Geological Survey Water Supply Paper 2045
[b] Without industrial discharges
[c] With industrial discharges

Source - Science Applications International Corporation 1987

The Ashtabula River portion of the AOC lies entirely within the lake effect, or freshwater estuary area. The river reaches the lake level at approximately RM 2, and this is considered the upstream limit of lake effect. Flushing time in the AOC is extremely variable depending on volume of flow from the river, inflow from the lake, total volume of water in the AOC, circulation patterns and the effluent wastewater volume. Flushing time computed in May 1967, when the average flow was 586 cfs (more than 3 times the average annual flow), was 2.83 days. Flushing time calculated in September 1973 when average flow was 1.57 cfs was 137.1 days (Terlacky et al. 1975). During periods of low flow, most of the water in the AOC is lake water. At times, flow in Fields Brook is due solely to industrial wastewater discharge.

The majority of discharge from the Ashtabula River flows north through the harbor mouth. A much smaller amount flows east through the opening in the east breakwall (Terlacky et al. 1975). The river discharge typically remains within 1.5 miles of the shoreline and moves eastward due to prevailing southwest winds (U.S. Dept. Health, Education and Welfare 1965).

The predominantly eastward currents create a west to east littoral drift. Sand and other beach building materials are carried eastward until they are slowed by the west harbor breakwall which extends out into the lake. This accounts for the accrual of a large sand beach at Walnut Park on the west side of the harbor. Conversely, Lakeshore Park, on the east side of the harbor mouth has problems with erosion. The eastward currents continue along the shore, but no longer carry the beach building materials trapped by the west breakwall.

A stone retaining wall, offshore breakwaters and groins have been constructed at Lakeshore Park to control the erosion problem and build up the beach, but have not been as effective as anticipated. Sand is accumulating in an offshore area at the west end of the park near the boat ramps. It appears this accrual is induced by eddy currents caused by Ashtabula Harbor structures to the west and possibly wave reflection from the CEI power plant intake structure to the east (U.S. Army Corps of Engineers 1986b).

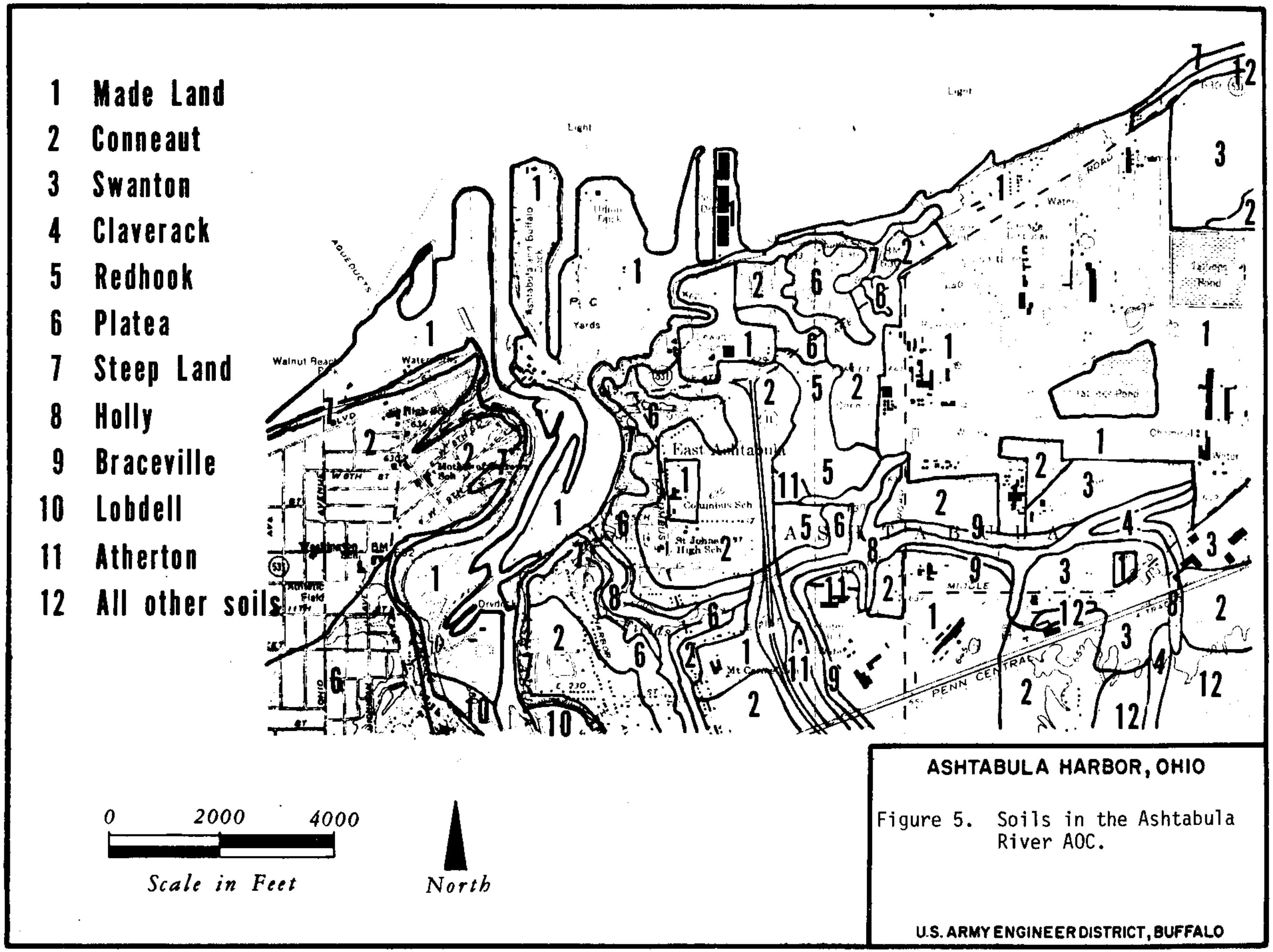
Geology and Soils

Bedrock underlying the AOC is Devonian Age shale of the Chagrin member of the Ohio Formation. The Ohio Formation is several hundred feet thick and consists of interbedded layers of shale and sandstone. In the upper portions, the shale has weathered extensively and consists of shale fragments and clay. Below the weathered zone the shale is soft, highly fractured and contains thin clay seams. The Chagrin member has a very low permeability, restricting the vertical movement of groundwater. Overlying unconsolidated materials are predominantly clays and silts deposited during the Wisconsin glacial stage (U.S. Army, Corps of Engineers 1975). The low permeability of surface deposits allows little opportunity for groundwater recharge. Considering the number of hazardous waste disposal sites in the area, it is probably fortunate that surface deposits allow little groundwater recharge.

Groundwater can be obtained within the entire basin, but only to a limited degree. Groundwater from the beach ridge deposits can produce 5 gallons per minute (gpm), while wells in shale will yield an average of 2 to 3 gpm (Ohio EPA 1975). Very little groundwater is used in Ashtabula County. Almost all water supplies are from surface waters, except for the occasional isolated farm house that has a shallow, low yield well (C. Khourey, Ohio EPA, personal communication 1987). These sites are all outside the AOC.

Soils in the Ashtabula Harbor area are indicated in Figure 5. The Conneaut-Swanton-Claverack Association occupies areas that were covered with water following the retreat of the Wisconsin glacial ice from Ohio, and comprises a major part of those soils in the study area. The terrain on this old lake plain is mostly level to gently sloping, but some steeper areas are located on breaks along streams. The major soils in this association were formed on silt loam material that was deposited in the old glacial lake or in fine sandy deposits overlying silty material, that is, glacial till or lake sediments (Reeder et al. 1973).

Most of the soil in the harbor region and in the industrial area to the east is classified as "Made Land" by the Soil Conservation Service. It consists of landfill, manganese ore tailings ponds, industrial waste lagoons, borrow pits, and those areas where the soil is covered by streets, homes, factories or docks. In all of these areas, the original soils have been greatly altered (Reeder et al. 1973).



ASHTABULA HARBOR, OHIO

Figure 5. Soils in the Ashtabula River AOC.

U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table 5. Soil association characteristics, Ashtabula Harbor region.

Soil Association	Map Symbol*	Soil Series	Parent Material	GENERAL CHARACTERISTICS: Depth to - Bedrock (feet)	Depth to - Seasonal High Water Table (feet)	Depth From Surface (typical profile) (inches)	Dominant USDA Texture	Permeability (Inch/Hr)	Reaction (pH)	Soil Features Affecting Waterways
Conneaut-Swanton, Claverack	2	Conneaut	Strongly acid mantle and glacial till derived from lacustrine silt loam	>6	0 - 1/2	0 - 27	Silt loam	0.2 - 0.63	4.6 - 5.5	Subject to sever silting
						27 - 70	Silt loam	0.06 - 0.2	6.1 - 7.8	
	3	Swanton	Calcareous weathered glacial till	>6	0 - 1/2	0 - 11	Fine sandy loam	0.63 - 2.0	4.6 - 5.5	Subject to prolonged wetness
						11 - 27	Fine sandy loam	0.63 - 2.0	5.1 - 6.5	
						27 - 70	Silt loam	<0.06	6.1 - 7.8	
	4	Claverack	Silt loam glacial till	>6	1-1/2 - 3	0 - 33	Loamy fine sand	6.3 - 12.0	4.6 - 5.5	Channels are erodible and droughty
						33 - 70	Silt	<0.06	6.1 - 7.8	
Chenango-Red Hook-Atherton	5	Red Hook	Acid glacial outwash derived mainly from sandstone and shale	>6	1/2 - 1-1/2	0 - 15	Silt loam	0.63 - 2.0	4.6 - 5.5	Prolonged wetness
						15 - 36	Loam	0.06 - 0.2	4.6 - 5.5	
						36 - 54	Gravelly sandy loam	2.0 - 6.3+	4.6 - 5.5	
	11	Atherton	Same as Red Hook but in lowest, wettest areas	>5	0 - 1/2	0 - 19	Silt loam	0.63 - 2.0	4.6 - 5.5	Poorly drained
						19 - 32	Gravelly silt loam or silty clay loam	0.06 - 0.2	5.6 - 6.0	
						32 - 50	Loamy gravel	>6.3	6.1 - 6.5	
	8	Holly	Loamy alluvium washed from loamy glacial till	>6	0 - 1/2	0 - 10	Silt loam	0.63 - 2.0	4.6 - 6.0	Subject to flooding
						10 - 27	Silty clay loam	0.2 - 0.63	5.6 - 6.0	

Table 5. Soil association characteristics, Ashtabula Harbor region. (continued)

Soil Association	Map Symbol*	Soil Series	Parent Material	GENERAL CHARACTERISTICS: Depth to – Bedrock (feet)	Depth to – Seasonal High Water Table (feet)	Depth From Surface (typical profile) (inches)	Dominant USDA Texture	Permeability (inch/Hr)	Reaction (pH)	Soil Features Affecting Waterways
Platea-Pierpont	6	Platea	Silt loam glacial till of Wisconsin age	>6	1/2 - 1-1/2	0 - 13	Silt loam	0.2 - 2.0	4.1 - 5.5	Erodible on slopes, seepage on fragipan
						13 - 18	Silty clay loam	0.2 - 0.63	4.1 - 5.5	
						18 - 60	Silt loam	>0.06	6.6 - 7.8	
	9	Brace-ville	Loamy materials and underlying sand and gravel derived from noncalcareous sandstone	>6	1-1/2 - 3	0 - 10	Loam	0.63 - 2.0	4.6 - 6.0	Subject to seepage and erosion
						10 - 29	Silt loam	0.63 - 2.0	5.1 - 5.5	
						29 - 34	Loamy sand	0.2 - 0.63	4.6 - 5.0	
						34 - 60	Sand and gravel	6.3 - 12.0+	4.6 - 5.0	
	10	Lobdell	Silt loam or loam sedmients	>6	1-1/2 - 3	0 - 14	Silt loam	0.63 - 2.0	5.1 - 6.0	Subject to flooding
						14 - 50	Silt loam	0.63 - 2.0	5.1 - 6.0	

*See Figure 5

Source: From Reeder, et al., 1973, as compiled by U.S. Army Corps of Engineers, 1975.
Figure 5. Soil associations in the Ashtabula River AOC.

The majority of the undisturbed soil in the area is in the Conneaut Series which are classified as poorly drained, loamy soils that generally occur on nearly level land. The upper part of these soils were formed in silt loam material that was deposited over glacial till. These soils are seasonally wet and require artificial drainage to improve crop yields. Many of the areas where they occur have been drained (Reeder et al. 1973).

Important soil characteristics are shown in Table 5. Erosion potential is high for soils in the Claverack, Platea and Braceville Series. These soils occur along the east bank of the Ashtabula River and the reaches of Fields Brook. The riverbed is composed of Lobdell silt loam. The Lobdell material follows the old riverbed out into Lake Erie and under the west breakwall of the harbor. (Reeder et al. 1973).

General land use

Land use patterns in the Ashtabula River AOC do not contribute significantly to the pollution problems of the river since point sources rather than nonpoint sources are responsible for the sediment contamination.

Land use in the Ashtabula River watershed was categorized by the Ohio Department of Natural Resources from 1986 aerial photographs (Ohio Dept. of Natural Resources, 1990). The breakdown is presented in Table 6. Approximately 87 percent of the watershed is rural, with 40 percent as forested lands and 47 percent devoted to agricultural activities. Most of the agricultural activities are restricted to the upper river reaches. Vineyards and dairy farming dominate the agricultural use, but other crops include corn, lumber, soybeans, hay, oats and winter wheat (Dispenza 1987).

Land use statistics for the City of Ashtabula and Ashtabula Township generally describe the land use patterns in the AOC. These uses are also presented in Table 6. Residential property is largely concentrated on the west side of the river, although there are several neighborhoods which are located adjacent to the lower reaches of Fields Brook. Within these residential areas are four central business districts of varying economic importance.

Industries are located in Ashtabula west of the river and along Strong Brook, but the majority of the industrial facilities in the AOC are located along Fields Brook and the Lake Erie shore, east of Ashtabula Harbor. Ashtabula's industrial base is concentrated in chemicals, metal alloys and plastics manufacturing. The lowest reaches of the river, including the harbor, support additional industrial uses in the form of dock facilities and railyards to accommodate commercial shipping. There are also a number of abandoned hazardous waste disposal sites in the AOC which will be further discussed in the chapter on known and potential sources.

Recreational land use along the banks of the Ashtabula River in the AOC consists mostly of marina facilities and launching ramps. There are two public beaches and parks on Lake Erie: Walnut Beach to the west of the harbor mouth and Lakeshore Park east of the harbor mouth. The area along the river immediately upstream from the AOC is parkland. There are no existing or proposed state nature preserves or scenic rivers in the Ashtabula River AOC (Ohio Dept. of Natural Res. 1986). In order to comparatively visualize

Table 6. General land use statistics in the Ashtabula River watershed and Area of Concern. Data summarized from information provided by the Ohio Department of Natural Resources (Ohio Dept. Nat. Res. 1990).

Land Use	Ashtabula River Watershed Acres	Ashtabula River Watershed Percent	Ashtabula River AOC Acres	Ashtabula River AOC Percent
Residential	5,703.79	5.98	3,546.55	26.17
Industrial	592.69	0.62	1,254.60	9.26
Commercial & Services	1,296.54	1.37	1,302.22	9.61
Recreational	392.44	0.40	176.88	1.31
Utilities & Communications	1,671.09	1.76	888.22	6.55
Agricultural	44,973.95	47.13	1,865.41	13.77
(Confined Feeding)	(178.15)	(0.40)	(--)	(--)
(Rangeland)	(6,400.37)	(14.23)	(1,195.30)	(64.08)
(Cropland)	(31,900.60)	(70.93)	(546.72)	(29.31)
(Pasture)	(3,991.56)	(8.88)	(--)	(--)
(Orchards)	(125.86)	(0.28)	(36.90)	(1.98)
(Farmsteads)	(2,377.41)	(5.29)	(70.65)	(3.79)
(Nurserys)	(--)	(--)	(15.84)	(0.85)
Forests	37,840.68	39.65	3,971.02	29.31
Wetlands & Water	2,557.69	2.68	250.62	1.85
Undeveloped & Other	396.64	0.41	294.82	2.18
	95,425.51	100.00	13,550.34	100.00

general land use in the Ashtabula area, percentages of the different uses are presented in a pie chart in Figure 6.

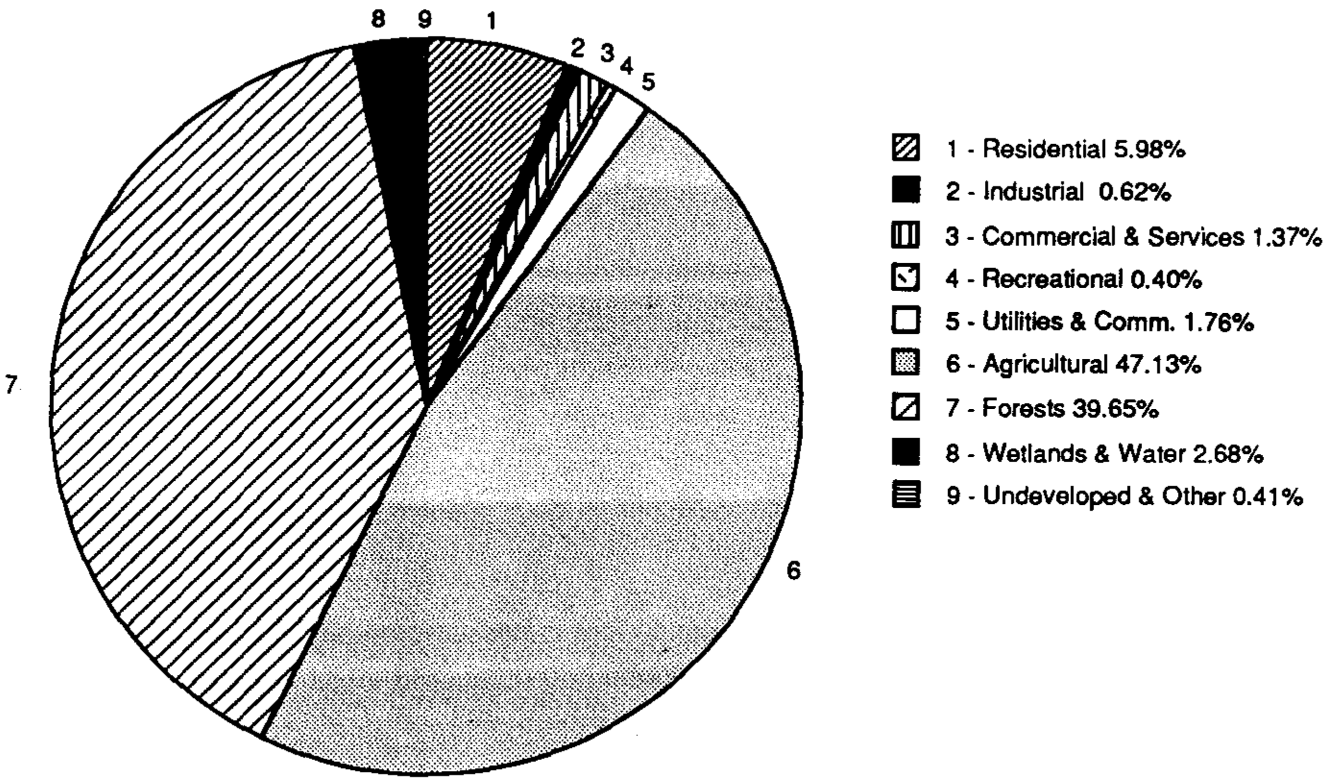
Water uses

Waters from the Ashtabula River AOC are used for a number of activities. A general overview of water uses is presented in Table 7 and a map of water supply intakes and recreational facilities is presented in Figure 7.

The Ohio American Water Company provides drinking water to approximately 38,000 people in the city of Ashtabula and the surrounding townships. The company has two 1500 ft. intake pipes in Lake Erie west of the river mouth. Plant design capacity is 10 MGD and average production is 5.06 MGD.

Water for industrial use is taken from Lake Erie by the Cleveland Electric Illuminating Company (CEI) Power Plant and several other industries located

GENERAL LAND USE STATISTICS FOR THE WATERSHED



GENERAL LAND USE STATISTICS FOR THE AOC

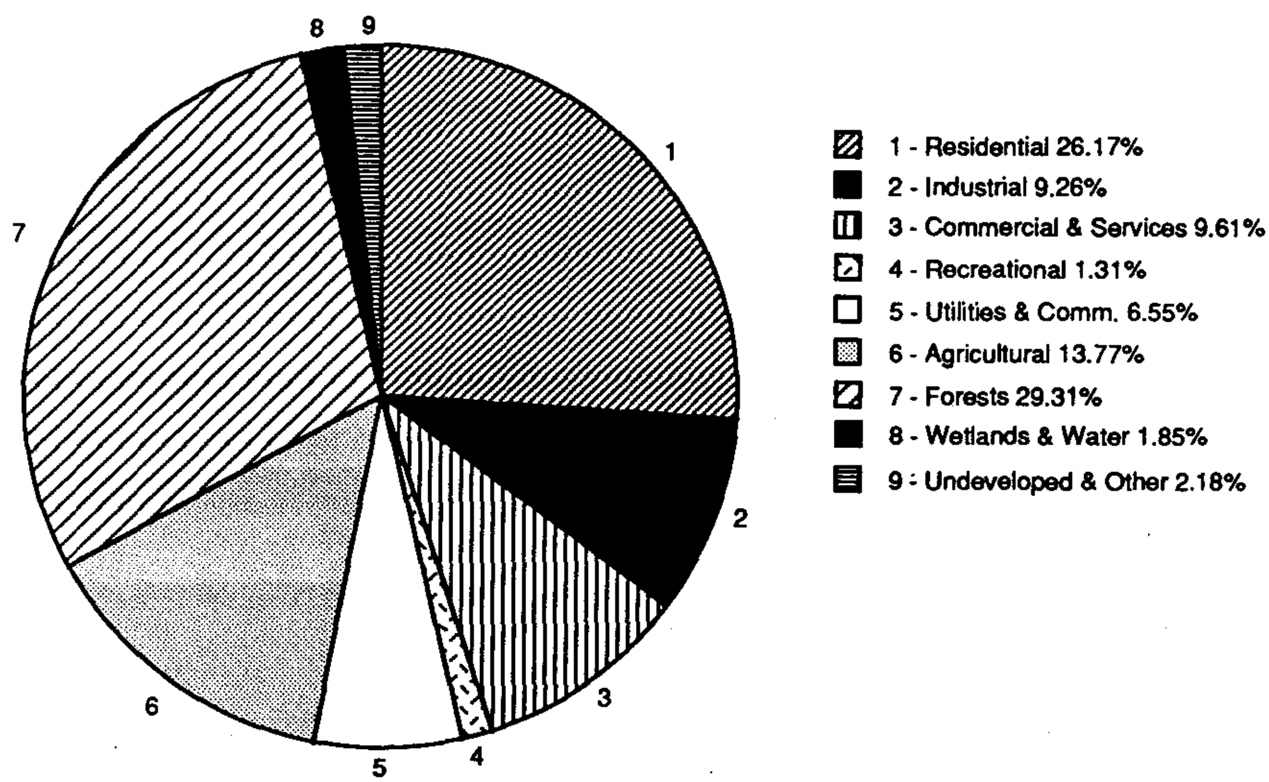


Figure 6. Comparative percentages of land use in the Ashtabula River watershed and the AOC.

Table 7. Water Uses in the Ashtabula River AOC. (Classifications are subjective and not based on statistical surveys).

	River	Harbor	Fields Brook	Lake Erie
Shipping	L	S	N	S
Commercial Fishing	N	N	N	F
Sport Fishing	L	L	L	S
Boating/Sailing	S	S	N	S
Swimming	N	O	N	S
Surface Water Supply to:				
Drinking Water				
- Municipal				X
Industrial				
- Power Plants				X
- Chemical Companies				X
Receiving Waters for:				
- Municipal WWTP				X
- Chemical Industry			X	X
- Cooling Water			X	X
- Landfill leachate	X		X	
- Combined Sewer Overflow	X			

N - Negligible Use
L - Limited Use
O - Occasional Use
F - Frequent Use
S - Significant Use
X - Present

near the lakeshore. A company called ASHCO operates an intake east of the harbor mouth, approximately 4000 ft. offshore, and supplies water to a number of the Fields Brook industries. Generally, this water undergoes no treatment prior to its use. Several companies have experienced problems attaining their NPDES discharge limits because ambient metals concentrations in the water supply from Lake Erie are greater than the allowable discharge concentrations.

The heaviest use of the lower river is for recreational boating. Presently, there are nine marinas and yacht clubs in the area with an estimated 1200 slips, almost a three-fold increase from the 350 slips available in 1985. In 1988, there were ten launching ramps for day use, but demand far exceeds availability. Further expansion is already being planned by some marinas. Accumulation of contaminated sediments has postponed dredging, and many of the deeper draft boats now have trouble navigating.

1. Ashtabula Public Water Supply Intake
2. CEI Intake
3. ASHCO Intake
4. Walnut Beach
5. Lakeshore Park
6. Point Park
7. Sutherland Marine
8. Marshall Marine
9. Ashtabula Yacht Club
10. Kister Marine
11. Jack's Marine North
12. Riverside Yacht Club
13. Harbor Yacht Club
14. Jack's Marine
15. Recreation Unlimited
16. Community Boating Center

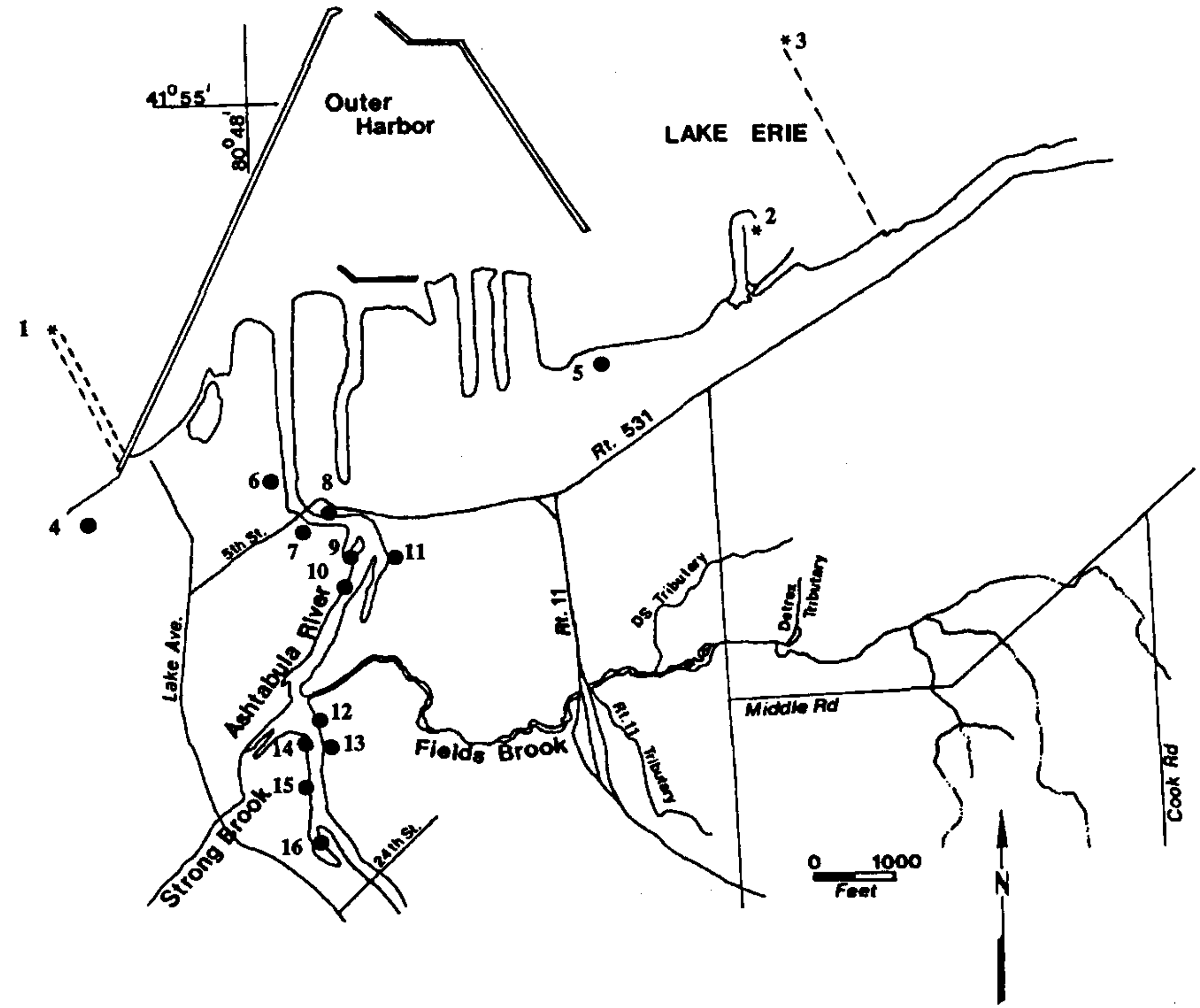


Figure 7. Location of water supply intakes and recreational facilities in the Ashtabula River AOC.

* Water Supply Intake
● Recreational Facility

Ashtabula is still an important deep draft commercial harbor, although total tonnage has declined from that of a few decades ago. Coal is the major commodity shipped from Ashtabula. Approximately 4,974,709 tons of coal were loaded in 1990. Stone and iron ore are unloaded at Ashtabula, and it is one of the leading United States receiving ports for potash (Lake Carriers' Association 1990). The shallowness of the river limits commercial traffic to the channel downstream from the 5th St. Bridge. Even in this area, shoaling is hindering freighter movement. Sediments in this area have become increasingly contaminated as pollutants move downriver, and the material can no longer be dredged and disposed of in the open lake.

Swimming in the river is not commonplace within the boundaries of the AOC. The river itself is not conducive to swimming due to the potential health hazard from contact with contaminated sediments, the heavy recreational boat traffic and lack of beaches. Boaters occasionally anchor and swim in the outer harbor near the west breakwater where a sheltered sand bar exists. The two bathing beaches in the area - Walnut Beach and Lakeshore Park - are located along the Lake Erie shoreline east and west, respectively, of the harbor mouth. Walnut Beach has a large sand beach. An organized effort was initiated in April 1989, to focus on improving the beach and the concessions, providing security and promoting entertainment activities at the beach. Lakeshore Park has a smaller beach and recurring problems with erosion. Several shore structures have been built over the years to address this problem. Lakeshore Park also has launch ramps and a picnic and camping area. Both beaches consistently meet bacteriological water quality standards for bathing waters.

Although a fish consumption advisory for all species is in effect for the lower two miles of the river, people still fish from the river banks. Fishing is also popular from the west breakwall and along rip rap in the outer harbor. Fishing for perch and walleye (particularly walleye) in Lake Erie has improved considerably over the past several years, and there are now more than 50 registered fishing charters operating out of Ashtabula. There were no charters registered in 1983. Fishing tournaments have become very popular. Several commercial fishing boats have also begun fishing the Ashtabula/Lake Erie area and come into Ashtabula to unload. The productivity of the fishery will be discussed in more detail in Chapter 4.

The AOC receives wastewater from 17 industries, a municipal WWTP, storm sewers, several combined sewer overflows and the water treatment plant. Although not exactly a beneficial use as far as the environment is considered, wastewater discharge is a necessity for all of these operations.

<u>Standards, Guidelines and Specific Objectives Applicable to the AOC</u>

Related to water uses discussed in the previous section are the Ohio Water Quality Standards (WQS), Chapter 3745-1 of the Ohio Administrative Code. In the WQS, streams and waterbodies in the state have been assigned use designations identifying the basic uses the waterbody supports or is capable of supporting. Specific water quality standards protective of aquatic life and human health are associated with each designated use. Violations of these standards indicate there is a pollution problem and beneficial uses may potentially be impaired. The designated uses relevant to the Ashtabula River

AOC are presented in Table 8.

The WQS have five general criteria, referred to as the five freedoms. The specific water quality standards developed for each designated use are protective of these five freedoms. The five freedoms are listed as follows:

1. Free from suspended solids or other substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life.

2. Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation.

3. Free from materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to cause a nuisance.

4. Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone (e.g. metals, organic chemicals).

5. Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae (e.g. phosphorus, nitrogen).

The GLWQA also lists the five freedoms as general objectives to be met for the waters of the Great Lakes system. One of the main goals of the GLWQA is to work toward the prohibition of discharge of toxic substances in toxic amounts and the virtual elimination of the discharge of persistent toxic substances. Annex 1 of the Agreement lists specific objectives to be achieved for selected pollutants in ambient water and fish. These objectives are applicable to the Great Lakes boundary waters which include river mouths at the same elevation as the lakes. In the Ashtabula AOC, those objectives are applicable to Lake Erie, the harbor and the river, but not Fields Brook or Strong Brook.

The U.S. EPA also has ambient water quality criteria for the protection of aquatic life and human health. For most substances, U.S.EPA criteria and Ohio water quality standards are the same. In some instances, Ohio WQS are less stringent than U.S. EPA criteria. This is usually because the species for which the more stringent standards are required are not found in Ohio. The Ohio WQS also contain standards for a number of parameters for which U.S. EPA has not yet developed criteria.

Of the Ohio WQS, GLWQA objectives and U.S. EPA criteria, only the Ohio WQS are legally enforceable for regulatory programs in Ohio, but Ohio WQS must be approved by U.S. EPA. A comparison of the Ohio WQS, GLWQA objectives and U.S.EPA criteria is presented in Appendix Table A-1.

There are no standards for pollutants in sediment. In 1977, U.S. EPA issued guidelines for the classification of Great Lakes harbor sediments in response

Table 8. Use designations for the Ashtabula River AOC as listed in the Ohio Water Quality Standards. Also includes proposed revisions for the November 1991 rule-making. (X indicates existing: * indicates proposed)

Stream Segment	Use Designations: Aquatic Life Habitat: State Resource Water	Warmwater	Exceptional Warmwater	Modified Warmwater	Seasonal Salmonid	Coldwater	Limited Resource Water	Water Supply: Public	Agricultural	Industrial	Recreation: Bathing Waters	Primary Contact	Secondary Contact	Comments
Strong Brook		X					*		X	X		X		* Proposed for change to Limited Resource Water - Small Drainageway Maintenance. Agricultural Water Supply use to be deleted.
Fields Brook														
- from St. Rte. 11 to confluence with the Ashtabula River		L							X	X		X		L=Limited Warmwater Habitat Varied criteria for total dissolved solids (3500 mg/l).
- West Brook (Rte. 11 Tributary)							*			*			*	Currently not listed.
- all other segments		L							X	X		X		Limited Warmwater Habitat. Exempt from total dissolved solids standard. Proposed to delete Agricultural Water Supply for all of Fields Brook.
Ashtabula River		X							X	X		X		
Ashtabula Harbor - from river mouth to outer harbor breakwall	X		X					X	X	X	X			This area is considered to be part of Lake Erie.
Lake Erie	X		X					X	X	X	X			

to the need to make immediate decisions regarding the disposal of dredged material (U.S. EPA 1977a). These guidelines were considered interim until more scientifically sound criteria could be developed. However, they are still being used today. In May 1988, U.S. EPA issued preliminary interim sediment criteria values for some additional organic chemicals (U.S. EPA 1988b). Criteria are based on total organic carbon content of the sediment. The 1977 sediment guidelines are listed in Appendix Table A-2. The proposed 1988 guidelines require some additional calculations, are not presented in the Appendix, and have not been used for comparisons in this report.

Criteria exist for very few contaminants in fish tissue. These consist of concentrations developed by the Food and Drug Administration and as listed in the GLWQA. These criteria are presented in Appendix Table A-3.

CHAPTER 4. ENVIRONMENTAL CONDITIONS

A detailed investigation of current environmental conditions was required to document the extent of the pollution problem in the AOC. This chapter compiles the background information needed to define the problems as related to the 14 beneficial uses listed in the GLWQA.

Environmental investigations have been conducted on the lower Ashtabula River, Fields Brook and the adjacent Lake Erie nearshore by state and federal agencies and consulting firms contracted by various companies discharging to the area waters. None of these have provided a long-term, continuous data base. These studies have not always identified the same parameters of concern, but they have always concluded that there are severe pollution problems in the area. For example, Terlacky et al. (1975) found high residual chlorine, mercury, dissolved solids and other metals as the primary pollutants impacting the Ashtabula River and Fields Brook. At that time, residual chlorine concentrations up to 12 mg/l effectively eliminated or severely impacted the biological community in segments of the river and Fields Brook. Investigations by U.S. EPA in 1980 revealed the presence of numerous organic chemical compounds in the water column, sediment and fish. Fish returning to the area after the elimination of high residual chlorine accumulated elevated body burdens of PCBS and numerous other chlorinated organics (Barna and Easterling 1981). Sampling by the U.S. Army Corps of Engineers prior to maintenance dredging of the navigation channel (which was subsequently never completed) revealed high concentrations of metals and organic chemicals in the sediments. PCBs were found in high enough concentrations to classify some of the sediments as toxic (greater than 50 mg/kg) (Environmental Research Group 1979 and Aqua Tech 1983).

Elevated concentrations of contaminants today are found mainly in the sediments, but some pollutants do occasionally exceed standards for the water column and fish tissue. A summary of pollutants found in the Ashtabula AOC is presented in Table 9. Contaminants are further identified as priority pollutants and carcinogens, and whether they are found in the water column, sediment or fish tissue. In addition to the pollutants listed in Table 9, uranium was found above background levels in the river sediment. The concentrations were below Nuclear Regulatory Commission guidelines and ruled by U.S. EPA to be within the boundaries of acceptable risk. The rest of this chapter focuses on the existing quality of the water, sediment and biological community in the AOC.

Water Quality

Over 90% of the water supply to Lake Erie comes from the Detroit River. Only 0.072% of the water supply is provided by the Ashtabula River (Terlacky et al 1975). In the overall picture, the Ashtabula River discharge has little impact on open-lake water quality of Lake Erie, but it does impact the immediate area and the nearshore.

Upstream of the AOC (essentially upstream from RM 2), levels of nutrients, conductivity, total suspended solids, total dissolved solids, hardness and

Table 9: Pollutants identified in the Ashtabula River Area of Concern. This table was compiled from the results of a number of studies conducted in the area since 1975. This table documents only positive identification of pollutants.

				WATER				SEDIMENT				FISH
PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	
<u>Inorganics</u>												
Aluminum	N	N	N	X	X	X	–	X	X	X	–	–
Arsenic	Y	Y	Y	–	–	–	X	X	X	X	X	X
Barium	N	N	N	X	X	X	X	X	X	X	X	–
Beryllium	Y	Y	–	–	–	–	–	–	X	X	–	X
Cadmium	Y	N	Y	X	X	X	X	X	X	X	X	–
Chromium	Y	N	Y	X	X	X	X	X	X	X	X	–
Copper	Y	N	Y	X	X	X	X	X	X	X	X	X
Cyanide	Y	N	N	–	X	–	–	X	X	X	–	–
Iron	N	N	Y	X	X	X	X	X	X	X	X	–
Lead	Y	N	Y	X	X	X	X	X	X	X	X	X
Manganese	N	N	N	X	X	X	–	X	X	X	X	–
Mercury	Y	N	Y	X	X	X	X	X	X	X	X	X
Nickel	Y	N	Y	X	–	–	X	X	X	X	X	–
Nitrogen (Ammonia)	N	N	N	X	X	X	X	X	–	–	X	–
Nitrate + Nitrite	N	N	N	X	X	X	X	X	–	–	X	–
Phosphorus	N	N	N	X	X	X	X	X	–	–	X	–
Oil and Grease	N	N	N	–	–	–	–	X	X	–	X	–
Silver	Y	N	–	–	–	–	–	–	X	X	–	X
Zinc	Y	N	Y	X	X	X	X	X	X	X	X	X
Total Dissolved Solids	N	N	Y	X	X	X	X	–	–	–	–	–
Phenols	Y	N	–	–	–	–	–	X	X	–	X	–
<u>Organics</u>												
Aldrin + Dieldrin	Y	Y	Y	X	X	–	X	–	X	–	–	–
PCBs	Y	Y	Y	–	–	–	X	X	X	X	X	X

Table 9: Pollutants identified in the Ashtabula River Area of Concern. (Continued)

				WATER				SEDIMENT				FISH
PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	OUTER HARBOR	ASHTABULA RIVER	FIELDS BROOK	LAKE ERIE	
PAHs												
Acenaphthene	Y	Y	-	-	-	-	-	X	-	-	-	-
Anthracene	Y	Y	-	-	-	-	-	X	X	-	-	-
Benzo(a)anthracene	Y	Y	-	-	-	-	-	X	X	-	X	-
Benzo(a)pyrene	Y	Y	-	-	-	-	-	X	X	X	X	-
Benzo(b)fluoroanthene	Y	Y	-	-	-	-	-	X	X	-	X	-
Chrysene	Y	Y	-	-	-	-	-	X	X	-	X	-
Fluoranthene	Y	Y	-	-	-	-	-	X	X	X	X	X
Fluorene	Y	Y	-	-	-	-	-	X	X	-	-	-
Naphthalene	Y	Y	-	-	-	X	-	X	X	-	-	-
Phenanthrene	Y	Y	-	-	-	-	-	X	X	X	X	-
Pyrene	Y	Y	-	-	-	-	-	X	X	-	-	-
2-chloronaphthalene	-	-	-	-	-	-	-	-	X	-	-	-
Benzo(k)fluoranthene	Y	Y	-	-	-	-	-	-	X	-	-	-
Other Organics												
Acetone	N	N	-	-	-	-	-	-	X	X	-	-
Benzene	Y	Y	-	-	-	-	-	-	-	X	-	-
Bis(2-ethylhexyl) phthalate	Y	N	Y	-	-	-	-	X	X	X	X	-
2-butanone	N	N	-	-	-	-	-	-	X	X	-	-
Butylbenzyl phthalate	Y	N	Y	-	-	-	-	-	X	X	-	-
Chlorobenzene	Y	N	-	-	-	-	X	-	X	-	-	-
Chloroform	Y	Y	-	-	-	X	-	-	-	X	-	-
1,1-dichloroethene	Y	Y	-	-	-	-	-	-	-	X	-	-
Diethyl phthalate	Y	N	Y	-	-	X	-	-	-	X	-	-
Dimethyl phthalate	Y	N	Y	-	-	-	-	-	-	X	-	-
Di-n-butyl phthalate	Y	N	Y	-	-	-	-	-	X	X	-	-
Ethylbenzene	Y	N	-	-	-	-	-	-	X	X	-	-

Table 9: Pollutants identified in the Ashtabula River Area of Concern. (Continued)

PARAMETER	PRIORITY POLLUTANT	CARCINOGEN	PERSISTANT TOXIC*	WATER: OUTER HARBOR	WATER: ASHTABULA RIVER	WATER: FIELDS BROOK	WATER: LAKE ERIE	SEDIMENT: OUTER HARBOR	SEDIMENT: ASHTABULA RIVER	SEDIMENT: FIELDS BROOK	SEDIMENT: LAKE ERIE	FISH
<u>Other Organics (Continued)</u>												
Fluorotrichloromethane	N	N	–	–	–	–	–	–	–	X	–	–
Hexachlorobenzene	Y	Y	–	–	–	X	X	–	X	X	–	X
Hexachlorobutadiene	Y	Y	–	–	–	X	–	–	X	X	–	X
Hexachloroethane	Y	Y	–	–	–	–	–	–	X	X	–	–
Methylene chloride	Y	Y	–	–	X	X	–	X	X	X	X	–
1,2-Dichlorobenzene	Y	N	–	–	–	X	X	–	–	–	–	–
1,3-Dichlorobenzene	Y	N	–	–	–	X	X	–	X	–	–	–
1,4-Dichlorobenzene	Y	N	–	–	–	X	X	–	X	–	–	–
n-nitrosodiphenylamine	Y	Y	–	–	–	X	–	–	–	–	–	–
Carbon tetrachloride	Y	Y	–	–	–	X	X	–	–	–	–	–
Octachlorostyrene	N	N	–	–	–	–	–	–	X	–	–	X
Xylene	N	N	–	–	–	–	–	–	X	X	–	–
Pentachlorobenzene	N	N	–	–	–	–	X	–	–	–	–	X
1,1,1,2-tetrachloro-ethane	N	N	–	–	–	–	–	–	X	–	–	–
1,1,2,2-tetrachlor-ethane	Y	Y	–	X	X	X	–	–	–	X	–	–
Tetrachloroethene	Y	Y	–	X	X	X	–	–	X	X	–	X
1,2-transdichloroethene	N	N	–	–	–	X	–	–	–	X	–	–
1,1,2-trichloroethane	Y	Y	–	–	–	X	–	–	–	X	–	–
1,1,1-trichlorethane	Y	N	–	–	–	–	–	–	–	X	–	–
Trichloroethene	Y	N	–	X	X	X	–	–	X	X	–	X
Toluene	Y	N	–	–	–	–	–	–	X	X	–	–
Vinyl chloride	Y	Y	–	–	–	–	–	–	–	X	–	–
1,2,4-trichlorobenzene	N	N	–	–	–	–	X	–	X	–	–	–
1,2-dichloroethane	Y	Y	–	–	–	X	–	–	–	–	–	–
1,3,5-trichlorobenzene	N	Y	–	–	–	–	X	–	–	–	–	–
1,2,3,4-tetrachlorobenzene	N	Y	–	–	–	–	X	–	–	–	–	–

* As identified in the Great Lakes Water Quality Agreement

Y – Yes　　X – Pollutant detected in medium

N – No　　"–" – Pollutant not present or not tested alkalinity were found to be some of the lowest in the state for streams unimpacted by point source discharge (Brown 1988). Conversely, concentrations of chromium and cadmium at 19.8 and 3.5 ug/l, respectively, were some of the highest background levels in the state (Brown 1988). This was determined by statistical analysis of data collected on the river upstream from Fields Brook.

Monthly sampling at river mile 6.24, approximately four miles upstream from the AOC, indicates occasional violations of Ohio Water Quality Standards (WQS) and U.S. EPA Water Quality Criteria for iron. The source of these violations is attributed to background levels and nonpoint source runoff. An organic scan conducted by Ohio EPA in 1987 at this site did not detect any organic chemicals. Based on available information it appears the sources and pollutant impacts in the river are confined to the AOC.

The U.S.G.S. operated a water quality monitor at river mile 0.8 from 1968 to 1979, which recorded daily measurements of dissolved oxygen (DO), pH, conductivity and temperature. Occasional violations of Ohio WQS were noted for conductivity and pH, but DO standards were violated numerous times from June through September throughout the period of record. During 1979, the last year of record, DO standards were exceeded 11% of the time in the summer months, with a minimum concentration of 3 mg/l. This showed a marked improvement over the early 1970s when standards were exceeded over 60% of the time and a minimum of 0.3 mg/l was recorded. Dissolved oxygen concentrations in the lower river are strongly influenced by harbor morphology, low flow, meteorological conditions and lake levels, so low DO's are not related solely to chemically degraded water quality. However, low DO's are a problem whether related to pollution or alteration of the natural river morphology. Corps of Engineers' sediment analysis over the years indicate sediments are moderately polluted with oxygen demanding materials. Since no more recent DO data is available, it will be assumed low DO's still occur occasionally during the summer months of high temperaure and low flow.

During remedial investigation studies for the Fields Brook Superfund site in 1983, water quality samples were collected at six stations in the river and outer harbor (CH_2M Hill 1985). Violations of Ohio water quality standards were noted for cadmium, lead and mercury. Aldrin and dieldrin appeared to exceed standards at the river mouth, but quality control data could not totally substantiate this. GLWQA objectives were exceeded for all these parameters as well as for iron and zinc (Table 10). Mercury violations were difficult to assess because concentrations were measured close to the detection limit of 0.2 ug/l. Methylene chloride was the only organic chemical detected above the confluence of Fields Brook. Tetrachloroethene, trichloroethene and 1,1,2,2-tetrachloroethane were detected downstream from the Fields Brook confluence, but only 1,1,2,2-tetrachloroethane was quantifiable (present at concentrations above the detection limit) (CH2M Hill 1985). None of the organics exceeded water quality standards.

Additional water quality samples were analyzed from the river in 1990, also in association with the Fields Brook Superfund investigation (Woodward Clyde Consultants 1991). GLWQA objectives were exceeded for iron, total dissolved solids (TDS) and copper for most of the river. Two sites on the river exceeded Ohio WQS for iron, there were no TDS violations and copper standards were exceeded only at the mouth of Fields Brook. Cadmium exceeded Ohio WQS, U.S. EPA criteria and GLWQA objectives at the mouth of Fields Brook, but was not detected at any other sites. Lead concentrations exceeded U.S. EPA criteria at the mouth of Fields Brook and Strong Brook, but did not violate Ohio WQS or GLWQA objectives. Ohio WQS and U.S. EPA criteria for endosulfan were exceeded at the mouth of Strong Brook as was the GLWQA objective for zinc. Violations are summarized in Table 10. Methylene chloride, vinyl acetate, acetone and trichloroethene were the only organics detected, and none exceeded water quality standards or objectives.

Both of the above surveys provide only a snapshot of ambient water quality conditions at the time of sampling, and cannot be used to track water quality trends. However, there were no contaminants that continually exceeded WQS or were present in amounts greatly exceeding acceptable levels.

No recent data is available for fecal coliform content in the river; however, bacteriological water quality at the Walnut Beach and Lakeshore Park beach adjacent to the harbor mouth continually meet bathing water standards. An exception to this was exceedence of bathing water standards for two days at Lakeshore Park in July 1989. The violations were recorded following a heavy rainfall (R. Saporito, Ashtabula County Health Department, personal communication 1990).

Ohio EPA has analyzed monthly water quality samples from river mile 0.33 on Fields Brook since 1975. This is the only long-term monitoring data available for the AOC. Over the period of record, violations of WQS have been measured for ammonia, cyanide, cadmium, copper, iron, zinc, fecal coliform, total residual chlorine, mercury and total dissolved solids (conductivity). Since 1985, violations have been recorded for only iron and total dissolved solids.

Organic scans from RM 0.33 in 1987 and 1988 measured 12 organic chemicals in the water column, but none exceeded water quality standards. Two of the most important contaminants, PCBs and mercury, have not been analyzed from this site since 1983 and 1981, respectively. At that time, both exceeded water quality standards.

During the remedial investigation for Fields Brook (CH_2M Hill 1985), sixteen sites were analyzed for water quality in the Fields Brook watershed. Fourteen organic chemicals were detected but only six were quantifiable: chloroform, 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane; tetrachloroethene; trichloroethene; and 1,2-trans-dichloroethene. Three exceeded water quality standards: 1,1,2,2-tetrachloroethane; tetrachloroethene and trichloroethene (Table 10). All violations were restricted to the DS tributary (See Figure 2 for location of DS tributary).

Total dissolved solids (TDS) have been a continual problem in Fields Brook and have initiated considerable discussion between industry and regulatory agencies. The normal criteria for TDS in the Ohio Water Quality Standards is 1500 mg/l. However, due to difficulties in removing TDS from several of the industrial waste streams and the low flow of Fields Brook, a criteria variance of 3500 mg/l was granted for lower Fields Brook downstream from Route 11. There is no TDS standard from Route 11 upstream to the headwaters because the number of outfalls in close proximity in this area make mixing zones difficult to define and because the brook has been culverted for at least 600 ft. in

Table 10. A summary of ambient Water Quality Standards violations measured in the Ashtabula River AOC. (All concentrations are ug/l).

Site / Parameter	Concentrations Max.	Min.	Mean	Standard Deviation	Number of Samples	Detection Limits	Ohio WQS Aquatic Life	Ohio WQS Human Health[1]	U.S. EPA Criteria Aquatic Life	U.S. EPA Criteria Human Health	GLWQA Objectives
Ashtabula River											
* Cadmium	5.9	1.0	2.1	1.4	11	1.	1.8(5)[2]	---	1.5(6)	---	0.2(11)
* Iron	800.	160.	516.	193.	11	20.	1000.	---	1000.	---	300.(10)
* Aldrin & Dieldrin	0.21	0.0	0.02	0.060	11	0.1	0.1(1)	0.00079(1)	3.0	0.00079(1)	0.001(1)
* Mercury	0.3	0.2	0.21	0.029	11	0.2	0.2(2)	0.012(2)	0.012(2)	0.146(2)	0.2(2)
* Lead	29.	5.	9.8	7.1	11	5.	11(3)	---	4.9(6)	---	25.(1)
* Zinc	130.	10.	31.	33.7	11	10.	140.	---	141.	---	30.(3)
** Dissolved Oxygen (mg/l)	15.2	2.5	9.0	3.7	48	---	4.0(8)	---	4.0(8)	---	6.0(13)
x Copper	129.	0.0	13.5	30.6	23	2.4	16(2)	---	16(2)	---	5.(9)
x Cadmium	3.5	0.0	0.15	0.7	23	3.2	1.8(1)	---	1.5(1)	---	0.2(1)
x Iron	4850.	353.	900.	860.	23	13.7	1000.(2)	---	1000.(2)	---	300.(23)
x Lead	7.8	0.0	1.29	2.26	23	1.5	11.	---	4.9(4)	---	25.
x Zinc	62.3	6.8	16.0	14.6	23	1.4	140.	---	141.	---	30(2)
x Endosulfan	0.13	0.0	0.01	0.03	23	.05	.003(2)	2.0	.056(2)	159	---
Fields Brook											
* Cadmium	13.	1.	2.2	3.0	18	1.	6.4(1)	---	5.2(2)	---	[3]
* Mercury	0.7	0.2	0.3	0.16	18	0.2	0.2(7)	0.012(7)	0.012(7)	0.146(7)	---
* 1,1,2,2-tetrachloroethane	1900[4]	5.	42.4	24.5	9	5.	360.(1)	107.(1)	2400.	107.(1)	---
* Tetrachloroethene	230[4]	5	22.5	14.9	9	5.	73.(1)	3500.	840.	8.85(7)	---
* Trichloroethene	1300[4]	7.5	44.3	25.9	9	5.	75.(1)	807.(1)	21900.	807.(1)	---
* Iron	3310.	275.	1117.	856.4	18	20.	1000.(5)	---	1000(5)	---	---
+ Total Dissolved Solids--See Figure 8											
Lake Erie (Water intake)											
+ 1985											
Cadmium	0.7	0.2	0.4	0.29	3	0.2	1.8	10.	1.5	10.	0.2(1)
Chromium	70.	30.	43.	23.1	3	30.	270.	50.(1)	270.	170000.	50.(1)
Copper	30.	10.	14.	8.9	5	10.	16.(1)	1000.	16.(1)	---	5(1)
Iron[5]	22600.	280.	4874.	9911.	5	20.	1000.	---	1000.	300.	300.
Lead	22.	2.	6.	8.9	5	2.	11.(1)	50.	4.9(1)	50.	25.
Zinc	115.	10.	65.	70.7	5	10.	140.	5000.	141.	---	30.(1)
x 1990											
Copper	35.5	4.8	17.5	.75	12	2.4	16.(7)	1000.	16.(7)	---	5(11)
Iron	4810.	892.	2502.	1610.4	12	13.7	1000.(8)	---	1000.(8)	300.(12)	300.(12)
Zinc	41.0	6.0	19.7	9.81	12	1.4	140.	5000.	141.	---	30.(2)
Total Diss. Solids (mg/l)	227.	169.	194.2	17.1	12	10.	1500.	---	---	---	200(4)
Mercury	0.5	0.0	0.05	0.15	12	0.4	0.2(1)	0.012(1)	0.012(1)	0.146(1)	0.2(1)
Bis(2-ethylhexyl)phthalate	13.0	0.0	1.08	3.59	12	10	8.4(1)	59.	---	50000.	0.6(1)

Table 10. A summary of ambient Water Quality Standards violations measured in the Ashtabula River AOC. (All concentrations are ug/l). (Continued)

Site / Parameter	Concentrations: Max.	Min.	Mean	Standard Deviation	Number of Samples	Detection Limits	Ohio WQS: Aquatic Life	Ohio WQS: Human Health[1]	U.S. EPA Criteria: Aquatic Life	U.S. EPA Criteria: Human Health	GLWQA Objectives
++Lake Erie (nearshore)[5]											
Cadmium	57.	0	4.9	---	78	2.	1.8	10.	1.5	10.	0.2
Copper	217.	0	31.2	---	78	10.	16.	1000.	16.	---	5.
Mercury	1.0	0	0.18	---	77	0.2	0.2	0.012	0.012	0.146	0.2
Iron	4710.	8.	602.	---	78	20.	1000.	---	1000.	---	300.
Zinc	325.	4.	49.	---	78	5.	140.	5000.	141.	---	30.
Nickel	139.	0	17.	---	78	20.	232.	610.	210.	13.4	25.
Lead	313.	0	10.	---	78	50.	11.	50.	4.9	50.	25.

1 Human health standards for the Ashtabula River and Fields Brook are based on surface water concentrations that could bioaccumulate in fish tissue making fish consumption potentially deleterious to human health. Human health standards for Lake Erie include consumption of water as well since Lake Erie is designated as public water supply.

2 The number in parenthesis indicates the actual number of violations recorded during the sampling period. Due to the nature of the data, individual violations are not listed for Lake Erie nearshore data.

3 GLWQA objectives are not applicable to Fields Brook as it is not considered a boundary water (not at lake level).

4 These values indicate localized extreme maximums on the DS tributary. They were not used to calculate means or standard deviations.

5 Exact number of violations could not be determined.

Sources:

* CH_2M Hill 1985
** U.S.G.S. Water Resources Data 1968-1979
\+ Ohio EPA STORET data
++ 1978-1979 U.S. EPA STORET data
x Woodward Clyde Consultants 1991

this segment. The 3500 mg/l TDS was a concentration calculated to occur during drought conditions when all industries were simultaneously discharging at maximum permitted levels. It was intended that Fields Brook TDS concentrations of 3500 mg/l would be sufficiently assimilated by the time the brook flow reached the 15th Street water quality guage so that Fields Brook discharge would have minimal impact on the lower brook and the Ashtabula River.

TDS concentrations can be closely correlated to conductivity, and conductivity has often been used to track changes in TDS because it is easier to measure. The USGS water quality monitor at 15th Street (RM 0.33) on Fields Brook records daily maximums, minimums and means of conductivity. Extreme variations are recorded from day-to-day indicating discharge slugs of high TDS. Violations are frequent, often occuring more than 50 percent of the time. As measured by Ohio EPA, TDS concentrations appear to be increasing over the years rather than decreasing (Figure 8).

TDS in Fields Brook is a parameter that is being more closely investigated. Toxicity in water in the upstream segment of Fields Brook has been found to be acutely toxic to Daphnia. It is suspected that the toxicity is due to high TDS. Several industries discharging elevated TDS are currently required to conduct bioassays to determine if their effluents are toxic and if the toxicity is due to TDS. This will continue to be an element of concern in Fields Brook.

Due to the elevated TDS, hardness in Fields Brook is extremely high, averaging 700 mg/l. The hardness allows higher metal concentrations than normally accepted in WWH streams. Cadmium is the only hardness dependent parameter exceeding water quality standards in Fields Brook (CH_2M Hill 1985). Other violations are noted for mercury and iron. The quality assurance/quality control results for mercury indicate the data may not be reliable. Violations cannot be substantiated, but the data suggest they may exist.

It is difficult to determine existing water quality in the Lake Erie portion of the AOC. The most complete data base is from the 1978-1979 Nearshore Study (Rathke 1984). The nearshore study indicated ambient water quality exceeded Ohio WQS, U.S. EPA criteria and GLWQA objectives for cadmium and copper. The nearshore data for mercury suggest U.S. EPA criteria, Ohio WQS and GLWPA objectives were often exceeded. However, the 0.2 ug/l detection limit itself was greater than all of the above criteria. Again, mercury violations cannot be substantiated but may exist. In addition to the above violations, GLWQA objectives were consistently exceeded for iron and zinc with occasional violations for Ohio WQS and U.S. EPA criteria. Occasional violations of GLWQA objectives for nickel and lead were also noted.

Analysis of raw water at the Ashtabula public water supply intake provides an indication of water quality in the nearshore as well as documenting the suitability of the water as a drinking water source. Metals and organics were monitored monthly at the intake until 1986 by Ohio EPA. Violations of Ohio WQS for copper and lead were noted in 1985. All of the violations occurred during December, suggesting they may have resulted from a winter storm. No violations were found in 1986 (Table 10)(Ohio EPA, unpublished STORET data).

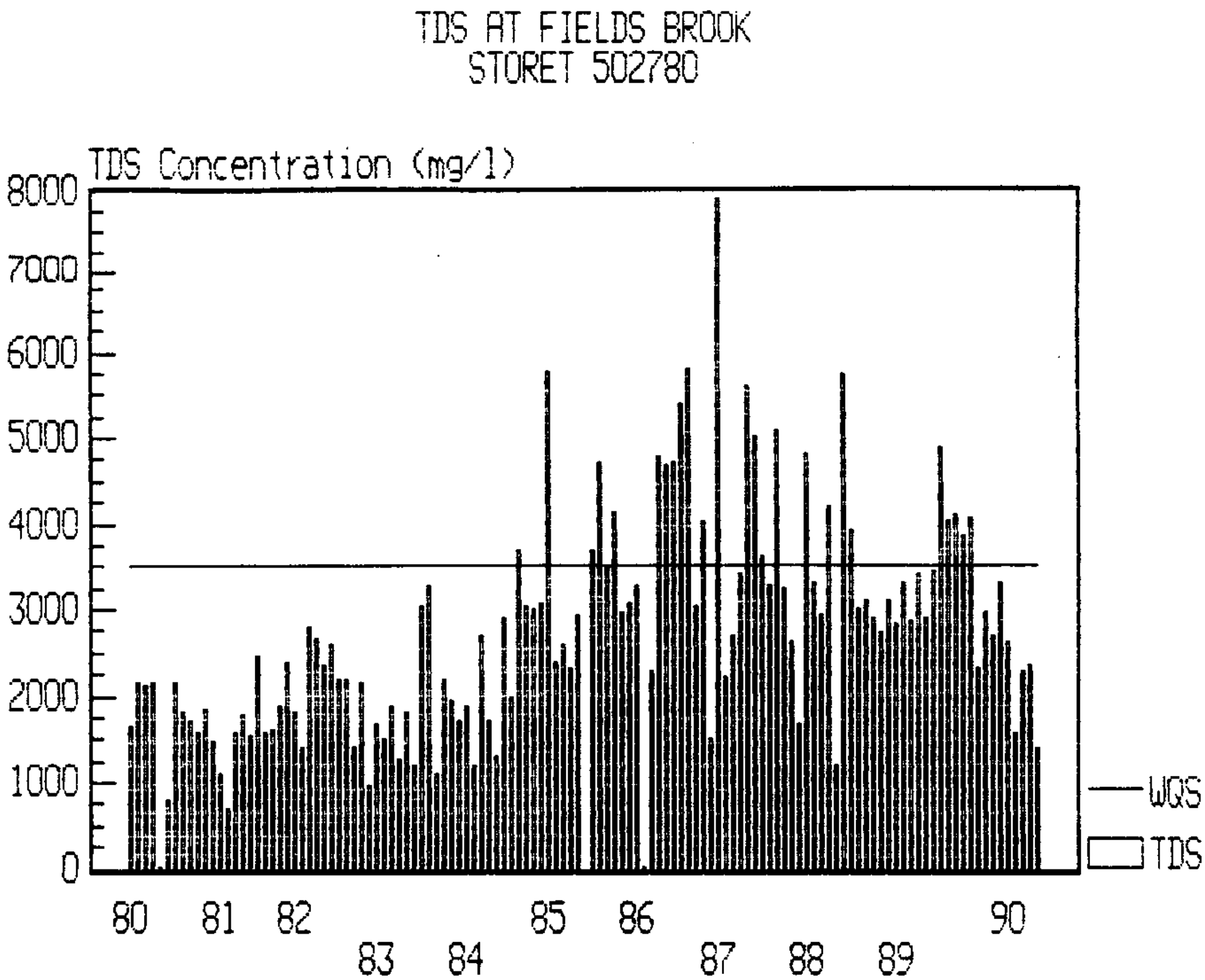


Figure 8. Total Dissolved Solids (TDS) concentrations measured at RM 0.33 on Fields Brook from 1980 to 1990. (STORET data).

Finished drinking water meets public drinking water standards and no difficulties meeting these standards have been reported regardless of the raw water quality.

Sampling at the intake under varying weather conditions was conducted in 1990 to determine if the Ashtabula River plume impacted water quality at the intake (Woodward Clyde Consultants 1991). Violations of Ohio WQS were noted for copper, iron and bis(2-ethylhexyl)phthalate. GLWQA objectives were also exceeded for these parameters and for zinc and total dissolved solids. One mercury violation was noted, but the detection limit was too high to determine if other mercury violations occurred (Table 10). Methylene chloride was the only other organic detected. Sampling was not extensive enough to determine if violations were caused by the river plume or were the result of ambient concentrations in the lake. The U.S. Army Corps of Engineers (1988b) has calculated that a 25 mph northeast wind coupled with a river flow greater than 450 cfs would be needed for the river discharge to directly affect the water supply intake. Contaminant concentrations in the river water would also have to be high at that time.

Violations of water quality criteria for metals are common throughout the Lake Erie southshore nearshore zone, particularly near river mouths, and cannot be readily associated with any specific sources in Ashtabula. One exception to this may be mercury with elevated concentrations at the river mouth and east of the harbor down-current from the industries discharging directly to Lake Erie. Due to the nature of the data retrieval, Lake Erie water quality violations are not listed individually in Table 10. However, the summary does provide comparison of ranges and means with water quality criteria. Complete water quality data for the nearshore is presented in Appendix Table A-4.
The typical eutrophication-related conditions of high phosphorus and nitrogen concentrations, elevated BOD and low dissolved oxygen levels were not recorded for the nearshore. In 1978-1979, the Ashtabula nearshore area was considered to be borderline eutrophic/mesotrophic (Rathke 1984).

Several investigations of organics in the Lake Erie water column have been completed using analytical methods with detection limits in the range of nanograms/liter (ng/l), which are equivalent to parts per trillion. Kaiser and Valdmanis (1979) revealed Ashtabula to be a source of carbon tetrachloride and trichloroethene in the water column of Lake Erie. Concentrations off Ashtabula were higher than ambient concentrations in the central basin, but were still lower than Ohio Water Quality Standards. Unpublished data analyzed by Environment Canada indicate organochlorine pesticides, PCBs and chlorobenzenes are all below water quality standards in the Lake Erie waters off Ashtabula. However, many were reported above detection limits (Rathke and McRae 1989). 1,3,5-trichlorobenzene and 1,2,3,4-tetrachlorobenzene at concentrations of 0.162 and 0.092 ng/l, respectively, observed offshore of Ashtabula were the highest in Lake Erie and indicate the Ashtabula River is probably a source (Stevens and Nielson 1989).

Ground Water

As mentioned in the water uses section, ground water in the AOC is limited and not used as a water supply. Some ground water contamination has been documented in the Fields Brook drainage basin area of the AOC east of the river. Its contribution to the pollution of Fields Brook, the Ashtabula River or Lake Erie is unknown.

Most of the ground water contamination has been found via monitoring wells in the Fields Brook area.

Several old impoundments at the Detrex site have leached methylene chloride, tetrachloroethene and trichloroethene into the ground water. Ground water contamination at the Occidental site is attributed to poor disposal practices in the past when the company was owned by Diamond Shamrock. Carbon tetrachloride was identified as the primary chemical of concern. At both of these sites the companies are now required to collect and treat stormwater runoff on their property to prevent further ground water contamination.

The Elkem Metals Company reports leachate containing ammonia, sulfates and metals is seeping into the shallow ground water from two of its sludge ponds. Mercury in ground water has been identified at Linchem (formerly Linden Chemical and Plastics - LCP). L-TEC reported chlorobenzene in the ground water near its site. Ground water contaminated with trichlorethene, uranium and technetium 99 has been discovered at the RMI Extrusion Plant.

An assessment of overall ground water contamination and flow in the area has not been completed, but is underway as part of the Superfund investigation. Most of the ground water monitoring conducted to date has been done under RCRA. Contamination has not been considered a significant risk to human health because of the slow movement of ground water and the fact that ground water is not used as a public water supply in the area. This Stage 1 Report will not attempt to speculate on the severity or potential impact of contamination documented to date.

Sediment Quality

The majority of sediments in the Ashtabula River AOC are fine silts and clays washed down from the Ashtabula River watershed, and these types of particles are ones on which contaminants will readily adsorb. Larger, coarser particles, such as sands, do not retain pollutants as easily and result in cleaner sediment.

For many of the organic chemicals found in the Ashtabula River AOC, sediment standards or guidelines to rank the severity of contamination do not exist. Many of these chemicals are considered to be priority pollutants and/or carcinogens by U.S. EPA, and their mere presence in the sediment is a matter of concern. In addition to elevated concentrations, the variety of chemicals present poses a particular problem for selecting effective remediation treatment technologies for contaminated sediments.

The U.S. EPA and the U.S. Army Corps of Engineers have been involved in a substantial amount of testing with regard to pollutional characteristics of the Ashtabula River and Fields Brook since 1971. Sediments in the river channel have been variously classified as heavily polluted, non-polluted, moderately polluted, hazardous and toxic. Chemical tests referred to as EP toxicity performed in 1982 for U.S. EPA removed the hazardous designation, but sediments in the upper turning basin were still classified as toxic due to PCB concentrations greater than 50 mg/kg (Aqua Tech 1983). Bioassays on river sediments revealed those near the confluence of Fields Brook to be highly toxic to Hexagenia limbata (mayfly) and Daphnia magna (water flea), with mortalities of 55 to 80% and 40 to 62.5%, respectively (Aqua Tech 1979a). The current U.S. EPA classification lists the upper turning basin and area immediately downstream from Fields Brook as toxic, most of the river channel as heavily polluted, and the outer harbor as non-to-moderately polluted (See Figure 4 for detail).

Although there are no sediment standards, U.S. EPA has developed guidelines based on a comparative assessment of Great Lakes Harbors. When compared to these U.S. EPA guidelines (U.S. EPA 1977a), sampling in 1979 (Environmental Research Group 1979) and 1983 (Aquatech 1983) indicated Ashtabula River sediments were heavily polluted with arsenic, barium, cadmium, chromium, lead, mercury, nickel, zinc and PCB. Chemicals for which there were no guidelines but which were measured at elevated concentrations included hexachlorobenzene, hexachlorobutadiene, bis (2-ethylhexyl) phthalate, and other chlorobenzenes. Hexachlorobenzene and hexachlorobutadiene were especially high in comparison to other Great Lakes harbors. Sediment core samples suggested underlying sediment was more polluted than the surface sediments. A historical summary of sediment concentrations in the heavily polluted range is presented in Table 11. Elevated levels for selected organics are also included. Station locations are presented in Figure 9.

Extremely elevated concentrations of oil and grease (33,000 mg/kg), lead (350 mg/kg), and zinc (830 mg/kg) in surface sediment samples taken in the slip near the confluence of Strong Brook indicated a significant pollutant contribution from Strong Brook (Aqua Tech 1979b). No sediment data were available for Strong Brook itself.

Sediments in the outer harbor are classified as non-to-moderately polluted and open-lake disposed when dredged. However, a comparison of 1984 and 1988 data revealed a noticeable increase in PCB concentrations, as noted in Figure 10 (Aquatech 1984, T.P. Associates 1988). In some instances, the 1988 PCB concentrations were 9 times higher than 1984 concentrations. Only two stations showed lower concentrations in 1988 compared to 1984. These sites are at the outer edge of the harbor. Although still considered to be in the non-to-moderately polluted range, continued increases could preclude open-lake disposal.

Additional sediment sampling was undertaken in 1989 and 1990 by Woodward Clyde Consultants (WCC) for five of the Fields Brook settling PRPs: Centerior Energy (CEI), Detrex, Gulf and Western, Occidental, and RMI Titanium. This sampling effort was required under the Record of Decision for the Fields Brook Superfund site to determine the extent of contamination in the river, if the public water supply was impacted and if there were sources of pollution to the

Table 11. A historical summary of heavily polluted sediments in the Ashtabula River. All concentrations are in mg/kg.

U.S.EPA Guidelines for Heavily Polluted Sediment	Station	Arsenic 8	Cadmium 6	Chromium 75	Barium 60	Lead 60	Mercury 1	Nickel 50	Zinc 200	PCB 10	Hexachloro-butadiene NA	Hexachloro-benzene NA	Chloro-benzenes NA
Environmental Research	1(7)+	17	10.0	2200	—	66	.83	140	390	9	1.2	0.9	—
Group 1979	1(8)	19	1.1	300	—	29	.52	50	150	3	0.1	1.0	—
	1(9)	11	1.2	270	—	52	.26	43	150	12	0.3	1.4	—
+ Number in ( ) indicates	2(8)	33	<.5	57	—	31	1.60	44	140	10	6.5	2.8	—
sampling depth in feet	2(9)	37	<.5	45	—	24	2.00	44	110	5	0.9	1.1	—
below LWD	3(11)	12	4.9	83	—	50	1.20	51	250	22	0.6	3.2	—
	3(12)	26	2.1	430	—	43	0.30	50	180	13	0.3	1.3	—
	4(15)	17	4.3	120	—	55	0.89	49	300	4	0.2	0.4	—
	4(16)	17	5.3	300	—	61	3.40	44	240	27	22.0	4.6	—
	5(10)	30	7.9	440	—	52	1.30	61	320	72	12.0	22.0	—
	6(13)	8	9.8	1000	—	96	1.40	87	660	63	1.7	15.0	—
	6(14)	31	1.0	90	—	34	3.00	48	190	3	0.2	0.4	—
Aqua Tech 1983	1*	12	8.	501	990	78	.78	63	604	29	0.3	0.7	23.4
	1**	23	8.	629	660	89	1.70	51	278	120	2.0	9.9	179.0
* Composite to 10 ft.	2*	14	5.	787	1160	54	2.70	54	188	25	0.3	3.2	89.4
below LWD	2**	56	7.	214	600	79	3.70	46	172	31	0.2	10.0	103.9
	3*	25	5.	72	530	38	2.00	38	187	8	0.02	0.3	7.8
** Composite to 14 ft.	3**	47	6.	64	220	63	2.20	32	138	11	0.1	2.1	36.9
below LWD	4*	27	5.	98	570	45	1.00	39	206	10	0.02	0.5	7.3
	4**	39	3.	132	200	56	1.80	28	144	24	0.1	1.5	23.6
	5*	26	5.	82	680	45	0.90	35	157	8	0.03	1.1	8.1
	5**	20	9.	541	690	88	4.70	55	173	70	0.5	32.0	306.0

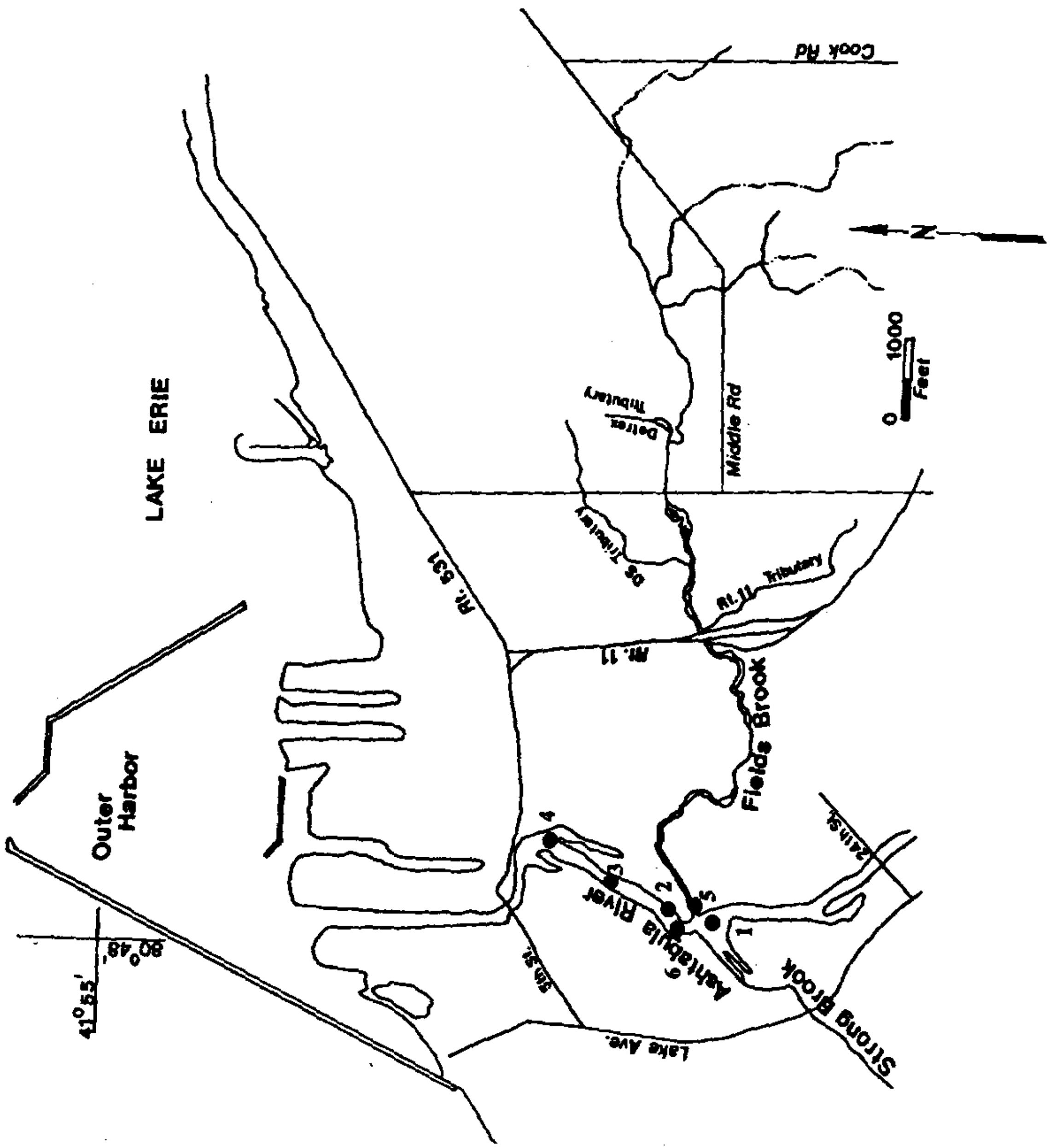


Figure 9. Sampling locations for the sediment summary presented in Table 11.

river in addition to Fields Brook. The study plan was coordinated with U.S. EPA, the U.S. Army Corps of Engineers and the Ohio EPA. This was an intensive study designed to determine the vertical and horizontal extent of contamination and identify pollutant sources to the Ashtabula River.

During this sampling effort, 115 stations throughout the AOC were analyzed for metals and organics. Stations were located in Lake Erie, the harbor, the main navigation channel, outside the channel, in slips off the river itself and upstream from the navigation channel. Sediment cores were taken at most stations and sectioned to profile the vertical distribution of contaminants. The physical characteristics of the sediment were also determined. Sediment sample locations are presented in Figure 11 and Figure 12.

When compared to U.S. EPA guidelines (U.S. EPA 1977a), results of the WCC sediment analyses indicated the four lake and harbor stations (Figure 11) as non-to-moderately polluted with metals. The exception to this was arsenic which was found in heavily polluted concentrations outside the west breakwall (Station 72). Arsenic is found at naturally occurring background levels throughout the AOC which exceed the heavily polluted guideline of 8 mg/kg. Background levels of 10-15 mg/kg are common in the Lake Erie drainage basin. At the river mouth (Station 100), sediments were highly polluted with arsenic, barium and iron. Methylene chloride was the only organic chemical detected at all four stations, but bis (2-ethylhexyl) phthalate, acetone, toluene and PCBs were also detected in low concentrations at the river mouth (Station 100).

These results are consistent with the findings of the U.S. Army Corps of Engineers (T.P. Associates 1988) for the harbor stations. In addition to the two sites common to the WCC sampling effort, the ACOE analyzed samples from nine other locations in the outer harbor (Figure 11). All of these sites were heavily polluted with arsenic and barium. Most of the sites were also highly polluted with iron. In addition to the organic chemicals listed previously, nine PAHs were detected in sediment at the river mouth. Detection at other sites in the harbor was much less common. Concentrations of PAHs in the Ashtabula Harbor and River are comparable to those found in the Toledo Harbor (Maumee River) which are considered to be at the lower end of the range of values for cancer epizootics, but could pose a possible problem (Ohio EPA 1990b). WCC station 14803-08 was the only site with consistently elevated levels of PAHs. Appendix Table A-5 compares Ashtabula and Maumee River sediment PAH concentrations with those of the Black River, where high concentrations were the cause of tumors in brown bullheads. A high incidence of tumors in brown bullhead at the mouth of the Ashtabula River was discovered in 1990, but the source of the tumors has not yet been identified.

A general summary of the WCC sediment results is presented in Tables 12 and 13. Table 12 represents all stations located in the main channel of the river, while Table 13 represents stations in the slips off the main channel. These tables indicate the pollutants detected, the frequency at which they were detected and the range of concentrations. Metals and PCBs were found at almost every site. Detection of other organics was much more sporadic. Because of this, means calculated for most of the organics are not representative of sediment concentrations in the area. Means were calculated by averaging elevated concentrations at a few sites with zeroes at the majority of other sites where the chemical was not detected.

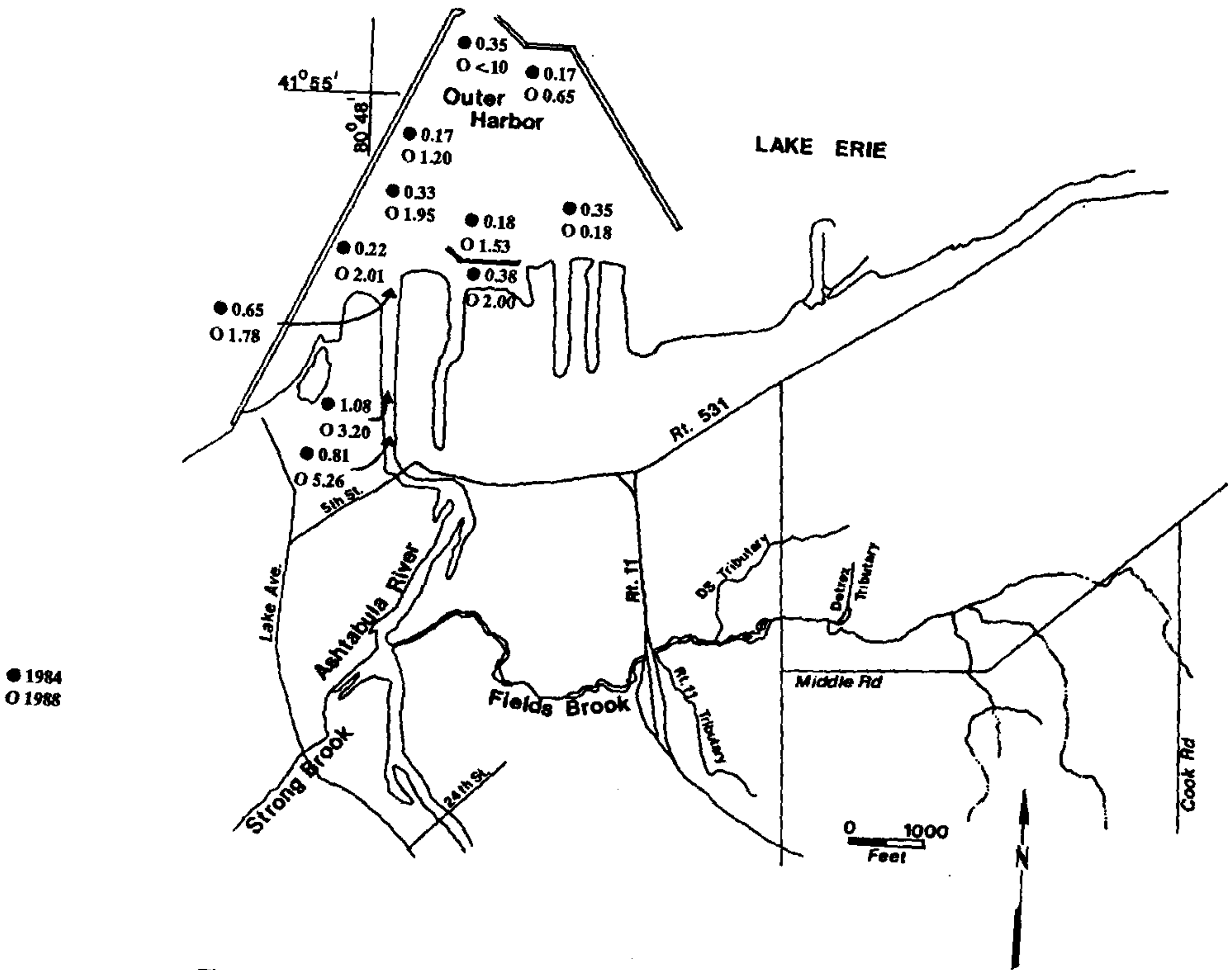


Figure 10. A comparison of 1984 and 1988 PCB concentrations in the Ashtabula outer harbor area. (Concentrations in mg/kg. Source: Aquatech 1984 and T.P. Associates 1988).

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Although all pollutants show a decreasing gradient with distance downstream from Fields Brook, this trend is most evident for the organics. Certain metals, such as chromium and mercury, show a more pronounced decrease with distance downstream, but they are also found in comparatively higher concentrations in the upper turning basin. The final Woodward Clyde Consultants Ashtabula River Investigation Report will contain detailed graphics portraying the distribution of the major pollutants longitudinally and vertically. These graphics are not yet available.

Review of the WCC data for the river indicates all sites and depths are heavily polluted with iron and arsenic. Sediments are heavily polluted with barium at all sites and depths except those upstream from the upper turning basin. For all other metals, sediments upstream from the upper turning basin are nonpolluted and vary from moderately to heavily polluted in the rest of the river. In most instances it appears contamination is greater with depth. The greatest concentrations of contaminants occur in the river at depths from 10 to 16 ft. below LWD. In the upper turning basin, highest concentrations are found from 8 to 14 ft. below LWD.

The upper turning basin and the east bank downstream from Fields Brook consistently contain the highest concentration of pollutants. This coincides with depositional patterns in the river. During periods of low lake levels, eddys created near the Conrail bridge and the mouth of Fields Brook influence deposition in these areas. During periods of high lake levels, river flow is restricted and sediments tend to settle in the upper turning basins (Woodward Clyde Consultants 1991).

Zinc and lead are highest in the Strong Brook and 5 1/2 slips, respectively. Concentrations of chromium, copper, lead and zinc are extremely elevated just downstream from the 5th St. Bridge (Station 139 Transect). Cadmium and mercury are also elevated here but not to such a high degree. Elevated concentrations are fairly near the surface, suggesting that the adjacent combined sewer overflow (CSO) was, and possibly still is, a significant pollutant source to the lower river.

One of the main purposes of the Woodward Clyde study was to document the extent and depth of PCB contamination. If PCB concentrations in the upper layers of sediment were low enough, interim dredging to relieve navigation hazards until the total river cleanup could be completed could be done without exposing toxic or more contaminated sediments. Profiling contaminants could also identify when the contaminants were deposited and possibly the source. PCBs were found at the majority of sites and depths sampled, and began to exceed the 10 mg/kg guideline for heavily polluted sediments (U.S. EPA 1977a) just downstream from the 5th St. Bridge. Moving upstream, the frequency of samples exceeding the 10 mg/kg guidelines increased, but heavily polluted concentrations were never measured in surface deposits. This suggests the original source of PCBs is no longer active, but contaminated sediments are continuing to move down the river.

Table 12. Summary of Woodward Clyde Consultants' data for sediment pollutant concentrations in the Ashtabula River navigation channel.

Parameter	Number of Samples	Number Detected	Mean	Minimum	Maximum
Metals and PCBs (mg/kg)					
Arsenic	130	130	12.9	4.5	31.1
Barium	130	130	399.5	27.6	2,152.0
Cadmium	130	88	2.7	0.0	25.0
Chromium	130	130	399.8	12.4	5,739.9
Copper	130	130	44.1	14.4	414.0
Iron	58	58	30,201.4	18,442.6	48,387.1
Lead	130	130	59.9	8.5	248.1
Manganese	58	58	491.4	124.4	2,900.4
Mercury	130	93	1.0	0.0	11.3
Nickel	130	130	41.1	13.6	142.0
Zinc	130	130	208.6	62.5	1,161.2
PCBs	402	322	11.9	0.0	660.1
Other Organics (ug/kg)					
1,2,4-trichlorobenzene	130	2	39.8	0.0	3,418.8
1,2-dichlorobenzene	130	1	5.2	0.0	675.9
1,3-dichlorobenzene	130	35	1,937.8	0.0	28,627.5
1,4-dichlorobenzene	130	15	364.5	0.0	15,047.0
2-chloronaphthalene	130	6	364.5	0.0	16,181.8
Hexachlorobenzene	130	49	734.7	0.0	26,524.4
Hexachlorobutadiene	130	34	4,562.8	0.0	560,000.0
Hexachlorethane	130	1	0.6	0.0	80.8
4,4'-DDD	62	1	11.9	0.0	738.9
2-methylnaphthalene	62	1	7.3	0.0	453.4
Anthracene	62	5	80.5	0.0	1,455.6
Benzo(a)anthracene	62	12	259.3	0.0	2,772.9
Benzo(a)pyrene	62	7	134.0	0.0	2,037.9
Benzo(b)fluoranthene	62	18	392.6	0.0	3,639.0
Benzo(g,h,i)perylene	62	2	42.6	0.0	1,601.2
Benzo(k)fluoranthene	62	5	96.1	0.0	2,079.7
Butyl benzyl phthalate	62	1	14.5	0.0	895.9

Table 12: Summary of Woodward Clyde Consultants' data for sediment pollutant concentrations in the Ashtabula River navigation channel. (Cont.)

Parameter	Number of Samples	Number Detected	Mean	Minimum	Maximum
Chrysene	62	12	266.1	0.0	2,805.3
Di-n-butyl phthalate	62	6	292.2	0.0	7,785.9
Fluoranthene	62	37	923.6	0.0	5,822.4
Fluorene	62	2	30.0	0.0	1,251.8
Indeno(1,2,3-cd)pryene	62	3	57.4	0.0	1,746.7
Naphthalene	62	2	23.8	0.0	1,018.9
Octachlorostyrene	58	10	367.9	0.0	6,000.0
Phenanthrene	62	36	1,185.8	0.0	15,185.2
Pyrene	62	25	812.5	0.0	11,093.8
Bis(2-ethylhexyl)phthalate	62	36	4,346.5	0.0	49,327.4
2-butanone	126	1	0.2	0.0	20.4
Acetone	130	91	69.1	0.0	1,254.1
Chlorobenzene	130	69	366.6	0.0	10,416.7
Chloromethane	130	5	6.8	0.0	396.3
Ethyl benzene	130	5	92.8	0.0	11,842.1
Methylene chloride	126	55	49.5	0.0	2,181.8
Toluene	130	86	38.9	0.0	731.1
Xylenes	130	22	465.3	0.0	59,210.5

Table 13: Summary of Woodward Clyde Consultants' data for sediment pollutant concentrations in slips outside the Ashtabula River navigation channel.

Parameter	Number of Samples	Number Detected	Mean	Minimum	Maximum
<u>Metals and PCBs (mg/kg)</u>					
Arsenic	24	24	12.3	6.8	21.2
Barium	24	24	342.2	35.7	1,123.1
Cadmium	24	20	3.6	0.0	15.1
Chromium	24	24	115.6	12.6	587.8
Copper	24	24	53.8	20.5	152.3
Iron	9	9	30,288.2	15,344.5	40,566.0
Lead	24	24	108.3	9.4	284.9
Manganese	9	9	333.2	104.1	468.3
Mercury	24	17	0.5	0.0	3.2
Nickel	24	24	39.0	23.1	71.4
Zinc	24	24	497.6	65.9	2,463.1
PCBs	34	15	12.8	0.0	369.4
<u>Other Organics (ug/kg)</u>					
1,2,4-trichlorobenzene	24	1	245.1	0.0	5,882.4
1,2-dichlorobenzene	24	2	426.5	0.0	8,755.1
1,3-dichlorobenzene	24	2	655.6	0.0	7,936.5
1,4-dichlorobenzene	24	4	1,849.3	0.0	24,024.0
2-chloronaphthalene	24	1	547.4	0.0	13,136.3
Hexachlorobenzene	24	3	1,975.2	0.0	45,143.6
Hexachlorobutadiene	24	6	1,673.7	0.0	34,199.7
4,4'-DDD	13	2	369.6	0.0	4,429.3
4,4'-DDE	13	1	31.5	0.0	408.9
4,4'-DDT	13	1	11.7	0.0	151.6
Dieldrin	13	1	160.6	0.0	2,087.7
4-methylphenol	9	1	4,612.2	0.0	41,509.4
Acenaphthene	13	1	769.2	0.0	10,000.0
Anthracene	13	1	1,275.8	0.0	16,585.4

Table 13: Summary of Woodward Clyde Consultants' data for sediment pollutant concentrations in slips outside the Ashtabula River navigation channel. (Continued)

Parameter	Number of Samples	Number Detected	Mean	Minimum	Maximum
Benzo(a)anthracene	13	1	1,876.2	0.0	24,390.2
Benzo(a)pyrene	13	1	1,519.7	0.0	19,756.1
Benzo(b)fluoranthene	13	3	1,922.7	0.0	22,926.8
Fluorene	13	1	1,332.1	0.0	17,317.1
Benzo(g,h,i)perylene	13	1	975.6	0.0	12,682.9
Benzo(k)fluoranthene	13	1	919.3	0.0	11,951.2
Chrysene	13	2	2,496.3	0.0	31,707.3
Di-n-butylphthalate	13	2	480.9	0.0	3,699.1
Fluoranthene	13	5	5,776.6	0.0	65,853.7
Indeno(1,2,3-cd)pyrene	13	1	1,069.4	0.0	13,902.4
Phenanthrene	13	5	7,414.3	0.0	87,804.9
Pyrene	13	5	6,131.1	0.0	73,170.7
Bis(2-ethylhexyl)phthalate	13	3	1,048.5	0.0	9,439.1
2-butanone	20	1	1.7	0.0	34.0
Acetone	24	15	316.2	0.0	5,636.7
Chlorobenzene	24	5	56.8	0.0	1,085.6
Ethyl benzene	24	2	10.6	0.0	238.5
Methylene chloride	20	7	9.3	0.0	66.4
Tetrachloroethene	24	1	0.6	0.0	13.6
Toluene	24	12	15.2	0.0	162.2
Trichloroethene	24	2	0.7	0.0	9.5
Xylenes	24	6	75.2	0.0	1,419.6

Sixteen locations were found with PCBs exceeding the 50 mg/kg standard classifying the sediments as toxic. With the exception of the mouth of Fields Brook, all toxic concentrations were covered by at least three feet of non-toxic sediment. The Fields Brook sample was only covered by 2.5 ft. A summary of this data is presented in Table 14. Station locations are identified on Figure 13.

Sediment samples from the Ashtabula River were also analyzed for radionuclides during the WCC survey in 1990. Although not in the original study plan, radionuclides were added when public concerns were raised. The RMI Extrusion plant on Fields Brook has done uranium extrusion for Department of Energy and Nuclear Regulatory Commission (NRC) uses and there was concern that discharge may have contaminated the river with uranium.

Seven transects along the river were analyzed for radionuclides (Figure 14). Each transect was divided into an upper horizon (0-10 ft. below LWD) and a lower horizon (10-20 ft. below LWD). Sediment from several locations within each horizon were homogenized to provide two representative composite samples of upper and lower layers of each transect. The sites selected for analysis were chosen for background comparison or because they were depositional zones where concentration of other pollutants had been found to be elevated. A total of 12 samples were analyzed for uranium, cesium, potassium, radium and thorium. Six samples were also analyzed for plutonium.

Uranium concentrations ranged from 2.4 to 14.1 picocuries per gram (pCi/g) in the upper horizon, with an average of 7.46 pCi/g. Concentrations ranged from 4.9 to 22.3 pCi/g in the lower horizon, with an average of 12.8 pCi/g. Natural background for Northeast Ohio is 3 to 5 pCi/g. As with most of the other pollutants, uranium concentrations increased with depth, but all concentrations were below the NRC guideline of 35 pCi/g for unrestricted use of cleaned up soils.

Uranium emits alpha particles which are low energy and can travel only short distances. Therefore, its property as a carcinogen becomes of concern when it is ingested or inhaled. The carcinogenicity of uranium is also dependent upon the duration of exposure. As with all carcinogens, there is no safe level, only a level of acceptable risk. There is some concern that the risks allowed by the NRC are not stringent enough to adequately protect human health. However, in the Ashtabula River situation, in addition to uranium concentrations falling below NRC guidelines, U.S. EPA has determined that there are no direct pathways of exposure to humans for ingestion or inhalation of the sediment. U.S. EPA has determined that no special precautions are required for dredging and disposal of Ashtabula River sediments due to radionuclides.

For the other radionuclides tested, plutonium ranged from 0.0006 to 0.02 pCi/g which is comparable to background levels worldwide from atomic weapons testing fallout. Gamma radiation emitters such as cesium, potassium, radium and thorium were not detected above background levels. Uranium concentrations are presented in Figure 14. Sampling sites and concentrations for radium, thorium and cesium are presented in Appendix Figures A-2 through A-4.

Table 14: Summary of toxic PCB concentration locations in the Ashtabula River (Woodward Clyde, 1991).

Station	Water Depth (ft below LWD)	Sediment Sampling Depth (ft. below LWD)	PCB (mg/kg) (dry weight)	Detection Limits (mg/kg)
15801	8	14	58.8	9.5
16701	12	16	62.5	14.9
16901	10	18	58.4	9.7
17001	11	14	69.1	15.0
17102	4	14	49.6	13.1
17201	8	14	107.4	16.8
		16	71.4	17.0
17601	2	10	134.0	40.0
17801	4	14	73.6	8.6
18201	1	8	191.0	117.9
18202	10	14	75.4	12.2
18501	10	16	67.1	15.2
18602	2	10	118.9	17.5
		14	280.9	83.6
18701	.5	3	369.4	68.4
18803	2	8	120.0	10.0
18902	2	8	61.8	14.7
		10	660.1	165.0
		12	101.2	19.5
19003	5	11	77.4	15.5

Figure 13. Locations of the 16 sampling sites on the Ashtabula River where PCB concentrations exceeded 50 mg/kg (ppm).

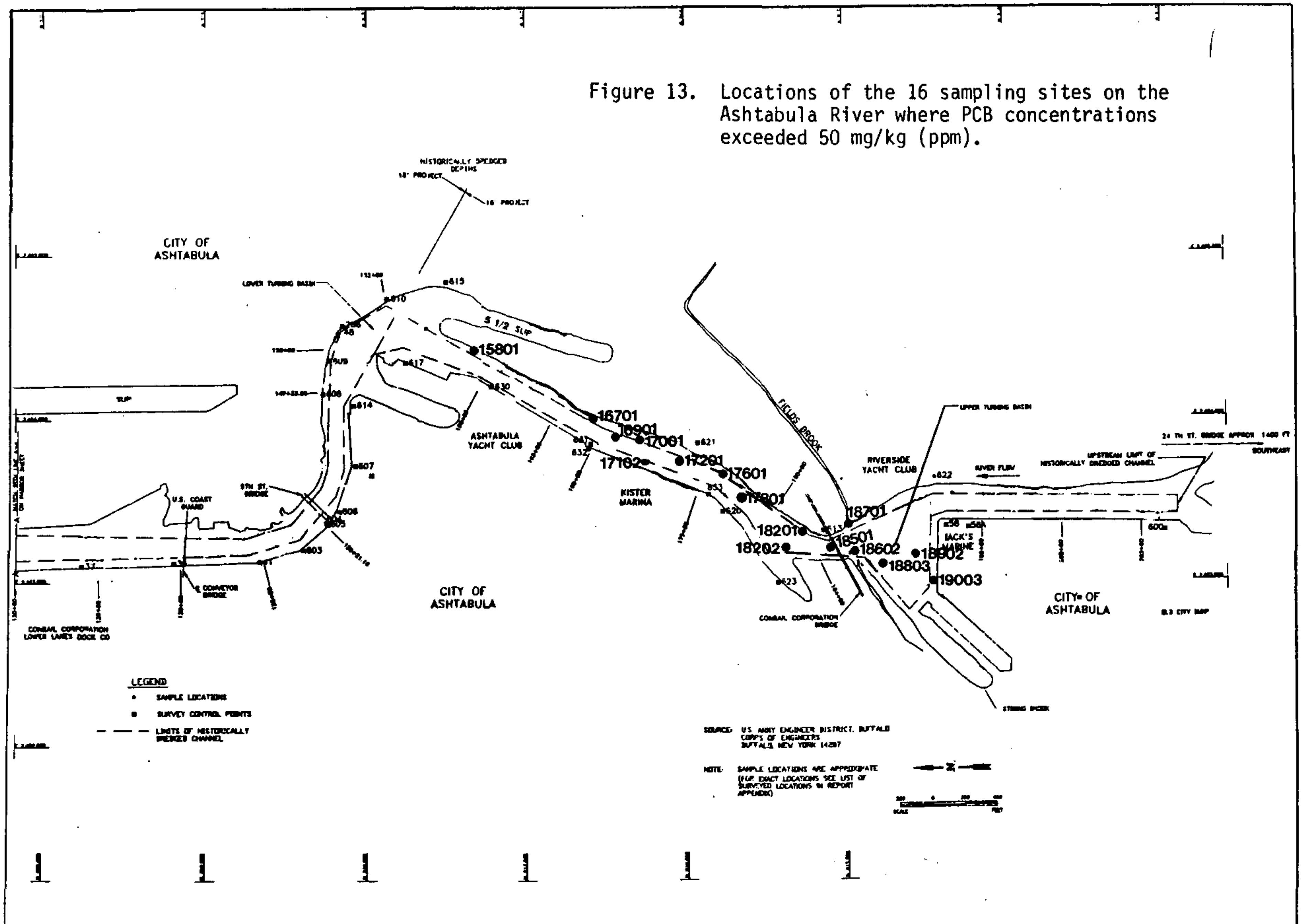
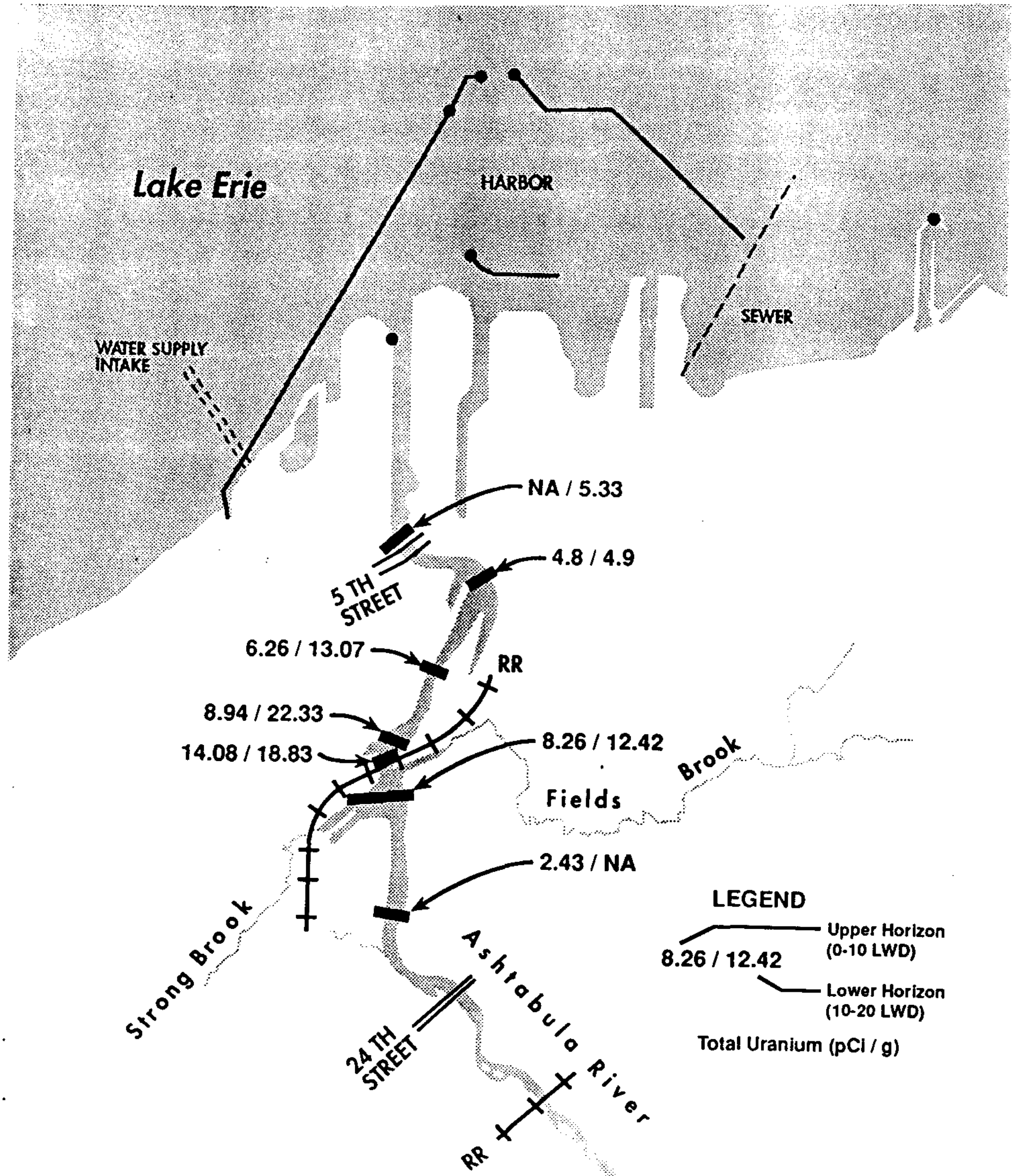


Figure 14. Radionuclide sampling locations and total uranium results for the Ashtabula River.



The most comprehensive sediment sampling effort on Fields Brook was done as part of the Superfund Remedial Investigation Report (CH_2M Hill 1985). A number and variety of organic compounds were found including volatile organic compounds (VOCs), chlorinated benzenes, PAHs, hexachlorobutadiene, phthalates, PCBs, and metals, some at extremely elevated levels. Most of these compounds were not detected upstream of the confluence of the Detrex tributary. The highest concentrations of VOCs, chlorinated benzenes, PAH, phthalates and hexachlorobutadiene were found in the DS tributary, the Detrex tributary and in Fields Brook from the Detrex tributary to the Rt. 11 tributary. Organics concentrations significantly decreased downstream of Rt. 11. Further investigations are underway.

Fourteen priority pollutant VOC's were detected in sediment samples from the Fields Brook watershed. The more frequently detected pollutants included chlorobenzene, 1,1,2,2-tetrachloroethane, methylene chloride, tetrachloroethene, trichloroethene and 1,2-transdichloroethene. Total VOC concentrations ranged as high as 900 mg/kg. Chlorinated benzene compounds ranged to 815 mg/kg, hexachlorobutadiene as high as 389 mg/kg, and PAH's greater than 10 mg/kg. These high concentrations were measured in the area described in the previous paragraph. The highest levels of phthalates (1 - 5 mg/kg) were found in Fields Brook between State Rd. and State Rt. 11. PCB concentrations greater than 50 mg/kg were very localized and found at and just downstream from State Rd. The highest concentrations were 518.3 mg/kg, 240 mg/kg, and 80 mg/kg. Concentrations downstream of State Rt. 11 decreased significantly and were generally less than 1 mg/kg until the sediment depositional zone near the mouth of the Brook (11.5 mg/kg) (CH_2M Hill 1985).

Most of the sediments downstream from the Detrex tributary are considered heavily polluted with iron, barium, arsenic, copper, nickel, zinc, cadmium, lead and mercury. Upstream of the Detrex tributary, arsenic is the only metal exceeding U.S. EPA guidelines.

Fields Brook sediments also were analyzed for radionuclides. One site was found with uranium concentrations greater than the NRC guideline of 35 pCi/g (up to 251.5 pCi/g). This site was at the RMI Extrusion Plant outfall. The material has been removed. Sampling sites and uranium concentrations found in Fields Brook are presented in Appendix Figure A-5.

Detailed maps of sampling locations and the associated pollutant concentrations can be found in the Superfund Remedial Investigation Report (CH_2M Hill 1985). Sources of pollutants can be inferred from existing data, but further studies are being conducted to substantiate assumptions and verify any active sources. Initial sampling efforts, although extensive, did not provide a good basis for determining the depth and severity of contamination. As required in the Fields Brook Record of Decision, two additional studies are currently underway on Fields Brook. These include: the Sediment Operable Unit to refine existing knowledge to properly design sediment removal and treatment; and the Source Control Remedial Investigation to determine sources of pollution.

A recent data base does not exist to adequately depict the current concentrations of pollutants in the sediment in the Lake Erie nearshore area of the AOC and the influence of the Ashtabula River discharge. However, historical information indicates there has been contaminant loadings to Lake Erie from the Ashtabula River.

The Ashtabula River discharges adjacent to a Lake Erie Central Basin sediment depositional area (Thomas and Mudrock 1979). This suggests that sediments washed from the Ashtabula River will generally remain in the area offshore from Ashtabula, and contaminated sediments from the west may also accumulate there. Data collected in 1971 (Thomas and Mudrock 1979) indicated the Ashtabula River was a source of lead, cadmium and PCB in adjacent Lake Erie sediments. Figures 15, 16 and 17 show Ashtabula as a pollutant source of these three pollutants. Concentrations of copper, chromium, cadmium, lead, iron and zinc exceeded U.S. EPA guidelines for sediment (U.S. EPA 1977a) throughout much of the sediment depositional zone in the central basin offshore of Ashtabula as shown in Figure 18 (Thomas and Mudroch 1979).

Although not found in concentrations exceeding U.S. EPA guidelines, mercury in sediment east of the mouth of the Ashtabula River is higher than that found in sediments to the west of the river. This suggests the Ashtabula River and direct dischargers to Lake Erie have contributed to mercury concentrations in the Lake Erie (Anderson and Carlson 1985). Mercury concentrations in sediment near the CEI "C" Plant outfall exceeded the 1 mg/kg guideline. Concentrations ranged from 0.7 to 3.9 mg/kg (Environmental Resource Associates 1983b). Sediments here also were heavily polluted with iron, manganese, barium and arsenic.

Air Quality

No violations of air quality standards occur in Ashtabula County. The six air quality parameters measured include ozone, total suspended particulates, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead.

BIOLOGICAL COMMUNITY AND HABITAT

Nearshore and Open Lake

Nearshore and offshore fishery studies were conducted from 1975 to 1977 in relation to open lake dredge disposal effects (Sweeney 1978). The list of species found during that study is presented in Table 15. Since the 1970's white perch have also become a prominant member of the central basin fish community (Mike Rawson, ODNR 1991, personal communication). The nearshore and open lake waters off Ashtabula have become an increasingly popular sport fishing area, particularly for walleye. In late summer, the cooler waters of the central basin produce a walleye harvest rivalling that of the western basin where productivity is highest in early summer. In fact, the productivity of the walleye fishery off Ashtabula and Conneaut has created a competition challenging Port Clinton in the western basin for the title of "Walleye Capital of the World."

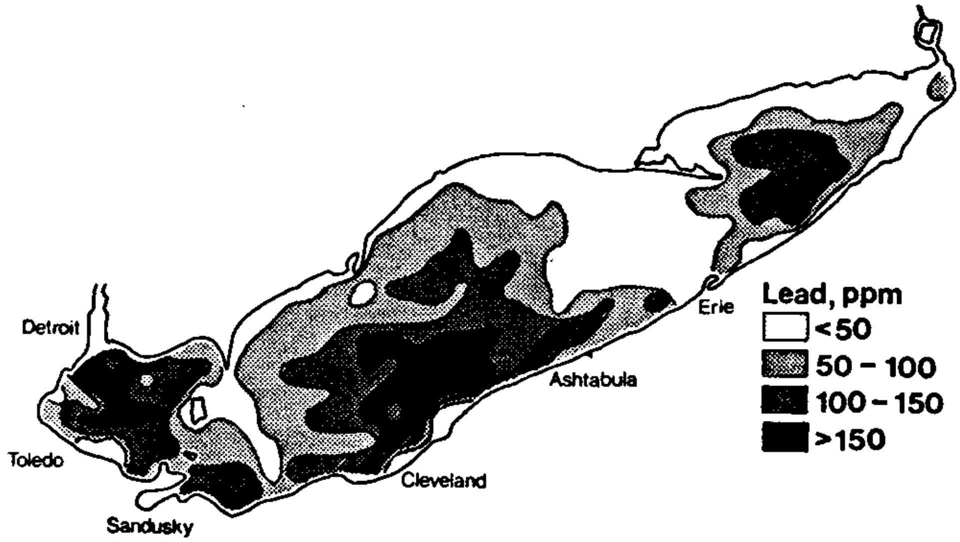


Figure 15. Concentrations of lead in the surface sediments of Lake Erie, showing the six major point sources of input. (Thomas and Mudroch 1979, Burns 1985)

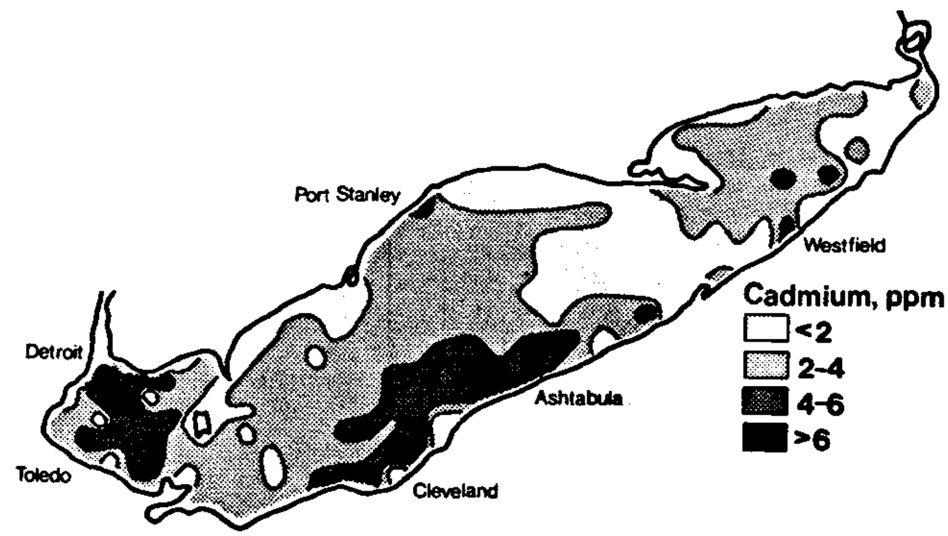


Figure 16. Distribution of cadmium in surface sediments of Lake Erie, showing the six major point sources of input. (Thomas and Mudroch 1979, Burns 1985)

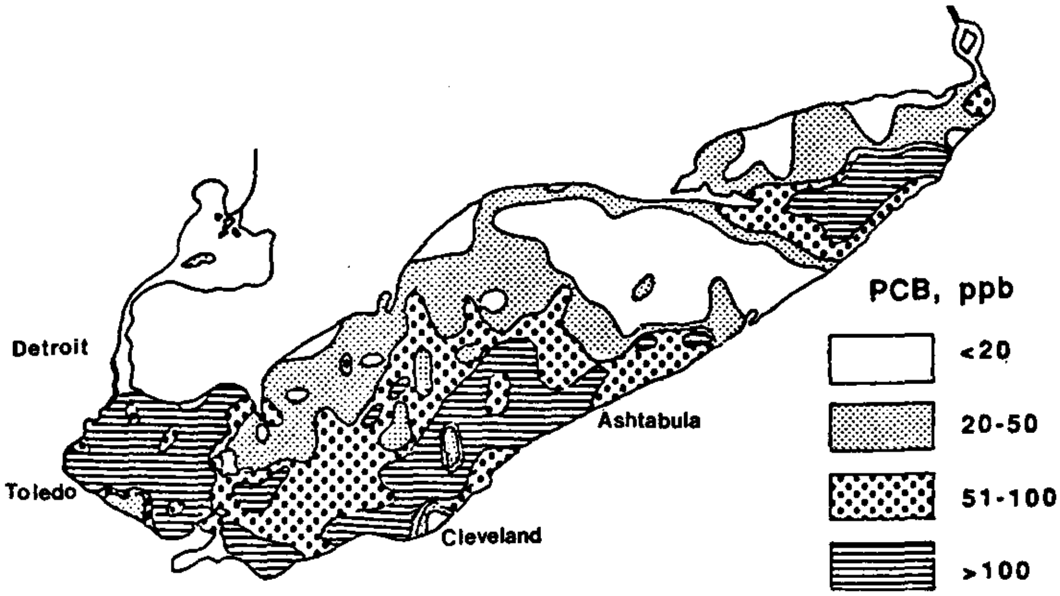


Figure 17. Concentrations of PCBs in surface sediments of Lake Erie. (PLUARG 1978)

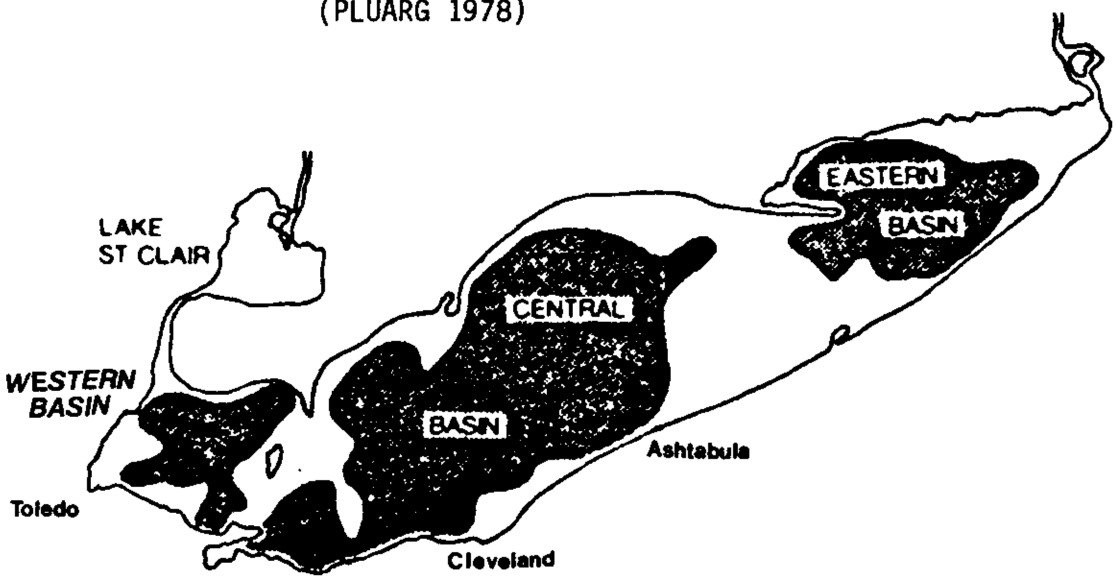


Figure 18. Sediment deposition zones in Lake Erie. (Thomas and Mudroch 1979)

In order to compile accurate statistics on the status of the Lake Erie fishery, the lake was divided into districts (Smith et al 1961). Ashtabula is in District 3 which covers the Ohio waters of Lake Erie from Fairport Harbor to Conneaut (Figure 19). Harvest statistics for the four major sport fish species in District 3 are presented in Table 16 (Ohio Department of Natural Resources 1991). The yellow perch harvest decreased drastically from 1989 to 1990. This decrease is largely related to bad weather. Perch fishing has become primarily seasonal, with fall being the preferred season. Bad weather kept fisherman off the lake in the fall of 1990 and kept the lake waters stirred up when they could get out, further reducing the catch rate. A parallel decrease in angler effort is also noted in Table 16. Complete tables comparing harvests from the three Ohio Lake Erie Districts over a 15-year period are presented in Appendix Tables A-6 to A-9. Other species, such as freshwater drum and white perch, are also caught by sport fisherman, but only the four major sought after species are highlighted.

Lake Erie was further divided into grids to focus on compiling statistics for more localized areas. Ashtabula is located in Grid 717 (Figure 19). The Ohio Department of Natural Resources conducted creel surveys of boat and shoreline anglers until 1984. The shore stations included Lakeshore Park and the west breakwall. Table 17 presents the results of the creel census from 1980 to 1985. Shoreline fishing accounted for only about 5 percent of the total fishing effort. Yellow perch was the most sought after species, but freshwater drum was the only species whose shore catch was significant in comparison to the boat catch.

A trap net commercial fishery also exists in this area (District 3). The major species harvested are yellow perch, white bass, freshwater drum, channel catfish, white perch and whitefish. Although not as productive as the western basin or the west end of the central basin, District 3 is still an important fishery, particularly for yellow perch. A summary of the 1990 commercial harvest for District 3 is presented in Table 18 (Ohio Department of Natural Resources 1991). A complete summary comparing the commercial harvests from all three districts is presented in Appendix Table A-10.

Much of the nearshore provides nursery and spawning grounds for the local fish community. The breakwall and gravel bars near the CEI power plant provide spawning grounds for rainbow smelt, carp, spottail shiner, shiner species, logperch, walleye and freshwater drum. The outer harbor breakwalls and the breakwalls lakeward of Lakeshore Park provide spawning sites for alewife, gizzard shad, rainbow smelt, brown bullhead and Johnny darter. The deeper nearshore waters provide spawning grounds for burbot, mottled sculpin and yellow perch (Goodyear, et al 1982).

Table 15. Nearshore and Offshore Fish Species in Ashtabula Harbor, 1976-1977.

Species	Nearshore	Offshore
Alewife	X	X
Gizzard shad	X	X
Rainbow smelt	X	X
Burbot	X	X
Longnose gar	X	-
Coho salmon	X	X
Northern pike	X	-
White sucker	X	X
Black redhorse	X	-
Golden redhorse	X	-
Northern redhorse	X	-
East quillback	X	-
Common carp	X	X
Goldfish	X	-
Carp x goldfish	X	-
Golden shiner	X	-
Emerald shiner	X	X
Spottail shiner	X	X
Spotfin shiner	X	-
Sand shiner	X	-
Longnose dace	X	-
Bluntnose minnow	X	-
Stonecat	X	X
Channel catfish	X	X
Black bullhead	X	-
Yellow bullhead	X	-
Brown bullhead	X	-
White bass	X	X
Banded killifish	X	X
Trout-perch	X	X
White crappie	X	-
Black crappie	X	-
Rock bass	X	X
Smallmouth bass	X	X
Largemouth bass	X	-
Green sunfish	X	-
Bluegill	X	-
Pumpkinseed	X	-
Sauger	-	X
Walleye	X	X
Yellow perch	X	X
Logperch	X	-
Johnny darter	X	-
Freshwater drum	X	X
Mottled sculpin	X	X
Total Number	44	20

Source: Sweeney, 1978

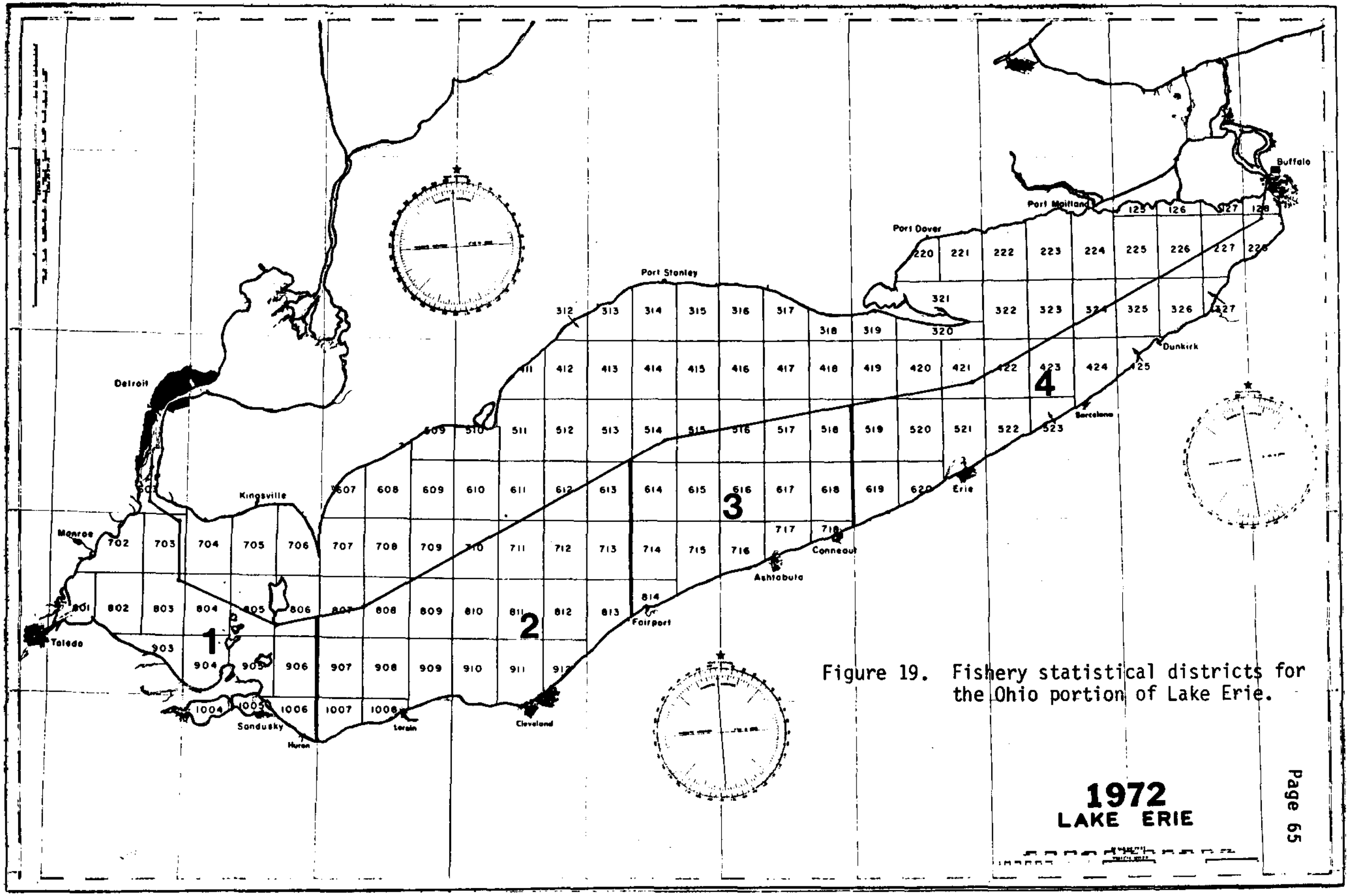


Figure 19. Fishery statistical districts for the Ohio portion of Lake Erie.

Table 16. Summary of sport fish harvest in Lake Erie waters off Ashtabula (Lake Erie Statistical District 3)

		Yellow Perch			Walleye			White Bass			Smallmouth Bass		
	Year	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total
Harvest	1986	355	22	377	163	13	176	32	0	32	71	<1	71
(in thousands	1987	472	29	501	110	22	132	23	2	25	31	<1	31
of fish)	1988	406	15	421	513	49	562	41	1	42	41	2	43
	1989	1031	27	1058	375	59	434	12	2	14	29	4	33
	1990	46	20	66	363	63	426	2	1	3	11	4	15
Effort	1986	116	6	122	512	26	538	5	<1	5	143	<1	143
(in thousands	1987	120	10	130	431	41	472	4	0	4	69	2	71
of angler hours)	1988	167	6	172	1018	63	1081	7	<1	7	59	4	63
	1989	243	5	248	800	83	883	2	0	2	40	8	48
	1990	26	6	32	789	80	869	<1	<1	<1	77	11	87
Catch Rates	1986	2.8	3.5	2.8	.30	.50	.31	2.14	0	2.10	.35	.25	.35
(fish per	1987	3.7	2.9	3.6	.25	.55	.28	1.80	0	1.80	.29	.19	.29
angler hour)	1988	2.7	2.6	2.7	.54	.78	.55	1.68	0	1.67	.13	.39	.15
	1989	4.1	5.0	4.1	.46	.72	.48	.16	0	.16	.38	.45	.39
	1990	1.6	3.3	1.9	.47	.79	.50	13.50	.06	11.13	.03	.35	.07

Source: Ohio Department of Natural Resources 1991.

Table 17. Results of boat and shore fishing creel census for the Ashtabula area (Grid 717) from 1980 to 1985.

	1980	1981	1982	1983	1984	1985*
Angler Hours						
Shore	22,002	14,038	15,708	29,287	19,097	--
Boat	367,731	279,709	149,768	100,835	272,549	--
Total	389,733	293,747	165,476	130,122	291,646	188,257
Yellow Perch						
Shore	596	2,440	245	949	198	--
Boat	68,568	93,433	101,876	22,087	64,719	--
Total	69,164	95,873	102,121	23,036	64,917	26,429
Walleye						
Shore	33	0	0	84	495	--
Boat	7,626	17,954	2,486	5,986	92,093	--
Total	7,659	17,954	2,486	6,070	92,588	24,066
White Bass						
Shore	251	14	1,285	3,601	16	--
Boat	115,186	79,093	77,809	40,068	13,125	--
Total	115,437	79,107	79,094	43,669	13,141	8,604
Freshwater Drum						
Shore	11,361	6,411	5,149	9,649	3,570	--
Boat	18,831	6,186	4,236	6,132	6,548	--
Total	30,192	12,597	9,385	15,781	10,118	3,698
Channel Catfish						
Shore	75	145	43	16	58	--
Boat	3,181	388	307	866	1,567	--
Total	3,256	533	350	882	1,625	202
Smallmouth Bass						
Shore	190	126	55	205	200	--
Boat	11,505	4,984	6,639	3,542	3,926	--
Total	11,695	5,110	6,694	3,747	4,126	1,427
Other Species						
Shore	1,085	1,288	114	757	464	--
Boat	8,593	11,096	401	1,740	4,471	--
Total	10,038	12,384	515	2,497	4,935	1,655
Total Fish						
Shore	13,593	10,432	6,892	15,258	5,001	--
Boat	233,854	213,135	193,752	80,425	186,449	--
Total	247,447	223,567	200,644	95,683	191,450	66,078

* Shore Counts were not done in 1985.

Source: Ohio Department of Natural Resources, Division of Wildlife

Table 18. Statistical summary of the 1990 commercial fish harvest for major species in the Ohio Lake Erie waters off Ashtabula (District 3).

Species	Effort[a]	Pounds[b]	Catch Rate[c]
Yellow perch	7,376	445,947	60.5
White bass	445	3,339	7.5
Freshwater drum	451	1,235	2.7
Channel catfish	2,113	8,422	4.0
White perch	1,473	21,191	14.4
Whitefish	317	277	0.9

[a] number of trap net lifts
[b] total pounds harvested
[c] pounds per trap net lift

Source: Ohio Department of Natural Resources 1991

The most recent survey of macroinvertebrates in the Ashtabula nearshore zone was conducted in 1978 and 1979. Macroinvertebrate species composition in the entire Ohio central basin nearshore zone indicated moderate organic enrichment in the areas outside harbors and evidence of a gradient of decreasing pollution in an offshore direction. The species composition is similar to that found in the eutrophic western basin open lake. Hexagenia (mayfly), a clean water indicator species, was absent throughout the southern nearshore indicating some degree of degradation everywhere. Similarities to the western basin population may be due to comparable seasonal temperatures, sediment types and depths as well as pollutant loadings (Krieger 1984). Mean number of individuals per square meter and percent contribution of the major groups to the nearshore zone macroinvertebrate community from Fairport Harbor to Ashtabula are presented in Table 19.

Phytoplankton communities in the Lake Erie southern nearshore zone were surveyed during the 1978-1979 Nearshore Intensive Study. The composition and density of the phytoplankton community in the Ashtabula nearshore zone reflected a strong seasonal variation. Densities were high throughout the year with diatoms (Bacillariophyta) dominant in the spring, green algae (Chlorophyta) dominant in early summer and blue-green algae (Cyanophyta) most abundant in late summer. Overall densities were highest in the spring and late summer. The majority of the species identified were indicative of degraded water quality. Samples collected at the mouth of the Ashtabula River showed the closest similiarity to phytoplankton composition of nearby lake stations of all the major tributaries in the Central Basin (Kline 1981). The relative abundance of the principal algal species comprising the phytoplankton in the Ashtabula area in 1978 and 1979 are presented in Table 20.

Table 19. Mean number per square meter and percent contribution of major macroinvertebrate groups to the southern nearshore zone of Lake Erie from Fairport Harbor to Ashtabula.

	1978	1979
Number of Stations	11	10
Oligochaeta (worms)		
Mean	989	1,815
Percent	44.9	50.2
Sphaeriidae (sphaerid clams)		
Mean	436	565
Percent	19.8	15.6
Chironomidae (midges)		
Mean	351	587
Percent	15.9	16.2
Crustacea (amphipods)		
Mean	232	346
Percent	10.5	9.6
Cumulative percent	91.1	91.6

Source: Krieger 1984.

Table 20. Relative abundance of principal algal species in the phytoplankton of surface waters in the Ashtabula nearshore zone of Lake Erie, 18 May through 20 October, 1978. (From Kline 1981. See Appendix for station locations.)*

Station Number	River 132	Harbor 133	Very Nearshore 123	126	127	128	136	137	138	Far Nearshore 124	125	129	130	131	134	135	139
<u>Taxon</u>																	
CRUISE NO. I (LATE SPRING)																	
Chlorophyta																	
Undetermined flagellates	1					2											
Chrysophyta																	
<u>Dinobryon</u> <u>sertularia</u>	1														1	1	
Cryptophyta																	
<u>Rhodomonas</u> <u>minuta</u>	1								1		1						
Undetermined cryptophytes	3	7	8	8	3	1	7	7	8	8	8	8	8	8	5	5	
Cyanophyta																	
<u>Gomphosphaeria</u> sp.					1												
<u>Microcystis</u> sp.					1	1											
CRUISE NO. II (EARLY SUMMER)																	
Bacillariophyta																	
<u>Cyclotella</u> sp.											1						
Chlorophyta																	
<u>Chlamydomonas</u> sp.							1										
<u>Chodatella</u> sp.							1										
<u>Coelosphaerium</u> <u>microporum</u>			1		3												
<u>Oocystis</u> <u>borgei</u>				1													
<u>Pediastrum</u> <u>duplex</u>		3	4	1								1		1			1
<u>Scenedesmus</u> <u>quadricauda</u>				2													
<u>Schroederia</u> <u>setigera</u>													1	1	1	1	2
<u>Sphaerocystis</u> <u>schroeteri</u>	1	1							2			2					
Undetermined flagellates								1				1					
Cryptophyta																	
<u>Crytomonas</u> <u>ovata</u>	2	1	1	1	1			1		1		1	1				
<u>Rhodomonas</u> <u>minuta</u>	1	1			2		2	1	4	4	4	3	4	4	4	4	4
Undetermined cryptophytes							1										
Cyanophyta																	
<u>Aphanizxomenon</u> <u>flos-aquae</u>	1							1							1		
<u>Microcystis</u> sp.											1		1			1	

Table 20. (Cont'd) Relative abundance of principal algal species in the phytoplankton of surface waters in the Ashtabula nearshore zone of Lake Erie, 18 May through 20 October, 1978. (From Kline 1981. See Appendix for station locations.)*

	River	Harbor	Very Nearshore							Far Nearshore							
Station Number	132	133	123	126	127	128	136	137	138	124	125	129	130	131	134	135	139
Taxon																	
CRUISE NO. III (SUMMER)																	
Bacillariophyta																	
Fragilaria crotonensis				2													
Chlorophyta																	
Coelastrum microporum				2													
Cyanophyta																	
Aphanothece nidulans			5		3		2	1					2	1			
Microcystis aerogenosa	8	7	2		4	6	6	5	6	6	7	8	6	6	7	8	5
Oscillatoria sp.				1													
CRUISE NO. IV (FALL)																	
Chlorophyta																	
Undetermined flagellates													1				
Cryptophyta																	
Rhodomonas minuta		1	1					1		1	1						
Undetermined cryptophytes																	1
Cyanophyta																	
Aphanizomenon flos-aquae	1	1	1							2	2	3			1	1	1
Microcystis aerogenosa								1	1	2		1				4	1
Microcystis sp.					1	1		1					1	2	1		
Oscillatoria limnetica	5	3	3	6	3	6	5	2	2		1	1	3	1	2		2

* Abundance compared to total phytoplankton for each sampling station, ranked in ten percentile intervals (e.g., 1 = 10 - 19%, 2 = 20 - 29%, etc).

Harbor and River

Protected areas of the harbor usually contain relatively large numbers of yellow perch, white bass, pumpkinseed, white crappie, goldfish and emerald shiner, while more open water areas contain lower densities of gizzard shad, yellow perch, carp, goldfish, brown bullhead and emerald shiner. Burbot and banded killifish, both listed by ODNR as Ohio endangered species, have been found in low numbers in the harbor area. (NOTE: The burbot was removed from the Ohio endangered species list in 1990). Various lake and stream species of fish migrate to and from the lower Ashtabula River when water conditions are favorable. Spawning migration runs for walleye and smallmouth bass occur in the spring (U.S. Fish and Wildlife Service 1984a). Species composition is typical of the warmwater fish community in Lake Erie river mouths.

During investigation of possible disposal sites for the sediments dredged from the river, the U.S. Fish and Wildlife Service surveyed a shallow 10-acre site north of the Pinney Dock Company's ore storage facility and south of the inner breakwall. The site proved to be a productive area of aquatic vegetation, and the species and numbers of fish found are presented in Table 21 (U.S. Fish and Wildlife Service 1984a). Results of a 1989 Ohio EPA survey reaffirmed the U.S. Fish and Wildlife findings at this site (Ohio EPA 1990c).

Upstream of the AOC, the river is characterized by excellent pool and riffle habitat and overhanging canopy shades the riverbanks. The Ohio Department of Natural Resources stocks steelhead trout in the Grand River and Conneaut Creek, rivers adjacent and comparable to the Ashtabula River (Ohio Dept. Natural Resources 1989). Steelhead trout also move up the Ashtabula River and are sought by river anglers. If not for the contaminant problem, the Ashtabula River would be a prime site for salmonid stocking consideration.

The 1989 Ohio EPA biological survey (Ohio EPA 1990c) sampled the fish community in the lower 10 miles of the Ashtabula River and the harbor. Biological indicies calculated from the data collected indicated the sites upstream from the AOC were fully attaining WWH status. The site just downstream from the Fields Brook confluence was dominated by the effects of the Fields Brook discharge. When compared to other lake effect areas of similar habitat conditions, this site displayed a much lower diversity, indicating an impact from the chemical discharge. The status of the fish community in this segment was ranked as fair when compared to Ohio EPA biological standards. Recreational boat traffic and marina development were also contributing factors to the lower rank.

The construction of vertical bulkheads at the commercial shipping facilities from RM 0.7 to the mouth severely affected the ability of this portion of the river to support a diverse fish community. Biological indicies were abnormally low resulting in WWH attainment status of poor to very poor. When compared to similar habitat conditions at Conneaut Creek, a tributary east of the Ashtabula River and also a commercial harbor, the low indicies proved to result from poor habitat rather than chemical pollution. This conclusion was reinforced by the discovery of the diverse, highly productive community in the well-vegetated area inside the inner breakwall in the Ashtabula Harbor.

Table 21. Species and number of fish collected inside the inner breakwall in Ashtabula Harbor

Species	U.S. Fish and Wildlife 1984*	Ohio EPA 1989**
Brown Bullhead	493	10
Pumpkinseed sunfish	96	228
Bluegill sunfish	64	203
Rock bass	71	139
Largemouth bass	--	84
Smallmouth bass	4	39
Bluntnose minnow	--	83
Common Carp	3	43
Yellow Perch	65	30
White Perch	1	33
White Crappie	38	--
Black Crappie	41	18
Spottail shiner	--	23
Goldfish	--	15
Brook silverside	--	13
Northern pike	4	6
Yellow bullhead	--	5
Bowfin	2	4
Spotted sucker	--	4
Golden shiner	2	4
Emerald shiner	--	3
Shorthead redhorse	1	--
Golden redhorse	--	2
White bass	3	--
Longear sunfish	2	--
Orangespotted sunfish	1	--
Green sunfish	--	2
Sunfish hybrids	--	5
Stonecat madtom	1	--
Striped shiner	--	2
Freshwater drum	--	2
Sand shiner	--	1
Longnose gar	--	1
Gizzard shad	--	1
Logperch	--	1
Mottled sculpin	--	1
	892 (18 species)	1005 (30 species)

* Fish were collected by trap nets (U.S. FWS 1984a).
** Fish were collected by electroshocking (Ohio EPA 1990).

(The results of these two studies are not necessarily comparable since two different collection methods were used, but are presented here to emphasize the productivity of the vegetated area inside the inner harbor breakwall.)

Biological indicies for the harbor improved enough to achieve partial to full attainment of WWH status. Interim biological criteria for Ohio's Lake Erie freshwater estuaries have been established as outlined in Ohio EPA 1989a and 1989b. Table 22 compares the biological indicies calculated for the river and harbor with the interim criteria to determine the current aquatic life use attainment status. A recent comparison of biological community status of the fourteen major Ohio Lake Erie tributaries based on data collected by Ohio EPA from 1982 to 1989 indicated the Ashtabula River, along with the Grand River, were the most biologically improved (Thoma 1990).

Table 22. Summary of biological use attainment status for the Ashtabula River and Harbor.

River Mile	IBI	MIwb	WWH Criteria IBI/MIwb	Attainment Status
Harbor				
0.1 (West breakwall)	31	6.6	32 ± 4/7.5 ± .5	Partial
0.2 (Inner breakwall)	30	7.4	32 ± 4/7.5 ± .5	Full
River				
0.5 (Commercial Docks)	13	2.8	32 ± 4/7.5 ± .5	Non
1.3 (Dst. Fields Brook)	26	5.8	32 ± 4/7.5 ± .5	Non
1.8 (Ust. Fields Brook)	32	7.6	32 ± 4/7.5 ± .5	Full
9.9 (Ust. AOC)	42	8.2	38 ± 4/7.9 ± .5	Full

IBI - Index of biotic integrity
MIwb - Modified index of well-being
WWH - Warmwater Habitat

Source: Ohio EPA 1990c

Past history suggests that the Ashtabula River was once an highly productive fishery. Indeed, the name Ashtabula originated from an Iroquois Indian word meaning "river of many fish." Early settlers survived hard winters and the rigors of the War of 1812 by eating river fish. Surviving on river fish would not be a very safe thing to do today.

Exploratory studies by Veith, et al (1981) of whole body, multi-species composites from the Ashtabula River - Fields Brook area revealed extremely complex mixtures of bioaccumulable chemicals in fish tissue. At least 45 chemicals were identified including high concentrations of hexachlorobutadiene, hexachlorobenzene, octachlorostyrene, PCBs and other chlorinated compounds. Subsequent analyses of single species whole body and skin-on fillet samples, collected between the mouth of the Ashtabula River and Fields Brook, confirmed the high concentrations of PCBs, hexachlorobenzene, pentachlorobenzene and tetrachloroethane presented in Table 23 (Armstrong 1983). This information was the basis for the issuance of a fish consumption advisory for the lower two miles of the river and harbor by the Ohio Department of Health and Ohio EPA in 1983 (Ohio Dept. of Health and Ohio EPA 1983). The full text of the advisory appears in the Appendix. The advisory recommends that no fish caught in the river from the 24th Street bridge to the harbor mouth be eaten. The advisory cites PCB concentrations ranging from 2.4 to 58.3 mg/kg in the edible portion (skin-on fillet). The current Food and Drug Administration action level for safe consumption is 2 mg/kg for the edible portion. The FDA action level at the time the advisory was issued was 5 mg/kg.

There are no criteria for the other organic chemicals listed in the advisory, but the presence of so many different chemicals is a concern. Listing the other pollutants in the advisory was precautionary insurance to keep the advisory in effect in the event that the PCB problem was corrected but the other chemicals were still elevated (J. Estenik, Ohio EPA, personal communication 1990).

In addition to the advisory in the Ashtabula River, a general advisory is in effect for Lake Erie. Based on elevated PCB concentrations in skin-on fillets, it is recommended that no carp or channel catfish from the lake be consumed.

Additional fish tissue sampling was conducted on the Ashtabula River in 1990 as part of the Fields Brook Superfund investigation (Woodward Clyde Consultants 1991). Fish were collected at the inner breakwall in the outer harbor, downstream from the upper turning basin and the confluence of Fields Brook, the upper turning basin and near the 24th Street bridge. Carp, brown bullhead, bluegill, largemouth bass and smallmouth bass were the species collected and analyzed as whole and skin-on fillets. Samples were grouped as composites of five comparatively sized fish of the same species and analyzed for organics and metals previously found at elevated concentrations and suspected to still be the major pollutants in the AOC. A summary of results is presented in Table 24. This summary includes only detected concentrations.

Fish tissue concentrations for organics in 1990 appeared to be much lower than those found in earlier studies. Although PCB concentrations no longer exceed the FDA standard of 2 mg/kg, they still exceed the GLWQA objective of 0.1 mg/kg in whole fish (Appendix Table A-3). There are no previous data with

Table 23. Mean concentrations of selected organic compounds in fish samples collected within a .5 mile area of the Fields Brook-Ashtabula River confluence in 1980 and 1981. The fish consumption advisory was largely based on this information. (Armstrong 1983).

Samples	Length (mm)	Weight (g)	Lipid Content (mg/g)	Total PCB (ug/g)	Hexachlorobenzene (ug/g)	Pentachlorobenzene (ug/g)	1,1,1,2 Tetrachloroethane (ug/g)	1,1,2,2 Tetrachlorethane (ug/g)
Carp, whole (25 samples)								
Range	172 - 454	184 - 2910	51 - 304	4.0 - 152.6	.28 - 7.49	.06 - .63	1.08 - 5.70	.01 - .62
Mean	318	1053	211	50.0	3.40	0.22	2.60	.22
Std. Dev.	77	701	234	46.1	2.40	0.16	1.80	.15
Carp, Fillet								
(21 samples)	75 - 506	246 - 4320	21 - 267	2.4 - 58.3	.37 - 5.80	.03 - .36	.02 - 3.66	.02 - .51
Mean	359	2317	203	19.0	2.0	0.14	1.50	0.16
Std. Dev	107	2841	250	18.0	1.5	0.08	1.00	0.11
Bullhead, Whole (11 samples)								
Range	146 - 282	73 - 574	25 - 79	.94 - 8.53	.04 - 1.13	.01 - .06	.01 - .39	.004 - .04
Mean	197	222	77	4.44	0.57	0.03	0.07	.02
Std. Dev.	47	175	62	2.86	0.37	0.02	0.13	.01
Bullhead, Fillet (26 samples)								
Range	ND	39 - 574	4 - 138	.60 - 28.0	.003 - 4.66	0* - 0.19	0* - .84	.002 - 1.05
Mean	ND	195	38	5.6	0.96	0.04	0.06	0.07
Std. Dev.	ND	152	28	6.4	1.11	0.04	0.17	0.20

0* Indicates less than detection limit.

Table 24. Mean concentrations of chemicals in fish tissue samples collected in the lower two miles of the Ashtabula River in 1990. All samples were composites. Hexachlorobenzene, 1,1,1,2-tetrachloroethane and pentachlorobenzene were not detected. (Woodward Clyde Consultants 1991).

Sample	Length (mm)	Weight (g)	Lipid Content (%)	Total PCB (ug/g)	1,1,2,2 Tetrachloroethane (ug/g)	Tetrachloroethene (ug/g)	Trichloroethene (ug/g)
Carp, whole (4 samples)							
Range	490-557	1638-2478	.2-4.7	.07-.81	.006-.028	.025-.270	.007-.040
Mean	531	2150	1.6	0.28	.017	.094	.018
Std. Dev.	30.2	375	1.9	0.31	.016	.102	.019
Small/Largemouth Bass, whole (4 samples)							
Range	218-361	128-752	1.4-1.8	.09-.20	.01-.04	.02-.45	.01-.07
Mean	301	474	1.5	.14	.02	.18	.04
Std. Dev.	61.9	273	0.2	.05	.02	.23	.04
Small/Largemouth Bass, fillet (2 samples)							
Range	292-308	405-455	.06-.14	ND	--	.04-.15	--
Mean	300	430	.10	ND	.01	.10	.01
Std. Dev.	11.3	35	.06	ND	--	.08	--
Bluegill, fillet (2 samples)							
Range	130-147	53-74	.06	ND	ND	MD	ND
Mean	139	64	.06	ND	ND	ND	ND
Std. Dev.	12.0	14.8	--	ND	ND	ND	ND
Brown Bullhead (1 sample)	NA	NA	.67	0.7	NA	NA	NA

ND - Not detected
NA - Not available

which to compare the metals concentrations and no FDA standards for these parameters. Although contaminant concentrations have decreased, more extensive monitoring will be required before the fish consumption advisory would be revoked.

During the 1989 Ohio EPA survey, a population of brown bullhead afflicted with numerous lip and skin tumors was discovered inside the west breakwall in the Ashtabula Harbor. Similar tumors were not found in fish further upstream or near the mouth of Fields Brook. This suggests a significant pollutant source in addition to Fields Brook exists near the river mouth. There is speculation that coal dust from the adjacent coal yard and conveyor may be a source of PAHs which could be the cause of the tumors. Large amounts of coal dust were observed on the bottom sand where the infected bullheads were found.

In connection with the U.S. EPA - Great Lakes National Program Office ARCS program, the U.S. Fish and Wildlife Service conducted an intensive tumor survey of the lower river in 1990. The survey focussed on brown bullheads. All analyses have not yet been completed, but initial results indicated prolific skin and liver tumors in fish in the harbor and in the river. U.S Fish and Wildlife Service expects to complete their report by late 1991. They also hope to continue studies to determine the cause and source of the tumors.

Limited benthic sampling by Terlacky et al. (1975), showed high populations of oligochaetes (worms) in the harbor area. Studies conducted in the harbor in 1978-1979 revealed a benthic community indicative of organically polluted sites with the oligochaete Limnodrilus hoffmeisteri as the most abundant species (Krieger 1984). A 1983 study for the Corps of Engineers (Swanson Environmental 1983) also revealed oligochaetes to be the most abundant species. The 1989 Ohio EPA biological survey indicated a highly diverse macro-invertebrate community in the free-flowing section of the Ashtabula River upstream from the AOC. Diversity decreased with distance downstream and in lentic water (non-flowing) sections of the river. The diversity at RM 1.9 upstream from Fields Brook was much lower than expected. Moderate to heavy siltation was observed on the artificial substrate samplers suggesting that heavy recreational boat traffic was impacting the colonization of the samplers by covering them with silt. This same problem was observed at the RM 1.3 site downstream from Fields Brook. The study concluded boating activities and shoreline modifications overshadowed any impacts that could have been associated with contaminants from Fields Brook (Ohio EPA 1990c).

As with the fish community, the commercial shipping channel modifications severely limited macroinvertebrate community composition and diversity. Over 80 percent of the organisms collected in this area were zebra mussels or oligochaetes. The harbor population was dominated by tubificids, oligochaete species that are most tolerant to gross organic enrichment. Compared to Goodnight and Whitley (1961), the macroinvertebrate community indicated polluted conditions. Howmiller and Scott (1977) proposed a Trophic Condition Index (TCI) to compare harbor sites with open water sites. On a scale of 0 to 2, with 0 indicating a pollution sensitive community and 2 indicating a pollution tolerant community, the Ashtabula Harbor had a TCI of 1.9 (Ohio EPA 1990c). This value is similar to all the other Lake Erie harbors along the southshore.

Fields Brook

A fish survey was conducted on Fields Brook in 1980 (White and Alldridge 1981). Seven sites were sampled, each with a somewhat different habitat. The mouth of Fields Brook was 3 to 4 ft. deep with a good canopy, undercut banks and lots of bank cover. Eleven species were found there, some popular sport species. At E.15th St., five species were found. The Brook was 2 to 3 ft. deep here, channelized with constant flow, no pools, no bank cover and no canopy.

Further upstream at Columbus Avenue, the Brook exhibited considerable habitat diversity, but only one species, a bluegill, was collected. The small tributaries south of Fields Brook are extremely shallow and form a damp meadow. Some have been ditched and culverted. Only one bluegill was recorded from this area.

Near State Rd., no fish were collected. The sediments emitted strong organic chemical odors and were covered with an encrustation several inches thick. Vegetation did not exist in the brook and was dead along the banks. Further upstream the brook is channelized and culverted. Three species were found at the site near Middle Rd. (White and Alldridge 1981). Species recorded are presented in Table 25.

During the Fields Brook remedial investigation (CH_2M Hill 1985), several sites were sampled for fish. Upstream of all industrial dischargers, at a site near Cook Rd., largemouth bass, bluegill and bluegill-pumpkinseed hybrids were found. Three blue gill spawning beds were also observed. At another site just upstream from the Detrex Tributary, only gizzard shad were collected. Eleven species were found at the mouth (Table 25). Biological sampling sites are located on Figure 20.

Strong Brook

Ohio EPA completed a use designation survey on Strong Brook in 1990. No fish were found and only six species of macroinvertebrates were identified. The original mouth of Strong Brook has been moved and culverted to its confluence with the Ashtabula River at the end of an old freighter slip in the upper turning basin. There are three open segments between Ohio Avenue and the river, but the rest of the upstream area has been culverted. The use designation report stated that Strong Brook cannot support a Warmwater Habitat community and recommends it be listed as a Limited Resource Water (Davic 1990).

Terrestrial Flora and Fauna

Ashtabula County is reported to have more birds than any other county in Ohio (U.S. Army Corps of Engineers 1986a). This may be attributed to the abundant wooded, wetland, and upland habitat, and its location in both the Atlantic and Mississippi flyways. Over three million ducks and geese use this migration corridor on north-south and east-west routes. Gulls nest on the outer breakwalls. In addition to water fowl, many species of shorebirds, hawks, woodpeckers, and songbirds inhabit the area.

Table 25. Fish species observed in Fields Brook.

Location	Species: White and Alldridge 1981	Species: CH_2M Hill 1985
Mouth Fields Brook	Banded Killifish Smallmouth Bass Largemouth Bass Longnose Gar Gizzard Shad Golden Shiner Goldfish White Perch Pumpkinseed Bluegill Black Bullhead	Carp Freshwater Drum Yellow Perch Rock Bass Gizzard Shad Golden Shiner Goldfish Brown Bullhead Pumpkinseed Bluegill Black Bullhead
15th St.	Gizzard Shad Banded Killifish Bluegill Smallmouth Bass Largemouth Bass	
Columbus Ave.	Bluegill	
Small Tributaries south of Fields Brook	Bluegill	
State Rd.	None	
Middle Rd.	Mudminnows Bluegill Pumpkinseed	Gizzard Shad
Cook Rd.		Bluegill Largemouth Bass Bluegill + Pumpkinseed

The Ashtabula Harbor area supports several kinds of mammals, some of which are limited to the wetland and park areas, including squirrel, cottontail rabbit, opposum, skunk, raccoon, house mouse and Norway rat. Critical mammalian habitat is limited to a few scattered areas left to natural growth, and the Ashtabula River wetland. This Palustrine wetland serves as a bird sanctuary and is located inside the west harbor breakwall. The wetland covers about 7 acres, has little relief and is strongly influenced by lake levels (U.S. Army Corps of Engineers 1986a). There currently is no information available on deformities or tissue concentrations of contaminants in any birds or mammals.

State endangered animal species and state endangered, threatened or potentially threatened plant species reported by the Division of Natural Areas and Preserves, Ohio DNR, are presented in Table 26. The numbers on the list correspond to the circled location on the accompanying map (Figure 21). A scientific name, common name, and status are given for each species (see status codes on Table 26). Fay and Herdendorf (1984) cited the biological community located at Walnut Beach as the most diverse Dune Community in Ohio. A recent survey indicated Potomogeton richardsonii in area 2 (Figure 21) has declined to one small clump covering 0.5 square meters. This may be the result of lower lake levels (Cleveland Museum of Natural History 1989).

Summary

At least 74 pollutants have been measured in the Ashtabula River AOC. These include metals, pesticides, nutrients, PCBs, PAHs and a number of chlorinated organic compounds. Sediment contains by far the greatest number and highest concentrations of contaminants. At least 45 pollutants have been detected in fish tissue. Pollutants in the water column are less prevalent and violations of water quality standards are infrequent and localized.

The most contaminated area of the AOC is Fields Brook, particularly the DS tributary and the area near State Rd. Sediments are heavily polluted with PCBs, metals and many chlorinated organics. An assessment of the extent of the contamination is not yet complete but is being evaluated under Superfund. Much of the brook is devoid of biological communities, and those which are present are small and not very diverse. The biological community improves near the mouth as habitat improves and pollutant conditions lessen. Water quality violations have been measured for cadmium, mercury, iron and total dissolved solids. Total dissolved solids are a persistent problem due to the nature of the effluent from several Fields Brook industries and the low flow of Fields Brook. Water quality violations for three organics: 1,1,2,2-tetrachloroethane, tetrachloroethene and trichloroethene, were measured on the DS tributary.

Strong Brook, entering the Ashtabula River from the west bank almost opposite from the Fields Brook confluence, is largely a culverted storm sewer. No fish were found and only six species of macroinvertebrates were found. Sediments near the mouth of Strong Brook contained the highest concentrations of zinc, lead, and oil and grease in the AOC. Most of the other metals were elevated at this site suggesting it could be a source of metals to the AOC.

LEGEND

1. U.S. Fish and Wildlife Service 1984a
2. Ohio EPA 1990c
3. White and Alldridge 1981
4. CH2M Hill 1985

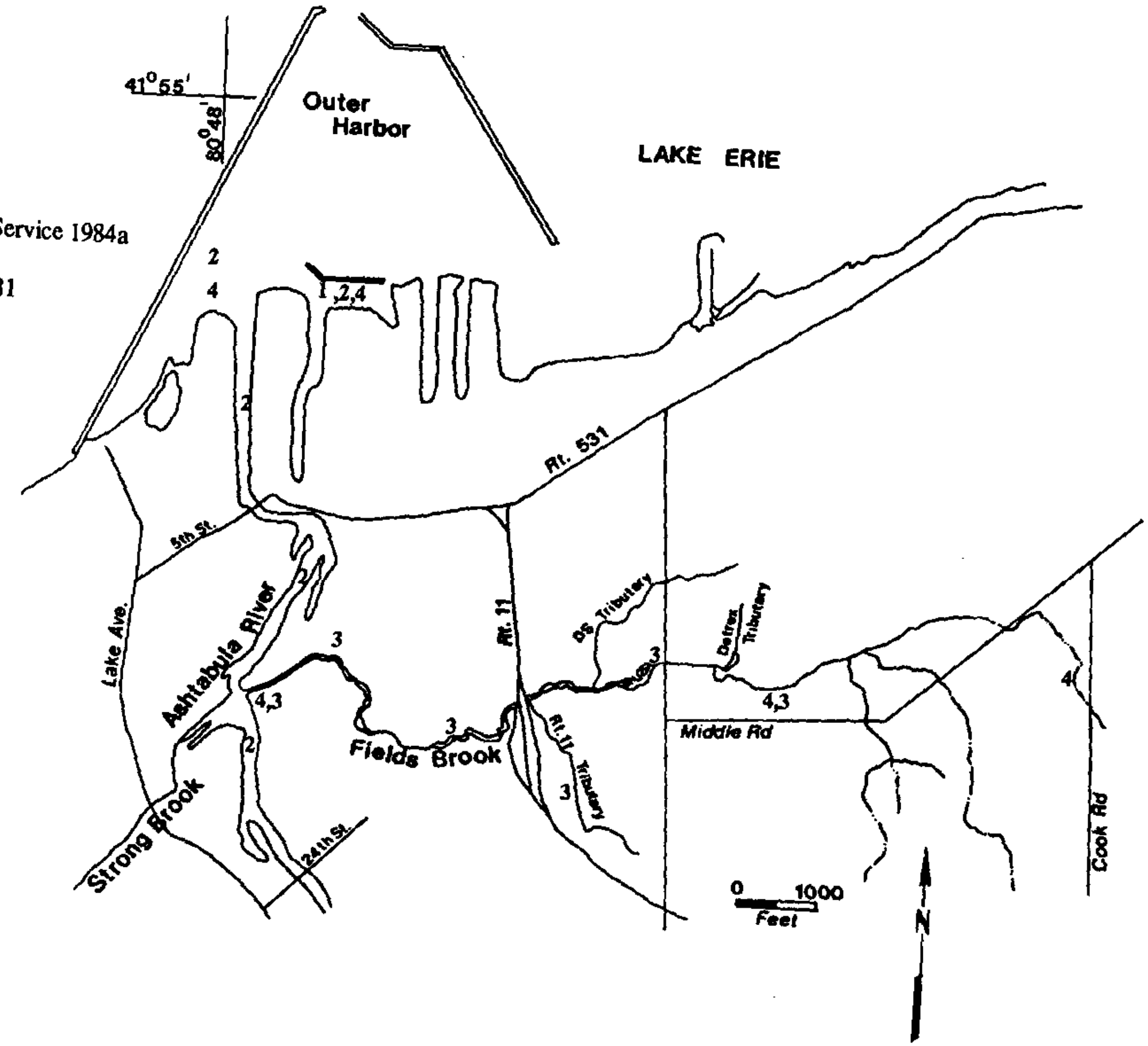


Figure 20. Fish community sampling sites in the Ashtabula River and Fields Brook.

Table 26. State Endangered, Threatened or Potentially Threatened animal and plant species - Ashtabula River AOC.

1. Lakeshore Park

   Cakile edentula - Inland Sea-rocket, P

2. Area inside West Breakwall

   Cyperus schweinitzii - Schweinitz's Umbrella-sedge, P
   Juncus balticus - Baltic Rush, P
   Najas flexilis - Slender Naiad, OWE
   Najas minor - OWE
   Potomogeton richardsonii - Richardson's Pondweed, T
   Potentilla anserina - Silverweed, P
   Potentilla paradoxa - Bushy Cinquefoil, T
   Sporobulus cryptandrus - Sand Dropseed, P
   Vallisneria americana - Eel-Grass, P
   Zannichellia palustris - OWE

3. Walnut Beach City Park

   Ammophila breviligulata - American Beach Grass, P
   Cakile edentula - Inland Sea-rocket, P
   Cyperus schweinitzii - Schweinitz's Umbrella-sedge, P
   Euphorbia polygonifolia - Seaside Spurge, P
   Lathyrus japonicus - Inland Beach-pea, T
   Myriophyllum heterophyllum - Two-leaved Water-milfoil, T
   Potentilla anserina - Silverweed, P
   Sporobolus cryptandrus - Sand Dropseed, P
   Triplasis purpurea - Purple Sand-grass, P

4. Beach-Dune Plant Community

   Ammophila breviligulata - American Beach Grass, P
   Cakile edentula - Inland Sea-rocket, P
   Carex bebbii - OWE
   Euphorbia polygonifolia - Seaside Spurge, P
   Lathyrus japonicus - Inland Beach-pea, T
   Triplasis purpurea - Purple Sand-grass, P

5. Outer Harbor

   Lota lota - Burbot, OWE (Removed from Endangered Species List in 1990)

Status Codes

Animals: OWE = State Endangered
Plants: T = State Threatened
P = Potentially Threatened (not a legal designation)

Source: Ohio Dept. of Natural Resources, Division Natural Areas and Preserves

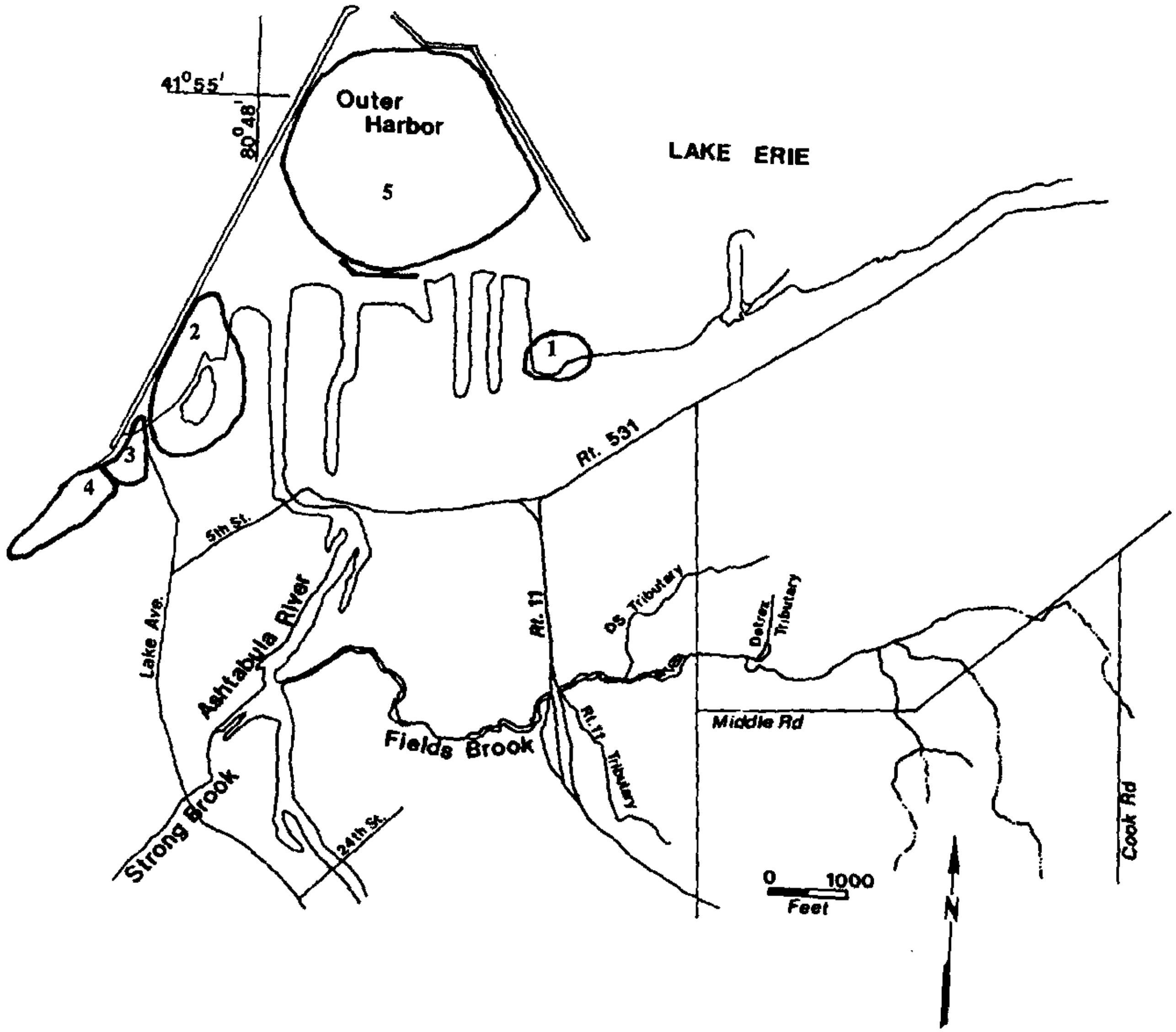


Figure 21. Site locations of State endangered, threatened or potentially threatened animal and plant species in Ashtabula. (See Table 26) Source: Fay and Herdendorf 1984

The upper turning basin, including the area near the mouth of Fields Brook, is the most contaminated area of the river. The biological community does not meet WWH standards and is impacted by discharge from Fields Brook as well as habitat destruction and extensive recreational boat traffic. Most of the toxic sediments in the AOC are found in this area and are covered by 4 to 12 feet of moderately to heavily polluted sediments. The highest concentrations and largest number of organic chemicals are found in the sediment in this area. Water quality standards for copper, cadmium and lead were exceeded only near the confluence of Fields Brook. Several organics were detected in the water column but none exceeded water quality standards. Upstream from the turning basin and the recreation marinas, the river supports a healthy diverse biological community.

The main stem of the river, from the upper turning basin to the mouth, supported only a poor biological community. This is considered due primarily to lack of habitat. Most of the river in this section is developed as marinas or bulkheaded for commercial docks. Limited water quality sampling in this segment of the river in 1990 indicated violations of Ohio Water Quality Standards only for iron. Only four organics were detected in the water column. Sediments in this section of the river had toxic concentrations of PCBs at six sites. All of these locations were covered by at least three feet of nontoxic sediments. In general, average sediment pollutant concentrations in the river decreased with distance from Fields Brook. However, metals concentrations increased near CSO and pump station overflows. Analyses of river sediment for radionuclides indicated uranium was present at concentrations above background levels. However, these concentrations, as well as those for the other radionuclides measured, were well below guidelines established by the Nuclear Regulatory Commission. U.S. EPA has ruled that no special precautions will be required for dredging and disposal of river sediments due to the presence of radionuclides.

The Ashtabula outer harbor supports a diverse fish community of river and lake species, particularly in a vegetated area protected by the inner breakwall. The banded killifish, listed by ODNR as an Ohio endangered species, has been recorded here. The fish community achieves partial to full attainment of WWH biological standards considering diversity and abundance. However, a high incidence of lip tumors and precancerous conditions was noted in brown bullhead along the west breakwall, an area with piles of coal dust accumulated on bottom sediments. Further work by the U.S. Fish and Wildlife Service found severe liver cancers in brown bullhead from upstream, in addition to the lip tumors of the harbor bullhead. The source and cause of these concerns remains a mystery, but is undergoing further investigation.

Few water quality violations have been documented in the outer harbor. Methylene chloride, acetone, vinyl acetate and trichloroethene were the only organics detected. The sediments in the outer harbor are considered non-to-moderately polluted and still acceptable for open lake disposal. Arsenic is the only pollutant which exceeds U.S. EPA guidelines, but high background levels exist throughout the AOC, and in most of the southern Lake Erie drainage basin. Sediment PCB concentrations have increased from 1984 to 1988 indicating movement of more heavily polluted sediment from the river to the harbor. Increasing pollution may curtail open lake disposal in the near future.

The Lake Erie nearshore supports a large fish community and provides habitat for spawning and nursery. Sport fishing for perch and walleye has become increasingly popular. A general fish advisory, due to PCBs, in effect in Lake Erie for carp and channel catfish also applies to the Ashtabula nearshore area. There are no reports of tumors, deformities or lesions on fish in the lake. Macroinvertebrate communities in the nearshore are indicative of eutrophic conditions with a gradient of improving quality with distance from shore. The composition and density of the phytoplankton community in the nearshore and at the harbor mouth is more similar to the open lake phytoplankton community than any other major tributary in the central basin.

Sediments in the nearshore were found to exceed U.S. EPA guidelines for copper, chromium, cadmium, lead, iron and zinc. Mercury in sediment east of the mouth of the river near several industrial outfalls exceeded the 1 mg/kg U.S. EPA guideline. Organics in the lake sediment were not found at elevated concentrations, if found at all.

Historical records of water quality violations in the nearshore have been noted for most metals. However, high detection levels in the past obscure the accuracy of the historical data. Metals concentrations were often recorded in the data files as the detection limit if no value was actually measured. Since detection levels at that time were higher than today's standards, a review of historical data could indicate a water quality violation when, in fact, actual concentrations may have been lower. More recent water quality tests indicated frequent violations of water quality standards for copper and iron. Occasional and possible exceedences were noted for lead, cadmium, chromium, zinc, mercury and bis(2-ethylhexyl)phthalate. Carbon tetrachloride, trichloroethene, PCBs and chlorobenzenes were detected at ng/l (parts per trillion) levels in the nearshore waters off Ashtabula. All were below Ohio water quality standards, but suggested the Ashtabula area was a source of these chemicals.

Ground water in much of the Fields Brook area has been found to be contaminated, but the extent to which this affects the surface waters is unknown. Ground water is not used as a water supply in these areas.

Air quality standards are met in the AOC.

CHAPTER 5. DEFINITION OF THE PROBLEM

All of the beneficial use impairments in the Ashtabula River AOC are directly related to contaminated sediment. The sediment was contaminated by past uncontrolled discharge of metals and organic chemicals, spills and mismanagement of hazardous waste materials. Most companies in the Fields Brook industrial complex still discharge pollutants to some degree, some are still not in total compliance with their NPDES permits, and occasional spills or accidental discharges are reported. The contaminated Fields Brook Superfund area continues to be a source of pollutants to the Ashtabula River AOC. The contaminants of greatest concern in the AOC are PCBs, mercury, zinc, hexachlorobenzene, hexachlorobutadiene, chromium, and other volatile organic compounds. This chapter will discuss the environmental problems of the Ashtabula River in relation to the impairment of the 14 beneficial uses listed in the GLWQA. A summary of use impairments and their causes is presented in Table 27.

1. Restrictions on fish and wildlife consumption.

   An advisory was issued in 1983 by the Ohio Department of Health and Ohio EPA recommending that no fish caught in the lower two miles of the Ashtabula River be eaten. The advisory was based on the results of fish tissue sampling from 1978 to 1981. Forty-five organic chemicals had been detected in fish tissue. Those of greatest concern included PCBs, hexachlorobenzene, hexachlorobutadiene, pentachlorobenzene, tetrachloroethane and octachlorostyrene. Many of the identifed chemicals were classified as carcinogens, so their mere presence was of concern.

   The chemicals found in fish tissue also have been found in the sediment in the river and Fields Brook. Ambient concentrations in the water column are very low or below detection limits. It appears that the contaminated sediments provided a concentrated source of pollutants to contaminate fish tissue, particularly since the highest levels of contaminants were found in bottom feeding fish. Recent sediment analyses reveal surface sediments contain much lower concentrations of pollutants than deeper sediments, indicating the original sources of pollutants have declined considerably. The results of recent fish tissue sampling indicate concentrations of contaminants in fish tissue have also declined considerably. No fish were found with PCB concentrations greater than the FDA action level of 2 mg/kg. However, much more positive data will be needed before the advisory would be revoked.

   In addition to the river advisory, a general advisory against consumption of carp and channel catfish in Lake Erie is in effect. The advisory is based on elevated PCB concentrations.

2. Tainting of fish and wildlife flavor.

   No specialized studies have been conducted but tainting of fish and wildlife flavor has not been reported for the Ashtabula River AOC. Since the AOC is currently under a fish consumption advisory, no studies for fish tainting are planned. There is no information on other wildlife.

Table 27. Ashtabula River Beneficial Use Impairments - Causes, Sources and Additional Notes.

Use Impairment	Impaired?	Causes	Sources	Notes
1. Restriction on fish and wildlife consumption	Yes	PCB's, hexachlorobenzene, hexachlorobutadiene, pentachlorobenzene, tetrachloroethane, octachlorostyrene, other organics	Bottom sediments Past point source discharge Existing point sources (potential)	Fish consumption advisory for all species. No information on other wildlife.
2. Tainting of fish and wildlife flavor	Not Likely	Chlorinated organic compounds, PAH's	Bottom sediments Point sources Coal handling facilities Railyards Treated wood pilings	None reported. The presence of tainting chemicals may impair taste, but existing fish advisory precludes a creel survey
3. Degraded fish and wildlife populations	Yes	Habitat destruction Toxic cheimcals	Construction of marinas and commercial shipping facilities Bottom sediments Toxic chemicals from Fields Brook discharge	Biological indices reveal a poor-to-fair fish community. Main impact is from habitat destruction. Ashtabula County is reported to have more birds than any other Ohio County. No other wildlife information available.
4. Fish tumors or other deformities	Yes	PAH's (potential)	Coal fines (potential)	Brown bullheads near the river mouth have a high incidence of lip and skin tumors. Additional study needed to determine cause.

Table 27. Ashtabula River Beneficial Use Impairments - Causes, Sources and Additional Notes (continued).

Use Impairment	Impaired?	Causes	Sources	Notes
5. Bird or animal deformities or reproductive problems	Unknown	--	--	No problems have been documented, but no studies or surveys have been conducted.
6. Degradation of benthos	Yes	Organic enrichment Habitat destruction	Bottom sediments	Pollution-tolerant species dominant; similar to other harbors along the Ohio Lake Erie shoreline.
7. Restrictions on dredging	Yes	Sediments contaminated with PCB's Organic compounds Metals	Past point source discharge Point sources (potential) Leachate from hazardous waste sites (potential)	There is no available site for disposal of dredged material.
8. Eutrophication or undesirable algae	No	--	--	Although the AOC would still be classified as eutrophic, it does not experience the problems of low dissolved oxygen, elevated nutrients or algal blooms.
9. Restrictions on drinking water consumption	No	--	--	No taste and odor problems. Raw water sometimes exceeds WQS for metals, but finished water meets all drinking water standards. Special precautions will be needed to protect water supply during remedial dredging in the AOC.
10. Beach closings	No	--	--	

Table 27. Ashtabula River Beneficial Use Impairments - Causes, Sources and Additional Notes (continued).

Use Impairment	Impaired?	Causes	Sources	Notes
11. Dregradation of aesthetics	No	--	--	Some muddy water and debris following heavy rainstorms, but not a significant problem.
12. Added costs to agriculture or industry	No	--	--	--
13. Degradation of plankton populations	Unknown			No current information is available.
14. Loss of fish and wildlife habitat	Yes	Construction of marina and commercial shipping facilities	Not applicable	River mouth is mostly vertical bulkheads. Heavy recreational boat traffic also impacts habitat.

Taste and odor problems are generally associated with the following industries: pulp and paper; explosives; petroleum and gasoline; rubber; wood distillation; coke and coal tar; gas; tanneries; meat packing and glue; chemicals and dyes; milk products; canneries and the manufacture of beet sugar. The chemical industry dominates the Ashtabula industrial base. The specific chemicals responsible for taste problems include phenols, cresol hydrocarbons (benzenes), anthracene, naphthalene, xylenol, nitriles and chlorinated compounds. Elevated concentrations of benzenes and chlorinated compounds found in the fish tissue in the 1978 to 1981 samples may have tainted flavor. Although these chemicals are still present, the concentrations are much lower and it is not expected that fish flavor would be affected.

3. <u>Degradation of fish and wildlife populations.</u>

The Ashtabula River AOC is classified as Warmwater Habitat (WWH) in the Ohio Water Quality Standards. Upstream from the AOC, the river is fully attaining the WWH status. Within the upper turning basin and downstream from the Fields Brook confluence, biological indices are considerably lower than the standard criteria for WWH. Habitat destruction and boat traffic have impacted the biological community in this area, but chemical discharge from Fields Brook also has been identified as contributing to the poor community status in this area.

The lower 0.7 miles of the river have been lined with vertical sheet piling, railroad ties and concrete docks. This area is frequently dredged. These conditions have severely altered the natural habitat, resulting in the poorest biological community in the AOC. This effect appears to be localized as fish population and diversity recover in the outer harbor area where habitat conditions improve and the impacts from Fields Brook dischargers have dissipated. WWH status in the outer harbor is partially to fully attained. Fishery statistics for the nearshore and open-lake waters off Ashtabula indicate a productive fishery.

Ashtabula County is reported to support one of the largest bird populations in the state. There is no indication the avian population has been impacted or reduced by toxics or loss of habitat.

4. <u>Fish tumors or other deformities.</u>

Local fishermen have reported the presence of tumors and lesions on fish. During the Ohio EPA biological survey (Ohio EPA 1990c), fish were examined for external anomalies. Rock bass in the outer harbor were found with numerous abrasions. Rock bass have a peculiar habit of squeezing under rocks at night to rest. It was assumed the abrasions were probably incurred as a result of this practice. A few fish exhibited the circular wounds associated with lamprey attachment.

A community of brown bullhead in the area inside the west breakwall were discovered to have a high incidence of lip and skin tumors and precancerous conditions. This situation was not observed in the river, and appears to be related to sources of pollution at the river mouth rather than from Fields Brook. Black material lining the bottom sand ripples was noted in large amounts. This material appears to be coal dust. There is a coal handling facility on the west bank and upwind of the river which is the source of the coal dust. Tumors in brown bullhead are associated with PAHs as found in coal tars. Further investigations will be needed to determine the cause of tumors.

The U.S. Fish and Wildlife Service is currently examining approximately 100 brown bullheads collected from the river and harbor for evidence of cancers. Preliminary results, with half the samples analyzed, found skin cancers and external anomalies on approximately 40 to 50 percent of the fish in the harbor and the river. Histological changes ranging in severity from liver carcinomas to parasitic infestations were found. The most severe lesions were found in fish collected from the river. Evidence is not yet sufficient to conclude the severity and type of anomalies present. At this stage, insufficient data exist to connect the occurrence of the tumors and cancerous conditions with environmental conditions or particular chemicals in the ecosystem. Final results of the tumor survey are not expected to be published until early 1992.

5. Bird or animal deformities or reproductive problems.

No specific studies have been implemented to focus on bird or animal deformities, and no observations by area residents have been reported. The U.S. Fish and Wildlife Service collected gull eggs from the area in April 1991 to compare accumulation of contaminants with contaminants found in gull eggs collected at monitoring stations on the Great Lakes. These results are not yet available. The area continues to support a large and diverse bird population.

6. Degradation of benthos.

The macroinvertebrate community exhibited similar WWH attainment status as the fish community. Biological indices were high in flowing sections of the river, but decreased downstream from Fields Brook. Again, the major impacts appeared to be habitat related and affected by the heavy recreational use of the river, although some chemical impact was recorded near the confluence of Fields Brook.

The macroinvertebrate community in the nearshore was indicative of moderate organic enrichment and similar to the community found throughout the southern central basin nearshore. The harbor was more polluted and there was a noticeable gradient of decreasing pollution in an offshore direction.

7. Restrictions on dredging activities.

Restrictions on dredging are the main reason for the extreme delay in implementing remedial actions on the Ashtabula River. Classification of sediments in the Ashtabula River navigation channel as highly polluted and toxic due to metals, PCBs and other organics precluded open-lake disposal of dredged materials. Most of the river has not been dredged since 1962, and has become a navigational hazard as well as an environmental hazard. The shallow river impedes the passage of recreational boats, increases the frequency of boat and propeller repair and prevents the expansion of the recreational resource in an area where a new economic base is needed.

The history of the Ashtabula River dredging problem is a long, complicated story; only the highlights of which will be presented here. The Buffalo District of the Corps of Engineers has been attempting to dredge the Ashtabula River since the early 1970s, but has been frustrated by the unavailability of a locally acceptable disposal site. Under the authority of Public Law 91-611, the Corps attempted to site a confined disposal facility (CDF) in Ashtabula in the early 1970s. This law provided for the construction of CDFs for polluted materials dredged from the Great Lakes and was the funding source for all the CDFs constructed along the south shore of Lake Erie. According to the law, the local government was required to provide a location for construction of a CDF. The Corps proposed fourteen sites, all of which were opposed by local government. Finally, plans were begun to construct a CDF outside the east breakwall.

In the mid-1970s, sediments in the outer harbor were reclassified as non-polluted and suitable for open-lake disposal by U.S. EPA. At that time, sediments dredged from the harbor comprised the majority of the material to be placed in the CDF, and river dredging was minimal (1,000 cubic yards). Redesigning the planned CDF to contain a smaller amount of material was deemed economically unfeasible by the Corps and the project was terminated.

Sediment sampling in 1979 and 1983 confirmed river sediments were highly polluted and toxic (PCB concentrations >50 mg/kg). This further complicated both the dredging and disposal issues and required special treatment of toxic sediments. The Buffalo District Corps of Engineers submitted an Environmental Impact Statement (EIS) in 1983 proposing an extensive one-time dredging operation to remove and dispose of all contaminated sediment by dredging to two feet below the original channel depth of 16 feet below low water datum (channel would be dredged to 18 feet below LWD).

A number of obstacles and questions impeded the dredging project at this point:

1) If the river was dredged before remedial activities on Fields Brook were completed, would the river channel become recontaminated? 2) Would dredging uncover more severely contaminated sediment? 3) Who would be responsible for cleanup of contaminated sediments outside the federal channel? 4) Could heavily polluted and toxic sediments be adequately separated for disposal? 5) What permits and regulations must be followed? 6) Where could a suitable disposal site for toxics be located? 7) Where could a suitable site for disposal of heavily polluted material be located? 8) Who would be responsible for liability and monitoring at the disposal site? 9) Who would pay for the project? 10) What precautions would be taken to minimize resuspension of the contaminated sediments in the water column during the dredging project? 11) Would dredging activities impact the drinking water supply?

Once again, the project came to a halt when the local governments could not agree on a disposal site location.

The Buffalo District submitted another EIS in 1987. After considerable negotiations with the local government and regulating agencies involved, this EIS proposed disposal of all materials--200,000 cubic yards of toxic sediments and 300,000 cubic yards of highly polluted sediment--at a privately owned upland site. This plan was finally agreeable to all parties. However, by this time the cost of the project had escalated to $25 million. The Washington Office of the Chief Engineers (OCE) was unwilling to approve that much money for environmental cleanup in a predominantly recreational channel. A 25 percent budget cut under the Reagan Administration changed OCE policy to focus attention on maintenance of commercial channels only, eliminating maintenance in recreational channels. The OCE also felt that it was not the Corps' legal responsibility to clean up toxic sediments. The OCE did agree to investigate the possibility of removing several feet of sediment to temporarily relieve the navigation hazard, but only if the material was not toxic.

After considerable review, U.S. EPA approved this interim dredging operation with certain restrictions on what parts of the river could be dredged. Sediments would have to be disposed at an already constructed CDF in Cleveland or Erie in order to implement the dredging quickly. There is considerable local opposition to use of either of these facilities and another search is underway to locate on alternate disposal site in Ashtabula. Use of the Cleveland CDF 14 is considered the most advantageous, both environmentally and economically and is being pursued as the best option by State and federal agencies. This interim dredging project would not be a remedial action to restore any of the beneficial uses listed in the Great Lakes Water Quality Agreement. However, it would be a remedial action to help restore the local economic base.

Another obstacle has recently been noted in the commercial navigation channel at the mouth of the river. Sediments have accumulated to the point of impeding commercial operations. These sediments have been classified as highly polluted and must be confined disposed, but there is no CDF in Ashtabula. The Buffalo District is again investigating the construction of a CDF in Ashtabula Harbor to contain the highly polluted sediments from the river. This CDF would not be used for the sediments considered to be toxic.

Currently, sediments in the outer harbor are considered suitable for open-lake disposal. It has been observed that PCBs are migrating from the river out into the harbor. Sediment concentrations in the outer harbor in 1984 ranged from 0.17 to 1.08 mg/kg (average 0.39 mg/kg), while 1988 concentrations ranged from < 0.10 to 3.2 mg/kg (average 1.45 mg/kg). If the upstream situation is not remediated, it is possible that open-lake disposal will be curtailed in the future.

8. Eutrophication or undesirable algae.

Certainly, the lower Ashtabula River and harbor are eutrophic, as are all the Lake Erie estuary and harbor areas in Ohio. The Ashtabula nearshore area has been rated as borderline eutrophic/mesotrophic (Rathke 1984), indicating a comparatively low loading of phosphorus and other nutrients from the Ashtabula River. No algae blooms occur. Recent information on nutrients, temperature, dissolved oxygen and other eutrophication related parameters is not available, but present aesthetics and historical data indicate eutrophication is not a major issue in the Ashtabula River AOC.

9. Restrictions on drinking water consumption, or taste and odor problems.

No taste and odor problems have been reported from the Ashtabula Water Treatment Plant. Finished water meets all drinking water standards and there are no restrictions on drinking water consumption. Raw water analysis in 1986 (the most recent data) indicated no violations of water quality standards or GLWQA objectives, although historical monitoring records indicate violations of water quality standards for metals.

One of the deciding factors in ranking Fields Brook as a Superfund site was the possibility of contaminating the public water supply intake in Lake Erie. Prevailing winds and currents generally direct river flow away from the intake, and limited monitoring to date has not detected the presence of organic priority pollutants. Further tests were conducted at the intake under varying weather and flow conditions by Woodward Clyde Consultants as part of the Superfund investigations in 1990. Copper and iron frequently exceeded water quality standards. One exceedence each was recorded for mercury and bis (2-ethylhexyl) phthalate.

There is concern that contaminants in the sediment may be mixed with the water column during Fields Brook and river cleanup activities and move out to Lake Erie. Any remedial dredging operations will have to be accompanied by special precautions and monitoring to prevent possible temporary contamination of the public water supply.

10. Beach closings

There are two beaches in the Ashtabula River AOC, both located along the Lake Erie shoreline. Both areas exhibited consistently good water quality throughout the 1980's based on fecal coliform counts. Bathing water standards were exceeded at Lakeshore Park for two days in July 1989 following a particularly heavy rainfall. The beach was not closed, but an advisory was posted. The existing health advisory for the Ashtabula River applies to fish consumption only, not body contact. When compared to Ohio WQS for human health, ambient water quality concentrations do not present a potential health hazard. Toxic sediments are covered by less polluted sediments and there are no pathways for direct contact with humans.

11. Degradation of aesthetics.

Some debris and muddy water are reported after heavy rainstorms. Debris sometimes accumulates along docks or protected areas of the river after storms, and river current is often too slow to provide frequent flushing of these areas. Generally, the waters in the AOC do not look muddy or polluted. Locals report water clarity at Walnut Beach in 1990 was outstanding.

12. Added costs to agriculture or industry.

Currently, this is not a problem. However, the invasion of the zebra mussel may alter this. Most of the industries along Fields Brook draw water from Lake Erie and are considering treatment of this water to remove the zebra mussels. The RAP process must continue to review treatment plans and the effects they might have on contributing to pollution in the Ashtabula River AOC.

13. Degradation of phytoplankton and zooplankton populations.

There is little current information on the status of plankton communities in the Ashtabula River AOC. Studies conducted on the river and harbor in 1973 (Terlacky et al 1975) indicated plankton species to be more diverse in the harbor than the river. The most prominent species were highly pollution tolerant. Declining cell concentrations were associated with elevated chlorine concentrations being discharged to Fields Brook.

Studies completed during the 1978-1979 Lake Erie Nearshore Intensive Survey revealed the composition of phytoplankton species in Ashtabula Harbor to be similar to that in the adjacent nearshore zone. The majority of principal taxa identified were indicative of degraded water quality (Kline 1981). A review of the zooplankton community also indicated degraded water quality (Krieger 1981). Since no more recent information exists, it is assumed that the plankton community is still degraded.

14. Loss of fish and wildlife habitat.

This is a significant problem in the Ashtabula River AOC. The results of the 1989 Ohio EPA survey indicated non-attainment of WWH status at the river mouth was largely due to lack of habitat (Ohio EPA 1990c). Much of the river shoreline has been developed for marinas. The lower section of the river has been completely bulkheaded for commercial docking facilities and is the site of the poorest biological community. Heavy recreational boat traffic continually resuspends bottom sediment, covering macroinvertebrate on the river bottom.

In the case of habitat rehabilitation, things will have to get worse before they get better. The proposed cleanup operation for the river will severely deplete remaining habitat. Dredging from bank to bank to remove all heavily polluted and toxic materials will effectively remove all shallow areas and submerged vegetation. However, this will ensure that future populations will not be exposed to high concentrations of bioaccumulable contaminants. Future river development and dredging follow-up should include provisions for habitat restoration.

The same problem of total habitat destruction may also be experienced during the Fields Brook cleanup process. Both the river and brook are being addressed under the Natural Resource Damage Assessment provision of CERCLA to determine the overall loss of use of the area's natural resource due to pollution and stream alteration.

Human Health Effects

Although human health effects are not specifically mentioned as part of the 14 beneficial uses listed in the GLWQA, if a use is impaired, there is potential for risk to human health. Several human health related studies have been completed in the Ashtabula River AOC.

A risk assessment completed for Fields Brook as part of the CERCLA-Superfund requirements, determined portions of Fields Brook and its tributaries presented existing and future exposure of the public and the environment to contaminants at levels which may adversely affect public health and welfare (CH_2M Hill 1986). The contaminant levels in Fields Brook sediment presented a risk for residents and workers at both maximum and average concentrations, if the sediments were ingested. Chemicals identified as contributing to the risk were PCBs, hexachlorobenzene, hexachlorobutadiene, benzo(a)pyrene, arsenic, hexachloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene, trichloroethene and vinyl chloride. A summary of results from this risk assessment is presented in Appendix Table A-11. Additional risk assessment studies are being considered for Fields Brook.

A risk assessment has not yet been done for the Ashtabula River. The Risk Assessment Modeling Work Group of the ARCS program initiated a human health risk assessment for the river in July 1991.

The Ohio Department of Health conducted a cancer surveillance study of the human population in close proximity to Fields Brook (Indian and Hundley 1987). The study was initiated after local concern was expressed regarding a perceived higher than expected rate and clustering of cancer. In addition to the organic chemicals being released into the environment, some residents feared a local company that handled uranium was contaminating the area with radionuclides. The study involved review of death certificates as well as door to door interviews. The study area included residences within a one mile radius of the approximate geographical center of the Fields Brook industrial area. Occurrences of cancers over a ten year period from 1977 to 1986 were recorded.

The study concluded the total cancer incidence and mortality in the population close to Fields Brook did not differ significantly from the rest of Ohio or the United States. However, the incidence and mortality of brain and other central nervous system cancers was significantly higher, but it was not known if exposure to chemicals in the area had contributed to this situation.

Two follow-up surveys were recommended as a result of this study: one to identify factors that caused or contributed to the incidence of brain cancers and one to conduct an analysis of adverse reproductive outcomes. The follow-up studies could not identify the cause of the brain cancers. It was concluded that they may be due to a misclassification of the primary disease, environmental factors or chance. The Adverse Reproductive Outcomes survey examined congenital anomalies, low birthweight and fetal deaths and found they did not differ significantly from the Ohio or Ashtabula County experience (Indian and Rao 1988).

CHAPTER 6. DESCRIPTION OF KNOWN AND POTENTIAL POLLUTANT SOURCES

The major sources of contamination to the Ashtabula River AOC were unregulated municipal and industrial discharges of metals and organic chemicals and poor management of industrial wastes dating from the late 1940s. Permit limits and hazardous waste management restrictions are much more stringent now; however, a legacy of highly polluted, toxic and hazardous sediments remains. The presence of these in-place pollutants is now the major source of contamination impacting environmental quality and socio-economic development in the Ashtabula River AOC.

A detailed description of contaminants in the sediment was presented in the preceding chapter. The purpose of the Fields Brook Superfund investigation is to identify the sources of pollution to Fields Brook, the degree of contamination, the extent to which Fields Brook dischargers have polluted the river, establish responsibilities for cleanup and select remedial actions. The conclusions of these studies and the decisions made will be very important to implementation of the RAP remedial process and will be incorporated in the Stage 2 plan.

Since the extensive Superfund investigations will address in great detail the pollutant sources to Fields Brook, this chapter will highlight the sources of pollutants to the river, harbor and Lake Erie. Fields Brook sources will be addressed for their potential as continuing dischargers of priority pollutants to the AOC.

Under the National Pollutant Discharge Elimination System (NPDES) permitting program, dischargers are issued permits for a five-year period. In some cases, the permits may be granted for a shorter period of time. Prior to applying for a new or renewal permit, dischargers are required to submit a Form 2-C. This form lists the raw materials, products and byproducts used or produced by the applicant, and the chemicals that are or potentially may be present in the effluent. Ohio EPA reviews this Form 2-C, monthly monitoring data from previous permit requirements, bioassay results, ambient stream water quality, sediment quality near the outfall, stream use designations, water quality standards, biological information, stream flow, other dischargers in the area and any other pertinent, available information. A wasteload allocation is done to determine the concentrations of pollutants the stream will be able to assimilate at the point of discharge and downstream. All of this information is summarized in a report on Water Quality Based Effluent Limits (WQBEL) which evaluates risk assessment of the environmental hazards associated with pollutants in the effluent. The results of the WQBEL are compared to Best Available Technology (BAT), categorical standards applicable to certain industrial processes, and existing regulations specified by the Clean Water Act, the Ohio Regulatory Code and other legislation to develop limits for the NPDES permits. This procedure is applicable to point sources only. Including a particular substance in an NPDES permit does not necessarily grant the company the approval to discharge that substance. Certain parameters are listed in permits for monitoring only to ensure that these substances are not being discharged, or to determine if these substances should be limited.

Table 28 presents a summary of all point source dischargers with locations identified on Figure 22. Dischargers with expired permits continue to operate under the conditions of the expired permit until a new one is issued. Discharger compliance status with permit requirements is presented in Table 29.

Nonpoint sources are much more difficult to measure and control. Potential sources of nonpoint pollution include runoff from upstream agricultural areas (not a significant problem in the AOC), urban runoff, leachate from landfills, contaminated ground water impacts on surface water, combined sewer overflows and atmospheric deposition. Past disposal practices have created a number of hazardous waste sites in the AOC which have the potential to contribute to the existing contamination. Some of these sites are regulated under the Resource Conservation and Recovery Act (RCRA) and are subject to RCRA corrective actions. However, many have been abandoned for years with no record of what was deposited or by whom. Investigation of these sites falls under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA-Superfund). Preliminary assessments of most of these sites have been completed to prioritize the need for cleanup. CERCLA hazardous disposal sites are listed in Table 48 and located on Figure 24. RCRA sites are located on Figure 25.

Another potential source of pollutants to the AOC is spills. Table 30 lists the spills recorded by Ohio EPA's Division of Emergency and Remedial Response from 1986 to 1990. Two spills were classified as medium priority. All the rest were designated as low priority. No wildlife kills were associated with any of the spills. The spills data suggests that spills do not have a significant impact on the Ashtabula River AOC.

POINT SOURCES DESCRIPTIONS

LAKE ERIE DISCHARGERS

Ashtabula Wastewater Treatment Plant (WWTP)

The Ashtabula WWTP has a design capacity of 12 MGD, a hydraulic capacity of 18 MGD, and processes an annual average flow of 4.45 MGD. The plant serves a population of 26,000. The primary treatment portion of the plant was constructed in 1955, the secondary portion in 1970, phosphorus removal facilities in 1982 and further plant improvements in 1986. Treatment processes include grit removal, primary and secondary settling, activated sludge, aeration, phosphorus removal and chlorination with discharge to Lake Erie. There is no tertiary treatment. Sludge is landfilled outside the area of concern and the Ashtabula River drainage basin.

Approximately 95 percent of the flow to the Ashtabula WWTP is sanitary waste. The remaining 5 percent is industrial waste. The Ashtabula WWTP does have an approved pretreatment program which requires certain industrial and commercial users of the WWTP to pretreat their wastes prior to discharging to the WWTP system. There are twenty significant users. Specific reporting requirements of the pretreatment program are included in the WWTP's NPDES permit as the permittee is responsible for implementing and enforcing the plan.

Over the last three years, the City of Ashtabula has been fined twice for violations at the WWTP. A $40,000 fine was issued in 1989 for failing to meet

Discharger	NPDES Permit # (Expiration Date)	Ohio Permit #	River Mile	Average Discharge (MGD)	Parameters in NPDES Permits
LAKE ERIE DISCHARGERS					
1. Ashtabula WWTP	OH0023914 (8/1/93)	3PE00002	Lake Erie	4.45	TSS, Oil & Grease, Total Phosphorus, TU_a, TU_c Fecal Coliform, BOD_5, pH, TCR, CN, Cd, Cr, Cu, Pb, Ni, Zn, Hex Cr, Phenolics, Mercury, Ammonia, COD, Nitrite, Nitrate, Temp., DO, Bis(2-ethylhexyl)phthalate, Kjeldahl nitrogen
2. Ohio American Water Co.	OH0033723 (1/6/91)	31V00010	Lake Erie	0.25	TSS, Total Phosphorus, pH
3. Cleveland Electric Illuminating Co. (CEI)	OH0001121 (10/1/91)	31B00012	Lake Erie	913.5	Cr, Ni, Silver, Zn, Pb, Cu, Hg, Hex. Cr, TCR, pH, TSS, Oil and Grease, Temperature, CN, Arsenic, Selenium, Beryllium, Cd
4. Elkem Metals Company	OH0000027 (10/1/91)	31N00036	Lake Erie	25.54	Dibenzofuran, TU_a, TU_c, Temperature, TSS, CN, Phenolics, Cr, Total Phosphorus, TCR, Hex. Cr, Manganese, pH, Cd, Cu, Pb, Zn, PAH, Chloroform, bis (2-ethylhexyl) phthalate, Mercury
5. Linchem	OH0000752 (9/26/94)	31E00016	Lake Erie	4.3	TSS, Mercury, Antimony, Temp., pH, Cu, Pb, Zn, Total Phenolics, bis(2-ethylhexyl)phthalate, DDT, TU_a
6. ESAB Welding (L-TEC)	OH0063789 (4/27/95)	31C00071	Lake Erie	0.78	Cu, TSS, Oil and Grease, Temperature, TRC, Total Toxic Organics, pH, CN, Cd, Cr, Pb, Ni, Silver, Zn, TU_a, TU_c

Discharger	NPDES Permit # (Expiration Date)	Ohio Permit #	River Mile	Average Discharge (MGD)	Parameters in NPDES Permits
RIVER DISCHARGE					
7. Union Carbide, Industrial Gases, Inc. Linde Div.	OH0101117 (12/28/95)	3IN00152	Lake Erie	12	Temperature, pH, Oil and Grease, Total Phosphorus
8. Consolidated Rail Corporation (Conrail) Coal Dock	OH0064122 (4/12/90)	3IT00011	Lake Erie	.22	Discharge is stormwater runoff from coal yard. TSS, Total phosphorus, Manganese, Iron, pH
9. Consolidated Rail Corp. Diesel Fuel Facility	OH0083861 (12/27/90)	3IT00012	Ashtabula River upstream from AOC	.005	Stormwater runoff, Oil and Grease, pH
STRONG BROOK DISCHARGERS					
10. Iten Fibre Company	OH0051888 (4/13/91)	3IQ00021	Storm sewer to Strong Brook	<.001	Storm water only. No Monitoring Required.
11. Reliance Electric	OH0038431 (1/7/91)	3IS00076	Storm sewer to Strong Brook	<.03	Discharge consists of noncontact cooling water and stormwater runoff. Temperature, pH
FIELDS BROOK DISCHARGERS					
12. RMI Metals Reduction Plant	OH0002305 (10/1/91)	3IE00011	1.34	1.8	TDS, TSS, Cu, Pb, Zn, Temperature, pH, Oil and Grease, Total Phosphorus, Cr, Ni, Titanium, TU_a, TU_c

Discharger	NPDES Permit # (Expiration Date)	Ohio Permit #	River Mile	Average Discharge (MGD)	Parameters in NPDES Permits
FIELDS BROOK DISCHARGERS (continued)					
13. RMI Extrusion Plant	OH0000442 (9/27/92) (production shutdown)	31C00023	1.67	.07	Temperature, TDS, Total Phosphorus, Fecal Coliform, pH, Cu, TSS, Oil and Grease, Cr, Pb, Ni, Zn, Cd, Flouride, Molybdenum, Hex Cr, Barium
14. RMI Sodium Plant	OH0002313 (10/1/91)	31E00012	1.83	3.3	TDS, TSS, TCR, pH, Temperature, Total Phosphorus, Cu, Zn, Mercury, TU_a, TU_c
15. Detrex	OH0001872 (10/1/91)	31F00017	1.83 2.03	.39	TSS, TCR, TDS, Mercury, Oil and Grease, pH, Temperature, BOD_5, Total Phosphorus, Cd, Cr, PAH, VOCs, BNAs, Cu, Zn, TU_a, TU_c, carbon tetrachloride
16. Acme Scrap Metal	OH0088005 (6/28/96)	31N00093	1.93	.077	TSS, Oil and Grease, pH, TCR, Total Phosphorus, Fe, BOD_5, Turbidity, Color, Odor, Ammonia, Fecal Coliform, PCB
17. OxyChem	OH0029149 (9/26/94)	31F00002	1.83	.50	TDS, TSS, Cr, Cu, Mercury, CN, PCBs, PAHs, Zn, Total Phenolics, Hexachlorobutadiene, Carbon tetrachloride, BOD_5, Oil and Grease, Total Phosphorus, Temperature, pH, hexachlorobenzene, TU_c
18. VyGen	OH0002283 (9/26/94)	31F00006	2.28	.40	BOD_5, COD, TSS, TDS, VOCs, PAHs, Hexachlorobutadiene, Hexachlorobenzene, Temperature, Total Phosphorus, CN, Cd, Cr, Cu, Pb, Zn, Total Phenolics, Mercury, TU_a, TU_c, pH, BNAs

Discharger	NPDES Permit # (Expiration Date)	Ohio Permit #	River Mile	Average Discharge (MGD)	Parameters in NPDES Permits
FIELDS BROOK DISCHARGERS (continued)					
19. SCM #1	OH0000523 (3/30/92)	3IE00013	3.00	4.827	TSS, TDS, Cr, Cu, BOD_5, Temperature, Iron, Zn, Fecal Coliform, pH, Silver, PAH, Arsenic, Cd, Pb, Mercury, CN, TU_a, TU_c
20. SCM #2	OH0000493 (3/30/92)	3IE00017	1.95	9.5	Arsenic, TSS, TDS, Iron, TCR, Zn, Pb, Cr, Ni, Cu, mercury, Temperature, pH, Silver, Cd, tetrachlorethene, PCB, TU_a, TU_c, bis(2-ethylhexyl)phthalate, CN, thallium

BOD_5	Bio Chemical oxygen demand	Cu	Copper	COD	Chemical oxygen demand
TCR	Total chlorine residual	Pb	Lead	TDS	Total dissolved solids
CN	Cyanide	Ni	Nickel	TSS	Total suspended solids
Cd	Cadmium	Zn	Zinc	PCB	Polychlorinated biphenyl
Cr	Chromium	Hex Cr	Hexavalent Chromium	TU_c	Toxicity Unit, chronic
DO	Dissolved Oxygen	VOC	Volatile Organic Compounds	TU_a	Toxicity Unit, acute
PAH	Polynuclear Aromatic Hydrocarbon	BNA	Base neutral and acid extractables		

LEGEND

1. Ashtabula WWTP
2. Ohio American Water Co.
3A. CEI A Plant
3C. CEI C Plant
4C. Elkem cooling water
4P. Elkem process water
5. Linchem (LCP)
6. ESAB Welding (L-TEC)
7. Union Carbide - Linde Div.
8. Conrail - Coal Dock
9. Conrail - Diesel Fuel Facility
10. Iten Fibre Co.
11. Reliance Electric
12. RMI - Metals Reduction Plant
13. RMI - Extrusion Plant
14. RMI - Sodium Plant
15. Detrex
16. Acme Scrap Metal
17. Oxychem
18. Vygen
19. SCM #1
20. SCM #2 - TiO2 Plant
21. SCM #2 - TiCl4 Plant

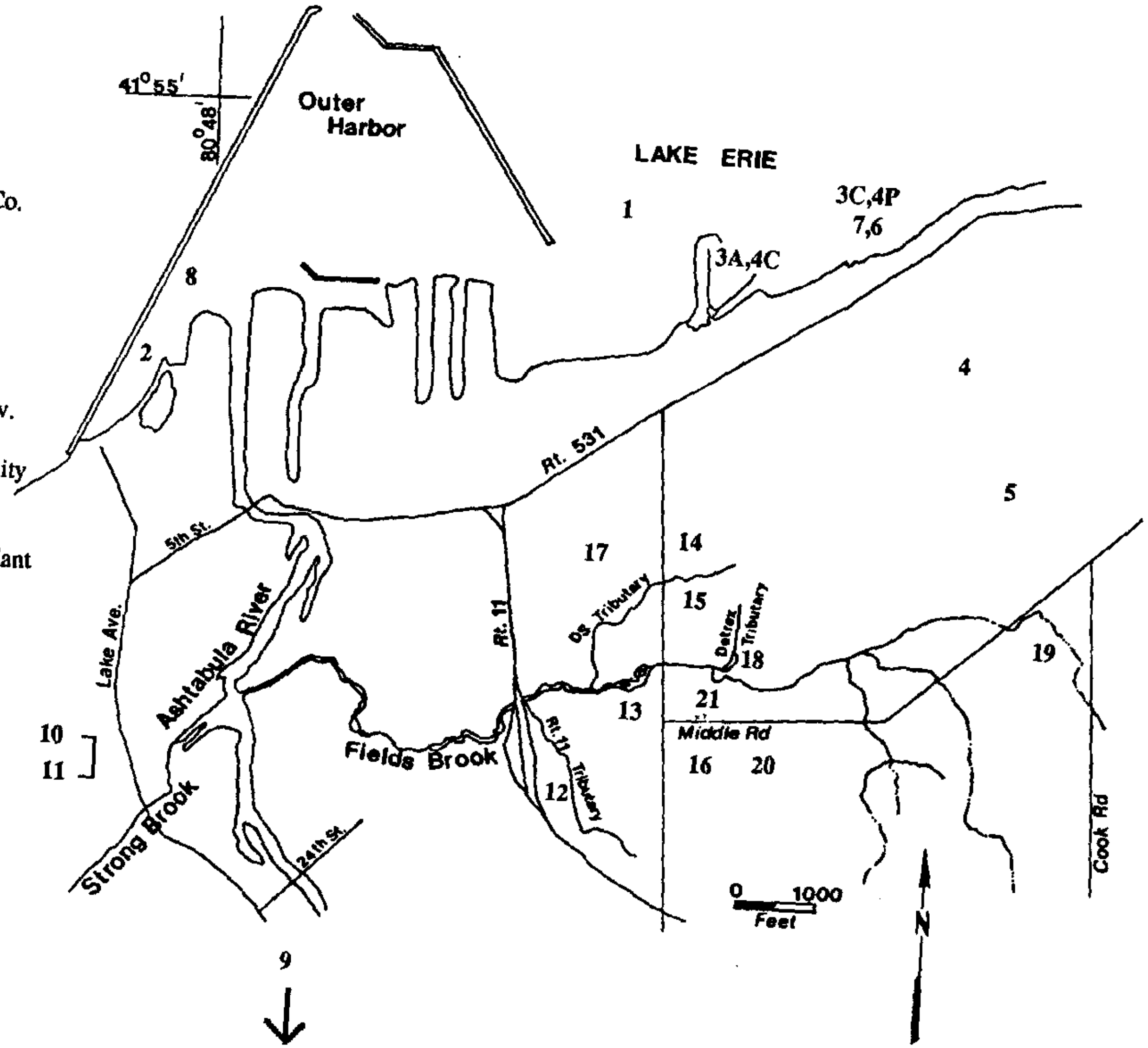


Figure 22. Location of point source dischargers in the Ashtabula River AOC.

Table 29. Summary of Ashtabula River AOC point source discharger compliance with final NPDES permit limits.

Discharger	Compliance	Action
1. Ashtabula WWTP	No	$40,000 fine - 1989 $30,000 fine - 1990 *Findings and Orders - 6/90
2. Ohio American Water Company	Yes	
3. CEI	Yes	
4. Elkem	No	Findings and Orders - 9/90
5. Linchem	No	Currently operating under interim limits. Compliance schedule in permit.
6. ESAB Welding	No	Currently operating under interim limits. Compliance schedule in permit.
7. Union Carbide	Yes	
8. ConRail-Coal Dock	Yes	Operating on expired permit (4/90)
9. ConRail-Diesel Facility	Yes	Operating on expired permit (12/90)
10. Iten Fibre	Yes	Operating on expired permit (4/91)
11. Reliance Electric	Yes	Operating on expired permit (1/91)
12. RMI-Metals Reduction	No	Findings and Orders - 11/90 $35,000 fine.
13. RMI - Extrusion Plant	Yes	Production discontinued - 10/90
14. RMI - Sodium and Chlorine	No	Findings and Orders - 11/90
15. Detrex	No	Consent Agreement with State of Ohio - 1989. $175,000 fine.
16. Acme Scrap	Yes	

Table 29. Summary of Ashtabula River AOC point source discharger compliance with final NPDES permit limits. (Continued)

Discharger	Compliance	Action
17. OxyChem	Yes	Conditions of Finding and Orders effective 10/89 have been met, including $7500 contribution to Ashtabula River RAP Advisory Council.
18. Vygen	No	Currently operating under interim limits. Compliance schedule in permit.
19. SCM #1	No	Findings and Orders - 4/91
20. SCM #2	No	Findings and Orders - 4/91

* Findings and Orders are official documents signed by the Director of Ohio EPA which issue, modify or revoke orders to prevent, control or abate water pollution. Findings and Orders are issued pursuant to Section 6111.03(H) of the Ohio Revised Code. Findings and Orders identify a problem situation and outline the steps and implementation schedule needed to correct the problem situation.

Table 30. Ashtabula River Spills from January 1986 to January 1990. None of these spills involved fish or wildlife kills.

Date	Material	Responsible Party	Priority*
3/27/86	mud, silt	CEI	3
4/1/86	green material with oil	Unknown	3
4/18/86	sand, paint dust	Unknown	3
5/21/86	gasoline	B&B Precision Tool	3
7/8/86	oil, tires, tar, debris	Unknown	2
8/15/86	fuel oil	U.S. Coast Guard	2
8/20/86	oil, tar, gummy stuff	Jack's Marine	3
11/26/86	dredge spoil possible PCB contamination	Ashtabula Recreation Unlimited	4
7/29/87	fly ash, debris	CEI	3
8/14/87	gasoline	Ashtabula Yacht Club	3
8/16/87	diesel fuel	Conrail	3
9/16/87	Unknown	Unknown	3
9/20/87	scum	Unknown	4
9/23/87	fuel oil, asphalt residue	Ashtabula Street Maintenance	3
6/21/88	diesel fuel	Conrail	3
9/28/88	sewage	Ashtabula WWTP	3
5/16/89	dredging spoil	Brockway Marine	3
1/15/90	antifreeze	Unknown	3

18 total

* Priority 2 medium
3 low
4 low

Source: Ohio EPA files, Division of Emergency and Remedial Response, 1990.

pretreatment program requirements on schedule. They have since been addressed. Another $30,000 fine was levied in 1990 due to repeated violations of NPDES permit limits for total phosphorus, suspended solids, carbonaceous biochemical oxygen demand ($CBOD_5$) and phenols. Findings and Orders issued June 22, 1990 set a schedule to comply with all permit conditions by November 15, 1990. The city of Ashtabula has taken the following steps to overcome the problems at the WWTP: hired a pretreatment program supervisor and a city engineer to provide consulting assistance; installed a constant monitor to measure inflow of pollutants to the WWTP; provided all staff the opportunity for training and testing to become State certified operators; and reviewed the quality assurance/quality control of laboratory analysis and reporting procedures. The city decided to hire an outside contractor to conduct laboratory testing required by Ohio EPA. Outfitting the plant laboratory to meet the Ohio EPA quality control/quality assurance requirements is currently cost-prohibitive. The city continues to work with Ohio EPA to achieve the requirements of their NPDES permit.

The WWTP is permitted to discharge from two bypasses under emergency conditions when flow exceeds capacity. One bypass consists of raw sewage and the other of supernatant from settled sewage. A continuous monitor at the bypasses has not yet been installed,and is contingent upon receiving construction grant funds from the State. These bypasses discharge directly to the lake.

Fifteen organic compounds were detected in the effluent by Ohio EPA during sampling conducted prior to reissuance of the NPDES permit in 1988 (Appendix Table A-12). Of these, only bis(2-ethylhexyl)phthalate was measured at more than trace levels. Therefore, in addition to the metals and conventional pollutants limited in the NPDES permit, bis(2-ethylhexyl)phthalate must be monitored. Current permit limits and a summary of monthly monitoring data are presented in Table 31.

Screening bioassays were conducted by Ohio EPA in 1987 on Ashtabula WWTP effluent prior to chlorination (Ohio EPA 1987a). Test results indicated that the effluent was not acutely toxic to Pimephales promelas (fathead minnow). No deaths or adverse effects were noted over a 48-hour period. However, the effluent was acutely toxic to Ceriodaphnia affinis/dubia (water flea). A definitive bioassay done for Ceriodaphnia resulted in an LC50 of 69.6 percent (1.4 TU_a). The LC50 is the median lethal concentration at which 50 percent of test organisms die. This is converted to acute toxicity units (TU_a) by 100/LC50. The allowable TU_a for discharge to Lake Erie is 1 TU_a. A review of water quality data analyzed at the same time suggested ammonia and copper contributed to the toxicity (Ohio EPA 1988a).

Due to the toxic results of the bioassays, the new NPDES permit issued in 1988 required quarterly acute and chronic bioassays for one year to determine the toxicity of the effluent. Results indicated acute toxicity for Pimephales and chronic toxicity for both Ceriodaphnia and Pimephales. Due to this toxicity, Ohio EPA issued a permit modification for the WWTP in January 1991, which required a toxicity reduction evaluation (TRE) and added whole effluent toxicity limits to the NPDES permit which will become effective in December 1993. Under the TRE, the Ashtabula WWTP must conduct tests to determine and remediate the source of toxicity. A summary of bioassay results is presented in Table 32.

Table 31. Current permit limits for the Ashtabula WWTP (3PE00002) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-Day	7-Day	1987 - 1989 n	Max	Min	Mean	Variance	Median	Mean Loading (kg/Day)	Ohio EPA* Mean Conc.
Temperature (^{o}C)	Monitor		674.	27.	9.	15.2	0.339	13.	--	--
Suspended Solids (mg/l)	20.	30.	664.	189.	1.	11.1	1.152	7.	177.	19.
Oil and Grease (mg/l)	Not to exceed 10		195.	15.	0.	5.6	0.536	5.	95.	1.8
Ammonia (mg/l)	Monitor		661.	103.	4.	15.3	0.452	14.2	244.	14.8
Total Phosphorus (mg/l)	1.0	1.5	658.	10.0	0.06	1.0	1.358	0.6	15.6	0.6
Fecal Coliform (#/100ml) Summer Only	1000.	2000.	211.	4300.	0.	98.	3.994	1.	--	
Flow (MGD)	Monitor		1028.	11.2	1.0	4.5	0.342	4.2	--	
$CBOD_5$ (mg/l)	15.	23.	662.	40.	0.4	10.8	0.692	9.	176.	
pH	6.5 -	9.0	806.	8.6	1.8	7.3	0.051	7.3	--	7.3
Total Chlorine Residual (mg/l) (Summer Only)	0.5		320.	11.	0.	0.3	2.214	0.2	6.2	
Dissolved Oxygen (mg/l)	Monitor		483.	112.	0.2	4.2	1.324	3.7	--	3.7
COD (mg/l)	Monitor		663.	206.	6.	56.9	0.546	50.	968.	64
Nitrite (mg/l)	Monitor		144.	1.3	0.04	0.16	0.855	0.1	2.8	<0.02
Nitrate (mg/LO	Monitor		160.	7.2	1.0	1.8	0.656	1.4	33.1	
Kjeldahl TKN (mg/l)	Monitor		137	44.5	0.08	15.2	0.441	14.3	249.	18.6
Total Cyanide (mg/l)	0.05	0.075	57.	0.520	0.	0.019	3.698	0.01	0.285	0.03
Total Cadmium (ug/l)	10.	15.	129.	31.	0.	6.8	0.791	6.	0.1	7.5
Total Chromium (ug/l)	44.	66.	99.	51.	0.	12.1	0.881	10.	1.0	<30.

Table 31. Current permit limits for the Ashtabula WWTP (3PE00002) [Cont.]

Parameter	Permit Limit Concentrations		1987 - 1989							Ohio EPA*
	30-Day	7-Day	n	Max	Min	Mean	Variance	Median	Mean Loading (kg/Day)	Mean Conc.
Total Copper (ug/l)	28.	42.	130.	808.	1.	44.	2.406	16.	0.7	10.
Total Lead (ug/l)	50.	75.	130	50.	1.	13.6	0.773	10.	0.2	3.5
Total Nickel (ug/l)	260.	390.	134.	240.	6.	72.3	0.691	58.	1.2	45.
Total Zinc (ug/l)	302.	453.	134.	580.	2.	68.9	1.321	42.	1.2	31.
Hexavalent Chromium (ug/l)	19.	29.	37.	36.	0.	9.2	0.794	0	0.2	
Phenolics (ug/l)	Not to exceed 10.		96.	10,200.	0.	110.	9.400	4.	1.4	<20
Bis(2-ethylhexyl) phthalate (ug/l)	Monitor		2.	0.	0.	0.	--	0	--	
Total Mercury (ug/l)	0.2	0.3	121.	5.	0.	0.3	0.311	0.12	.007	

* Mean of three to four effluent water quality samples analyzed by Ohio EPA in 1986 and 1987.

n Number of samples analyzed.

Table 32. Summary of results of definitive bioassays for the Ashtabula WWTP.

Acute Results	Ceriodaphnia (48-hour)		Pimephales promelas (96-hour)	
Date	LC50	TU_a	LC50	TU_a
6/87*	69.6%	1.4	no mortality	
11/88	no mortality		72.1%	1.4
1/89	no mortality		22.6%	4.4
5/89	no mortality		63.0%	1.6
8/89	no mortality		70.7%	1.4
Chronic Results	**Ceriodaphnia (7-day)**		**Pimephalas promelas (7-day)**	
Date	NOEL	TU_c	NOEL	TU_c
11/88	100.0%	1.0	100.0%	1.0
1/89	60.0%	1.7	60.0%	1.7
5/89	10.0%	10.0	30.0%	3.3
8/89	30.0%	3.3	Test not valid	

* From Ohio EPA 1987. All remaining results are from Microbac 1988, 1989a, 1989b and 1989c.

LC50 - concentration at which 50% of organisms die.
TU_a - acute toxicity unit $\left(\frac{100}{LC50}\right)$
NOEL - no observed effect level
TU_c - chronic toxicity unit $\left(\frac{100}{NOEL}\right)$

The majority of the Ashtabula River AOC is serviced by separate sewers. However, a small section in the harbor area (136 acres) has combined sewers (Figure 23.) This area is predominately residential and contains the small commercial business section of Ashtabula Harbor. The city has plans to construct new storm sewers in this area to eliminate flooding and overflow of sewage into the basements of area residents. There is one other combined sewer section in Ashtabula approximately 1 1/4 miles upstream from the AOC, in the vicinity of 32nd Street. It drains a residential area. The NPDES permit authorizes discharge from these CSO areas and overflow from a pump station near the harbor only during wet weather periods when flow exceeds capacity of the sewer system. Flow from these outfalls is minimal.

Near the mouth of Strong Brook is a blow-off valve connected to the sanitary sewer system. This valve is opened manually during periods of high flow and releases raw sewage into Strong Brook. The impact of this release on Strong Brook appears to be temporary. Ohio EPA is encouraging Ashtabula to eliminate this overflow, but there are currently no orders addressing this.

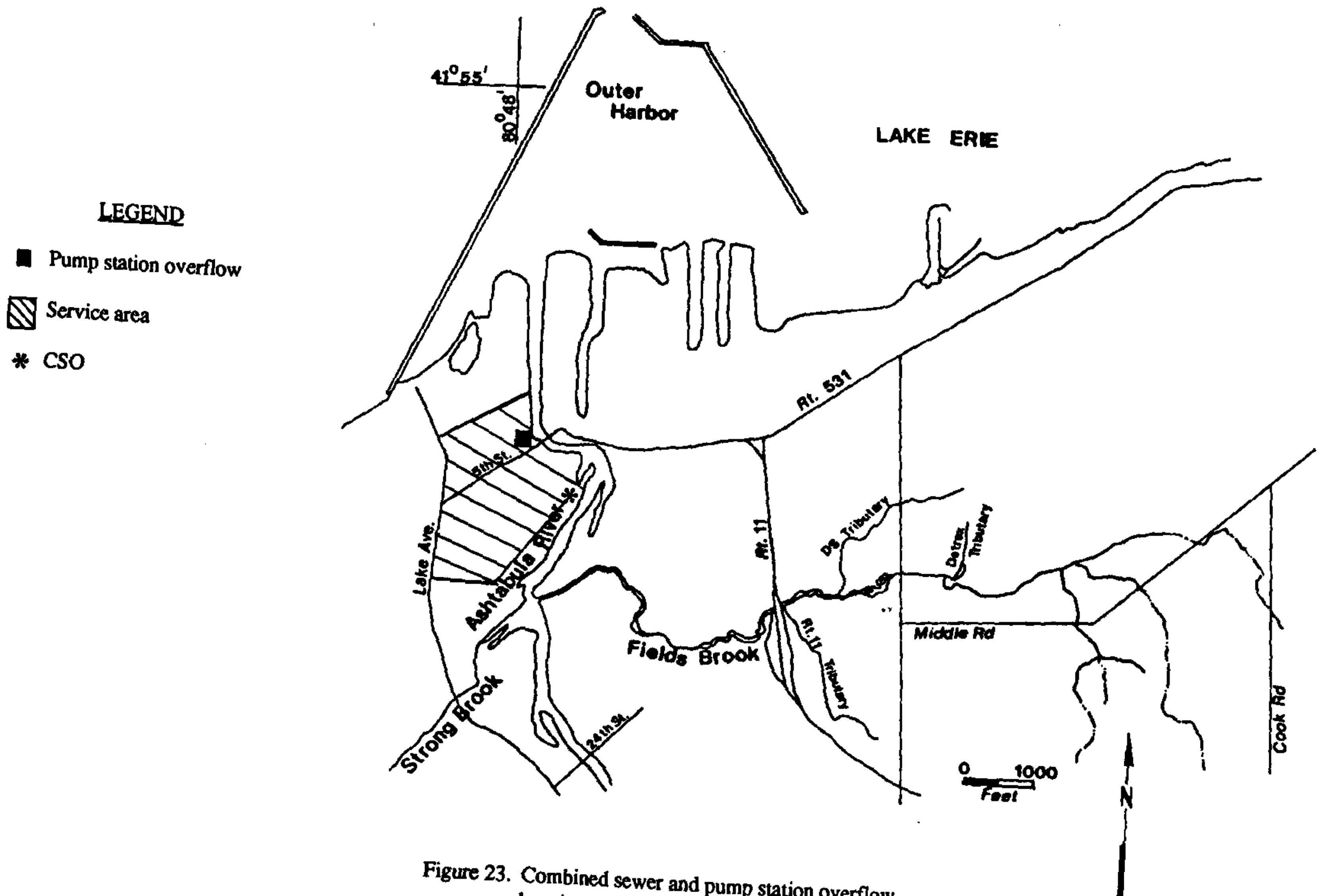


Figure 23. Combined sewer and pump station overflow locations and service area in the Ashtabula River AOC.

Much of Strong Brook is now an underground storm sewer receiving runoff from the city of Ashtabula. A small section of this area is unsewered and may be contributing to elevated levels of BOD, nutrients and fecal coliform bacteria measured in the Brook (Davic 1990).

The Ohio American Water Company

The Ohio American Water Company supplies drinking water to 38,500 people in the Ashtabula area. All water is taken from Lake Erie at an average production of 5.06 MGD. The treatment process consists of coagulation/flocculation, sedimentation, media filtration and disinfection. The discharge to Lake Erie averages 0.25 MGD and is released from the sludge lagoon containing backwash water. The key parameters limited by the permit are total suspended solids, total phosphorus and pH. A summary of current permit limits and discharge levels is presented in Table 33.

Table 33. Current permit limits for the Ohio American Water Company (3IV00010) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-Day	Permit Limit Concentrations Daily	n	Max	Min	Mean	Variance	Median	Mean Loading (kg/Day)
Suspended Solids (mg/l)	15	20	148	29	2	6.8	0.560	6.0	9.4
Total Phosphorus (mg/l)	Monitor		148	0.2	0	0.09	0.462	0.1	0.12
pH	6.5-9.0		148	7.8	7.2	7.5	0.015	7.5	--
Flow (MGD)	Monitor		1066	1.0	0.2	0.37	0.224	0.39	--

n = number of samples analyzed.

Cleveland Electric Illuminating Company (CEI) (Centerior Electric)

The CEI operates two electric generating power plants in the Ashtabula AOC, the "A" Plant and the "C" Plant. The "A" Plant consists of one operating steam-electric generating unit with a demonstrated total gross generation capacity of 260 Megawatts. The "C" Plant consists of four steam-electric generating units with a demonstrated total gross generation capacity of 190 Megawatts. Steam at both plants is produced in coal fired boilers. Coal is stored in a 14-acre pile with a runoff collection basin. The plants discharge an average of 397 MGD of noncontact cooling water and 3.9 MGD of process water. The wastewater treatment systems in both plants are considered the best available technology.

CEI has four discharges directly to Lake Erie. The main parameter of concern for the two cooling water discharges is total residual chlorine. The main parameters of concern for the combined ash basin-coal pile runoff-metal cleaning wastes outfalls and the oily waste basin outfalls are total suspended solids, pH, and oil and grease. Although no limits are specified in the NPDES permit, the combined ash basin-coal pile runoff-metal cleaning wastes effluent must be monitored for cyanide, arsenic, selenium, berylium, cadmium, hexavalent chromium, total chromium, nickel, silver, zinc, lead, copper and mercury. CEI occasionally exceeds pH and total suspended solids limits from the oily waste basin, but otherwise is in compliance with its permit. A summary of characteristic discharge and loading from the four process water outfalls is presented in Table 34.

There are four unlined fly ash collection basins. The CEI is considered a small quantity generator of RCRA hazardous wastes and has a RCRA permit as well as a NPDES permit (Ohio EPA 1985).

Elkem Metals Company

Elkem Metals Company is a 673-acre industrial complex that produces fero alloys, lime and calcium carbide using lime kilns and electrometallurgical furnaces. The operation was initiated by Union Carbide in 1943, and Elkem has continued to use the same processes since they acquired the plant in 1981. There are two outfalls to Lake Erie, one consisting of untreated noncontact cooling water, treated sanitary wastes and surface and groundwater runoff, and the other of treated process water. The key parameters limited in the NPDES permit are total suspended solids, total cyanide, cadmium, hexavalent chromium, total chromium, copper, lead, manganese, PAHs, total phenolics and total residual chlorine. There are monitoring only requirements for total phosphorus, zinc, chloroform, bis(2-ethylhexyl)phthalate, mercury and dibenzofuran. An effluent biomonitoring program must be initiated by 1993 to determine the toxicity of the effluent. Current NPDES permit conditions and a summary of discharge characteristics are presented in Table 35.

Ohio EPA has detected eleven organic chemicals in the Elkem effluent (See Appendix Table A-12). There are insufficient data to calculate aquatic or human health criteria for most of these chemicals. No bioassays have been conducted on the effluent and the effect on Lake Erie is unknown. The number of organic and inorganic chemicals present in the effluent suggests that there may be an environmental hazard to Lake Erie, which is why Elkem must initiate a program to determine the toxicity of its effluent. Implementing the biomonitoring program will measure whole effluent toxicity and characterize any impact on Lake Erie. Although not currently detected in the effluent, mercury must be monitored for. Elevated mercury concentrations in the lake sediment near Elkem suggest that mercury was discharged in the past or may still be entering the lake via nonpoint sources (Ohio EPA 1990f).

Outfall	Parameter	Permit Limit Concentrations 30-day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
002	Total Suspended Solids (mg/l)	30	100.0	462	36.0	0.0	2.6	1.497	0.0	2.2
	Oil & Grease (mg/l)	15	20.0	460	0.0	0.0	0.0	0.0	0.0	0.0
	pH (max.)	—	9.0	1066	9.0	6.9	8.0	.045	8.1	NA
	pH (min.)	—	6.5	1066	8.6	6.2	7.6	.059	7.6	NA
004	Total Suspended Solids (mg/l)	30	100.0	464	85.0	0.0	4.9	1.421	4.0	2.3
	Oil & Grease (mg/l)	15	20.0	459	9.0	0.0	0.02	—	0.0	0.01
	pH (max.)	—	9.0	1060	9.0	7.0	8.0	.029	8.0	NA
	pH (min.)	—	6.5	1059	8.3	6.1	7.6	.043	7.8	NA
006	Total Suspended Solids (mg/l)	30	100.0	473	94.0	0.0	13.0	1.036	9.0	96.1
	Oil & Grease (mg/l)	15	20.0	457	5.0	0.0	0.011	—	0.0	.052
	pH (max.)	—	9.0	1064	8.9	7.1	8.2	.032	8.2	NA
	pH (min.)	—	6.5	1063	8.4	6.0	7.4	.056	7.4	NA
007	Total Suspended Solids (mg/l)	30	100.0	474	164.0	0.0	12.6	1.104	9.0	71.9
	Oil & Grease (mg/l)	15	20.0	461	6.0	0.0	0.013	—	0.0	.070
	pH (max.)	—	9.0	1060	9.6	7.1	8.2	.030	8.2	—
	pH (min.)	—	6.5	1058	8.4	6.0	7.5	.052	7.5	—

Table 35. Final NPDES permit limits for Elkem Metals Company (3IN00036), Outfall 001, and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30 day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (Kg/Day)
pH	6.0 -	9.0	148	9.7	6.0	7.2	0.099	7.1	NA
Tot. Sus. Solids (mg/l)	30.3	60.6	146	26	1	5.3	0.850	4.0	50.8
Cyanide (mg/l)	.021	0.059	436	0.8	0	0.02	2.832	0	0.1
Phenolics (ug/l)	22.5	47	436	1350	0	21.7	3.905	12	0.13
Chromium (ug/l)	56	112	2	10	0	5.0	1.414	0	.071
Hex. Chromium (ug/l)	5.6	11.0	2	0	0	0	—	0	0
Manganese (ug/l)	562	1235	2	150	0	75.0	1.414	0	0.7
Tot. Chl. Res. (mg/l)	—	.038	146	7.2	0	1.6	0.684	1.3	14.8
Total Phosphorus (mg/l)	Monitor		34	0.23	0.01	0.05	0.895	0.04	0.7
Cadmium (ug/l)	13 -	16							
Copper (ug/l)	—	50							
Lead (ug/l)	70	410							
Zinc (ug/l)	Monitor								
PAH (ug/l)	3	—							
Chloroform (ug/l)	Monitor			(Monthly operating report data not available for these parameters)					
Bis(2-ethylhexyl) phthalate (ug/l)	Monitor								
TU_a, *Ceriodaphnia*	Monitor								
TU_c, *Ceriodaphnia*	Monitor								
TU_a, *Pimephales*	Monitor								
TU_c, *Pimephales*	Monitor								
Mercury (ug/l)	Monitor								
Dibenzofuran (ug/l)	Monitor								

Elkem is not in compliance with its NPDES permit. Findings and Orders issued by the Ohio EPA require Elkem to construct improved treatment facilities and achieve compliance by June 1993.

Most of the liquid and solid wastes generated by Elkem and previous Union Carbide operations have been landfilled on site. Since 1943, nine sludge ponds (1, 1A, 2, 3, 3A, 4A, 4B, 4C, 4D) have been located on the site. Ponds 1, 1A, 2, 3 and 3A were used for disposal by the former Union Carbide Metals Plant as well as the adjacent Union Carbide Linde Welding and Linde Gas Plants.

Since Elkem purchased the Union Carbide Metals Plant in 1981, no waste has been accepted from the Linde Division. Ponds 1, 1A, 2 and 3 have been abandoned as active waste disposal areas, and Pond 3 has been clay-capped. Wastes stored in the ponds include carbide shot, wastewater treatment sludge, metal shot and baghouse dusts. Carbide shot is now recycled in furnaces on site. The Pond 4 series is used for wastewater treatment and holds cyanide and phenolic wastewaters. Reports indicate that leachate containing ammonia, sulfate and metals is seeping into the shallow groundwater from Ponds 3 and 3A. A ground water collection trench has been constructed around these ponds (Ohio EPA 1985). Elkem is permitted under RCRA as a Treatment, Storage and Disposal Facility. Ground water monitoring and corrective actions have been implemented under RCRA.

<u>Linchem, Incorporated (formerly Linden Chemical and Plastics (LCP))</u>

This 25-acre facility has been in operation since 1963. Former owners were Detrex Chemical and International Minerals and Chemical Corporation. LCP purchased the property in 1982, and the company is now known as Linchem. Linchem operates a mercury-cell chlor-alkali plant for the production of chlorine, potassium hydroxide (caustic potash) and hydrogen. Potassium hypochlorite, potassium carbonate and chloropicrin (trichloronitromethane) are variably produced. The effluent amounts to an average of 4.2 MGD and consists of process and noncontact cooling water. The present treatment system routes wastewater through a clarifier for solids removal, then to storage tanks for chlorine removal and mercury reduction by sodium sulfite and sodium hydrosulfide. Neutralization and final pH adjustment in a cement-lined pond follow. Flow from the cement pond is combined with plant cooling waters in a surge pond and then discharged to Lake Erie. Solids from the clarifier are filtered and then landfilled at Chemical Waste Management in Fort Wayne, Indiana. The effluent is discharged to Lake Erie via a storm sewer (U.S. EPA 1989b).

Bioassays conducted by U.S. EPA in 1987 (U.S. EPA 1988a) and 1988 (U.S. EPA 1989a) indicated the effluent was rapidly lethal to all test organisms. Bioassay information is summarized in Table 36.

Table 36. Summary of results of definitive bioassays for Linchem.

Date	Pimephales promelas (96 hr) LC50	Pimephales promelas (96 hr) TU_a	Daphnia pulex (48 hr) LC50	Daphnia pulex (48 hr) TU_a	Ceriodaphnia dubia (48 hr) LC50	Ceriodaphnia dubia (48 hr) TU_a
12/87	20.8	4.8	16.9	5.9	8.8	11.4
12/88	14.6	6.9	8.8	11.4	All toxic	>100

LC50 - concentration at which 50% of organisms die; figures are percent concentration.

TU_a - acute toxicity unit $\left(\frac{100}{LC50}\right)$

Lake Erie policy in the Ohio State Surface Water Toxics Strategy limits discharges to 1.0 TU_a to protect against rapidly lethal conditions in the mixing zone. It appears that mercury concentrations, at least in part, are the cause of toxicity in the effluent (Ohio EPA 1989c). Sources of mercury in the effluent result from atmospheric deposition, leachate and fugitive mercury as well as the process wastes. Mercury wastes were formerly discharged through a ditch directly to Lake Erie until Detrex, an owner of the plant prior to Linchem, obtained an NPDES permit. The plant has been fined twice in the past for discharging mercury to Lake Erie, and mercury wastes disposed of in on site lagoons have contaminated groundwater. These lagoons were closed in 1980 and have never been used by Linchem. Chlor-alkali plants in general have contributed considerable loadings of mercury to the Great Lakes, and those on Lake St. Clair and the Detroit River were largely responsible for the mercury related fishing ban on Lake Erie in the early 1970's (Burns 1985). It is not surprising then to find that sediments in the Lake Erie nearshore, near the outfall of Linchem, have elevated mercury concentrations when compared to the sediments upcurrent to the west (Anderson and Carlson 1985).

Priority pollutants detected in the Linchem effluent in preparation for permit application included antimony, arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, zinc, total phenolics, methylene chloride, chloroform, carbon tetrachloride, bromodichloromethane, bromoform, 1,1-dichloroethane, 1,2-dichloroethane, vinyl chloride, tetrachloroethylene, toluene, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, phenanthrene and DDT. Not all of these were present in sufficient amount to require permit limits (Ohio EPA 1989c).

Linchem currently operates under interim permit conditions which require monitoring for the following parameters but do not set limits: temperature, total suspended solids, copper, lead, zinc, antimony, total phenolics, bis(2-ethylhexyl)phthalate, DDT, flow, mercury and acute toxicity for Ceriodaphnia and Pimephales promelas. Continuous monitoring for pH is required and values should fall between 6.5 and 9. By September 1992, Linchem must be in compliance with the final permit conditions which require

Table 37. Permit limits for Linchem, Incorporated (3IE00016) (to be in effect 9/92) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-day	Permit Limit Concentrations Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
Temperature °C	Monitor	Monitor	1008	37.8	0.3	21.8	.43	22.2	NA
Total Suspended Solids (mg/l)	Monitor	Monitor	430	271	0	10.2	1.65	5.0	161.6
Copper (ug/l)	Monitor	Monitor	1	0	0	0	--	0	0
Lead (ug/l)	Monitor	Monitor	1	0	0	0	--	0	0
Zinc (ug/l)	Monitor	Monitor	1	0	0	0	--	0	0
Antimony (ug/l)	Monitor	Monitor	1	0	0	0	--	0	0
Total Phenolics (ug/l)	10	--	4	4	0	1.5	1.28	0	0.026
Bis(2-ethylhexyl) phthalate (ug/l)	Monitor	Monitor	ND	ND	ND	ND	ND	ND	ND
DDT	Monitor	Monitor	1	0	0	0	--	0	0
Acute Toxicity, Ceriodaphnia	--	1.0	ND	ND	ND	ND	ND	ND	ND
Acute Toxicity, Pimephales	--	1.0	ND	ND	ND	ND	ND	ND	ND
Mercury (ug/l)	--	0.2	443	60	0.2	1.6	1.91	1.2	.025
pH	6.5	9.0	1027	9.4	4.4	7.95			NA

NA = Not Applicable
ND = No data

monitoring for all the above parameters and specific limits for total phenolics, mercury, pH, and acute toxicity of 1 TU_a. Linchem has initiated a Toxic Reduction Evaluation to determine the source of toxicity in its effluent so remedial actions can be implemented to meet the 1 TU_a limit by 1992. A summary of permit conditions and characterization of effluent content is presented in Table 37.

ESAB Welding Products, Incorporated (Formerly L-TEC)

ESAB Welding produces welding rod and wire and is categorized as a metal finisher. The company was formerly known as L-TEC and previously owned by Union Carbide. The facility itself has been in operation since 1963. Discharge from this facility mixes with discharge from the adjacent Union Carbide Industrial Gases plant before it empties into Lake Erie via a storm sewer. Until 1989 both of these facilities operated under the same NPDES permit. Separate permits now are in effect for each discharger, but additional testing is required at each facility to determine the pollutant loadings from each plant and develop specific limits for the final effluents.

Process water treatment consists of mixing, neutralization and settling in four surface impoundments. Although the plant itself does not produce hazardous materials presently, the sludges in the impoundments are considered hazardous due to mixing wastewaters with lime and alkaline cleaning wastes. Therefore, the facility also has a RCRA permit which requires ground water monitoring. Monitoring wells have contained solvents (i.e. chlorobenzene) of undetermined origin (Ohio EPA 1985), but current groundwater monitoring has not detected any contamination from the site (Ohio EPA 1991).

After treatment, process waters are monitored for pollutants. Priority pollutants detected by ESAB in the treated process water included chromium, copper, lead, nickel, zinc, bromoform, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, xylene, chrysene, butylbenzylphthalate and bis(2-ethylhexyl)phthalate. None of these chemicals were present at levels which posed an environmental hazard, however, one acute bioassay proved to be highly toxic to Ceriodaphnia (Ohio EPA 1990g). Thus, NPDES permit restrictions for this discharge, in addition to limiting the above metals and industrial categorical parameters, also limit the amount of total toxic organics allowed in the effluent. The permit requires construction of improved treatment facilities and compliance with final effluent limitations by 1993.

Process waters are mixed with nonprocess cooling waters before discharge to the storm sewer. This combined effluent is monitored for all the parameters limited in the treated process water effluent, and is subject to a biomonitoring program to determine any acute or chronic toxicity to Ceriodaphnia and Pimephales promelas. Before this effluent is discharged to Lake Erie, it is mixed with the nonprocess cooling waters of the Union Carbide Industrial Gases plant. The NPDES permit also requires ESAB Welding to conduct bioassays on the combined final effluent at the point where it discharges to Lake Erie in order to detect any toxicity. Table 38 lists the permit limits for the process water discharge and a summary of monitoring data from 1987 to 1989. The previous permit was not as restrictive as the current permit, so there is no data for many of the parameters.

Table 38. Permit limits for process wastewater from ESAB Welding (3IC00071) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-day	Permit Limit Concentrations Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
Total Suspended Solids (mg/l)	19.2	40.2	144	120	1	15.4	1.01	10.0	7.3
Oil and Grease (mg/l)	11.8	20.	144	99	0	3.3	2.5	2.0	1.9
Cyanide (mg/l)	0.226	0.419	ND	ND	ND	ND	ND	ND	ND
Cadmium (ug/l)	69	240	ND	ND	ND	ND	ND	ND	ND
Chromium (ug/l)	596	966	ND	ND	ND	ND	ND	ND	ND
Copper (ug/l)	722	1178	141	2545	0	99.1	2.66	29	2.3
Lead (ug/l)	65	198	ND	ND	ND	ND	ND	ND	ND
Nickel (ug/l)	830	1388	ND	ND	ND	ND	ND	ND	ND
Silver (ug/l)	83	149	ND	ND	ND	ND	ND	ND	ND
Zinc (ug/l)	88	266	ND	ND	ND	ND	ND	ND	ND
Total Toxic Organics (ug/l)	--	742	ND	ND	ND	ND	ND	ND	ND
pH	6.5 to	9.0	142	10.5	6.2	8.8	.07	8.9	NA

N = Number of samples analyzed
ND = No data

Union Carbide Industrial Gases Inc., Linde Division

Union Carbide Industrial Gases Inc., Linde Division produces industrial gases which include hydrogen and atmospheric gases (i.e. oxygen, nitrogen and argon). There are two outfalls on site, 001 from the atmospheric gas production facility, and 002 from the hydrogen production facility. Downstream from the plant, both effluents combine with the effluent from the ESAB Welding facility (L-TEC) before discharge to Lake Erie. Plant effluent consists primarily of untreated, noncontact cooling water. Less than one percent of the total discharge consists of stormwater runoff, blowdown and filter backwash from steam boiler systems, and atmospheric condensate. Total discharge averages 12 MGD. Key parameters limited in the permit are oil and grease, and pH. Union Carbide is in compliance with its NPDES permit.

Consolidated Rail Corporation (Conrail)

Conrail has two facilities in the AOC. The coal storage and transshipment terminal is located on the Ashtabula Coal Dock at the river mouth. The effluent consists of stormwater and averages 0.2 MGD. Treatment before discharge to Lake Erie includes equalization, lime addition and settling. Key parameters limited in the NPDES permit are total suspended solids and pH. Total phosphorus, manganese, and iron are monitored. Periodic violations of pH occur. NPDES permit conditions and a summary of monthly operating data from 1987 to 1989 are presented in Table 39.

Table 39. Permit limits for Conrail Coalyard facility (3IT00011) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
Total Suspended Solids (mg/l)	--	50	77	156	1	20.7	1.1	14.0	3.4
pH	6.5 to	9.0	77	8.7	2.2	7.1	0.12	7.2	NA
Total Phosphorus (mg/l)	Monitor	Monitor	17	6.7	0	.6	2.6	0.05	0.1
Manganese (ug/l)	Monitor	Monitor	17	910	0	73.8	3.12	1.0	.06
Iron (ug/l)	Monitor	Monitor	17	7310	0	517	3.45	1	0.27

The Conrail coal storage piles and the coal conveyor spanning the river are sources of coal dust problems at the river mouth. Conrail is required to routinely water down the coal piles, but local residents and boaters still complain of coal dust clouds impacting river travel and rapidly soiling boats and buildings. Coal dust accumulation on the sandy bottom inside the west breakwall is suspected to be associated with the high incidence of tumors in brown bullhead in the area.

The second facility is a diesel locomotive fueling facility located west of the river. It discharges to the Ashtabula River via storm sewer upstream from the AOC. The effluent consists of stormwater runoff, and oil and grease are the key parameters listed in the NPDES permit.

STRONG BROOK DISCHARGERS

Iten Fibre

Iten Fibre Company produces industrial laminates and custom fabrications. Only stormwater is discharged to Strong Brook. Process wastewaters are sent to the Ashtabula WWTP. Total discharge averages less than 0.001 MGD and the NPDES permit does not require monitoring for any pollutants.

Reliance Electric Company

The Reliance Electric Company produces electric AC/DC motors (1-100 hp). Discharge to the Strong Brook storm sewer includes only noncontact cooling water and stormwater runoff and does not require treatment. Process wastes are sent to the Ashtabula WWTP.

FIELDS BROOK DISCHARGERS

RMI Titanium, Metals Reduction Plant

The RMI Metals Reduction Plant has been in operation since 1956. This facility produces titanium sponge by reacting sodium and titanium tetrachloride. Brine solution and precipitate produced as byproducts of this process are recycled at the RMI Sodium and Chlorine Plant. Wastes generated include titanium fines and slag, scrap metallic sodium and steel wool impregnated with metallic sodium. The sodium wastes are considered hazardous wastes due to the reactive properties of sodium, classifying the RMI facility as a small quantity generator of hazardous wastes. Thus, it is regulated under the RCRA program as well as the NPDES program.

All process waters, sanitary wastes and stormwater runoff are treated by settling in two connected lagoons prior to discharge. Some titanium fines, slag and sodium wastes are open burned, but Ohio EPA is urging RMI to discontinue this practice. A major titanium fire occurred on August 7, 1984, resulting in limited population exposure, but no further incidents have been reported. RMI currently burns about 100 lbs. of waste material a year.

In its early years of operation, RMI Metals used mercury and zirconium in processing. High levels of mercury were found in the Route 11 tributary (West Brook) near the plant discharge in 1970. The contaminated material was removed from the tributary and buried on-site along with other mercury contaminated wastes.

Bioassays conducted on the final effluent from RMI in 1989 indicated 20% toxicity to fathead minnows (Pimephales promelas) and no toxicity to Ceriodaphnia. Organic pollutants were rarely detected in the effluent and the data indicated RMI Metals plant was no longer contributing to the sediment contamination in Fields Brook (Ohio EPA 1989d). The current NPDES permit limits the discharge of total suspended solids, total dissolved solids, oil and grease, chromium, copper, lead, nickel, titanium and pH. Temperature, total phosphorus and zinc must be monitored. Biological monitoring for acute and chronic toxicity to Ceriodaphnia and Pimephales promelas is required as well. NPDES permit conditions are presented in Table 40. Because of its inability to meet the requirements of this permit, RMI was fined $35,000 and currently is under Findings and Orders to meet Best Available Technology (BAT) by mid 1993.

RMI Titanium, Sodium and Chlorine Plant

The RMI Sodium and Chlorine Plant produces sodium metal and chlorine through electrolysis of sodium chloride brine from the Metals Reduction facility. This plant has one outfall to Fields Brook (storm sewer which also receives discharge from Detrex and Occidental) which consists of sanitary wastewater, process wastewater and cooling water. Process wastewaters are treated in settling ponds following neutralization and catalytic destruction of hypochlorite. This treatment was implemented because of numerous complaints and NPDES permit violations for discharge of high levels of total residual chlorine to Fields Brook.

Bioassays conducted in 1988 and 1989 on the RMI effluent resulted in intermittent acute toxicity to Ceriodaphnia. Two of three samplings showed acute effects, while the third showed no toxicity. Definitive bioassays completed within 24 hours of the screening bioassays exhibited no adverse effects to Ceriodaphnia, indicating the toxicity initially observed was not persistent. Because of this periodic shock toxicity, RMI must conduct a Toxicity Reduction Evaluation to define the source of toxicity in its effluent and remedial measures necessary to achieve the whole effluent toxicity limits in its permit. (Ohio EPA 1990h).

Parameters limited in the existing permit are copper, zinc, total dissolved solids, mercury, pH, acute toxicity to Ceriodaphnia and acute toxicity to Pimephales promelas. Temperature, total suspended solids, total phosphorus and total residual chlorine must be monitored. The only organic chemical detected in the plant outfall was chloroform (1.2 ug/l), therefore, no organics are included in the NPDES permit (Ohio EPA 1990h). RMI Sodium and Chlorine is under Findings and Orders to meet all permit conditions by 1993. Permit conditions and a summary of effluent monitoring data from 1987 to 1989 are presented in Table 41.

Table 40. Permit limits for RMI Titanium Metals Reduction Plant (3IE00011) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
Temperature °C	Monitor	Monitor	58	17.0	37.0	25.0	.276	24.0	NA
Total Dissolved Solids (mg/l)	600	700	154	703	214	353	.218	328	2470
Total Suspended Solids (mg/l)	3.6	7.6	154	71	0	1.8	4.3	0	79
Oil and Grease (mg/l)	2.2	3.7							
Total Phosphorus (mg/l)	Monitor	Monitor							
Chromium (ug/l)	9.0	21.8							
Copper (ug/l)	17.4	26.4							
Lead (ug/l)	7.6	16.5							
Nickel (ug/l)	21.8	32.5							
Zinc (ug/l)	Monitor	Monitor							
Titanium (ug/l)	13.6	31.3							
TU_a *Ceriodaphnia*	Monitor	Monitor							
TU_c *Ceriodaphnia*	Monitor	Monitor							
TU_a *Pimephales*	Monitor	Monitor							
TU_c *Pimephales*	Monitor	Monitor							
pH	6.5 to	9.0	155	10.7	6.7	8.1	.053	8.1	NA

Blank spaces indicate no data. Permit in effect from 1987 to 1989 did not require monitoring for these parameters.

Table 41. NPDES permit limits for RMI Titanium Sodium and Chlorine Plant (3IE00012) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30-day	Permit Limit Concentrations Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (kg/day)
Temperature °C	Monitor	Monitor	152	28.7	10.0	18.7	.260	18.4	NA
Total Suspended Solids (mg/l)	Monitor	Monitor	152	173	0	8.9	1.9	5.0	120.6
Total Phosphorus (mg/l)	Monitor	Monitor							
Copper (ug/l)	18	27							
Zinc (ug/l)	150	170							
Total Chlorine Residual (mg/l)	Monitor	Monitor	152	.1	0	.002	7.07	0	.028
TU_a *Ceriodaphnia*	--	1.0							
TU_c *Ceriodaphnia*	Monitor	Monitor							
TU_a *Pimephales*	--	1.0							
TU_c *Pimephales*	Monitor	Monitor							
Total Dissolved Solids (mg/l)	--	2500	152	4859	164	1176	.637	958	14723
Mercury (ug/l)	.012	1.1							
pH	6.5 to	9.0	152	9.0	7.4	8.5	.029	8.5	NA

The sodium plant is also a RCRA-permitted facility. Hazardous wastes generated include sulfuric acid, spent cell bath (contaminated with barium), and metallic sodium/calcium residue. Sulfuric acid that is not recycled is neutralized in the on-site wastewater treatment system. Prior to August 1983, the sodium residue was open-burned on a concrete pad and in a burn room having no pollution abatement equipment. Following a Consent Agreement and Final Order from U.S. EPA, a second burn room was fitted with pollution equipment and open burning ceased.

Under Part B of its RCRA permit, RMI is permitted to store reactive sodium and barium. They are currently exceeding their storage limits, but no Findings and Orders have been issued to date. There is no evidence this storage site is contributing to the Fields Brook contamination, but exploratory ground water monitoring continues (Ohio EPA 1991).

A 3.6 acre landfill on the RMI property received cell bath waste and construction debris from 1950 - 1980. This waste contained barium, lead and cadmium. The area has a closure plan and has been capped with two feet of clay. A drainage ditch which transversed the site was rerouted to reduce the potential for infiltration of water to the landfill. Ground water studies indicate contamination with barium, zinc and lead. A leachate seep at the south end of the sodium plant revealed the presence of trichloroethene, tetrachloroethene and trichloroethane. It is suspected infiltration from off site may have caused this contamination as these solvents were never used by RMI.

RMI Extrusion Plant

The RMI Extrusion Plant is a private company which is a subcontractor to Westinghouse Materials Company of Ohio (WMCO), a contractor to the Department of Energy (DOE), and is licensed under the Nuclear Regulatory Commission (NRC). The principal activity under the WMCO subcontract was the conversion of depleted and slightly enriched uranium ingots into rod or tube shapes via extrusion. Additional processing included the cutting, straightening, acid pickling, and machining of the extruded uranium parts. RMI also conducted non-DOE activities for other clients including the processing of copper, nickel, molybdenum, cobalt, zirconium, steel, aluminum, titanium, beryllium and zinc. The Extrusion Plant discontinued production in 1990 and currently is undergoing decontamination prior to closure. Decontamination, which will require removal of all radioactive materials and equipment, is expected to take ten years.

An aerial radiological survey to determine background levels of radionuclides in a 30 square mile area around the Extrusion facility was conducted in 1985 (EG and G 1986). The results of this survey provided a baseline against which to measure any increase in radionuclides in subsequent years. During this survey, two sites were identified with elevated emissions associated with uranium. These were both on the plant site. Several other sites were noted in the survey area with elevated radionuclide emissions due to thorium, potassium-40, radium and cesium 137. These materials were not associated with the RMI facility, but were connected to other activities in the Ashtabula area, none of which were considered to contribute to environmental problems.

RMI does extensive monitoring for radionuclides. The 1987 monitoring summary for RMI indicated all operations to be in compliance with DOE and NRC regulations. Three soil samples collected within 20 ft. of the fence along the northern boundary of RMI property had uranium concentrations above the NRC guideline of 35 picocuries per gram (150, 126, and 42 pCi/g). Sources of uranium contamination were identifed, covered, decontaminated or removed. All other soil samples were within limits and similar to background levels (RMI 1987).

RMI Extrusion's current NPDES permit limits total dissolved solids, fecal coliform and pH in the final outfall to Fields Brook. Treated process water is limited for total suspended solids, oil and grease, fluoride, cadmium, chromium, copper, lead, molybdenum, nickel, zinc and pH prior to comingling with other waste streams and discharge to Fields Brook. Even though the plant is no longer producing, RMI is still required to monitor the effluent and meet the limits and reporting requirements of its permit. Current permit conditions are presented in Table 42. Due to differences between the old and new permit monitoring requirements, monthly monitoring report data is not presented. The Extrusion Plant's NPDES permit required RMI to conduct bioassays to determine the toxicity of the final effluent. Two of five bioassay tests conducted from 1988 to 1989 showed greater than 50 percent mortality (100% and 75%) for Ceriodaphnia. Fathead minnows (Pimephales promelas) did not show adverse effects in any of the toxicity tests. Director's Findings and Orders are in draft to require RMI to take remedial action to investigate possible sources of toxicity, and set a schedule for reducing toxicity.

Some contamination of ground water at the site has been discovered for trichloroethene, uranium and technetium 99. The uranium is thought to have originated from a solar evaporation pond for sodium nitrate solution that contained small amounts of uranium. The trichloroethene is suspected to have resulted from a single unauthorized disposal into the pond prior to 1972. The pond was closed in 1984. Water ponding at the north end of the RMI property at the foot of a steep slope has also been found to contain traces of trichloroethene, uranium and technetium 99. The water is the result of ground water discharge, precipitation and intersection with the shallow ground water table. A risk assessment study (AWARE 1988) indicated no public health risk associated with the ground water contamination because ground water movement is very slow and there are no domestic wells in the area. Approximately thirty monitoring wells at the RMI site are analyzed quarterly for pH, specific conductance, total organic carbon and total organic halogens. Routine analyses are also done for uranium, gross alpha and beta radiation, sodium, chloride and trichloroethene.

The Extrusion Plant is permitted under the RCRA program as a generator of mixed hazardous wastes (hazardous plus low level radioactive wastes). Wastes are stored onsite and transported offsite for disposal. The Extrusion plant now is in the remedial phase before closure, which is expected to take 10 years due to the radioactivity. The DOE is overseeing the closure. There are some lagoons still being investigated, but all known violations have been corrected (Ohio EPA 1991). Several years ago, RMI built an air emissions control system designed to prevent radioactive materials from escaping into the atmosphere. Construction rubble, scrap metal and soil excavated for construction of the system were trucked to Nevada for disposal. They were considered low level radioactive wastes.

Table 42. NPDES permit limits for RMI Titanium Extrusion Plant (3IC00023).

Parameter	Permit Limit Concentration 30-day	Permit Limit Concentration Daily	Loading (Kg/day) 30-day	Loading (Kg/day) Daily
Final effluent 001				
Temperature °C	Monitor		NA	
Total dissolved solids (mg/l)	400	1500	77	410
Total phosphorus (mg/l)	Monitor		Monitor	
Fecal coliform (#/100ml) Summer only	1000	2000	NA	
pH	6.5 to 9.0		NA	
Treated Process Water outfall 601				
Total suspended solids	--	--	1.53	3.10
Oil and Grease	--	--	0.94	1.57
Total fluoride	--	--	.217	.490
Total cadmium	--	--	.001	.002
Total chromium	--	--	.005	.007
Total copper	--	--	.015	.028
Total lead	--	--	.002	.004
Total molybedenum	--	--	.018	.041
Total nickel	--	--	.015	.018
Total zinc	--	--	.006	.013
Hexavalent chromium	Monitor			
Total barium	Monitor			
pH	7.5 to 10.0			

Detrex Chemical Industries, Inc.

Detrex Chemical produces muriatic acid, N-methylpyrrole and pyrrole. This operation began in 1972. During the period from 1949 to 1972, the company produced chlorinated solvents, particularly trichloroethylene and perchloroethylene. At that time, waste products were stored and disposed of on site in at least nine lagoons. By 1982, all of the lagoons had been closed, cleaned and hazardous wastes disposed of off site at approved storage/disposal facilities. However, chlorinated solvents continued to be detected in the Detrex effluent and the water and sediments on and near the Detrex property were highly contaminated. In fact, the DS Tributary and Fields Brook in the vicinity of the Detrex discharge were identified as the most contaminated sites in the Fields Brook Superfund area (CH_2M Hill 1985).

Priority pollutants present in the Detrex outfall included: mercury; methylene chloride; chloroform; carbon tetrachloride; vinyl chloride; 1-1-dichloroethylene; t-1,2-dichloroethylene; trichloroethylene; tetrachloroethylene; 1,1,1-trichloroethane; 1,1,2-trichloroethane; 1,1,2,2-tetrachloroethane; toluene; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,2,4-trichlorobenzene; hexachlorobenzene; hexachlorobutadiene; hexachlorocyclopentadiene; hexachloroethane; phenol; 2,4,6-trichlorophenol; chrysene; di-n-butylphthalate; di-n-octylphthalate; 1,2-dichloroethane; and c-1,2-dichloroethylene (Ohio EPA 1990i). It was evident that stormwater runoff contaminated by chlorinated solvents emanating from the Detrex property was contaminating the plant's final discharge to Fields Brook. A stormwater runoff discharge (outfall 001) to the Detrex Tributary also contained chlorinated solvents. Inspections by Ohio EPA revealed a number of additional storm water discharges to the DS Tributary (Ohio EPA 1990i).

A Consent Decree resulting from enforcement action against Detrex by the State of Ohio in 1989 required Detrex to construct a collection and treatment system on their property. All plant process water, cooling water, sanitary waste and stormwater runoff was to be collected and subjected to carbon adsorption treatment before final discharge to Fields Brook. The treatment system was completed in August, 1990. The current NPDES permit, issued in 1990, limits the concentrations of chlorinated solvents in effluent from the treatment system as listed in Table 43. The final effluent concentrations allowed prior to discharge to the storm sewer to Fields Brook are presented in Table 44. Compliance inspections in 1991 indicate limits for these organics are being met.

The NPDES permit also requires Detrex to conduct bioassays to determine the toxicity of its final effluent. In 1981 and 1984, the main process water and stormwater outfall (002) was slightly acutely toxic to Daphnia pulex at 30 percent effluent concentration. Both 002 and 001 (stormwater only) exhibited significant chronic toxicity to Daphnia pulex at 100 and 30 percent effluent concentrations. Instream bioassays conducted at the same time on Fields Brook and the DS Tributary, indicated acute and chronic toxicity in the ambient waters near Detrex outfalls (Ohio EPA 1990i).

Table 43. NPDES permit limits for Detrex (3IF00017) for effluent following carbon adsorption treatment (Outfall 602).

Parameter	Discharge Limitations: Concentrations (ug/l) 30-day	Discharge Limitations: Concentrations (ug/l) Daily	Discharge Limitations: Loading (kg/day) 30-day	Discharge Limitations: Loading (kg/day) Daily	Ohio EPA Compliance Sampling: Concentrations 6/4/91	Ohio EPA Compliance Sampling: Concentrations 9/24/91
PAH	21	--	.008	--	1.9	ND
Carbon tetrachloride		Monitor			ND	ND
Chloroform	111	325	.041	.12	4.8	7.1
Hexachlorocyclopentadiene		Monitor			ND	ND
Hexachloroethane	196	--	.072	--	ND	ND
Methylene chloride	36	170	.013	.062	ND	ND
Tetrachloroethene	52	164	.019	.060	ND	ND
1,1-dichloroethene	22	60	.008	.022	1.5	4.6
1,1,1-trichloroethane	22	59	.008	.022	1.5	ND
1,1,2-trichloroethane	32	127	.012	.047	10.8	5.7
1,1,2,2-tetrachloroethane		Monitor			2.9	ND
1,2-dichlorobenzene	196	794	.072	.291	ND	ND
t-1,2-dichloroethylene	25	66	.009	.024	ND	ND
2,4,6-trichlorophenol		Monitor			ND	ND
Trichloroethene	26	69	.009	.025	7.0	3.0
Hexachlorobenzene	53	--	.019	--	ND	ND
Hexachlorobutadiene	142	--	.052	--	ND	ND

Table 44. NPDES permit limits for Detrex (3IF00017) for final discharge to storm sewer emptying into Fields Brook (Outfall 002).

Parameter	Discharge Limitations: Concentrations (ug/l) 30-day	Concentrations (ug/l) Daily	Loading (kg/day) 30-day	Loading (kg/day) Daily
Temperature (^oC)		Monitor		
BOD - 5 day		Monitor		
Total dissolved solids (mg/l)	--	821	--	1445
Total suspended solids (mg/l)	No net increase over intake water			
Oil and grease (mg/l)	2	4	3.48	6.95
Total phosphorus (mg/l)		Monitor		
Cadmium (ug/l)	3.1	15	.0055	.026
Chromium (ug/l)		Monitor		
Copper (ug/l)	18	27	.032	.047
Zinc (ug/l)	150	170	.26	.30
Total residual chlorine (mg/l)	--	.05	--	.087
TU_a, _Ceriodaphnia_	--	1.0	--	--
TU_c, _Ceriodaphnia_		Monitor		
TU_a, _Pimephales promelas_	--	1.0	--	--
Tu_c, _Pimephales promelas_		Monitor		
Mercury (ug/l)	.012	1.1	.00002	.002
pH	6.5 to 9.0			

Bioassays conducted in June and September 1991 indicated Dextrex's final effluent (002) was not acutely toxic to fish or Daphnia. However, it was discovered during these tests that dilution water collected from Fields Brook upstream from the Detrex outfall was acutely toxic to Daphnia. Since conductivity of dilution water for these tests was 8700 and 6720 umhos/cm for the June and September tests, it is suspected that TDS from upstream sources was the source of toxicity.

Due to its role as a generator of hazardous waste, Detrex is also regulated under the RCRA program. Ground water monitoring wells at the adjacent RMI Titanium Sodium and Chlorine facility contain high concentrations of methylene chloride, tetrachloroethene and trichloroethene. The presence of these contaminants is attributed to Detrex since RMI has never used these chemicals (Ohio EPA 1985). Corrective actions are underway to recover and treat the contaminated ground water (Ohio EPA 1991).

Acme Scrap Iron and Metal Company

Acme Scrap Iron and Metal Company reclaims metal products. In the past, transformers containing PCBs were cut and burned to recover copper, aluminum and steel. Soil on Acme property is saturated with oil and runoff is discharged to Fields Brook via storm sewers. PCB levels measured in soil and oil near the sewer outfall have exceeded 114 and 350 ppb, respectively. An oil retention lagoon was installed in 1982 to capture oils from site drainage (Ohio EPA 1985). The original storm sewer which traversed the property has been plugged and runoff now drains to the retention lagoon.

The facility currently has two outfalls to Fields Brook. The sanitary wastewater outfall is limited for BOD_5, total suspended solids, fecal coliform, total residual chlorine and ammonia. The other outfall is for stormwater runoff from the retention lagoon. Total suspended solids and oil and grease are the key parameters restricted. Acme is also required to monitor this outfall to ensure that PCBs are not being discharged.

OxyChem Plant (formerly Diamond Shamrock Chemicals)

The OxyChem Plant manufactures specialty chemicals and serves the Corporation as a semi-commercial facility for introducing new products. OxyChem acquired this facility in September 1986 when it purchased Diamond Shamrock Chemicals Company.

The products manufactured throughout the history of the plant include, mercaptan resins, chloroesters, metal-treating compounds, specialty polymers, water treatment chemicals, and proprietary intermediates for Ag Chem, animal health and pharmaceutical use. Current products include agricultural chemical, animal health and pharmaceutical intermediates; mercaptan resins; paint additives; high temperature lubricating oils and greases; lubricating oil additives and polymer intermediates.

The plant discharges at a single point into a county storm sewer. This sewer discharges the combined effluents of OxyChem, RMI Sodium and Detrex Chemical into Fields Brook. OxyChem's plant also has a stormwater discharge to the DS tributary just south of the plant property.

The OxyChem Plant was issued a renewal NPDES permit which requires compliance with the Organic Chemical, Plastics, and Synthetic Fiber (OCPSF) guidelines. These guidelines were established by the U.S. EPA and went into effect in March 1989. In response to OCPSF guidelines, the Toxic Substances Control Agreement and the Great Lakes Water Quality Agreement, the Ohio EPA has begun incorporating more stringent limits in permits. Specific limits were set for this facility: 1) volatile organic compounds (VOC's); 2) copper, zinc, chromium, and mercury; 3) cyanide, phenol, and total phenolics; and 4) hexachlorobutadiene, hexachlorobenzene, PCB's, and PAHs. PCB's are not allowed in detectable amounts. The renewed permit also requires bioassays for chronic toxicity. Specific NPDES permit limits are listed in Table A-13 in the Appendix.

Eighteen organic compounds have been identified in OxyChem's outfall. These compounds were traced to contaminated soils resulting from past operations during Diamond Shamrock's ownership rather than from current plant practices.

In response to this problem, approximately 20 monitoring wells were installed on the property to establish: 1) the location of the contaminants; 2) the volume of ground water; 3) the direction of flow of ground water; and 4) whether or not the contaminants were flowing off the property. Ground water flow was found to be minimal due to the very low permeability of the soils at this site. Also, no evidence was found of movement of contaminants off the plant property.

In March 1990 OxyChem completed a remediation project and started up the treatment system. This system includes a series of French drains which serve as interceptor trenches. Ground water is pumped from these trenches and fed to a stripper tower where nearly all organic contaminants are removed using air stripping. This treated water is combined with retained stormwater, process water and other sources of wastewater and fed to a second stripper tower which also employs air stripping. Water exiting the second stripper tower is pumped through two liquid carbon adsorbers, which are in series, and discharged to the county storm sewer system. Initial results show no detectable levels of organic chemicals in the treated water at the final plant discharge. The air from the two stripper towers carries the VOC's (which were stripped from the wastewater) to thermal destruction. The treated air is released to the environment. The new treatment system supplements solids removal and pH control which were in operation prior to the completion of this system. Lastly, a slurry wall was constructed around the majority of the 40 acre site to ensure that no contaminated ground water leaves, and to minimize ground water entering the property.

It appears that operations at OxyChem have not contributed to the hazards found in Fields Brook. A 1983 survey found no macroinvertebrate community immediately downstream of the county storm sewer outfall containing discharge from OxyChem, RMI Sodium and Detrex, but bioassays on the OxyChem effluent did not reveal acute toxicity. Apparently the degradation of this habitat can be attributed to contaminated sediments and possibly toxicity of other dischargers (Ohio EPA 1989e).

Due to its production and storage of solvents, which are considered hazardous waste, OxyChem is regulated under the RCRA program as well. They are in compliance with this permit and cause no known problems to Fields Brook (Ohio EPA 1991).

VyGen (formerly General Tire and Rubber Company)

In late 1984, General Tire and Rubber closed this polyvinyl chloride (PVC) producing plant. In late 1985, the plant was sold and reopened under the name VyGen. The manufacture of PVC involves the reaction between vinyl chloride (VC) monomer and various chemicals in a suspension polymerization system. The finished product, PVC, is dried, stored in silos, and then sold. Wastewater generated by this process is passed through a neutralization pit and then into a series of five ponds for settling and aeration. After a retention period in the ponds, the treated water is released via outfall 001 into Fields Brook. Three or four times a year pond number one is dredged and the resultant sludge hauled to an off-site waste treatment facility. Wastes from other processes are incinerated or recycled onsite or shipped offsite to landfills.

A biosurvey of Fields Brook conducted in 1983 indicated the VyGen outfall was impacting the macroinvertebrate community. Pollution tolerant organisms were present upstream, but a significant number of sensitive species were present also. Downstream from VyGen, sensitive species were virtually absent (CH_2M Hill 1985). U.S. EPA measured an LC_{50} of 92.3% effluent for Daphnia pulex in a definitive bioassay test in 1987. This indicated VyGen's discharge was acutely toxic to Daphnia pulex. The effluent was chronically toxic to fathead minnows and Ceriodaphnia (Ohio EPA 1988b).

Due to the observed toxicity in its effluent, VyGen is required to conduct a Toxicity Reduction Evaluation (TRE) to identify the source of toxicity and a plan to reduce this toxicity. The TRE is to be completed by December 1991 and VyGen must comply with toxicity limits in its NPDES permit by September 1992.

Priority pollutants detected in VyGen's effluent include cadmium, chromium, copper, lead, nickel, zinc, chloroform, vinyl chloride, t-1,2-dichloroethylene and trichloroethylene. VyGen's existing permit lists interim effluent limits for 64 pollutants including volatile organic compounds (VOC), PAH, metals and oxygen demand. Final permit limits are listed for 68 parameters and VyGen is required to be in compliance with all the limitations by September 1992. Final effluent limits are listed in Table A-14 in the Appendix.

SCM Plant #1

SCM Plant #1 manufactures titanium dioxide pigment via the chloride process. Both process and sanitary wastes are discharged into Fields Brook via two separate outfalls. Most of the solid wastes generated at SCM are disposed of off-site. The site does contain two rubber-lined metal tanks designed to store process waste acid. The plant produced barium and strontium products between 1968 and 1970. Remnants of the facilities and lagoons associated with these products are west of the current site. All current process water and stormwater is routed to treatment which consists of pH adjustment, settling and neutralization.

Bioassay tests conducted by Ohio EPA in 1988 revealed SCM's process water discharge to be acutely toxic to Ceriodaphnia (LC_{50} 74.8%) and intermittently toxic to Pimephales promelas (fathead minnows). It is suspected the toxicity was caused by high total dissolved solids concentrations since no other pollutants were present at high enough levels to create a hazard (Ohio EPA 1990j).

Total dissolved solids (TDS) have been of concern in Fields Brook for years. There has been considerable debate among the local industries and the regulatory agencies as to whether or not TDS exceeding the 1500 mg/l in the water quality standards would impact the biological community. The debate resulted in a 3500 mg/l variance for Fields Brook from the mouth to Route 11. The upstream portion of Fields Brook, in the area of the SCM #1 discharge, is exempt from a TDS standard.

SCM #1 is in the process of expanding their operation to double production. Due to the demonstrated toxicity of their effluent, Ohio EPA has required SCM to conduct a Toxicity Reduction Evaluation to determine the source of the toxicity and develop a plan to eliminate it. The NPDES permit issued in March 1991, requires SCM to characterize the components of TDS in their discharge. This will allow SCM to conduct parallel bioassays with actual effluent and reconstituted effluent using the salts identified in the TDS characterization. The results of these bioassays should indicate if toxicity is indeed due to elevated TDS or if some other pollutant in the discharge is responsible. This acute testing program must be completed by December 1991.

Findings and Orders issued March 1991 require SCM to attain full compliance with the final effluent limitations of its permit by April 1993. Until full attainment is achieved, SCM must meet interim limits attached to the Findings and Orders. Final permit limits and a summary of monitoring data from 1987 to 1989 are presented in Table 45.

<u>SCM Plant #2</u> (formerly Gulf and Western)

SCM Chemicals produces titanium tetrachloride ($TiCl_4$) and titanium dioxide (TiO_2) in two interconnected units separated by several hundred feet. The $TiCl_4$ Unit produces $TiCl_4$ by the reaction of titanium-bearing ores and chlorine. The TiO_2 Unit reacts $TiCl_4$ with oxygen and the chlorine liberated is recycled.

The units have two outfalls. The first, 001, from the TiO_2 Unit, contains primarily storm and cooling water which is pH-controlled and put through settling ponds to remove suspended solids prior to discharge. The second, 002, contains almost all process water from the TiO_2 Unit and storm and process water from the $TiCl_4$ Unit. Prior to discharge the combined effluent passes through a four-stage neutralization/clarification/settling system.

At the Titanium tetrachloride facility, approximately half of the acid waste is concentrated and then stored in two rubber-lined tanks. This waste is then shipped off-site to disposal facilities. The remaining acid waste is sluiced and neutralized on-site. The acidic waste water contains metallic chlorides, blow over ore and coke. The sludge generated from the neutralization clarification system is shipped to off-site landfills. Prior to 1976 some sludge was stockpiled on site near the banks of Fields Brook. The sludge is non hazardous (Ohio EPA 1985).

Table 45. Final NPDES permit limits for SCM #1 (3IE00013) and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30 day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (Kg/Day)
Temperature (°C)	Monitor		152	34.0	11.0	22.2	.245	22.0	NA
pH (maximum)	--	9.0	1060	11.9	6.7	8.1	.092	7.9	NA
pH (minimum)	--	6.5	1060	8.0	2.5	6.9	.079	6.9	NA
Tot. Sus. Solids (mg/l)	15	30	152	38.0	0.0	4.8	.962	4.0	17.0
Chromium (ug/l)	72	143	153	50	0	11.4	.751	9.0	.04
Copper (ug/l)	18	27	39	59	4	32.8	.426	34.0	.11
Iron (ug/l)	Monitor		35	371	27	116.5	.645	100.0	.39
Zinc (ug/l)	150	170	36	106	3	24.0	.760	20.0	.08
Tot. Dis. Solids (mg/l)	--	4083	153	628,446	1428	12,614	5.523	4547	42,222
Cyanide (mg/l)	Monitor								
Arsenic (ug/l)	Monitor								
Cadmium (ug/l)	Monitor								
Lead (ug/l)	Monitor								
Silver (ug/l)	1.3	3.4							
PAH	.31	--		(No monthly operating report data available					
Mercury (ug/l)	Monitor			for these parameters)					
Tu_a, Ceriodaphnia	Monitor								
Tu_c, Ceriodaphnia	Monitor								
Tu_a, Pimephales	--	1.0							
TU_c, Pimephales	Monitor								

The SCM Plant #2 was previously owned by Gulf and Western. Heat exchangers used at the G&W Plant are thought to have contributed heavily to the PCB contamination in Fields Brook and possibly the river (Harsh 1983). A site inspection by U.S. EPA reported leaks and highly contaminated soil around the heat exchangers (U.S. EPA 1981). All soil samples revealed PCB concentrations well over 300 ppm (U.S. EPA 1984). In a U.S. EPA Consent Agreement signed September 4, 1984, Gulf and Western was fined $21,000 and ordered to remove PCB contaminated soils from a stormwater trench and surrounding area. Cleanup action on site was completed in September 1984, but no action was taken in Fields Brook or the Ashtabula River.

The SCM #2 Plant is also expanding. It is subject to the same toxicity reduction evaluations and bioassays as is SCM #1. Findings and Orders issued March 1991 require SCM #2 to be in full compliance with the conditions of its NPDES permit by April 1993. Until then, the interim limits attached to the Findings and Orders must be met. Final permit limits and a summary of monthly operating report data are presented in Tables 46 and 47.

NONPOINT SOURCES

In addition to the direct point sources, there are also a number of nonpoint sources potentially impacting the Ashtabula River AOC. These include hazardous waste landfills, urban runoff, combined sewer overflows and sediment loading from upstream and atmospheric deposition.

Landfills

Under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), more commonly known as Superfund, every person who owned or operated a facility where hazardous substances were stored or disposed was required to report that facility to U.S. EPA by 1981. This list was used to create an inventory of potential problem sites referred to as the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS).

Twenty-four such unregulated hazardous waste sites have been identified in the Ashtabula River AOC. Most of these sites have undergone Preliminary Assessments (PA) to determine the need for further investigation. Ohio EPA determined that sites posing any threat to the environment or public health would be a State priority for additional investigations. If available information indicated known hazardous conditions to humans, the site was assigned a high priority status; potential hazards ranked a medium priority. The low priority sites have little evidence to indicate a problem exists, and "zero" priority sites have been found not to be a hazard to humans or the environment.

Ohio EPA also assigned a secondary priority rating to most of the listed sites. This rating was based on the site's likelihood to score near or above the National Priority List (Superfund) cutoff point. It is used to prioritize the need to ask U.S. EPA to assign a Field Investigation Team (FIT) to conduct follow-up site inspections. A list of sites and rankings is presented in Table 48. These sites are located on Figure 24. Many of the sites have a FIT priority lower than the state priority. In most cases this is because these

Table 46. Final NPDES permit limits for SCM #2 (3IE00017), Outfall 001, and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30 day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (Kg/Day)
Temperature (°C)	Monitor		154	40.0	4.0	19.8	.462	18.0	NA
Tot. Sus. Solids (mg/l)	25	40	153	69	0	8.2	.987	6.0	1.8
pH	6.5 -	9.0	155	8.2	6.8	7.6	.036	7.6	NA
Tot. Dis. Solids (mg/l)	—	609	155	731	142	296	.343	272	336
Iron (ug/l)	2000	4000	152	2312	43	448	.776	377	.562
Zinc (ug/l)	150	170	40	163	0	51	.714	48	.058
Copper (ug/l)	18	27							
Cadmium (ug/l)	Monitor								
Chromium (ug/l)	Monitor								
Lead (ug/l)	Monitor								
Nickel (ug/l)	Monitor		(No monthly operating report data are						
Silver (ug/l)	Monitor		available for these parameters)						
Tetrachloroethylene	Monitor								
Bis(2-ethylhexyl)phthalate	Monitor								
Tu_a, Ceriodaphnia	Monitor								
TU_c, Ceriodaphnia	Monitor								
TU_a, Pimephales	Monitor								
TU_c, Pimephales	Monitor								
Mercury (ug/l)	Monitor								

Table 47. Final NPDES permit limits for SCM #2 (3IE00017), Outfall 002, and a summary of monthly operating report data from 1987 to 1989.

Parameter	Permit Limit Concentrations 30 day	Daily	N	Max.	Min.	Mean	Variance	Median	Mean Loading (Kg/Day)
Temperature (°C)	Monitor		154	42	12	26.2	.290	26	NA
pH - Maximum	--	9.0	1066	9.4	7.4	8.1	.032	8.0	NA
pH - Minimum	--	6.5	1066	8.4	6.2	7.8	.039	7.8	NA
Tot. Sus. Solids (mg/l)	25	62	156	23,137	1.0	159	11.640	10	1229
Tot. Dis. Solids (mg/l)	--	4083	194	10,100	2689	6657	.177	6670	63,536
Chromium (ug/l)	--	175	154	64,500	0	442	11.752	17	3.4
Iron (ug/l)	2000	4000	154	9,999,900	160	65,555	12.291	546	500
Lead (ug/l)	12	175	43	1660	0	51.4	4.894	12.0	.4
Nickel (ug/l)	250	323	153	1940	0	23.3	6.737	10.0	.19
Zinc (ug/l)	150	170	44	1280	0	40.4	4.747	10.0	.32
Copper (ug/l)	18	27							
Thallium (ug/l)	26	116							
Silver (ug/l)	1.4	3.6							
Tetrachloroethylene(ug/l)	108	800							
Cyanide (mg/l)	Monitor								
Arsenic (mg/l)	Monitor			(No monthly operating report data					
Bis(2-ethylhexyl)-phthalate (ug/l)	Monitor			available for these parameters)					
PCB	Monitor								
TU_a, <u>Ceriodaphnia</u>	Monitor								
TU_c, <u>Ceriodaphnia</u>	Monitor								
TU_a, <u>Pimephales</u>		1.0							
TU_c, <u>Pimephales</u>	Monitor								
Mercury (ug/l)	Monitor								

Table 48. Unregulated hazardous waste disposal sites (CERCLIS) in the Ashtabula River AOC including priority ranking for further investigation.

Site	Priority Ranking State	Priority Ranking FIT	
1. Acme Scrap	M	L	
2. Ashtabula City Dump	H	--	
3. Ashtabula Hide and Leather	L	L	
4. Brenkus Shop*	0	0	
5. CEI	M	L	
6. Detrex Chemical	H	L	
7. Diamond Shamrock (Occidental)	L	L	
8. E. 19th Street Dump	--	--	
9. Elkem	L	L	
10. General Tire and Rubber (Vygen)	M	L	
11. Gulf and Western (SCM #2)	M	L	
12. Hooker Chemical - Minnesota Ave. Dump - Pinney Dock	0	0	
13. IMC (Linchem)	H	L	
14. Miscellaneous Dump Site #4	H	0	
15. Miscellaneous Dump Site #1	L	L	
16. Miscellaneous Dump Site #3	L	L	
17. Miscellaneous Dump Site #5	H	0	
18. Olin	H	L	
19. Plasticolors	M	L	
20. RMI Extrusion	M	L	
21. RMI Metals Reduction	M	L	
22. RMI Sodium and Chlorine	H	L	
23. SCM #1	M	L	
24. Union Carbide (ESAB Welding)	M	L	
25. Fields Brook	H	0	NPL-Superfund

H = High
M = Medium
L = Low
-- = no rank assigned
0 = no hazard found (state) or no further action required (FIT)

* = This site was found to be the residence of the owner of Brenkus Shop and not a hazardous waste site.

Source: Ohio EPA 1990 Unregulated Sites Master List

LEGEND

1. Acme
2. Ashtabula City Dump
3. Ashtabula Hide & Leather
4. Brenkus Shop
5. CEI
6. Detrex Chemical
7. Diamond Shamrock (Occidental)
8. E. 19th St. Dump
9. Elkem
10. General Tire & Rubber (Vygen)
11. Gulf & Western (SCM #2)
12. Hooker Chemical-Minnesota Ave. Dump
13. IMC (Linchem)
14. Misc. Dump Site #4
15. Misc. Dump Site #1
16. Misc. Dump Site #3
17. Misc. Dump Site #5
18. Olin
19. Plasticolors
20. RMI Extrusion
21. RMI Metals Reduction
22. RMI Sodium & Chlorine
23. SCM #1
24. Union Carbide (ESAB Welding)

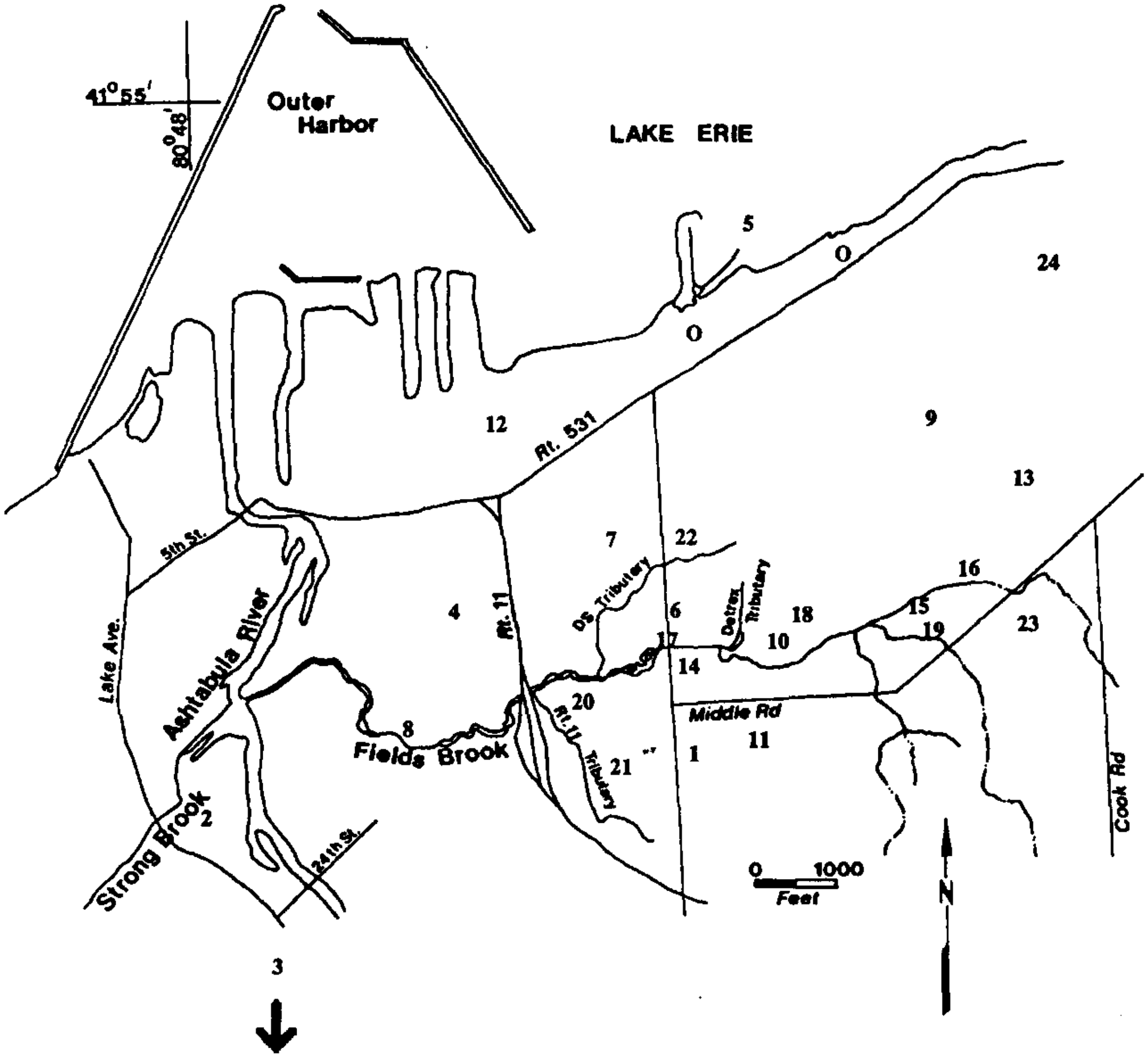


Figure 24. Location of CERCLA (unregulated) hazardous waste disposal sites in the Ashtabula River AOC.

sites are currently being further addressed in association with the Fields Brook Superfund investigations; therefore no additional recommendations are warranted now.

The CERCLIS sites which continued to be used after 1980 were required to be permitted under RCRA as treatment, storage or disposal (TSD) facilities. This subjected them to RCRA regulations. Monitoring and cleanup has been implemented under RCRA corrective action authority at ESAB Welding, RMI Sodium, RMI Extrusion, Detrex Chemical, Oxychem and Olin. RCRA sites are located on Figure 25.

Brief descriptions of CERCLIS and RCRA sites and any actions which have already been undertaken are included in the discussion of the associated point source discharger. Descriptions for those sites or actions not previously addressed are presented in this section.

<u>Acme Scrap</u>

As described in the point source discharger section, runoff from the oil saturated soils on Acme Scrap property is now routed to an oil separation basin prior to its discharge to Fields Brook. The company is still required to monitor effluent for PCBs.

Burning PCBs at insufficient temperatures increases the potential for dioxin formation. Due to the numerous accidental fires that have occurred at the site when cutting torches ignited PCB-laden oils, dioxin may be present. The Remedial Investigation for Fields Brook did not detect dioxin, but detection limits were higher than current applicable standards. Additional soil sampling for dioxin on-site is recommended for further investigations (Ohio EPA 1985).

<u>Ashtabula City Dump</u>

A public landfill was operated on the west side of the river near the 19th Street and Lake Avenue intersection from 1958 to 1974. The old dump is bounded by the Penn Central Railroad tracks to the west and the Ashtabula River to the east. In 1974 the site was sold to a private concern and currently is used as a marina, parking lot and campground.

Diamond Shamrock reported the disposal of approximately 3,000 gallons of halogenated aromatics in drums at the dump. No other records were kept to verify waste contributors, but it is assumed municipal and industrial wastes were co-disposed at the site.

A U.S. EPA field investigation team observed a leachate stream flowing into the river from the southern portion of the site in 1980 (Ohio EPA 1984). An Ohio EPA site investigation conducted in 1984 found the 20 acre area to be adequately covered and vegetated. An organic scan of leachate from the site detected chlorobenzene (184 ug/l), tetrachloroethene (9 ug/l), 1,1,2,2-tetrachloroethane (12 ug/l) and PCB (3100 ug/l). A 1986 analysis of leachate measured elevated concentrations only for iron (31,000 to 78,000 ug/l). Debris and leachate were observed during shoreline excavation in 1988.

LEGEND

1. CEI
2. ESAB Welding
3. RMI Sodium
4. RMI Extrusion
5. Detrex
6. Oxychem
7. Olin
8. Linchem

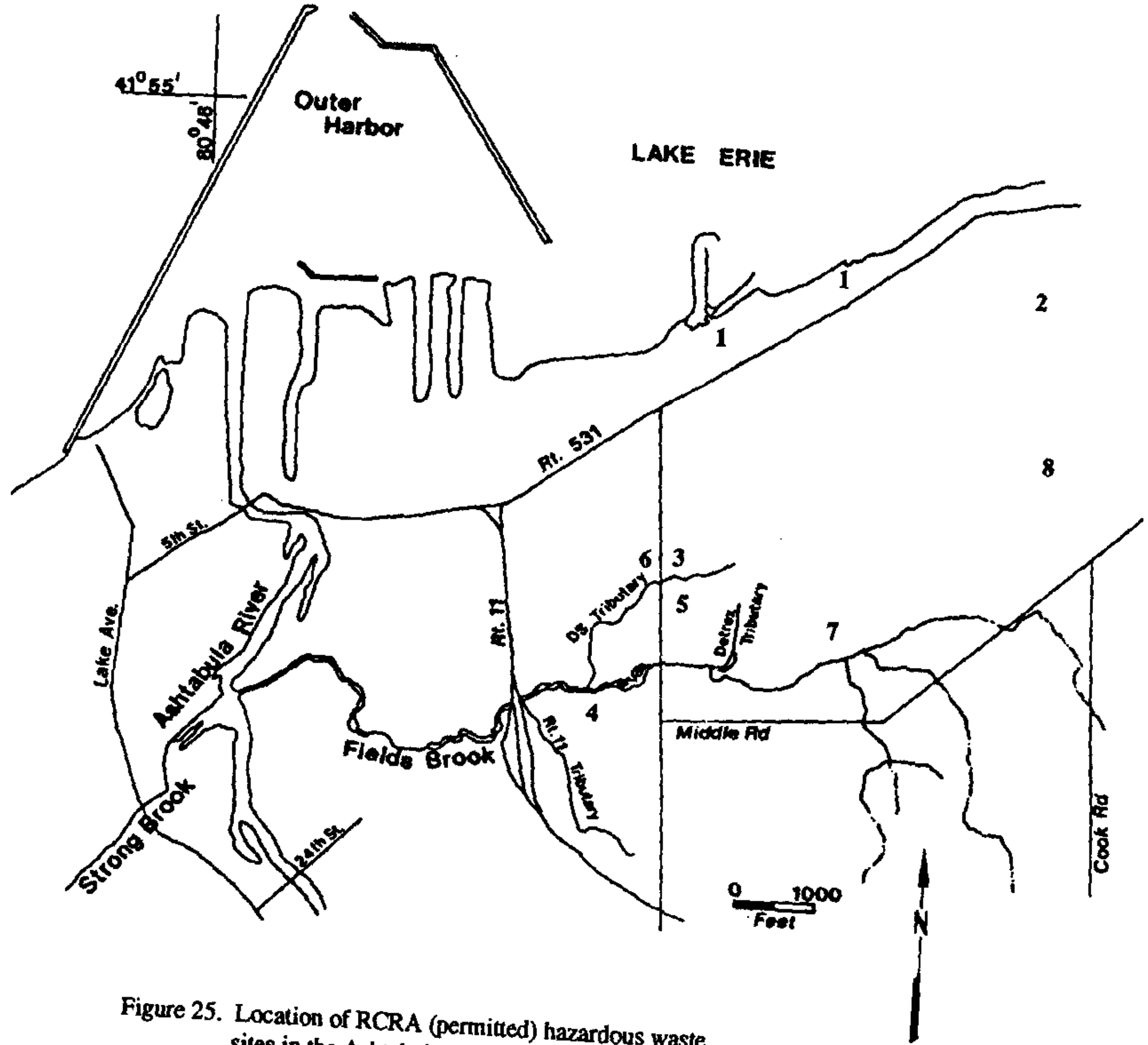


Figure 25. Location of RCRA (permitted) hazardous waste sites in the Ashtabula AOC.

The old dump site is still under development. Further U.S. EPA and Ohio EPA site visits and sampling have occurred over the past several years, but no evidence of hazard to humans or the environment has been documented. However, due to its proximity to the river and subsequently, the public water supply intake in Lake Erie, the site will continue to be observed.

Ashtabula Hide and Leather

Ashtabula Hide and Leather was a tannery located on a bend in the river approximately 1.5 miles upstream from the AOC. The company shut down in the early 1960s and is now the site of a winery and flea market. Waste hides from the tannery operation were frequently disposed of in the river and can still be seen along the river banks and in the bottom sediment. The old tannery buildings were used for storage of asbestos, solvents, tars and resins until 1981. Due to fires and potential fire hazards to the Route 20 bridge that passes over the site, the Fire Marshall ordered all waste materials removed.

Soil samples analyzed from the site detected benzo(a)pyrene (5.5 mg/kg), chrysene (4.70 mg/kg), PCBs (18 mg/kg), cadmium 318 mg/kg) and chromium (1140 mg/kg) (Ecology and Environment 1989). It is unknown as to whether or not this site has contributed to the contamination in the AOC.

Hooker Chemical

This location is known also as the Minnesota Avenue Dump and Pinney Dock on the Unregulated Sites Master List (Ohio EPA 1990k). It is a 2-acre site that was originally a gully draining to Lake Erie. In the 1950s, sludge contaminated with trichloroethene was disposed of on site. In 1987, discharge to Lake Erie from a storm sewer transecting the site was found to contain 1,1-dichloroethene, trans-1,2-dichloroethene, trichloroethene, tetrachloroethene and hexachlorobenzene in excess of Ohio water quality standards. As a temporary remedial action, Pinney Dock Company constructed a grate on the bottom of a section of the storm sewer to allow trichloroethenes to settle out and be pumped to a holding tank. The future plan is to construct a new stormwater sewer to divert storm flows away from the landfill. A collection system will be constructed within the landfill to collect the leachate and treat it through carbon filtration before final discharge to Lake Erie. No contamination was found in groundwater monitoring wells near the site (Ohio EPA 1987b and Bill Zawiski, 1991 Ohio EPA, personal communication).

E. 19th Street Dump

No preliminary assessment has been done on this site, and no information is available.

Olin Corporation

Olin operated a toluene diisocyanate (TDI) plant from 1963 to 1982. In the years of TDI production, Olin's processes utilized a 14,000 sq.ft. TDI ground storage area, three hazardous waste drum storage areas, and an emergency spill basin.

Olin's closure in 1982 involved removal of all site buildings and site decontamination. Decontamination included removal of stored substances and contaminated sediment, and removal and disposal of Fields Brook sediment. The primary toxic chemicals that soils were tested for were monochlorobenzene (MCB) and toluene diamine (TDA). The allowable soil concentrations of MCB and TDA after cleanup agreed to by Ohio EPA were 100 ppm and 10 ppm, respectively. The concentrations in all contaminated soils encountered on the site ranged from non-detectable to 2,870 ppm of MCB and non-detectable to 37 ppm of TDA. All soils with MCB and TDA above the allowable levels were removed. Approximately 5,137 cubic yards of soil were removed. Clean backfill soils were predominantly clay (Ohio EPA 1986c).

Fields Brook was excavated along its entire length bordering the Olin site. MCB accumulation in the sediment was the primary concern of the project. Approximately 500 cubic yards of sediment were dredged and removed from Fields Brook and replaced by clean clay and rip-rap. A positive Ames test indicated the presence of mutagenic/carcinogenic compounds in an Olin outfall discharge sample. However, follow-up static bioassay tests were inconclusive. The storm sewers were vacuumed twice prior to closure to remove remaining sources of contaminants (Ohio EPA 1986c). The Olin Corporation is still involved in Superfund negotiations for past contributions to the Fields Brook hazard.

Plasticolors

Plasticolors operated a facility which produced pigment and chemical dispersions for the plastics industry. Wastes produced consisted of solvents and metal-laden dust containing lead chromate, lead oxide, lead molybdate, cadmium and selenium. Dust and a small amount of solid waste was collected weekly and landfilled off site. Solvents were stored in 55-gallon drums and transported off site for disposal.

The facility had RCRA status as a small quantity hazardous waste generator and there have been no reported spills or complaints (Ohio EPA 1985). The company moved to a new location outside the AOC in 1989.

Miscellaneous Dump Sites

There are four sites on the CERCLIS list referred to as Miscellaneous Dump Sites Numbers 1, 3, 4, and 5. These sites are located generally in the area of the intersection of Middle and State roads. The exact boundaries of these sites are unknown as is any further information about them. The ongoing Fields Brook Superfund investigations should further define these sites and determine any contribution to the pollutant problem.

There is a site on the east side of the river near the 5 1/2 slip which currently is being investigated. The property is owned by Conrail and was previously leased to ACME and the TRIAD Corporation. ACME is now located on Fields Brook. Investigations of the TRIAD salvaging operation in 1989 and 1990 revealed asbestos contamination and numerous violations. The facility was shut down and remedial settlements are now being negotiated. Further investigations at the site by Conrail in 1991 uncovered approximately 700 capacitors containing PCBs which had been disposed of on the property. The source of these capacitors and when they had been buried was unknown. Soil sampling at the site revealed PCB concentrations up to 7,000 mg/kg. The capacitors have been dug up and will be disposed of at a TSCA waste disposal site. It is unknown as to whether or not this site was contributing to the PCB contamination in the Ashtabula River.

Other Nonpoint Sources

No information was found concerning the contribution of stormsewer outfalls and urban runoff. As mentioned previously, elevated concentrations of metals in sediments near the pump station and combined sewer overflows (CSO) in the AOC indicated there was or may still be some pollutant loading from CSO's. Strong Brook was also identified as the recipient of runoff from an unsewered area.

A large part of Ashtabula County is rural or agricultural, but only the northern third of the county lies within the Ashtabula River drainage basin. Agricultural runoff and the associated pollutants of sediment, phosphorus and pesticides have not been identified as problems in the mainstem of the Ashtabula River (Ohio EPA 1990l and 1990m). Certainly, the river is filling with sediment, but this situation has resulted after almost 30 years of no dredging and the influence of manmade alterations to the natural river channel. The three major Ohio rivers west of Ashtabula, which are also AOCs, have a much more significant problem with sediment loading from nonpoint sources. An average of 800,000 cubic yards of sediment must be dredged from the Maumee River and Bay annually; 400,000 cubic yards annually from the Cuyahoga River and Harbor; and approximately 150,000 cubic yards is removed from the Black River and Harbor every one to two years. By comparison, the Ashtabula Harbor has approximately 100,000 cubic yards of sediment dredged every two years. It has taken nearly 30 years for the approximately 500,000 cubic yards of sediment that now needs to be dredged from the Ashtabula River to accumulate.

Atmospheric Deposition

Atmospheric deposition is known to be a source of pollutants to the Great Lakes. For Lake Erie as a whole, atmospheric deposition provides a minor but significant fraction of the total pollutant load. The exceptions to this are benzo(a)pyrene (a PAH) and cadmium which provide 66 and 59 percent, respectively, of the total input to Lake Erie via atmospheric deposition (Kelly et al 1989). Air deposition data specific to Ashtabula don't exist.

Pollutant contributions and impacts from atmospheric deposition are much more difficult to measure than direct discharges to water. Studies suggest that over a 24-hour period, toxic substances from up to 500 miles away may be transported to Lake Erie. The Ashtabula AOC itself could be a source of toxics to the atmosphere. These toxics could be deposited immediately in the area or transported to areas further downwind. Most of the point sources previously described, as well as many other businesses and industries which do not discharge directly to the waters of the AOC, are permitted to discharge to the air. Twenty-four of these dischargers release toxic chemicals in amounts which require them to report annual loadings to the Toxic Chemical Release Inventory (TRI) established by the Superfund Amendments and Reauthorization Act of 198 (SARA). Loadings reported from the TRI will be presented in Chapter 7.

Summary

The history of discharger and waste management practices in the Ashtabula River AOC is long and complex. Companies have changed hands, names, manufacturing and treatment processes and waste management practices many times. There are currently twenty companies discharging to the AOC, only ten of which are in full compliance with their permits. All of the companies not in compliance are under Findings and Orders or have a compliance schedule included in their permit.

Since the implementation of the NPDES program, release of pollutants via direct discharge to the Ashtabula River AOC has been curtailed considerably. However, discharges of priority pollutants still occur to some degree, and ten effluents still exhibit toxic characteristics. Permit limits continue to be made more stringent as more information is obtained concerning cause/effect relationships and as advanced technologies and treatment processes are developed.

There are at least 24 hazardous waste disposal sites in the AOC. Most of the landfills are associated with past industrial practices, but the history of what has been deposited is largely unknown. All of the active sites are permitted under RCRA and some have undergone RCRA corrective actions. Groundwater monitoring and the pattern of sediment contamination in Fields Brook suggest some of the disposal sites have contributed to pollution in the area. Additional studies being conducted under Superfund should better define the impact associated with these sites.

Elevated metals' concentrations in sediment near CSO outfalls indicate the CSOs have contributed to pollution in the past, but no information is available concerning current loadings. Agricultural nonpoint sources have not been identified as a problem. Spills still occur on occasion, but have not been considered to be a major contributor to the pollution problems of the AOC. Atmospheric deposition is a potential source, but insufficient information is available to quantify this.

By far, the major sources of contaminants in the Ashtabula River AOC are in-place pollutants concentrated in the sediments after years of unregulated point source discharge. If all the contaminated sediments were removed from Fields Brook and the Ashtabula River, most of the beneficial uses would be restored. In order to prevent recontamination, dischargers must achieve full compliance with their permits and landfill leaching and contaminated ground water infiltration must be remediated.

CHAPTER 7. CURRENT LOADINGS

The beneficial use impairments in the Ashtabula River AOC are associated with sediments contaminated by past, largely unregulated discharge of toxic chemicals. These discharges are regulated now, but there is still a need to determine what pollutants are being discharged, in what quantities, and to what medium. There must be assurance that the area will not be recontaminated after the heavily polluted and toxic sediments are removed from the river. Such information is needed also to measure the progress of such initiatives as the virtual elimination of persistent toxic substances clause of the Great Lakes Water Quality Agreement and the U.S. EPA Pollution Prevention Program.

The previous chapter described all the point sources in the AOC and the restrictions on their discharges to the waters of the AOC. Wasteload allocations had been conducted to determine the quantities of pollutants that could be discharged without violating water quality standards. For some dischargers, sufficient data were available to present information on current loadings. For others, the NPDES permits had recently been revised to include additional chemicals and loading estimates were not yet available. Ten effluents still exhibit toxic characteristics and studies are underway to determine the cause of the toxicity.

In addition to the separate reporting requirements of NPDES permits, RCRA permits and other regulatory actions, manufacturing facilities of a specified size must report toxic chemical release data on an annual basis. This is required under Section 313 of the Emergency Planning and Community Right to Know Act of 1986 (Title III of the Superfund Amendments and Reauthorization Act-SARA). These companies must report estimates of all releases of toxic chemicals to air, water and land, whether they be authorized via permit or due to accidental discharges and spills. These data are entered into a Toxic Release Inventory (TRI) maintained by U.S. EPA and easily accessible to the public. Twenty-three companies in the vicinity of the Ashtabula River AOC reported releases of chemicals in the 1989 TRI Report. A summary of this information is presented in Table 49.

The TRI indicates over nine million pounds of toxic chemicals are released in the Ashtabula River AOC every year. This includes approximately 7.6 million pounds of waste chemicals which are transferred off-site for treatment, storage and disposal. The TRI does not indicate what percentage of the 7.6 million pounds remains at treatment facilities within the AOC, but the descriptions of industries presented in Chapter 6 suggests that the majority of this material is shipped to permitted solid and hazardous waste disposal sites outside the AOC. This material should have minimal impact on the environment within the AOC.

Of the remaining 1,444,978 pounds of toxic releases, 1,424,063 pounds are released to the air and 20,915 pounds are released to the water (Table 50). These data suggest that air deposition could have contributed to the pollution problems in the AOC and may still be a source of certain pollutants, particularly methanol, xylene, acetone, dichloromethane, styrene, toluene, phenol, vinyl chloride, hydrochloric acid and chlorine. However, insufficient data are available to substantiate this assumption.

Most of the chemicals found at elevated levels in the AOC environment were not reported in the TRI as currently being released or were discharged at low levels. Those not listed as currently being released included PCBs, hexachlorobenzene, hexachlorobutadiene, arsenic, cadmium, iron, arsenic, nickel, PAHs and most chloroethenes. Copper, mercury, zinc, chromium, barium, lead and trichloroethene were discharged at low levels. This further supports the supposition that the major sources of the existing contamination were past discharges.

Further studies continue on Fields Brook to determine active sources and loadings of pollutants. The TRI reveals discharge to the waters of the AOC constitutes the smallest loading of pollutants. As more stringent restrictions are developed under the water quality standards and the NPDES program, discharge of persistent toxic chemicals should continue to decrease toward the goal of virtual elimination.

Table 49. Facilities which reported releases of chemicals in the 1989 TRI Reports in Ashtabula River Area of Concern (pounds per year).

Chemical	Fugitive Releases	Stack Releases	Total Air Releases	Releases to Water	Transfers Offsite	Total Releases
Facility Ashland Chemical Co.						
Acetone	891	0	891	0	25517	26408
Ethylene glycol	1	8	9	0	0	9
Maleic anhydride	33	162	195	0	0	195
Methyl methacrylate	22	632	654	0	1802	2456
Phthalic anhydride	4	133	137	0	0	137
Styrene	2953	7070	10023	0	38782	48805
SUBTOTAL	3904	8005	11909	0	66101	78010
Facility Ashtabula Rubber Company						
Lead	8	1	9	0	0	9
SUBTOTAL	8	1	9	0	0	9
Facility Detrex Corporation						
Chlorine	250	250	500	250	0	750
Hydrochloric acid	250	250	500	250	0	750
SUBTOTAL	500	500	1000	500	0	1500

Table 49. Facilities which reported releases of chemicals in the 1989 TRI Reports (Cont'd) in Ashtabula River Area of Concern (pounds per year).

Chemical	Fugitive Releases	Stack Releases	Total Air Releases	Releases to Water	Transfers Offsite	Total Releases
Facility Dunne Plastic Co.						
Dichloromethane	0	0	0	0	250	250
SUBTOTAL	0	0	0	0	250	250
Facility Elkem Metals Company						
Chlorine	250	250	500	14953	0	15453
SUBTOTAL	250	250	500	14953	0	15453
Facility Iten Industries, Inc.						
Acetone	18000	42000	60000	0	4500	64500
Butyl benzoyl phthalate	800	1600	2400	0	0	2400
Formaldehyde	250	750	1000	0	0	1000
Methanol	750	620000	620750	0	250	621000
Phenol	250	56400	56650	0	750	57400
Styrene	4700	0	4700	0	250	4950
Toluene	250	12000	12250	0	750	13000
SUBTOTAL	25000	732750	757750	0	6500	764250
Facility L-Tec Welding & Cutting						
Copper compounds	250	250	500	264	5801	6565
Hydrochloric acid	250	250	500	0	0	500
Manganese compounds	250	250	500	2241	41304	44045
Sodium hydroxide (solution)	250	250	500	0	0	500
Sulfuric acid	250	250	500	0	0	500
SUBTOTAL	1250	1250	2500	2505	47105	52110

Table 49. Facilities which reported releases of chemicals in the 1989 TRI Reports (Cont'd) in Ashtabula River Area of Concern (pounds per year).

Chemical	Fugitive Releases	Stack Releases	Total Air Releases	Releases to Water	Transfers Offsite	Total Releases
Facility Lake City Plating Co.						
Hydrochloric acid	0	1600	1600	0	250	1850
SUBTOTAL	0	1600	1600	0	250	1850
Facility Linchem, Inc						
Chlorine	42	435	477	0	0	477
Hydrochloric acid	28	0	28	0	0	28
Mercury	1046	250	1296	6	2215	3517
SUBTOTAL	1116	685	1801	6	2215	4022
Facility Molded Fiber Glass Company						
Acetone	23090	0	23090	0	0	23090
Dichloromethane	74366	0	74366	0	0	74366
Methyl ethyl ketone	28077	0	28077	0	0	28077
Styrene	12870	0	12870	0	0	12870
Toluene	30407	0	30407	0	0	30407
Zinc compounds	250	0	250	0	0	250
SUBTOTAL	169060	0	169060	0	0	169060
Facility Molded Fiber Glass/Benefit Ave						
Acetone	14609	0	14609	0	0	14609
Dichloromethane	37678	0	37678	0	0	37678
Styrene	18190	0	18190	0	0	18190
Zinc compounds	250	0	250	0	0	250
SUBTOTAL	70727	0	70727	0	0	70727
Facility Occidental Chemical						
Dichloromethane	97	19000	19097	0	6260	25357
Epichlorohydrin	8	280	288	0	0	288
Methanol	1200	300	1500	0	410	1910
Toluene	0	8000	8000	0	156000	164000
SUBTOTAL	1305	27580	28885	0	162670	191555
Facility Picken's Plastics, Inc.						
Acetone	42826	0	42826	0	0	42826
Styrene	2041	27130	29171	0	0	29171
SUBTOTAL	44867	27130	71997	0	0	71997

Table 49. (Cont'd) Facilities which reported releases of chemicals in the 1989 TRI Reports in Ashtabula River Area of Concern (pounds per year).

Chemical	Fugitive Releases	Stack Releases	Total Air Releases	Releases to Water	Transfers Offsite	Total Releases
Facility Plasticolors, Inc., Plant 1						
Chromium compounds	200	0	200	0	649	849
Lead compounds	480	0	480	0	1980	2460
Styrene	1000	0	1000	0	18000	19000
Xylene (mixed isomers)	490	0	490	0	1100	1590
Zinc compounds	1100	0	1100	0	4520	5620
SUBTOTAL	3270	0	3270	0	26249	29519
Facility Plasticolors, Inc., Plant 2						
Styrene	340	42	382	0	0	382
SUBTOTAL	340	42	382	0	0	382
Facility Reliance Electric Co.						
Xylene (mixed isomers)	1293	97744	99037	0	155	99192
SUBTOTAL	1293	97744	99037	0	155	99192
Facility RMI Company Extrusion Plant						
Barium	11	0	11	43	55460	55514
Copper	8	0	8	3	0	11
Nitric acid	0	158	158	0	0	158
SUBTOTAL	19	158	177	46	55460	55683
Facility RMI Company Metals Reduction						
Hydrochloric acid	0	298	298	0	0	298
Titanium tetrachloride	0	377	377	0	0	377
SUBTOTAL	0	675	675	0	0	675
Facility RMI Company Sodium Plant						
Barium compounds	1945	0	1945	0	1154	3099
Chlorine	14324	219	14543	19	0	14562
Hydrochloric acid	0	14	14	0	0	14
Sulfuric acid	0	63	63	0	0	63
SUBTOTAL	16269	296	16565	19	1154	17738

Table 49. (Cont'd) Facilities which reported releases of chemicals in the 1989 TRI Reports in Ashtabula River Area of Concern (pounds per year).

Chemical	Fugitive Releases	Stack Releases	Total Air Releases	Releases to Water	Transfers Offsite	Total Releases
Facility SCM Chemicals, Plant I						
Carbonyl sulfide	0	750	750	0	0	750
Chlorine	250	250	500	0	0	500
Hydrochloric acid	0	42000	42000	0	6330000	6372000
Sulfuric acid	0	0	0	250	0	250
Titanium tetrachloride	250	0	250	0	0	250
Toluene	750	250	1000	0	0	1000
SUBTOTAL	1250	43250	44500	250	6330000	6374750
Facility SCM Chemicals, Plant II						
Ammonia	3100	0	3100	0	0	3100
Carbonyl sulfide	0	6800	6800	0	0	6800
Chlorine	140	22000	22140	0	0	22140
Hydrochloric acid	0	47000	47000	0	108160	155160
Manganese compounds	0	0	0	0	761100	761100
Titanium tetrachloride	1100	0	1100	0	0	1100
Toluene	920	230	1150	0	0	1150
SUBTOTAL	5260	76030	81290	0	869260	950550
Facility Vygen Corporation						
Sulfuric acid	0	250	250	0	0	250
Trichloroethylene	0	250	250	250	0	500
Vinyl acetate	0	250	250	1636	0	1886
Vinyl chloride	39499	250	39749	750	0	40499
SUBTOTAL	39499	1000	40499	2636	0	43135
Facility Zehrco Plastics, Inc.						
Acetone	2791	0	2791	0	250	3041
Dichloromethane	8373	0	8373	0	250	8623
Styrene	4636	0	4636	0	500	5136
Toluene	2791	1339	4130	0	250	4380
SUBTOTAL	18591	1339	19930	0	1250	21180
TOTALS	403,778	1,020,285	1,424,063	20,915	7,568,619	9,013,597

Table 50. Total chemicals released into the air and water of the Ashtabula River AOC in 1989. (Summary of Table 49)

Chemical	Total Discharged (lbs/year) Air	Water
Acetone	144,207	--
Ammonia	3,100	--
Barium & compounds	1,956	43
Butylbenzoyl phthalate	2,400	--
Carbonyl sulfide	7,550	--
Chlorine	38,660	15,222
Chromium & compounds	200	--
Copper & compounds	508	267
Dichloromethane	139,514	--
Epichlorohydrin	288	--
Ethylene glycol	9	--
Formaldehyde	1,000	--
Hydrochloric acid	91,940	250
Lead	489	--
Maleic anhydride	195	--
Manganese compounds	500	2,241
Mercury	1,296	6
Methanol	622,250	--
Methyl ethyl ketone	28,077	--
Methyl metharylate	654	--
Nitric acid	158	--
Phenol	56,650	--
Phthalic anhydride	137	--
Sodium hydroxide solution	500	--
Styrene	80,972	--
Sulfuric acid	813	250
Titanium tetrachloride	1,727	--
Toluene	56,937	--
Trichloroethene	250	250
Vinyl acetate	250	1,636
Vinyl chloride	39,749	750
Xylene	99,527	--
Zinc compounds	1,600	--
TOTAL	1,424,063	20,915

CHAPTER 8. STATUS OF REMEDIAL ACTIONS

Throughout this report a number of remedial actions have been described which were implemented at specific sites as a result of NPDES requirements, RCRA corrective actions or TSCA cleanup specifications. These actions significantly decreased the loading of contaminants to the Ashtabula River AOC and removed or remediated on-site contamination. Although many site specific remedial activities have been completed, no major coordinated remedial actions have yet been implemented to clean up the Ashtabula River or Fields Brook.

River Dredging

In 1987, after several years of planning and coordination, the Buffalo District of the Corps of Engineers presented a proposal to dredge the river channel to -18 feet LWD (essentially to bedrock), and to dispose of all 300,000 cubic yards of heavily polluted sediment and 200,000 cubic yards of toxic sediment at a privately owned upland facility. The intent of the project was to remove all contaminated material so future dredgings would be clean enough for open-lake disposal. This proposal was acceptable to all the federal, state and local government agencies involved. However, the estimated $25 million plan was not approved by the Washington Office of the Chief Engineers (OCE). Reasons for the denial included the unwillingness of the Corps to set a precedent for cleaning up highly polluted sites (particularly toxics), a Reagan Administration directive to refocus the Corps' maintenance activities solely on commercial navigation channels and the escalating cost of the project.

Through the efforts of Congressman Dennis Eckart, the Corps agreed to do interim dredging to 6 to 8 feet below LWD if no toxics would be removed or disturbed. This would at least temporarily alleviate the navigation hazard until remedial dredging could be implemented. The Corps' Buffalo District arranged to do additional sampling in the spring of 1989 to determine the depth to which dredging could be done without exposing or handling toxic sediments. In the interest of avoiding a duplication of effort, this sampling was rescheduled and coordinated with the intensive Downgradient Contamination Investigation of the Ashtabula River required under the Superfund Record of Decision for Fields Brook. Sampling was completed in June 1990. The results of this survey indicated the upper turning basin could be dredged to four feet below LWD and the main channel could be dredged to six feet below LWD without exposing or disturbing toxic sediments. It is anticipated approximately 10,000 to 15,000 cubic yards of moderately to heavily polluted sediments will need to be removed from the river to achieve these depths. Negotiations are currently underway to locate a disposal site for these sediments. The most economically and environmentally acceptable site is the confined disposal facility in Cleveland (CDF 14). Although, scientifically, the characteristics of the Ashtabula River interim dredging sediments are similar to those of the Cuyahoga River sediments disposed of in CDF 14, the public perception is that accepting any sediments from the Ashtabula River would produce an increased health risk to the area. This is especially of concern because the filled CDF is scheduled eventually to become a State park. It is doubtful that Cleveland will accept the Ashtabula sediments so alternative sites are being investigated in Ashtabula. Building a new disposal facility will take longer to implement, but may be the only alternative.

Promoting action to facilitate the total river cleanup has been the main focus of the Ashtabula River RAP Advisory Council. In 1990, the State of Ohio pledged $7 million toward the total cleanup of the Ashtabula River. This money was committed in an effort to secure matching federal funds, and its release is dependent upon a federal monetary commitment. In accordance with the original Corps' plan for upland disposal of toxic and heavily polluted river sediments, the local hazardous waste disposal facility--Reserve Environmental Services (RES)--is still interested in accepting the material. Centerior Energy (CEI), the company owning property adjacent to RES, is willing to sell RES property for construction of a TSCA disposal facility. All of these actions are contingent upon determination of where the funds for dredging will be found.

The City of Ashtabula passed an ordinance, effective August 1989, authorizing a tax on boat docks and launching ramps. The ordinance established a $25 tax on each boat dock and rack and $150 for each ramp. The revenue generated is to be used exclusively for improvements to the river, such as pump-out facilities, and as seed money to assist the dredging project.

The U.S. EPA Assessment and Remediation of Contaminated Sediments (ARCS) program will stage a sediment demonstration project in the fall 1992 to determine if low temperature thermal stripping will be a technology suitable for reducing the toxicity of Ashtabula River sediment. If the technology appears successful and the process is economically feasible, it could be an alternative to upland disposal of river sediments in a TSCA facility.

The Lake Erie Protection Fund, Ohio's return interest from its investment in the Great Lakes Protection Fund, has awarded $10,000 to the Ashtabula River RAP. This money will be used to help select a suitable disposal site or treatment alternative for the contaminated sediments and to fund a public awareness program to educate the public on the details of activities and technologies associated with the selected disposal option.

The Corps has begun investigating sites for location of a confined disposal facility to contain future maintenance dredgings of the outer harbor and the commercial section of the river. Sediments in these areas may no longer be suitable for open-lake disposal. Delays in dredging the river have allowed polluted sediments to move down the river and contaminate the harbor. Currently, three sites are being considered, and the Corps has publicized it's intention to build a CDF as required under the National Environmental Policy Act (NEPA).

<u>Fields Brook</u>

Since 1983, when it was placed on the National Priority List for cleanup of hazardous waste sites, Fields Brook has undergone considerable investigation. Following remedial investigation and feasibility studies, a Record of Decision (ROD) was signed in 1986 by U.S. EPA which recommended excavation, partial incineration, solidification and landfilling of contaminated Fields Brook sediments. The ROD also recommended future actions in two general categories: 1) activities related to the Sediment Operable Unit; and 2) subsequent remedial investigation/feasibility studies.

The Sediment Operable Unit activities included: sediment quantification studies to determine contaminant concentrations, vertical and horizontal extent of contamination and an estimate of sediment volume to be treated; pre-burns; facility siting; chemical characterization of the wastewater that will be generated by remedial activities; bench scale wastewater treatability studies; and a pilot study to determine if solidification is an acceptable method to reduce organic contaminant mobility. A schedule for completion of the Sediment Operable Unit activities is presented in Table 50. These activities must be completed before any sediment remediation can occur.

Table 51. Schedule for Completion of Fields Brook Superfund Sediment Operable Unit Activities.

Activity	Begin	End
Sediment quantification	3/89	7/92
Thermal treatment investigation	3/89	3/92
Solidification investigation	3/89	6/92
Aqueous treatment investigation	3/89	10/92
Facility siting	3/89	11/92
Final Report	11/92	9/93

In addition to the Sediment Operable Unit activities listed in the Record of Decision, the Fields Brook Council, a group of Ashtabula companies identified as PRPs, has proposed implementing a pilot test for an alternative technology. This technology, referred to as the B.E.S.T. extraction process, would strip PCBs and other organics from the sediment with a solvent. The spent solvent containing high concentrations of organics stripped from the sediments will be shipped off-site for disposal at a licensed facility. The treated sediments will be placed in an engineered containment cell on-site. The PRPs are proposing that the B.E.S.T. technology be used as an alternative to incineration. The PRPs hope to implement the pilot test in the fall of 1991 or spring of 1992. If the pilot test is successful and the B.E.S.T. process is approved by U.S. EPA, treatment of Fields Brook sediments could begin in 1993. The PRPs have estimated cleanup by the B.E.S.T. process would take months; whereas treatment by incinceration would take years.

The ROD specified a study to evaluate the nature and extent of sediment contamination in the river and harbor, to investigate potential sources to the river other than Fields Brook, and to determine the impact of contamination on the Ashtabula public water supply intake in Lake Erie. The Donwngradient Contamination Investigation, as this study was called, was jointly developed by the PRPs (Ashtabula River Group), Corps of Engineers, U.S. EPA and Ohio EPA, and was funded by the PRPs. The study included analysis of sediment cores to -18 feet LWD for organic and inorganic pollutants, fish tissue and water quality analysis, and stream flow characterization. A draft report was completed in March 1991, and the vertical sediment profiles are the main source of information for developing the specifications of the interim dredging project previously described in this chapter.

The ROD also required a remedial investigation/feasibility study to identify ongoing sources of contamination to Fields Brook referred to as the Source Control Investigation. A draft report was completed in July 1991. The purpose of this report is to ensure the brook will not be recontaminated once it is cleaned up, and to identify sites where further remediation to control discharge may be needed.

As stated repeatedly throughout this Stage 1 Report, the major remedial action needed for the Ashtabula River AOC is removal of contaminated sediments. The Stage 2 Report will focus on the selection of technologies to accomplish this removal, funding sources, responsibilities and implementation.

CHAPTER 9. RECOMMENDATIONS

There are several areas where further effort is needed to characterize sources of contaminants and the impacts on beneficial use in the Ashtabula River AOC. Some of this work is already underway but, in other cases, studies still need to be initiated.

No current information exists to determine the status of the plankton communities in the AOC. Past studies indicated river plankton communities were impacted from the discharge of chlorine from Fields Brook. Chlorine is no longer discharged in concentrations capable of impacting or eliminating planktonic species. Bioassays done on river sediment indicate some toxicity to plankton, but it is unknown as to whether or not sediment in the river channel is affecting ambient planktonic communities. It is recommended that monitoring be done to establish the composition of the present community.

Ground water studies in the Fields Brook area currently are underway. Information is needed to determine the extent of ground water contamination and if contaminated ground water is impacting the surface waters of Fields Brook, the Ashtabula River or Lake Erie.

Criteria for allowable levels of toxic chemicals in air are being developed, just as similar criteria are being developed for sediment and Great Lakes waters. A significant percentage of the contaminants detected in the Great Lakes are thought to be the result of atmospheric deposition. Judging by the information presented in the Toxics Release Inventory, it appears air toxic release in the Ashtabula River AOC may be a larger source of contaminants than direct discharge to the surface waters. It may be prudent to attempt a comparison of TRI data with NPDES discharge data and ambient water quality conditions. It also may be advantageous to monitor atmospheric deposition at several sites in the AOC.

When the results of the brown bullhead tumor survey become available, it is recommended tumor rates be compared with those in other Lake Erie harbors to determine conditions that may be unique to Ashtabula. Further investigation of the possible causes should be initiated.

The Ashtabula River AOC has a long history of industrial discharge and unregulated dumping. Several previously unknown disposal sites have been found in the the process of construction or remediation of a known problem. It is expected that more problems may be found in the future as the investigation and remediation program progresses. It is recommended that all the parties working on identifying and/or remediating the contamination in the Ashtabula River AOC continue to communicate and cooperate to eventually restore the environmental integrity of the area.

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ASHTABULA RIVER

REMEDIAL ACTION PLAN

STAGE 1

APPENDIX

APPENDIX TABLES

Appendix Table A-1. Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
Acetone	550,000	78,000	--	--	--	--	--	--	--
Acrolein	--	--	68	21	--	320	--	320	780
*Acrylonitrile	460	430	7,500	2,600	--	0.58	6.5	0.58	6.5
*Aldrin	--	0.01	3.0	--	0.001	0.00074	0.00079	0.00074	0.00079
Ammonia-N (Total)	Temperature and pH dependent				500	--	--	--	--
Aniline	10	0.44	--	--	--	--	--	--	--
Antimony	650	190	9,000	1,600	--	14	4,300	146	45,000
*Arsenic	360	190	360	190	50	50	--	--	--
Asbestos (fiber/l)	--	--	--	--	--	300,000	--	300,000	--
Barium	--	--	--	--	--	1,000	--	1,000	--
*Benzene	1,100	560	5,300	--	--	5.0	710	0.66	40
– Chlorobenzene	590	26	250	50	--	488	--	488	--
– Dichlorobenzenes	--	--	1,120	763	--	400	2,600	400	2,600
– 1,2-Dichlorobenzene	160	11	--	--	--	--	--	--	--
– 1,3-Dichlorobenzene	250	87	--	--	--	--	--	--	--
– 1,4-Dichlorobenzene	110	43	--	--	--	75	--	--	--
– Ethylbenzene	1,400	62	32,000	--	--	3,100	29,000	1,400	3,280
*– Hexachlorobenzene	--	--	--	--	--	0.96	0.99	.0072	0.0074
– Nitrobenzene	1,400	740	27,000	--	--	17	1,900	19,800	--
– 1,2,4-Trichlorobenzene	150	77	--	--	--	--	--	--	--
*Benzidine	--	--	2,500	--	--	0.0012	0.0053	0.0012	0.0053
*– 3,3'-Dichlorobenzidine	--	--	--	--	--	0.1	0.2	0.1	0.2
**Beryllium	900	40	130	5.3	--	0.068	1.17	0.068	1.17

Appendix Table A-1. Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l (Continued) unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
2-Butanone	160,000	7,100	--	--	--	--	--	--	--
+Cadmium	8.1	1.8	5.7	1.5	0.2	10	--	10	--
*Carbon Tetrachloride	1,800	280	35,200	50,000	--	2.5	44	0.4	6.94
*Chlordane	--	0.01	2.4	0.0043	0.006	0.0046	0.0048	0.0046	0.0048
Chlorides	--	--	--	--	--	250,000	--	--	--
Chlorine	19	11	19	11	--	--	--	--	--
Ciodrin	--	0.1	--	--	--	--	--	--	--
+Total Chromium	2,400	270	2,300	270	50	50	3,433,000	170,000	3,433,000
Hexavalent Chromium	15	11	16	11	--	--	--	50	--
+Copper	25	16	24	16	5	1,000	--	--	--
Coumaphos	--	0.001	--	--	--	--	--	--	--
Cyanide (Free)	46	12	22	5.2	--	200	--	200	--
2,4-Dichlorophenoxyacetic acid	--	--	--	--	--	100,000	--	100	--
Dalapon	--	110	--	--	--	--	--	--	--
DDT	--	0.001	1.1	0.001	0.003	0.00024	0.00024	0.00024	0.00024
Demeton	--	0.1	--	0.1	--	--	--	--	--
Diazinon	--	0.009	--	--	0.08	--	--	--	--
Dicamba	--	200	--	--	--	--	--	--	--
1,3-Dichloropropene	--	--	6,060	244	--	1.9	310	87	14,100
Dichlorvos	--	0.001	--	--	--	--	--	--	--
*Dieldrin	--	0.005	2.5	0.0019	0.001	0.00071	0.00076	0.00071	0.00076
Diethylamine	5,600	250	--	--	--	--	--	--	--
*1,2-Diphenylhydrazine	--	--	270	--	--	0.422	5.6	--	--
Diquat	--	0.5	--	--	--	--	--	--	--
Dissolved Oxygen (mg/l)	Min. 4.0, Min. 24-hour average 5.0, Min. for Harbor and Lake Erie 6.0				6.0				

Appendix Table A-1. Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l
(Continued) unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
Dissolved Solids (mg/l)[5]	--	1,500	--	--	200	500	--	250	--
Dursban	--	0.001	--	--	--	--	--	--	--
Endosulfan	--	0.003	0.22	0.056	--	0.93	2.0	74	159
Endrin	--	0.002	0.18	0.0023	0.002	0.2	--	1.0	--
Ethanes									
* - 1,2-Dichloroethane	12,000	3,500	118,000	20,000	--	3.8	990	0.94	243
* - Hexachloroethane	--	--	980	540	--	19	87.4	1.9	8.74
* - 1,1,2,2 -Tetrachloroethane	1,000	360	--	2,400	--	1.7	107	1.7	107
- 1,1,1-Trichloroethane	2,000	88	--	--	--	200	1,030,000	18,400	1,030,000
* - 1,1,2-Trichloroethane	2,000	650	--	9,400	--	6.0	418	6.0	418
Ethers									
- Bis(2-chloroethyl)ether	--	--	--	--	--	0.3	13.6	0.3	13.6
Bis(2-chloroisopropyl ether)	--	--	--	--	--	34.7	4,360	34.7	4,360
Ethenes									
* - 1,1-Dichloroethene	1,500	78	11,600	--	--	0.57	32	0.33	18.5
- trans-1,2-Dichloroethene	7,000	310	--	--	--	--	--	--	--
* - Tetrachloroethene	540	73	5,280	840	--	320	3,500	0.8	8.85
- Trichloroethene	1,700	75	45,000	21,900	--	5.0	807	27	807
Ethylene glycol	160	7.2	--	--	--	--	--	--	--
Fluoride	--	--	--	--	1,200	1.8	--	--	--
Guthion	--	0.005	--	0.01	0.005	--	--	--	--
Halomethanes	--	--	11,000	--	--	57	4,700	0.19	15.7
* - Bromoform	1,500	1,000	--	--	--	--	--	--	--
* - Chloroform	1,800	79	28,900	1,240	--	--	--	0.19	15.7
* - Methylene chloride	9,700	430	--	--	--	--	--	--	--

Appendix Table A-1. (Continued) Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
*Heptachlor	--	0.001	0.52	0.0038	0.001	0.0028	0.0028	0.0028	0.0029
Heptachlor Epoxide	--	--	--	--	0.001	0.1	--	--	--
*Hexachlorobutadiene	--	--	90	9.3	--	4.5	500	4.5	500
Hexachlorocyclohexanes									
- alpha-Hexachlorocyclohexane	--	--	--	--	--	0.092	0.31	0.092	0.31
- beta-Hexachlorocyclohexane	--	--	--	--	--	0.163	0.55	0.163	0.547
- Lindane	--	0.01	2.0	0.08	.01	0.19	0.63	0.19	0.63
Hexachlorocyclopentadiene	--	--	7	5.2	--	206	--	206	--
Iron, Total	--	1,000	--	1,000	300	--	--	300	--
Iron, Dissolved	--	--	--	--	--	300	--	--	--
Isophorone	6,000	900	117,000	--	--	5,200	520,000	5,200	520,000
+Lead	200	11	125	4.9	25	50	--	50	--
Malathion	--	0.1	--	0.01	--	--	--	--	--
Manganese	--	--	--	--	--	50,000	--	50	100
MBAS	0.50	--	--	--	--	--	--	--	--
Mercury	1.1	0.20	2.4	0.012	0.2	0.012	0.012	0.144	0.146
Methoxychlor	--	0.005	--	0.03	0.04	100	--	100	--
Mirex	--	0.001	--	0.001	<DL	--	--	--	--
Nalad	--	0.004	--	--	--	--	--	--	--
+Nickel	2,100	232	1,900	210	25	610	4,600	13.4	100
Nitrate (mg/l)	--	--	--	--	--	10	--	10	--
Nitrosamines									
* - N-Nitrosodimethylamine	--	--	--	--	--	0.014	160	0.014	160
- N-Nitrosodi-n-propylamine	--	--	--	--	--	0.008	12.4	--	--
* - N-Nitrosodiphenylamine	290	13	--	--	--	49	161	49	161

Appendix Table A-1. Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l
(Continued) unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
Oil and Grease	10,000	--	--	--	--	--	--	--	--
Parathion	--	0.008	--	0.04	0.0008	--	--	--	--
pH	6.5 - 9.0		6.5 - 9		6.5-9	--	--	--	--
Phenols									
- Phenol	5,300	370	10,200	2,560	--	1.0	--	3,500	--
- 2-Chlorophenol	200	8.8	4,380	2,000	--	0.1	--	--	--
- 2,4-Dichlorophenol	200	18	2,020	365	--	0.3	--	3,090	--
- 2,4-Dinitrophenol	--	--	--	--	--	70	14,300	70	14,300
- 4,6-Dinitro-o-cresol	--	--	--	--	--	13.4	765	13.4	765
- 2-Methylphenol	500	22	--	--	--	--	--	--	--
- 4-Methylphenol	140	6.2	--	--	--	--	--	--	--
- 4-Nitrophenol	790	35	--	--	--	--	--	--	--
- Pentachlorophenol	--	--	55	3.2	--	1,000	--	1,010	--
*- 2,4,6-Trichlorophenol	16	2.5	--	970	--	12	36	12	36
Phosphamidon	--	0.03	--	--	--	--	--	--	--
Phosphorus (mg/l)	Limited to the concentration necessary to control nuisance growths of algae, weeds and slimes. IJC proposed 10 for central basin, 15 for western basin.								
Phthalates									
- Bis(2-ethylhexyl)phthalate	1,100	8.4	--	--	0.6	18	59	15,000	50,000
- Butyl benzyl phthalate	230	49	--	--	0.2	--	--	--	--
- Diethyl phthalate	2,600	120	--	--	0.2	23,000	120,000	350,000	1,800,000
- Dimethyl phthalate	1,700	73	--	--	0.2	313,000	2,900,000	313,000	2,900,000
- Di-n-butyl phthalate	350	190	--	--	4.0	2,700	12,000	34,000	154,000
*PCBs	--	0.001	2.0	0.014	--	0	0.00079	0.00079	0.00079

Appendix Table A-1. Water Quality Criteria Applicable to the Ashtabula River AOC. All concentrations are ug/l
(Continued) unless otherwise noted.[1]

	Aquatic Life					Human Health			
	Ohio WQS		U.S. EPA Criteria		GLWQA[4]	Ohio WQS		U.S. EPA Criteria	
Parameter	Acute	Chronic	Acute	Chronic		PWS[2]	SW[3]	PWS	SW
*PAHs	--	--	--	--	--	0.028	0.31	0.0028	0.031
* - Acenaphthene	67	67	1,700	520	--	20	--	--	--
* - Fluoranthene	200	8.9	3,980	--	--	42	54	42	54
* - Napthalene	160	44	2,300	620	--	--	--	--	--
Selenium	20	5.0	260	35	10	10	--	10	--
+Silver	2.9	1.3	7.2	0.12	--	50	--	50	--
Silvex	--	--	--	--	--	10	--	--	--
Simizine	--	10	--	--	--	--	--	--	--
Styrene	1,300	56	--	--	--	--	--	--	--
Sulfates	--	--	--	--	--	250,000	--	--	--
Tetraethylpyrophosphate	--	0.4	--	--	--	--	--	--	--
*2,3,7,8-Tetrachlorodibenzo-p-dioxin (pg/l)	--	--	<0.01	<0.00001	--	0.13	0.14	0.13	0.14
Thallium	71	16	1,400	40	--	13	48	13	48
Toluene	2,400	1,700	17,500	--	--	10,000	300,000	14,300	424,000
* - 2,4-Dinitrotoluene	--	--	--	--	--	1.1	91	0.11	9.1
- 2,6-Dinitrotoluene	950	42	330	230	--	--	--	--	--
*Toxaphene	--	0.005	1.6	0.013	0.008	0.0071	0.0073	.0071	.0073
*Vinyl chloride	--	--	--	--	--	2.0	5,250	20	5,250
+Zinc	160	140	160	141	30	5,000	--	--	--
Hydrogen Sulfide	2.0	2.0	--	2.0	2.0	--	--	--	--

1. These criteria were summarized from the Ohio Water Quality Standards, U.S. EPA Criteria for Water Quality and the Great Lakes Water Quality Agreement. For more detail or regulatory applications, refer directly to these documents.

2. PWS - Public Water Supply. Standards are based on exposure to contaminants by consuming both fish and water.

3. SW - Surface Water. Standards are based on fish consumption only, and describe concentrations of pollutants in the water column that could bioaccumulate in fish to the extent of impacting human health.

4. Great Lakes Water Quality Agreement objectives do not apply to Fields Brook as it is not considered a boundary water.

5. There is a variance for total dissolved solids in Fields Brook. From the mouth to Rt. 11, the standard is 3,500 mg/l. Upstream of Rt. 11, total dissolved criteria do not apply.

* Carcinogens. Human health standards for these parameters are based on a risk factor of 10^{-5}.

\+ Hardness dependent. Values listed in the table are based on an average hardness of 140 mg/l and apply to the Ashtabula River, Harbor and Lake Erie. The average hardness for Fields Brook is 700 mg/l, and aquatic life standards based on this figure are presented below. All concentrations are ug/l.

	Ohio WQS		U.S. EPA	
Parameter	Acute	Chronic	Acute	Chronic
Beryllium	12,000	530		
Cadmium	47	6.4	35	5.2
Copper	130	71	110	62
Chromium	8,900	1,020	8,500	1,000
Lead	1,600	83	970	38
Nickel	8,500	940	7,400	820
Silver	45	1.3	120	0.12
Zinc	600	550	610	551

Appendix Table A-2. Region V EPA Guidelines Used to Classify Sediments from Great Lakes Harbors.

	Nonpolluted	Moderately Polluted	Heavily Polluted
Volatile Solids (%)	<5	5-8	>8
COD (mg/kg dry weight)	<40,000	40,000-80,000	>80,000
TKN (mg/kg dry weight)	<1,000	1,000-2,000	>2,000
Oil and Grease (Hexane Solubles) (mg/kg dry weight)	<1,000	1,000-2,000	>2,000
Lead (mg/kg dry weight)	<40	40-60	>60
Zinc (mg/kg dry weight)	>90	90-200	>200

Supplemental Guidelines Subject to Modification by Addition of New Data

	Nonpolluted	Moderately Polluted	Heavily Polluted
Ammonia (mg/kg dry weight)	<75	75-200	>200
Cyanide (mg/kg dry weight)	<0.10	0.10-0.25	>0.25
Phosphorus (mg/kg dry weight)	<420	420-650	>650
Iron (mg/kg dry weight)	<17,000	17,000-25,000	>25,000
Nickel (mg/kg dry weight)	<20	20-50	>50
Manganese (mg/kg dry weight)	<300	300-500	>500
Arsenic (mg/kg dry weight)	<3	3-8	>8
Cadmium (mg/kg dry weight)	*	*	>6
Chromium (mg/kg dry weight)	<25	25-75	>75
Barium (mg/kg dry weight)	<20	20-60	>60
Copper (mg/kg dry weight)	<25	25-50	>50

	Polluted
Mercury	1 mg/kg dry weight
Total PCB's	10 mg/kg dry weight

*Lower limits not established

Source: U.S. EPA (1977a) Guidelines for the Pollutional Classification of Great Lakes Harbor Sediments, U.S. Environmental Protection Agency, Region V.

Appendix Table A-3. Criteria for contaminants in fish tissue. (All concentrations are for concentrations skin-on fillets unless otherwise noted).

Substance	FDA* Action Level	GLWQA+ Objective
Aldrin + Dieldrin	0.3 mg/kg	0.3 mg/kg (aldrin + dieldrin)
Chlordane	0.3 mg/kg	----
DDT, TDE and DDE	5.0 mg/kg	1.0 mg/kg (whole fish)
Endrin	----	0.3mg/kg
Heptachlor + heptachlor epoxide	0.3 mg/kg	0.3 mg/kg
Kepone	.3 mg/kg	----
Mercury	1.0 mg/kg	----
Mirex	.1 mg/kg	----
PCBs	2.0 mg/kg	0.1 mg/kg (whole fish)
Toxaphene	5.0 mg/kg	
2,3,7,8-TCDD (Dioxin)	.000050	----

* Food and Drug Administration
\+ Great Lakes Water Quality Agreement

Appendix Table A-4. Lake Erie Water Quality Near Ashtabula - 1978/1979 Nearshore. All concentrations are ug/l. See Figure A-1 for station locations.

Station	n	Max	Min	Mean	Std. Dev.	Det. Limit
Station 127 (NS-West)						
Cadmium	6	40	0.4	8.3	15.63	2.
Copper	6	64	4	30	22.45	10
Iron	6	3900	101	791.8	1524	20
Lead	6	6	0	3.5	2.28	50
Nickel	6	110	0	23.4	42.5	20
Zinc	6	325	28	104.3	119.1	5
Mercury	6	0.4	-.1	0.13	0.16	.2
Chromium	6	11	0	4.6	4.55	20
Station 128 (NS-West)						
Cadmium	6	17	0	3.4	6.7	
Copper	6	79	5	25.7	29.4	
Iron	6	4160	86	849	1622	
Lead	6	6	0	3.8	2.07	
Nickel	6	84	0	21.2	31.5	
Zinc	6	90	13	35.7	28.3	
Mercury	6	0.5	0	0.18	0.172	
Chromium	6	10	0	4.4	3.32	
Station 129 (PWS)						
Cadmium	6	16	0.2	4.6	6.11	
Copper	6	81	3	27.3	30.72	
Iron	6	2500	25	526	969	
Lead	6	10	0	3.1	3.71	
Nickel	6	29	4	13.8	10.52	
Zinc	6	61	4	34.7	24.14	
Mercury	6	1.0	0	.27	.374	
Chromium	6	6	0	2.2	2.26	
Station 130 (off harbor)						
Cadmium	6	3	0	1.3	1.05	
Copper	6	100	0	23.7	37.61	
Iron	6	2490	15	491	982	
Lead	6	6	0	2.7	2.37	
Nickel	6	88	0	19.8	33.92	
Zinc	6	68	6	28.5	21.46	
Mercury	6	0.5	0	0.13	0.197	
Chromium	6	36	2	8.3	13.64	

Table A-4. Lake Erie Water Quality Near Ashtabula - 1978/1979 Nearshore (Continued)

Station 131 (open lake)	n	Max	Min	Mean	Std. Dev.	Det. Limit
Cadmium	6	40	0	7.6	15.9	2
Copper	6	162	3	41.7	62.74	10
Iron	6	1450	12	310	561	20
Lead	6	43	0	9.2	16.6	50
Nickel	6	21	0	9.5	7.77	20
Zinc	6	71	6	37.5	22.26	5
Mercury	5	0.5	0	0.14	0.207	.2
Chromium	6	7	0	3.4	2.3	20
Station 137 (NS-East)						
Cadmium	6	15	.2	4.1	5.8	
Copper	6	217	4	55.6	85.2	
Iron	6	4710	117	926	1854	
Lead	6	101	3	20	39.6	
Nickel	6	101	0	25.9	37.6	
Zinc	6	296	13	76.5	108.7	
Mercury	6	0.9	0	0.2	0.33	
Chromium	6	30	2	8.7	10.6	
Station 138 (open lake-East)						
Cadmium	6	57	0.2	11	22.6	
Copper	6	86	0	32	40.8	
Iron	6	1610	20	339	625	
Lead	5	11	2	5.8	3.5	
Nickel	6	24	0	13.2	8.6	
Zinc	6	76	23	47	20.5	
Mercury	6	0.4	-.1	.14	.19	
Chromium	6	8	.4	5	2.7	
Station 139 (NS-East)						
Cadmium	6	5	0	1.3	1.9	
Copper	6	76	0	21.9	28.8	
Iron	6	2210	20	451	865	
Lead	6	313	2	59	125	
Nickel	6	64	0	14	25	
Zinc	6	85	19	45	22.6	
Mercury	6	0.8	0	.25	.29	
Chromium	6	34	0	11	14.2	

Table A-4. Lake Erie Water Quality Near Ashtabula - 1978/1979 Nearshore (Continued)

Station 132 (river mouth)	n	Max	Min	Mean	Std. Dev.	Det. Limit
Cadmium	6	33	0.3	8.5	12.4	2
Copper	6	81	7	31.9	30.96	10
Iron	6	2470	147	725	865	20
Lead	6	43	0	10.8	16.17	50
Nickel	6	30	9	15.9	7.52	20
Zinc	6	84	4	51.7	32.3	5
Mercury	6	0.4	0.1	0.26	.094	.2
Chromium	6	8	0	5.3	2.8	20
Station 133 (harbor entrance)						
Cadmium	6	6	0.3	2.6	2.24	
Copper	6	102	2	31.7	39.4	
Iron	6	3830	27	764	1503	
Lead	6	6	0	2.7	2.34	
Nickel	6	88	0	21	33.1	
Zinc	6	135	17	48	44.0	
Mercury	6	0.2	0.1	0.18	0.04	
Chromium	6	42	0	9.1	16.2	
Station 134 (open lake)						
Cadmium	6	2	0	0.7	0.75	
Copper	6	71	3	17.8	26.3	
Iron	6	1840	18	383	716	
Lead	6	7	0	3.0	2.3	
Nickel	6	15	-3	5	7.1	
Zinc	6	82	18	35	24.5	
Mercury	6	0.4	0	0.1	0.17	
Chromium	6	21	0	5.7	7.9	
Station 135 (open lake)						
Cadmium	6	19	.2	4	7.4	
Copper	6	123	2	32	46.3	
Iron	6	1690	8	355	657	
Lead	6	5	0	2.0	1.8	
Nickel	6	53	0	15	19.5	
Zinc	6	74	27	44	17.6	
Mercury	6	.4	-.1	.14	.18	
Chromium	6	5	0	2.2	1.9	

Table A-4. Lake Erie Water Quality Near Ashtabula - 1978/1979 Nearshore (Continued)

Station 136 (CEI)	n	Max	Min	Mean	Std. Dev.	Det. Limit
Cadmium	6	6	0.3	2.4	2.5	2
Copper	6	99	0	25	37	10
Iron	6	4500	65	911	1761	20
Lead	6	10	0	4.5	3.5	50
Nickel	6	139	0	29	54	20
Zinc	6	118	9	45	39.8	5
Mercury	6	0.5	0	0.17	0.17	.2
Chromium	6	72	0	15	28	20

Water Quality Criteria for Comparison

	Ohio WQS		U.S. EPA Criteria		IJC-GLWQA
Parameter	Aquatic Life	Human Health	Aquatic Life	Human Health	
Cadmium+	1.8	10	1.5	10	0.2
Copper+	16	1000	16	--	5.0
Iron	1000	--	1000	300	300
Lead+	11	50	4.9	50	25
Nickel+	232	610	210	13.4	25
Zinc+	140	5000	141	--	30
Mercury	0.2	.012	.012	.144	0.2
Chromium+	270	50	270	170,000	50

+ Based on a hardness of 140 mg/l.

Table A-5: Comparison of average PAH concentrations in the sediment of the Ashtabula, Maumee and Black rivers, Ohio. All concentrations are mg/kg.

Parameter	Ashtabula River	Maumee River	Black River
Acenaphthene	.34 (10.00)[1]	.39	36.0
Anthracene	.91 (16.59)	.47	9.4
Benzo(a)anthracene	1.26 (24.39)	1.21	51.0
Benzo(a)pyrene	1.08 (19.76)	.70	43.0
Benzo(g,h,i)perylene	1.32 (12.68)	--	24.0
Chrysene	1.27 (31.7)	1.46	51.0
Fluoranthene	1.60 (65.9)	1.29	220.0
Benzo(b)fluoranthene	1.35 (22.93)	--	75.0
Benzo(k)fluoranthene	-- (11.95)	--	--
Fluorene	.78 (17.3)	--	--
Naphthalene	.69 (-)	.59	31.0
Phenanthrene	1.83 (87.8)	1.08	390.0
Pyrene	1.90 (73.2)	1.62	140.0

1 - Number in parenthesis is concentration measured at Station 14803-08. This concentration was consistently much higher than the rest of the river and was not used in calculating averages.

NOTE: Ashtabula and Maumee River values represent the probable highest concentrations since no zeroes or detection limits were used in calculating averages.

Sources: Woodward Clyde Consultants 1991; Ohio EPA 1990b; Baumann et al 1982.

Table A-6. Yellow perch sport angler harvest (thousands of fish), angler effort (thousands of angler hours), and catch rate (fish per angler hour) by statistical district and fishery, 1975-90.

		District 1			District 2			District 3			Total		
	Year	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total
Harvest	1975	5,198	95	5,293	1,809	7	1,826	355	0	355	7,372	102	7,474
	1976	5,071	60	5,131	772	0	772	142	0	142	5,985	60	6,045
	1977	9,119	158	9,277	1,083	0	1,083	278	0	278	10,480	158	10,638
	1978	--	50	--	--	5	--	--	0	--	--	55	--
	1979	--	82	--	--	0	--	--	0	--	--	82	--
	1980	10,076	138	10,214	1,014	0	1,014	146	0	146	11,236	138	11,374
	1981	9,895	345	10,240	506	2	508	243	0	243	10,644	347	10,991
	1982	9,039	166	9,205	2,132	37	2,169	428	0	428	11,599	203	11,802
	1983	3,846	103	3,949	912	14	926	75	<1	75	4,833	117	4,950
	1984	6,042	259	6,301	2,522	78	2,600	266	3	269	8,830	340	9,170
	1985	4,455	323	4,778	2,259	33	2,292	193	4	197	6,907	360	7,267
	1986	6,371	326	6,697	1,860	72	1,932	355	22	377	8,586	420	9,006
	1987	4,625	269	4,894	1,840	97	1,937	472	29	501	6,937	395	7,332
	1988	4,130	549	4,679	841	93	934	406	15	421	5,377	657	6,034
	1989	3,042	436	3,478	1,923	144	2,067	1,031	27	1,058	5,996	607	6,603
	1990	516	112	628	616	44	660	46	20	66	1,178	176	1,354
Effort	1975	1,812	26	1,838	866	21	887	165	0	165	2,843	47	2,890
	1976	1,446	16	1,462	490	0	490	88	0	88	2,024	16	2,040
	1977	1,984	31	2,015	591	0	591	147	0	147	2,722	31	2,753
	1978	--	30	--	--	2	--	--	0	--	--	32	--
	1979	--	16	--	--	0	--	--	0	--	--	16	--
	1980	2,032	22	2,054	652	<1	652	181	0	181	2,865	22	2,887
	1981	2,121	38	2,159	312	1	313	178	0	178	2,611	39	2,650
	1982	2,328	30	2,358	921	21	942	211	0	211	3,460	51	3,511
	1983	1,094	19	1,113	524	21	545	104	<1	104	1,722	40	1,762
	1984	833	36	869	651	38	689	105	1	106	1,589	75	1,664
	1985	791	46	837	652	19	671	125	2	127	1,568	67	1,635
	1986	1,351	53	1,404	436	26	462	116	6	122	1,903	85	1,988
	1987	1,001	45	1,046	393	37	430	120	10	130	1,514	92	1,606
	1988	1,062	91	1,153	362	40	402	167	6	172	1,591	137	1,728
	1989	926	103	1,029	525	48	573	243	5	248	1,694	156	1,850
	1990	302	47	350	367	34	401	26	6	32	695	87	782
Catch Rates	1975	3.1	3.3	3.1	2.0	0.3	2.0	2.0	--	2.0	2.7	3.1	2.7
	1976	4.2	3.7	4.2	1.8	--	--	1.8	--	1.8	3.5	3.7	3.5
	1977	5.3	4.7	5.3	2.2	--	--	2.2	--	2.2	4.5	4.7	4.5
	1978	--	1.7	--	--	2.1	--	--	--	--	--	1.7	--
	1979	--	4.7	--	--	--	--	--	--	--	--	4.7	--
	1980	5.1	5.7	5.1	1.6	8.1	1.6	0.7	--	0.7	4.0	5.7	4.0
	1981	4.4	7.5	4.5	1.8	0.5	1.8	0.7	--	0.7	3.8	7.3	3.9
	1982	4.4	5.2	4.4	2.6	2.1	2.6	2.2	--	2.2	3.8	3.9	3.8
	1983	3.8	4.9	3.8	1.6	0.6	1.5	0.7	0.9	0.7	2.9	2.6	2.9
	1984	7.3	6.4	7.3	4.1	2.0	4.0	2.3	3.4	2.3	5.7	4.1	5.6
	1985	5.2	6.4	5.2	3.2	1.7	3.2	1.4	1.9	1.4	4.1	4.9	4.1
	1986	4.3	5.3	4.3	4.5	2.7	4.4	2.8	3.5	2.8	4.3	4.4	4.3
	1987	3.8	4.8	3.8	4.1	2.5	4.0	3.7	2.9	3.6	3.9	3.7	3.9
	1988	4.1	5.4	4.2	2.5	2.1	2.4	2.7	2.6	2.7	3.6	4.3	3.6
	1989	2.7	3.4	2.8	3.4	2.8	3.4	4.1	5.0	4.1	3.1	3.3	3.1
	1990	1.3	1.7	1.4	1.5	1.2	1.5	1.6	3.3	1.9	1.4	1.7	1.4

Table A-7. Walleye sport angler harvest (thousands of fish), angler effort (thousands of angler hours), and catch rate (fish per angler hour) by statistical district and fishery, 1975-90.

		District 1			District 2			District 3			Total		
	Year	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total
Harvest	1975	70	6	76	9	0	9	1	0	1	80	6	86
	1976	588	17	605	33	0	33	2	0	2	623	17	630
	1977	2,057	73	2,130	35	0	35	2	0	2	2,094	73	2,167
	1978[a]	1,488	105	1,593	--	0	--	--	0	--	--	105	--
	1979[a]	3,040	214	3,254	--	0	--	--	0	--	--	214	--
	1980	1,921	172	2,093	48	0	48	24	0	24	1,993	172	2,165
	1981	2,606	238	2,844	37	0	37	48	0	48	2,691	238	2,929
	1982	2,692	262	2,954	46	0	46	8	0	8	2,746	262	3,008
	1983	1,369	255	1,624	193	4	197	24	0	24	1,586	259	1,845
	1984	2,710	375	3,085	764	13	777	173	3	176	3,647	391	4,038
	1985	2,828	519	3,347	279	16	295	83	6	89	3,190	541	3,731
	1986	3,173	570	3,743	455	25	480	163	13	176	3,791	608	4,399
	1987	3,061	693	3,754	504	48	552	110	22	132	3,675	763	4,438
	1988	3,047	696	3,744	534	51	584	513	49	562	4,095	796	4,890
	1989	2,155	736	2,891	763	104	867	375	59	434	3,293	899	4,192
	1990	940	526	1,467	355	35	389	363	63	426	1,658	625	2.283
Effort	1975	471	15	486	61	0	61	7	0	7	532	22	554
	1976	1,339	17	1,356	163	0	163	10	0	10	1,512	17	1,529
	1977	2,693	75	2,768	151	0	151	8	0	8	2,852	75	2,927
	1978[a]	2,755	125	2,880	--	0	--	--	0	--	--	125	--
	1979[a]	4,006	173	4,179	--	0	--	--	0	--	--	173	--
	1980	3,718	220	3,938	237	0	237	187	0	187	4,142	220	4,362
	1981	5,412	354	5,766	264	0	264	382	0	382	6,058	354	6,412
	1982	5,530	398	5,928	220	3	223	114	0	114	5,861	401	6,265
	1983	3,695	473	4,168	557	11	568	128	0	128	4,380	484	4,864
	1984	3,485	592	4,077	1,291	31	1,322	384	8	392	5,160	631	5,791
	1985	3,902	704	4,606	1,034	44	1,078	443	21	464	5,379	769	6,148
	1986	5,639	798	6,437	1,039	47	1,086	512	26	538	7,190	871	8,061
	1987	5,651	979	6,630	1,343	88	1,431	431	41	472	7,425	1,108	8,533
	1988	6,483	1,064	7,547	1,560	117	1,677	1,018	63	1,081	9,061	1,243	10,305
	1989	4,203	1,043	5,246	1,354	178	1,532	800	83	883	6,358	1,303	7,661
	1990	3,046	1,070	4,116	1,574	101	1,674	789	80	869	5,408	1,251	6,659
Catch Rate	1975	0.12	0.36	0.13	0.12	--	0.12	0.12	--	0.12	0.12	0.36	0.13
	1976	0.32	0.97	0.33	0.16	--	0.16	0.16	--	0.16	0.30	0.97	0.31
	1977	0.61	0.96	0.62	0.20	--	0.20	0.20	--	0.20	0.59	0.96	0.60
	1978[a]	0.44	0.84	0.46	--	--	--	--	--	--	--	--	--
	1979[a]	0.57	1.23	0.60	--	--	--	--	--	--	--	--	--
	1980	0.41	0.77	0.44	0.15	--	0.15	0.08	--	0.08	0.38	0.77	0.40
	1981	0.32	0.67	0.34	0.13	--	0.13	0.10	--	0.10	0.30	0.67	0.32
	1982	0.47	0.65	0.48	0.18	0.11	0.18	0.07	--	0.07	0.45	0.65	0.46
	1983	0.30	0.54	0.33	0.24	0.34	0.24	0.13	--	0.13	0.29	0.54	0.31
	1984	0.62	0.63	0.62	0.45	0.40	0.45	0.37	0.38	0.37	0.56	0.62	0.57
	1985	0.59	0.73	0.61	0.22	0.36	0.23	0.16	0.28	0.17	0.49	0.70	0.52
	1986	0.54	0.71	0.56	0.41	0.52	0.42	0.30	0.50	0.31	0.50	0.69	0.52
	1987	0.52	0.71	0.55	0.36	0.54	0.37	0.25	0.55	0.28	0.48	0.69	0.51
	1988	0.54	0.65	0.56	0.33	0.42	0.34	0.54	0.78	0.55	0.50	0.64	0.52
	1989	0.51	0.71	0.55	0.55	0.58	0.55	0.46	0.72	0.48	0.51	0.69	0.54
	1990	0.33	0.49	0.37	0.22	0.34	0.23	0.47	0.79	0.50	0.32	0.50	0.35

[a]Survey conducted for district 1 only.

Table A-8. White bass sport angler harvest (thousands of fish), angler effort (thousands of angler hours), and catch rate (fish per angler hour) by statistical district and fishery, 1975-90.

		District 1			District 2			District 3			Total		
	Year	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total
Harvest	1975	175	42	217	1,164	0	1,164	167	0	167	1,506	42	1,548
	1976	201	6	207	423	0	423	25	0	25	648	6	654
	1977	86	9	95	748	0	748	37	0	37	871	9	880
	1978	--	3	--	--	0	--	--	0	--	--	3	--
	1979	--	4	--	--	0	--	--	0	--	--	4	--
	1980	91	4	95	229	0	229	120	0	120	440	4	444
	1981	100	--	100	403	--	403	80	--	80	583	--	583
	1982	405	10	415	1,567	1	1,568	88	0	88	2,060	11	2,071
	1983	727	35	762	713	1	714	58	0	58	1,498	36	1,534
	1984	167	19	186	85	0	85	15	0	15	267	19	286
	1985	108	12	120	185	0	185	17	1	18	310	13	323
	1986	126	14	140	121	0	121	32	0	32	279	14	293
	1987	189	12	201	121	3	124	23	2	25	333	17	350
	1988	206	18	224	164	4	168	41	1	43	412	24	436
	1989	124	19	143	89	6	95	12	2	14	225	27	252
	1990	25	6	31	34	1	36	2	1	2	61	8	69
Effort	1975	77	9	86	406	0	406	61	0	61	544	9	553
	1976	96	2	98	159	0	159	10	0	10	265	2	267
	1977	66	1	67	192	0	192	10	0	10	268	1	269
	1978	--	1	--	--	0	--	--	0	--	--	1	--
	1979	--	<1	--	--	0	--	--	0	--	--	<1	--
	1980	38	<1	38	73	0	73	57	0	57	168	<1	168
	1981	4	<1	4	62	--	62	18	--	18	84	--	--
	1982	11	1	12	281	0	281	72	0	72	364	1	365
	1983	42	2	44	177	0	177	17	0	17	236	2	238
	1984	33	<1	33	49	0	49	7	0	7	89	<1	89
	1985	6	<1	6	60	<1	60	4	<1	4	70	<1	70
	1986	10	<1	10	40	<1	40	5	<1	5	55	<1	55
	1987	13	<1	13	23	0	23	4	0	4	39	<1	39
	1988	11	<1	11	38	0	38	7	<1	7	57	<1	57
	1989	5	<1	5	17	<1	17	2	0	2	24	1	25
	1990	1	<1	1	12	<1	13	<1	<1	<1	14	<1	14
Catch Rate	1975	1.33	3.13	1.52	2.17	--	2.17	2.17	--	2.17	2.05	3.13	2.07
	1976	1.55	2.20	1.56	2.24	--	2.24	2.24	--	2.24	1.99	2.20	1.99
	1977	0.64	3.11	0.68	3.55	--	3.55	3.55	--	3.55	2.83	3.11	2.83
	1978	--	1.13	--	--	--	--	--	--	--	--	1.13	--
	1979	--	0.53	--	--	--	--	--	--	--	--	0.53	--
	1980	1.31	5.40	1.32	2.77	--	2.77	1.87	--	1.87	2.13	5.40	2.14
	1981	2.63	--	2.63	6.82	--	6.82	2.46	--	2.46	5.69	--	5.69
	1982	10.82	4.44	10.29	5.06	--	5.06	2.70	--	2.70	4.77	4.44	4.77
	1983	3.37	4.66	3.43	4.61	--	4.61	2.74	--	2.74	4.25	4.66	4.26
	1984	1.75	2.83	1.75	1.64	--	1.64	0.67	--	0.67	1.60	2.83	1.61
	1985	3.95	29.17	4.36	2.17	2.88	2.17	2.70	0.13	2.64	2.35	4.34	2.36
	1986	1.96	1.36	1.95	2.98	0.04	2.97	2.14	0.00	2.10	2.72	0.55	2.71
	1987	4.80	3.88	4.79	3.14	--	3.14	1.80	--	1.80	3.55	3.88	3.55
	1988	4.96	0.45	4.89	2.99	--	2.99	1.68	0.00	1.67	3.21	0.33	3.20
	1989	7.36	7.11	7.35	2.91	3.44	2.92	0.16	--	0.16	4.39	2.98	3.01
	1990	1.11	0.87	1.09	1.12	0.67	1.11	13.50	0.06	11.13	1.27	0.69	1.18

Table A-9. Smallmouth bass sport angler harvest (hundreds of fish), angler effort (hundreds of angler hours), and catch rate (fish per angler hour) by statistical district and fishery, 1975-90.

		District 1			District 2			District 3			Total		
	Year	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total	Private Boat	Charter Boat	Total
Harvest	1975	120	53	173	85	0	85	99	0	99	304	53	357
	1976	268	17	285	16	0	16	17	0	17	301	17	318
	1977	151	27	178	26	0	26	31	0	31	208	27	235
	1978	--	34	--	--	0	--	--	0	--	--	34	--
	1979	--	17	--	--	0	--	--	0	--	--	17	--
	1980	133	17	150	43	0	43	195	0	195	371	17	388
	1981	123	42	165	47	0	47	147	0	147	317	42	359
	1982	638	41	679	27	0	27	129	0	129	794	41	835
	1983	445	68	513	63	0	63	99	0	99	607	68	675
	1984	122	60	182	35	0	35	79	0	79	236	60	296
	1985	101	24	125	42	1	43	51	<1	51	194	25	219
	1986	175	35	210	17	<1	17	71	<1	71	263	36	299
	1987	197	77	274	53	<1	53	31	<1	31	281	79	360
	1988	105	91	196	35	8	43	41	2	44	181	101	282
	1989	107	112	219	5	2	7	29	4	33	141	118	259
	1990	197	69	266	105	6	112	11	4	15	313	80	393
Effort	1975	69	65	134	20	0	20	24	0	24	114	65	179
	1976	91	34	125	4	0	4	5	0	5	99	34	133
	1977	40	10	50	7	0	7	9	0	9	56	10	66
	1978	--	62	--	--	0	--	--	0	--	--	62	--
	1979	--	29	--	--	0	--	--	0	--	--	29	--
	1980	281	25	306	56	0	56	135	0	135	472	25	497
	1981	144	51	195	64	0	64	617	0	617	826	51	877
	1982	920	66	986	80	0	80	127	0	127	1,128	66	1,194
	1983	1,194	120	1,314	49	0	49	178	0	178	1,421	120	1,541
	1984	659	106	765	24	0	24	152	0	152	835	106	941
	1985	180	22	202	2	1	3	140	1	141	322	24	346
	1986	302	42	344	14	2	16	143	<1	143	459	44	503
	1987	247	102	349	24	1	25	69	2	71	340	105	445
	1988	289	147	435	17	5	23	59	4	63	365	156	521
	1989	385	223	608	0	2	2	40	8	48	425	233	658
	1990	807	135	942	45	15	60	77	11	87	929	160	1089
Catch Rate	1975	0.14	0.63	0.38	0.18	--	0.18	0.18	--	0.18	0.16	0.63	0.33
	1976	0.15	0.40	0.22	0.15	--	0.15	0.15	--	0.15	0.15	0.40	0.21
	1977	0.12	1.16	0.33	0.06	--	0.06	0.06	--	0.06	0.10	1.16	0.76
	1978	--	0.42	--	--	--	--	--	--	--	--	0.42	--
	1979	--	0.36	--	--	--	--	--	--	--	--	0.36	--
	1980	0.38	0.41	0.38	0.09	--	0.09	0.28	--	0.28	0.32	0.41	0.32
	1981	0.26	0.44	0.31	0.11	--	0.11	0.20	--	0.20	0.20	0.44	0.22
	1982	0.40	0.53	0.41	0.26	--	0.26	0.27	--	0.27	0.38	0.53	0.38
	1983	0.18	0.40	0.20	0.38	--	0.38	0.24	--	0.24	0.19	0.40	0.21
	1984	0.14	0.38	0.17	0.00	--	0.00	0.26	--	0.26	0.16	0.38	0.18
	1985	0.27	0.47	0.29	0.00	0.27	0.09	0.31	0.28	0.31	0.29	0.45	0.30
	1986	0.33	0.45	0.34	0.16	0.02	0.14	0.35	0.25	0.35	0.33	0.43	0.34
	1987	0.21	0.53	0.30	0.29	0.08	0.28	0.29	0.19	0.29	0.23	0.52	0.30
	1988	0.16	0.44	0.25	0.18	0.49	0.26	0.13	0.39	0.15	0.16	0.39	0.24
	1989	0.07	0.43	0.20	--	0.49	0.49	0.38	0.45	0.39	0.10	0.43	0.24
	1990	0.16	0.35	0.19	0.15	0.21	0.16	0.03	0.35	0.07	0.13	0.34	0.18

Table A-10. Commercial effective effort[a] and catch rates[b] for major species by statistical district in 1990.

Species		District 1			District 2	District 3	Total		
		Trap Net	Seine	Trotline	Trap Net	Trap Net	Trap Net	Seine	Trotline
Yellow perch	Effort	6,299	133.0	—	6,238	7,376	19,913	133	—
	Pounds	462,759	140	—	681,255	445,947	1,589,961	140	—
	Catch rate	73.5	1.1	—	109.2	60.5	79.8	1.1	—
White bass	Effort	5,055	552.3	—	2,175	445	7,675	552.3	—
	Pounds	200,932	104,790	—	14,328	3,339	218,599	104,790	—
	Catch rate	39.7	189.7	—	6.6	7.5	28.5	189.7	—
Freshwater drum	Effort	4,205	346.0	—	1,356	451	6,012	346.0	—
	Pounds	206,791	86,022	—	14,237	1,235	222,263	86,022	—
	Catch rate	49.2	248.6	—	10.5	2.7	37.0	248.6	—
Channel catfish	Effort	5,162	437.9	23.4	2,750	2,113	10,025	437.9	23.4
	Pounds	103,917	68,909	2,735	12,073	8,422	124,412	68,909	2,735
	Catch rate	20.1	157.4	116.9	4.4	4.0	12.4	157.4	116.9
White perch	Effort	5,706	396.3	—	3,407	1,473	10,586	396.3	—
	Pounds	561,125	19,224	—	145,239	21,191	727,555	19,224	—
	Catch rate	98.3	48.5	—	42.6	14.4	68.7	48.5	—
Whitefish	Effort	1,198	21.9	—	493	317	2,008	21.9	—
	Pounds	9,231	48	—	445	277	9,953	48	—
	Catch rate	7.7	2.2	—	0.9	0.9	5.0	2.2	—

a Trap net lifts, thousand feet of seine, thousands of trotline hooks.

b Pounds per trap net lift, pounds per thousand feet of seine, pounds per thousand trotline hooks.

Source: Ohio Dept. Nat. Res. 1991.

Table A-11. Summary of excess lifetime cancer risk from ingestion of sediment from Fields Brook, and its tributaries. (Source CH_2M Hill 1986a)

Carcinogens	Maximum: Incremental Concentration Above Background ug/kg	Maximum: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Maximum: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Mean: Incremental Concentration Above Background ug/kg	Mean: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Mean: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
UNNAMED TRIBUTARY 22						
Inorganics						
Arsenic	88,600	2×10^{-2}	2×10^{-4}	Only one sample, no mean possible.		
Total		2×10^{-3}	2×10^{-4}			
DETREX TRIBUTARY						
Organics						
Volatiles						
1,1,2,2-Tetrachloroethane	5,400	2×10^{-5}	-	605	2×10^{-6}	-
Tetrachloroethene	5,200	4×10^{-6}	-		-	-
Trichloroethene	7,800	1×10^{-6}	-		-	-
Pesticides						
γ-Hexachlorocyclohexane	3,410	8×10^{-5}	-	379 **	9×10^{-6}	
PCB's	111	8×10^{-6}	-			-
Base/Neutrals						
Hexachlorobenzene	824,400	2×10^{-2}	2×10^{-4}	190,533	5×10^{-3}	2×10^{-6}
Hexachloroethane	45,880	1×10^{-5}	-	11,034	3×10^{-6}	-
Hexachlorobutadiene	389,300	5×10^{-4}	5×10^{-6}	121,008	2×10^{-4}	1×10^{-6}
Inorganics						
Arsenic	97,600	2×10^{-2}	2×10^{-4}	48,000	1×10^{-2}	1×10^{-4}
Total		5×10^{-2}	5×10^{-4}		2×10^{-2}	1×10^{-4}

(Continued)

Table A-11. Continued - Page 2 of 6.

Carcinogens	Maximum: Incremental Concentration Above Background ug/kg	Maximum: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Maximum: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Mean: Incremental Concentration Above Background ug/kg	Mean: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Mean: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
DS TRIBUTARY						
Organics						
Volatiles						
1,1,2,2-Tetrachloroethane	180,000	6×10^{-4}	6×10^{-6}	19,946	7×10^{-5}	-
Chloroform	3,614	4×10^{-6}	-	942	1×10^{-6}	-
Tetrachloroethene	160,000	1×10^{-4}	1×10^{-6}	27,679	2×10^{-5}	-
Trichloroethene	160,000	3×10^{-5}	-	28,058	5×10^{-6}	-
Vinyl Chloride	31	1×10^{-8}	-		-	-
Pesticides						
Heptachlor	22,741	1×10^{-3}	1×10^{-5}	3,408	2×10^{-4}	2×10^{-6}
Base/Neutrals						
Hexachlorobenzene	810,000	2×10^{-2}	2×10^{-4}	228,285	6×10^{-3}	6×10^{-5}
Hexachloroethane	49,000	1×10^{-5}	-	9,461	2×10^{-6}	-
Hexachlorobutadiene	140,000	2×10^{-4}	2×10^{-6}	36,164	5×10^{-5}	-
Benzo(a)pyrene	5,900	1×10^{-3}	1×10^{-5}	1,478	3×10^{-4}	3×10^{-6}
Inorganic						
Arsenic	8,100	2×10^{-3}	2×10^{-5}		-	-
Total		3×10^{-2}	3×10^{-4}		7×10^{-3}	7×10^{-5}
ROUTE 11 TRIBUTARY						
Organics						
Pesticides						
PCB's	1,544	1×10^{-4}	1×10^{-6}	525	4×10^{-5}	-
Base/Neutrals						
Hexachlorobenzene	804	2×10^{-5}	-	161	5×10^{-6}	-
Total		1×10^{-4}	1×10^{-6}		4×10^{-5}	

(Continued)

Table A-11. Continued - Page 3 of 6.

Carcinogens	Maximum: Incremental Concentration Above Background ug/kg	Maximum: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Maximum: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Mean: Incremental Concentration Above Background ug/kg	Mean: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Mean: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
			UNNAMED TRIBUTARY 9			
Organics						
Pesticides						
PCB's	57	4×10^{-6}	-	Only one sample, no mean possible.		
Total		4×10^{-4}	-			
			FIELDS BROOK REACH 8			
Inorganics						
Arsenic	4,700	1×10^{-3}	1×10^{-5}	-	-	-
Total		1×10^{-3}	1×10^{-5}	-	-	-
			FIELDS BROOK REACH 7			
Organics						
Volatiles						
1,1,2,2-Tetrachloroethane	33,000	1×10^{-4}	1×10^{-6}	33,000	1×10^{-4}	1×10^{-6}
Tetrachloroethene	9,400	8×10^{-6}	-	6,250	5×10^{-6}	-
Trichloroethene	22,000	4×10^{-6}	-	15,550	3×10^{-6}	-
Total		1×10^{-4}	1×10^{-6}		1×10^{-4}	1×10^{-6}
			FIELDS BROOK REACH 6			
Organics						
Volatiles						
1,1,2,2-Tetrachloroethane	130,000	4×10^{-4}	4×10^{-6}	34,286	1×10^{-4}	1×10^{-6}
Tetrachloroethene	250,000	2×10^{-4}	2×10^{-6}	71,440	6×10^{-5}	-
Trichloroethene	470,000	9×10^{-5}		130,008	2×10^{-5}	-
Pesticides						
PCB's	518,293	4×10^{-2}	4×10^{-4}	82,048	6×10^{-3}	6×10^{-5}

(Continued)

Table A-11. Continued - Page 4 of 6.

Carcinogens	Maximum			Mean		
	Incremental Concentration Above Background ug/kg	Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Incremental Concentration Above Background ug/kg	Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
			FIELD BROOKS REACH 6 (Cont'd)			
Base/Neutrals						
Hexachlorobenzene	57,000	2×10^{-3}	1×10^{-5}	21,641	6×10^{-4}	6×10^{-6}
Hexachloroethane	43,000	1×10^{-5}	-	13,043	3×10^{-6}	-
Hexachlorobutadiene	77,000	1×10^{-4}	-	27,843	4×10^{-5}	-
Inorganics						
Arsenic	2,900	7×10^{-4}	7×10^{-6}		-	-
Total		4×10^{-2}	4×10^{-4}		7×10^{-3}	6×10^{-5}
			FIELDS BROOK REACH 5			
Organics						
Volatiles						
1,1,2,2-Tetrachloroethane	380	1×10^{-6}	-	53	-	-
Tetrachloroethene	4,100	4×10^{-6}	-	631	-	-
Vinyl Chloride	210	8×10^{-6}	-	28	1×10^{-6}	-
Pesticides						
PCB's	600,000	4×10^{-2}	3×10^{-4}	81,966	6×10^{-3}	6×10^{-5}
Base/Neutrals						
Hexachlorobenzene	70,180	2×10^{-2}	2×10^{-5}	14,320	4×10^{-4}	6×10^{-6}
Hexachlorobutadiene	205,700	3×10^{-4}	3×10^{-6}	24,514	3×10^{-5}	-
Benzo(a)pyrene	4,500	9×10^{-4}	8×10^{-6}	835	2×10^{-4}	1×10^{-6}
Inorganics						
Arsenic	10,200	3×10^{-3}	2×10^{-5}		-	-
Total		5×10^{-2}	5×10^{-4}		7×10^{-3}	6×10^{-5}

(Continued)

Table A-11. Continued - Page 5 of 6.

Carcinogens	Maximum: Incremental Concentration Above Background ug/kg	Maximum: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Maximum: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Mean: Incremental Concentration Above Background ug/kg	Mean: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Mean: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
			FIELDS BROOK REACH 4			
Organics						
Pesticides						
PCB's	44,693	3×10^{-3}	3×10^{-5}	13,226	1×10^{-3}	9×10^{-6}
Base/Neutrals						
Hexachlorobenzene	321,000	9×10^{-3}	9×10^{-5}	68,175	2×10^{-3}	2×10^{-5}
Hexachlorobutadiene	49,220	6×10^{-5}	-	10,840	1×10^{-5}	-
Benzo(a)pyrene	2,280	4×10^{-4}	4×10^{-6}	374	7×10^{-5}	-
Total		1×10^{-2}	1×10^{-4}		3×10^{-3}	3×10^{-5}
			FIELDS BROOK REACH 3			
Organics						
Pesticides						
PCB's	6,180	5×10^{-4}	4×10^{-6}	3,039	2×10^{-4}	2×10^{-6}
Base/Neutrals						
Hexachlorobenzene	3,900	1×10^{-4}	1×10^{-6}	975	3×10^{-5}	-
Total		6×10^{-4}	5×10^{-6}		2×10^{-4}	2×10^{-6}
			FIELDS BROOK REACH 2			
Organics						
Pesticides						
PCB's	3,301	2×10^{-4}	2×10^{-6}	825	6×10^{-5}	-
Base/Neutrals						
Hexachlorobenzene	3,915	1×10^{-4}	1×10^{-6}	1,041	3×10^{-5}	-
Hexachlorobutadiene	2,700	4×10^{-5}	-	675	-	-
Benzo(a)pyrene	500	1×10^{-4}	-	125	2×10^{-5}	-
Total		5×10^{-4}	4×10^{-6}		1×10^{-4}	1×10^{-6}

(Continued)

Table A-11. Continued - Page 6 of 6.

Carcinogens	Maximum: Incremental Concentration Above Background ug/kg	Maximum: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Maximum: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day	Mean: Incremental Concentration Above Background ug/kg	Mean: Excess Lifetime Cancer Risk Residents 0.017g of sed/kg-day	Mean: Excess Lifetime Cancer Risk Workers 0.00016g of sed/kg-day
			FIELDS BROOK REACH 1			
Organics						
Pesticides						
PCB's	11,451	8×10^{-4}	8×10^{-6}	Only one sample, no mean possible.		
Base/Neutrals						
Hexachlorobenzene	5,880	2×10^{-4}	2×10^{-6}			
Hexachlorobutadiene	1,029	4×10^{-6}	-			
Total		1×10^{-3}	1×10^{-5}			

Note: Means less than 1×10^{-6}, see Appendix B for actual risk value. Inorganic concentrations corrected for background; amount shown is greater than background.

Based on cancer potency factors published on October 1, 1985, in the Draft Superfund Public Health Evaluation Manual.

Table A-12. Summary of organic chemicals measured in effluent discharged to the Ashtabula River Area of Concern as analyzed by Ohio EPA. All concentrations in ug/l.

	WWTP		SCM#1		Vygen Corp.	SCM#2	RMI-Sodium Chloride	RMI-Metals		Elkem		
Parameter	5/18/87	6/23/87	10/25/88	12/06/84	10/19/89	7/20/88	8/16/88	8/3/88	4/4/89	4/20/87	8/1/89	9/6/89
Chloroform	1.2	1.9	1.2	1.2			1.2	1.2	0.6	108.1	222.0	8.0
Xylenes	4.3	2.3	2.4									
Ethylbenzene	1.2	0.7	0.7	ND								
Napthalene			2.1	1.9						16.9	ND	
O-xylene			1.0	ND								
Trichloroethene	1.1	0.5			7.4	0.5						
Cis-1,2-dichloroethene					2.6	2.4						
Tetrachloroethene	ND	1.7				2.2						
Bromodichloromethane	ND	0.1						0.5		10.2	59.7	13.9
1,2-dichlorobenzene	ND	0.5							0.8			
Dibromochloromethane	ND	0.1								2.0	27.9	21.2
Toluene	ND	0.1								11.3	ND	
Benzene										36.1	ND	
Fluorene										5.1	ND	
Methylene chloride										15.9	ND	
2-chloronaphthalene										62.1	ND	
Bis(2-ethylhexyl) phthalate	7.2	39.6								2.8	ND	
Bromoform										ND	2.1	7.3
Chlorobenzene	ND	0.1										
1,1,1-trichloroethane	0.4	ND										
1,1,2,2-tetrachloroethane	ND	0.2										
1,4-dichlorobenzene	1.3	3.4										
Phenol	ND	ND										

Appendix Table A-13. NPDES permit conditions for OxyChem.

OEPA Permit No. 3IF00002*FD

Application No. OH0029149

Effective Date: September 29, 1989

Expiration Date: September 26, 1994

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq. hereinafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Section 6111),

Occidental Chemical Corporation

is authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA", to discharge from the Ashtabula Plant wastewater treatment works located at

725 State Road and East Sixth Street, Ashtabula, Ohio, Ashtabula County

and discharging to Fields Brook via State Road Storm Sewer

in accordance with the conditions specified in Parts I, II and III of this permit.

This permit is conditioned upon payment of applicable fees as required by Section 3745.11 of the Ohio Revised Code.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Richard L. Shank, Ph.D.
Director

3398P

Form EPA 4428

Table A-13. Continued.

PART I, A. – FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning three years after the effective date and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00002001. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS**				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE/UNITS		PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
00010	°C	Water Temperature	–	–	–	–	Daily	Grab*
00310	MG/L	Biochemical Oxygen Demand, 5 Day	16	43	17.05	45.11	1/Week	24 Hr. Comp.
00515	MG/L	Residue, Total Filterable	1500	2500	–		1/Week	24 Hr. Comp.
00530	MG/L	Residue, Total Nonfilterable	21	66	21.52	68.56	1/Week	24 Hr. Comp.
00550	MG/L	Oil and Grease, Total	–	10	–	–	1/Week	Grab
00665	MG/L	Phosphorus, Total (P)	–		–	–	1/Quarter	24 Hr. Comp.
00720	MG/L	Cyanide, Total	0.149	0.427	0.156	0.446	1/Quarter	24 Hr. Comp.
32102	UG/L	Carbon Tetrachloride	142	380	0.148	0.397	1/Month	Grab
32106	UG/L	Chloroform	111	325	0.116	0.34	1/Month	Grab
32730	UG/L	Phenolic 4AAP, Total	12	18	0.013	0.019	1/Month	Grab
34010	UG/L	Toluene, Total	28	74	0.029	0.077	1/Month	Grab
34030	UG/L	Benzene, Total	57	134	0.060	0.140	1/Month	Grab
34423	UG/L	Methylene Chloride, Total	36	170	0.0375	0.177	1/Month	Grab
34475	UG/L	Tetrachloroethylene, Total	52	164	0.054	0.171	1/Month	Grab
34511	UG/L	1,1,2-Trichloroethane	12	45	0.012	0.047	1/Month	Grab
34531	UG/L	1,2-Dichloroethane	180	574	0.188	0.6	1/Month	Grab
34546	UG/L	1,2-trans-Dichloroethylene, Total	9	24	0.0093	0.025	1/Month	Grab
39180	UG/L	Trichloroethylene, Total	26	69	0.027	0.072	1/Month	Grab
39516	UG/L	PCBs	–	0.001	–	1×10^{-6}	1/Quarter	24 Hr. Comp.
39702	UG/L	Hexachlorobutadiene	51	135	0.053	0.1414	1/Quarter	24 Hr. Comp.
50050	MGD	Flow Rate		–	–	–	Daily	24 Hr. Total Measured
50060	MG/L	Chlorine, Total Residual	–	–	–	–	1/Week	Grab
61426	TUc	Chronic Toxicity, Ceriodaphnia	–	–	–	–	See Part II, F.	
61428	TUc	Chronic Toxicity, Pimephales promelas		–	–	–	See Part II, F.	
81551	UG/L	Xylene, Total	–	–	–	–	1/Quarter	24 Hr. Comp.

* The use of maximum indicating thermometer is acceptable. Report maximum temperatures.
** The above effluent limitations were based on a total outfall flowrate of 0.276 MGD.

2. The pH (Reporting Code 00400) shall not be less than 6.5 S.U. nor greater than 9.0 S.U. and shall be monitored 2/Week by grab sample.

3. Samples taken in compliance with monitoring requirements specified above shall be taken at Sampling Stations described in Part II, OTHER REQUIREMENTS.

Form EPA 4428

Table A-13. Continued.

PART I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning three years after the effective date and lasting until the expiration date of this permit, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00002091*. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS**				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE	UNITS	PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
01092	UG/L	Zinc, Total (Zn)	-	-	-	-	1/Quarter	24 Hr. Comp.
34200	UG/L	Acenaphthylene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34220	UG/L	Anthracene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34230	UG/L	3,4-BenzoFluoranthene	7	17	0.0074	0.0178	1/Quarter	24 Hr. Comp.
34242	UG/L	Benzo(k)Fluoranthene	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34247	UG/L	Benzo-A-Pyrene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34320	UG/L	Chrysene	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34336	UG/L	Diethyl Phthalate, Total	16	40	0.017	0.042	1/Quarter	24 Hr. Comp.
34341	UG/L	Dimethyl phthalate	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34381	UG/L	Fluorene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34461	UG/L	Phenanthrene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. C[illegible]
34469	UG/L	Pyrene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. [illegible]
34447	UG/L	Nitrobenzene	795	2282	0.83	2.382	1/Quarter	24 Hr. Comp.
34526	UG/L	Benzo(A)Anthracene	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34591	UG/L	2-Nitrophenol, Total Weight	23	83	0.024	0.086	1/Quarter	24 Hr. Comp.
34616	UG/L	2,4-Dinitrophenol	431	1529	0.45	1.596	1/Quarter	24 Hr. Comp.
34646	UG/L	4-Nitrophenol	58	205	0.0603	0.214	1/Quarter	24 Hr. Comp.
34657	UG/L	4,6-Dinitro-o-cresol	28	99	0.029	0.103	1/Quarter	24 Hr. Comp.
34694	UG/L	Phenol, (GC/MS) Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34696	UG/L	Napthalene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
39100	UG/L	Bis(2-Ethylhexyl) Phthalate, Total	34	92	0.0353	0.096	1/Quarter	24 Hr. Comp.
39110	UG/L	Di-N-Butyl Phthalate, Total	7	15	0.0074	0.016	1/Quarter	24 Hr. Comp.
39175	UG/L	Vinyl Chloride	35	61	0.0361	0.064	1/Month	Grab

* This station is actually 3IF00002001 but due to Ohio EPA computer constraints the above reporting codes, units, parameters, effluent limitations and monitoring requirements had to be listed under a different station number. The above parameters are to be reported under the above station designation.

** The above effluent limitations were based on a total outfall flowrate of 0.276 MGD.

Form EPA 4428

Table A-13. Continued.

PART I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until expiration date of the permit, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00002092*. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS**				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE/UNITS		PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
01034	UG/L	Chromium, Total (Cr)	398	987	0.413	1.0306	1/Quarter	24 Hr. Comp.
01042	UG/L	Copper, Total (Cu)	-	-	-	-	1/Quarter	24 Hr. Comp.
34205	UG/L	Acenaphthene, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
34215	UG/L	Acrylonitrile, Total	34	83	0.035	0.0863	1/Month	Grab
34283	UG/L	Bis(2-Chloroisopropyl)ether	-	-	-	-	1/Quarter	24 Hr. Comp.
34311	UG/L	Chloroethane	39	105	0.041	0.11	1/Month	Grab
34371	UG/L	Ethylbenzene, Total	142	380	0.148	0.397	1/Month	Grab
34376	UG/L	Fluoranthene, Total	8	19	0.0082	0.02	1/Quarter	24 Hr. Comp.
34396	UG/L	Hexachloroethane	70	283	0.073	0.295	1/Quarter	24 Hr. Comp.
34418	UG/L	Methyl Chloride, Total	39	105	0.041	0.11	1/Month	Grab
34496	UG/L	1,1-Dichloroethane	8	21	0.0082	0.022	1/Month	Grab
34501	UG/L	1,1-Dichloroethylene	8	21	0.0082	0.0223	1/Month	Grab
34506	UG/L	1,1,1-Trichloroethane, Total	8	21	0.0082	0.022	1/Month	Grab
34536	UG/L	1,2-Dichlorobenzene, Total	70	283	0.073	0.295	1/Quarter	24 Hr. Comp.
34541	UG/L	1,2-Dichloropropane	70	283	0.073	0.295	1/Month	Grab
34551	UG/L	1,2,4-Trichlorobenzene, Total	70	283	0.073	0.295	1/Quarter	24 Hr. Comp.
34566	UG/L	1,3-Dichlorobenzene, Total	51	135	0.053	0.1414	1/Quarter	24 Hr. Comp.
34571	UG/L	1,4-Dichlorobenzene, Total	51	135	0.053	0.1414	1/Quarter	24 Hr. Comp.
34606	UG/L	2,4-Dimethylphenol, Total	7	17	0.0071	0.0175	1/Quarter	24 Hr. Comp.
39700	UG/L	Hexachlorobenzene	70	283	0.073	0.295	1/Quarter	24 Hr. Comp.
40013	UG/L	Chlorobenzene	51	135	0.053	0.1414	1/Month	Grab
77163	UG/L	1,3-Dichloropropylene	70	283	0.073	0.295	1/Month	Grab

* This station is actually 3IF00002001 but due to Ohio EPA computer constraints the above reporting codes, units, parameters, effluent limitations and monitoring requirements had to be listed under a different station number. The above parameters are to be reported under the above station designation.

** The above effluent limitations were based on a total outfall flowrate of 0.276 MGD.

Form EPA 4428

Appendix Table A-14. NPDES permit conditions for VyGen.

OEPA Permit No. 3IF00006*HD

Application No. OH0002283

Effective Date: September 29, 1989

Expiration Date: September 26, 1994

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION TO DISCHARGE UNDER THE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq. hereinafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Section 6111),

Vygen Corporation

is authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA", to discharge from the wastewater treatment works located on Middle Road, Ashtabula, Ohio, Ashtabula County

and discharging to Vygen tributary of Fields Brook

in accordance with the conditions specified in Parts I, II and III of this permit.

This permit is conditioned upon payment of applicable fees as required by Section 3745.11 of the Ohio Revised Code.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Richard L. Shank

Richard L. Shank, Ph.D.
Director

5903P

Form EPA 4428

Table A-14. Continued

PART I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning 36 months after the effective date and lasting until the expiration of the permit the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00006001. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE	UNITS	PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
32102	UG/L	Carbon Tetrachloride	13	27	0.025	0.052	1/Year	24 Hr. Composite
32106	UG/L	Chloroform	15	34	0.029	0.066	1/Month	Grab
34030	UG/L	Benzene, Total	27	99	0.052	0.191	1/Year	Grab
34205	UG/L	Acenaphthene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
34215	UG/L	Acrylonitrile, Total	70	176	0.135	0.339	1/Year	Grab
34283	UG/L	Bis(2-Chloroisopropyl)ether	220	553	0.425	1.067	1/Year	24 Hr. Composite
34311	UG/L	Chloroethane	76	196	0.147	0.378	1/Month	Grab
34371	UG/L	Ethylbenzene, Total	23	79	0.044	0.152	1/Year	Grab
34376	UG/L	Fluoranthene, Total	18	50	0.035	0.096	1/Year	24 Hr. Composite
34396	UG/L	Hexachloroethane	15	39	0.029	0.075	1/Year	24 Hr. Composite
34496	UG/L	1,1-Dichloroethane	16	43	0.031	0.083	1/Month	Grab
34501	UG/L	1,1-Dichloroethylene	12	18	0.023	0.035	1/Month	Grab
34506	UG/L	1,1,1-Trichloroethane, Total	15	39	0.029	0.075	1/Month	Grab
34531	UG/L	1,2-Dichloroethane	50	154	0.096	0.297	1/Month	Grab
34536	UG/L	1,2-Dichlorobenzene, Total	56	119	0.110	0.230	1/Year	24 Hr. Composite
34541	UG/L	1,2-Dichloropropane	112	168	0.216	0.324	1/Year	Grab
34546	UG/L	1,2-trans-Dichloroethylene, Total	15	39	0.029	0.075	1/Month	Grab
34551	UG/L	1,2,4-Trichlorobenzene, Total	50	102	0.096	0.196	1/Year	24 Hr. Composite
34566	UG/L	1,3-Dichlorobenzene, Total	23	32	0.044	0.062	1/Year	24 Hr. Composite
34571	UG/L	1,4-Dichlorobenzene, Total	11	20	0.021	0.052	1/Year	24 Hr. Composite
34586	UG/L	2-Chlorophenol	23	71	0.044	0.137	1/Year	24 Hr. Composite
34601	UG/L	2,4-Dichlorophenol	28	82	0.054	0.158	1/Year	24 Hr. Composite
34606	UG/L	2,4-Dimethylphenol, Total	13	26	0.025	0.050	1/Year	24 Hr. Composite
34611	UG/L	2,4-Dinitrotoluene	82	208	0.158	0.401	1/Year	24 Hr. Composite
34626	UG/L	2,6-Dinitrotoluene	186	468	0.359	0.903	1/Year	24 Hr. Composite
39700	UG/L	Hexachlorobenzene	11	20	0.021	0.052	1/Year	24 Hr. Composite
40013	UG/L	Chlorobenzene	11	20	0.021	0.038	1/Year	Grab
50050	MGD	Flow	-	-	-	-	Daily	24 Hr. Total
77163	UG/L	1,3-Dichloropropylene	21	32	0.040	0.062	1/Year	24 Hr. Composite

2. Samples taken in compliance with monitoring requirements specified above shall be taken at Sampling Stations described in Part II, OTHER REQUIREMENTS.

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Table A-14. Continued.

PART I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning 36 months after the effective date and lasting until the expiration of the permit the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00006002. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC			DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
			Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE/UNITS		PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
34200	UG/L	Acenaphthylene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
34220	UG/L	Anthracene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
34230	UG/L	3,4-BenzoFluoranthene	17	44	0.033	0.085	1/Year	24 Hr. Composite
34242	UG/L	Benzo(k)Fluoranthene	16	43	0.031	0.083	1/Year	24 Hr. Composite
34247	UG/L	Benzo-A-Pyrene, Total	17	44	0.033	0.085	1/Year	24 Hr. Composite
34320	UG/L	Chrysene	16	43	0.031	0.083	1/Year	24 Hr. Composite
34336	UG/L	Diethyl Phthalate, Total	59	148	0.114	0.286	1/Year	24 Hr. Composite
34341	UG/L	Dimethyl phthalate	14	37	0.027	0.066	1/Year	24 Hr. Composite
34381	UG/L	Fluorene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
34010	UG/L	Toluene, Total	19	58	0.037	0.112	1/Year	Grab
34418	UG/L	Methyl Chloride, Total	63	139	0.122	0.268	1/Month	Grab
34423	UG/L	Methylene Chloride, Total	29	65	0.056	0.125	1/Month	Grab
34447	UG/L	Nitrobenzene	20	50	0.039	0.096	1/Year	24 Hr. Composi
34461	UG/L	Phenanthrene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
34469	UG/L	Pyrene, Total	18	49	0.031	0.083	1/Year	24 Hr. Composite
34475	UG/L	Tetrachloroethylene, Total	16	41	0.031	0.083	1/Year	Grab
34511	UG/L	1,1,2-Trichloroethane	15	39	0.029	0.075	1/Month	Grab
34526	UG/L	Benzo(A)Anthracene	16	43	0.031	0.083	1/Year	24 Hr. Composite
34591	UG/L	2-Nitrophenol, Total Weight	30	50	0.058	0.096	1/Year	24 Hr. Composite
34616	UG/L	2,4-Dinitrophenol	52	90	0.100	0.174	1/Month	24 Hr. Composite
34646	UG/L	4-Nitrophenol	52	90	0.100	0.174	1/Month	24 Hr. Composite
34657	UG/L	4,6-Dinitro-o-cresol	57	202	0.110	0.390	1/Month	24 Hr. Composite
34694	UG/L	Phenol, (GC/MS) Total	11	19	0.021	0.036	1/Year	Grab
34696	UG/L	Napthalene, Total	16	43	0.031	0.083	1/Year	24 Hr. Composite
39100	UG/L	Bis(2-Ethylhexyl) Phthalate, Total	11	17	0.021	0.033	1/Quarter	24 Hr. Composite
39110	UG/L	Di-N-Butyl Phthalate, Total	20	42	0.039	0.081	1/Year	24 Hr. Composite
39175	UG/L	Vinyl Chloride	76	196	0.147	0.378	1/Month	Grab
39180	UG/L	Trichloroethylene, Total	15	39	0.029	0.075	1/Month	Grab
39702	UG/L	Hexachlorobutadiene	15	36	0.029	0.069	1/Year	24 Hr. Composite
50050	MGD	Flow	-	-	-	-	Daily	24 Hr. Total

This outfall is actually 3IF00006001 but due to Ohio EPA computer constraints the above reporting codes, units, parameters, effluent limitations and monitoring requirements had to be listed under a differnt outfall number.

2. Samples taken in compliance with monitoring requirements specified above shall be taken at Sampling Stations described in Part II, OTHER REQUIREMENTS.

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Table A-14. Continued.

PART I, A. - FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning 36 months after the effective date and lasting until the expiration of the permit the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements from the following outfall: 3IF00006003. SEE PART II, OTHER REQUIREMENTS, for location of effluent sampling.

EFFLUENT CHARACTERISTIC		DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
		Concentration Other Units (Specify)		Loading kg/day			
REPORTING CODE/UNITS	PARAMETER	30 DAY	DAILY	30 DAY	DAILY	Measurement Frequency	Sample Type
00010 °C	Water Temperature	-	-	-	-	1/Week	24 Hr. Composite
00310 MG/L	Biochemical Oxygen Demand, 5 Day	20	33	37	64	1/Week	24 Hr. Composite
00335 MG/L	Chemical Oxygen Demand	150	290	199	385	1/Week	24 Hr. Composite
00515 MG/L	Residue, Total Filterable	-	1500	-	2388	1/Week	24 Hr. Composite
00530 MG/L	Residue, Total Nonfilterable	20	40	39	77	1/Week	24 Hr. Composite
00665 MG/L	Phosphorus, Total (P)	-	-	-	-	1/Month	24 Hr. Composite
00720 MG/L	Cyanide, Total	-	-	-	-	1/Quarter	24 Hr. Composite
01027 UG/L	Cadmium, Total (Cd)	1.8	2.4	0.0034	0.0046	1/Month	24 Hr. Composite
01034 MG/L	Chromium, Total	-	-	-	-	1/Quarter	24 Hr. Composite
01042 UG/L	Copper, Total (Cu)	7.2	10.8	0.0014	0.021	1/Month	24 Hr. Composite
01051 UG/L	Lead, Total (Pb)	30	45	0.058	0.087	1/Month	24 Hr. Composite
01092 UG/L	Zinc, Total (Zn)	125	188	0.241	0.363	1/Month	24 Hr. Composite
32730 UG/L	Phenolic 4AAP, Total	-	-	-	-	1/Month	24 Hr. Composite
61425 TUa	Acute Toxicity, Ceriodaphnia	-	1.0	-	-	1/Month	See Part II, G
61426 TUc	Chronic Toxicity, Ceriodaphnia	-	-	-	-	1/Quarter	See Part II, G
61428 TUc	Chronic Toxicity, Pimephales promelas	-	-	-	-	1/Quarter	See Part II, G
71900 UG/L	Mercury, Total (Hg)	0.2	0.3	0.0004	0.0006	1/Month	24 Hr. Composite

* The use of a maximum indicating thermometer is acceptable report maximum temperatures.

This outfall is actually 3IF00006001 but due to Ohio EPA computer constraints the above reporting codes, units, parameters, effluent limitations and monitoring requirements had to be listed under a differnt outfall number.

2. The pH (Reporting Code 00400) shall not be less than 6.5 S.U. nor greater than 9.0 S.U. and shall be monitored 1/week by grab sample.

3. Samples taken in compliance with monitoring requirements specified above shall be taken at Sampling Stations described in Part II, OTHER REQUIREMENTS.

Form EPA 4428

March 1, 1983

JOINT STATEMENT OF HEALTH ADVISORY FOR CONSUMPTION OF ASHTABULA RIVER FISH

Ohio Department of Health and Ohio Environmental Protection Agency

For Immediate Release

CONTACT: Robert Indian, ODH
(614) 466-0281
Allan Franks, OEPA
Patricia Morrison, OEPA
(614) 466-8508

The Ohio Department of Health and the Ohio Environmental Protection Agency today recommended that people not eat fish caught in a two mile length of the Ashtabula River due to possible contamination with PCB's (polychlorinated biphenyls) and other organic chemicals. The area involved extends from the mouth of the Ashtabula River, including the harbor area within the breakwater, to the 24th Street bridge in Ashtabula. All species of fish are included in the advisory, which will remain in effect until further studies indicate that the fish are safe to eat.

Recent analyses of fish caught in this area have revealed high levels of PCB's, hexachlorobenzene, pentachlorobenzene, and tetrachloroethane. Similar advisories are in effect in Michigan, Wisconsin, New York and Ontario, Canada.

Ohio EPA Director Robert Maynard said that "A specific source of the contamination has not been pinpointed. Over the years, many industries in the area have used PCB's and other organic chemicals."

Ohio EPA and U.S. EPA are studying the Ashtabula River and Fields Brook to determine the extent of contamination and possible cleanup alternatives. "The only evidence we have right now comes from the two mile advisory area, and we can't say yet that fish taken upstream of the study area are not contaminated, too," Maynard noted.

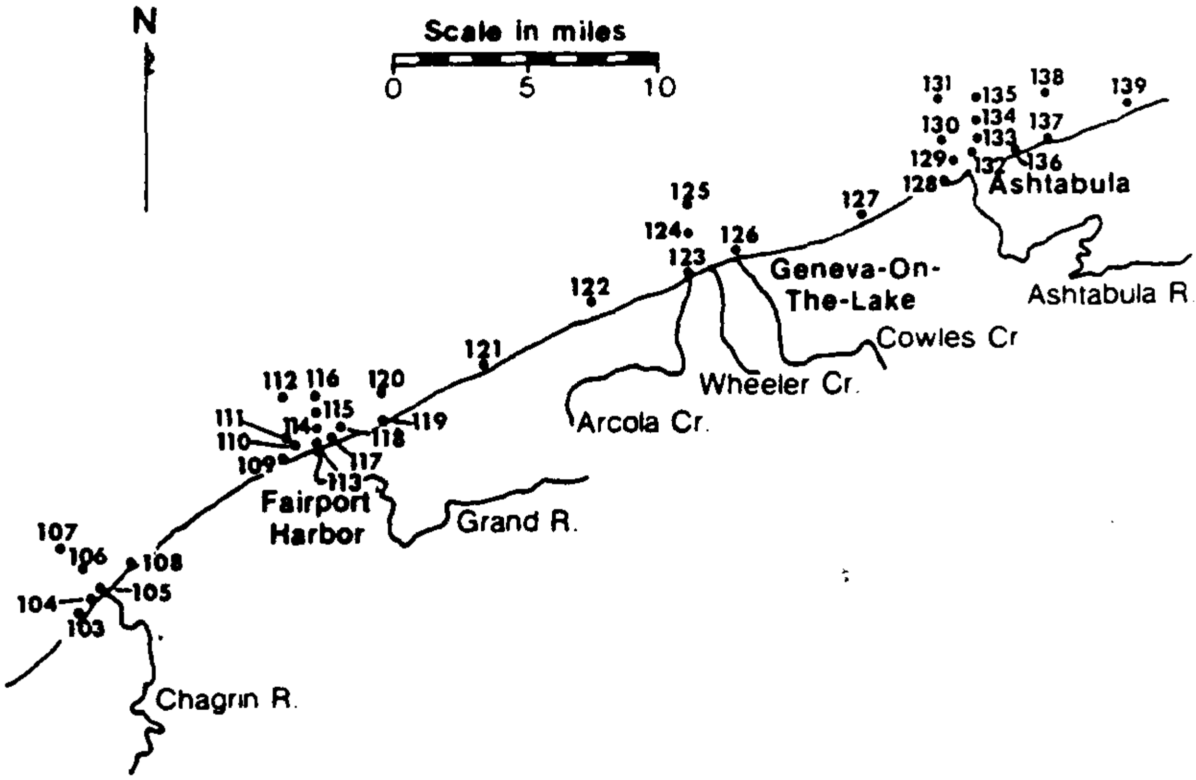
PCB's were widely used as an industrial coolant prior to being banned by U.S. EPA in 1979. Hexachlorobenzene and pentachlorobenzene are used in chemical manufacturing, and tetrachloroethane is an industrial solvent.

The chemicals involved remain in the environment for long periods of time and can accumulate in human fat tissue when ingested. According to Dr. Thomas Gardner, Acting Director of the Ohio Department of Health, there should be no immediate health effects from fish consumption with the levels found, but there is concern for the long term health effects as the chemicals accumulate in the body.

The U.S. FDA (Food and Drug Administration) allows human consumption of up to 5 ppm (parts per million) PCB's in fish. Sample results indicated levels of PCB's ranging from 2.4 ppm to 58.3 ppm in the edible portions of the fish. PCB's are known to cause skin disruptions, liver problems, and reproductive problems in humans when ingested in large quantities.

The U.S. FDA does not have a standard for the other chemicals. Hexachlorobenzene, pentachlorobenzene, and tetrachloroethane are suspected of causing cancer or birth defects in animals when ingested in large quantities over long periods of time.

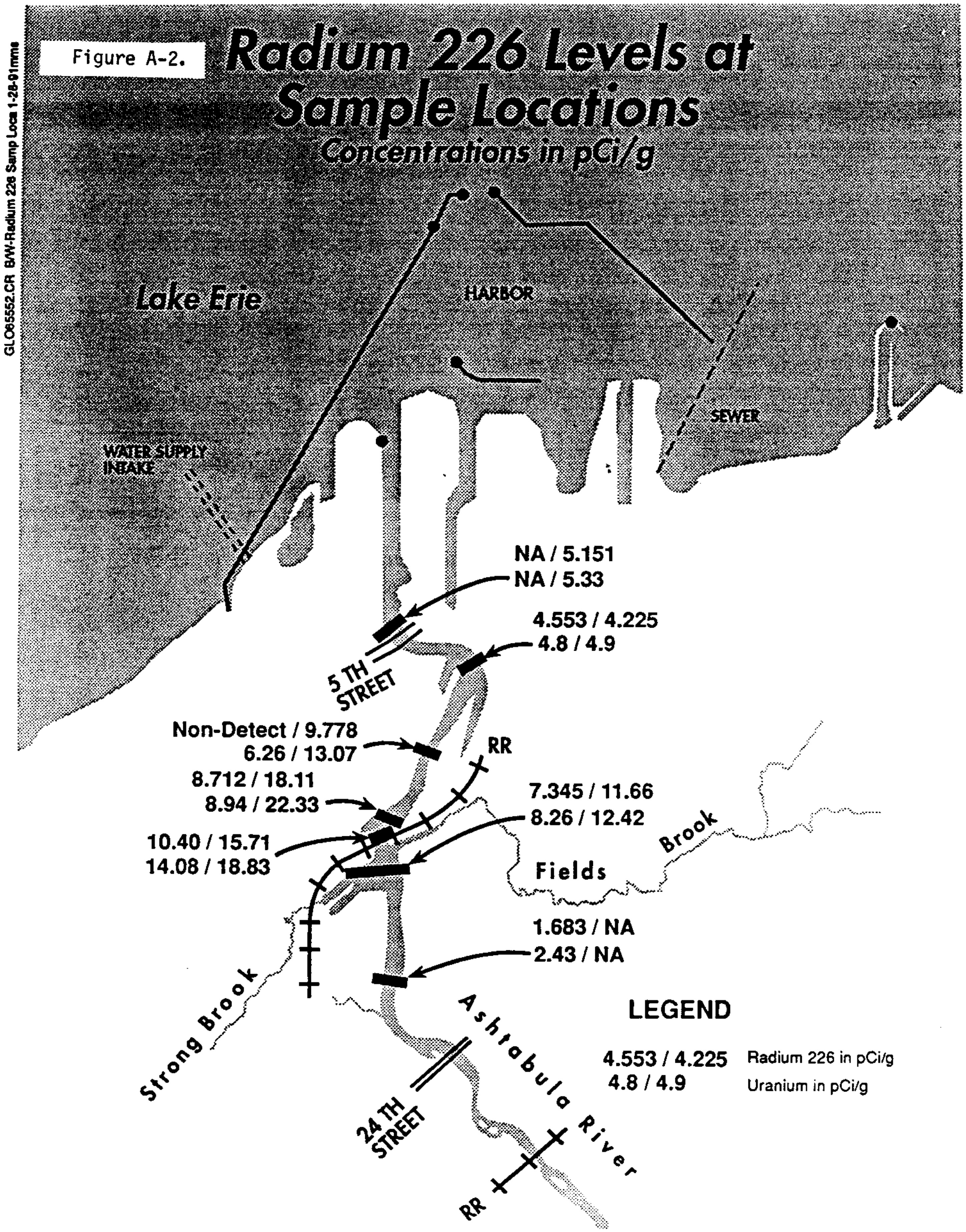
APPENDIX FIGURES



Station Number	Latitude	Longitude	Depth (ft.)	Notes
127	41° 52' 45"	80° 52' 50"	8	
128	41° 53' 56"	80° 49' 05"	6	
129	41° 54" 30"	80° 48' 40"	22	Ashtabula PWS intake
130	41° 55' 15"	80° 49' 05"	44	
131	41° 56" 40"	80° 49' 05"	53	
132	41° 54" 47"	80° 47' 55"	27	Ashtabula River mouth
133	41° 55' 15"	80° 47' 36"	35	Ashtabula Harbor entrance
134	41° 55' 55"	80° 47' 36"	48	
135	41° 56' 40"	80° 47' 36"	40	
136	41° 54' 47"	80° 45' 55"	6	Cleveland Electric Illum. Co.
137	41° 55' 12"	80° 44' 36"	6	
138	41° 56' 40"	80° 44' 36"	46	
139	41° 56' 21"	80° 41' 00"	20	

Figure A-1. Lake Erie sampling station locations in the Ashtabula area during the 1978-1979 Nearshore Study. (Source: Richards 1981)

Figure A-2.



GLO65552.CR B/W-Radium 226 Samp Locs 1-28-91mms
Radium 226 Levels at Sample Locations
Concentrations in pCi/g
Lake Erie
HARBOR
SEWER
WATER SUPPLY INTAKE
NA / 5.151
NA / 5.33
4.553 / 4.225
4.8 / 4.9
5 TH STREET
Non-Detect / 9.778
6.26 / 13.07
RR
8.712 / 18.11
8.94 / 22.33
7.345 / 11.66
8.26 / 12.42
10.40 / 15.71
14.08 / 18.83
Fields Brook
1.683 / NA
2.43 / NA
Strong Brook
Ashtabula River
24 TH STREET
RR
LEGEND
4.553 / 4.225 Radium 226 in pCi/g
4.8 / 4.9 Uranium in pCi/g

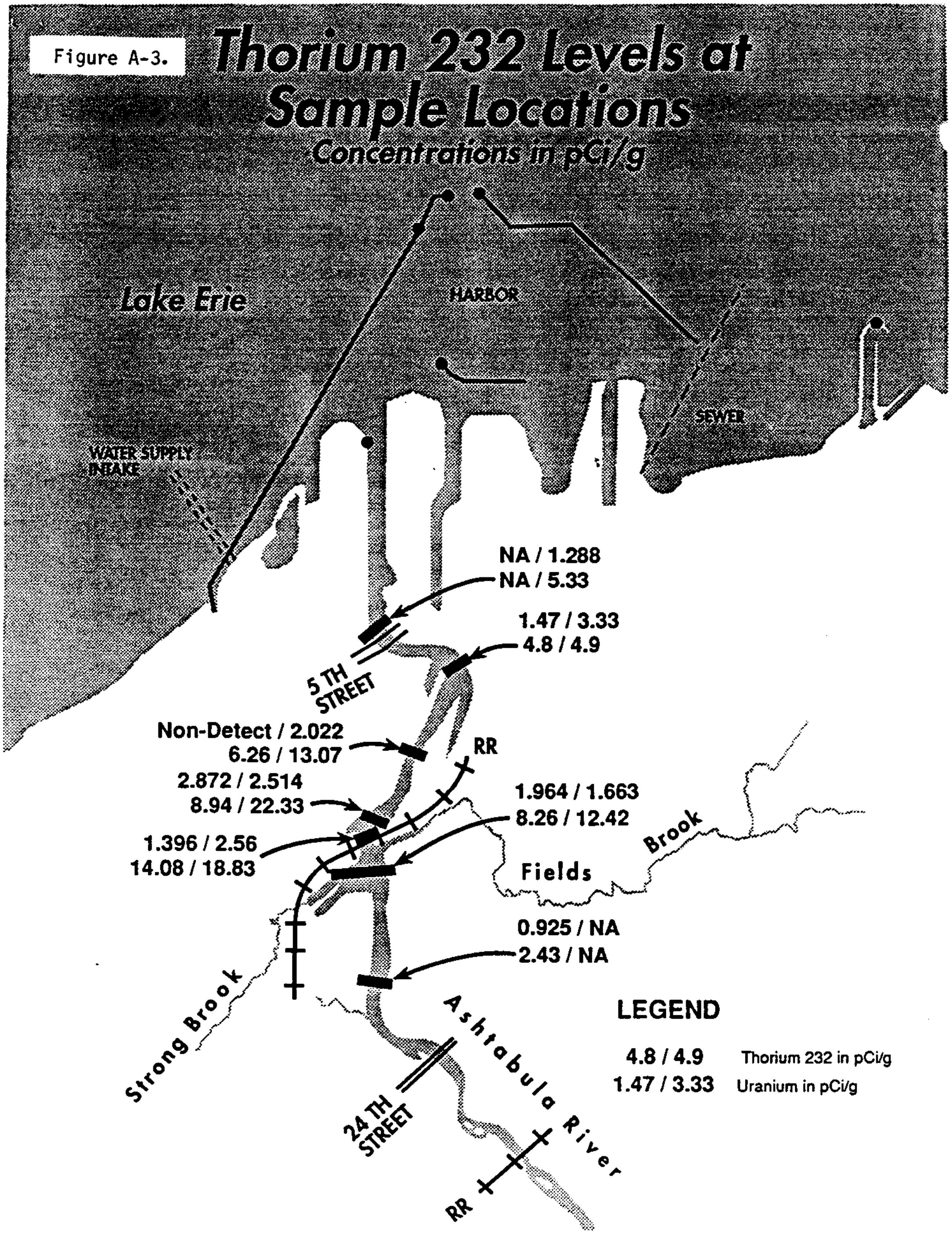


Figure A-3.
Thorium 232 Levels at Sample Locations
Concentrations in pCi/g
Lake Erie
HARBOR
SEWER
WATER SUPPLY INTAKE
NA / 1.288
NA / 5.33
1.47 / 3.33
4.8 / 4.9
5 TH STREET
Non-Detect / 2.022
6.26 / 13.07
RR
2.872 / 2.514
8.94 / 22.33
1.964 / 1.663
8.26 / 12.42
1.396 / 2.56
14.08 / 18.83
Fields
Brook
0.925 / NA
2.43 / NA
LEGEND
4.8 / 4.9 Thorium 232 in pCi/g
1.47 / 3.33 Uranium in pCi/g
Strong Brook
Ashtabula River
24 TH STREET
RR

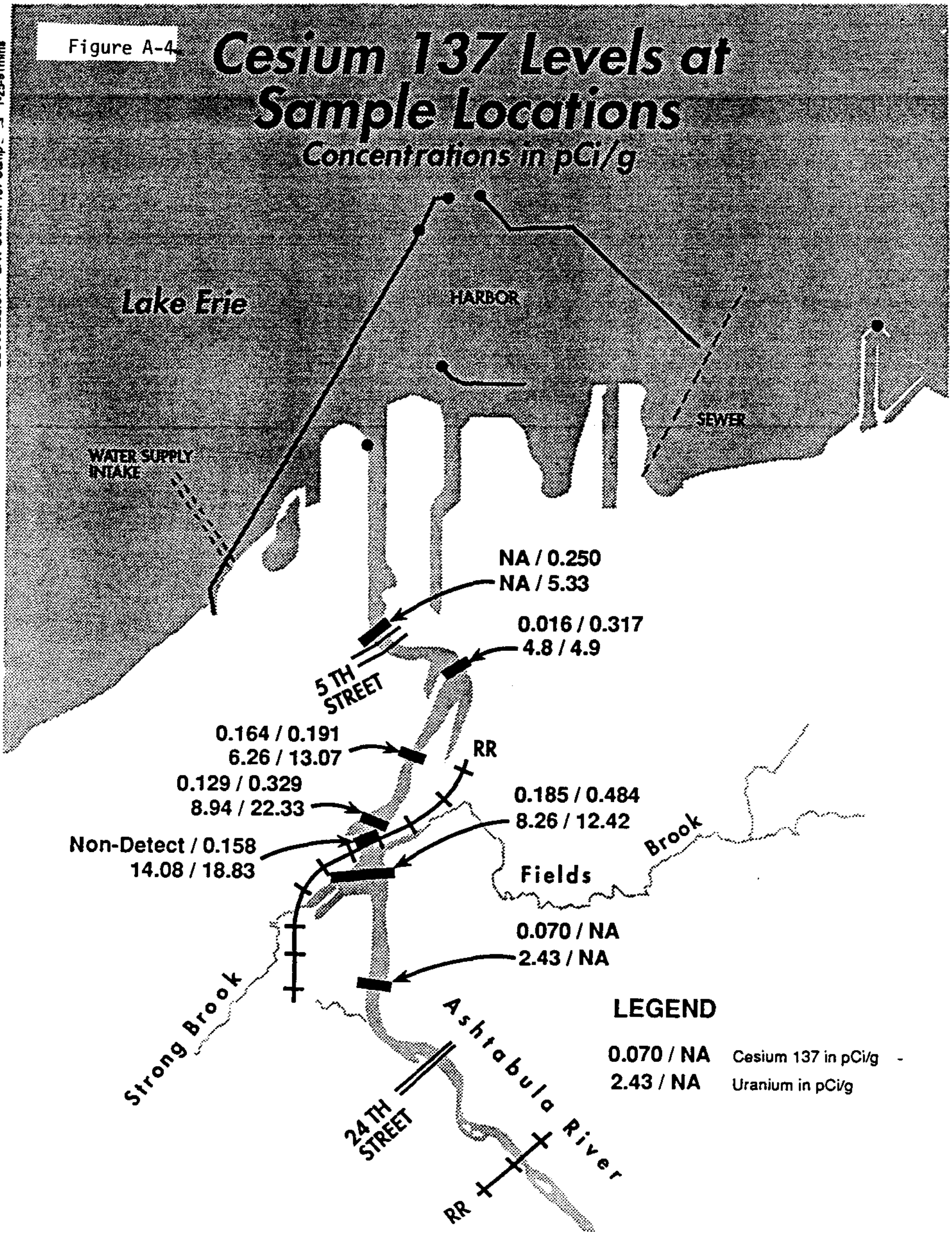
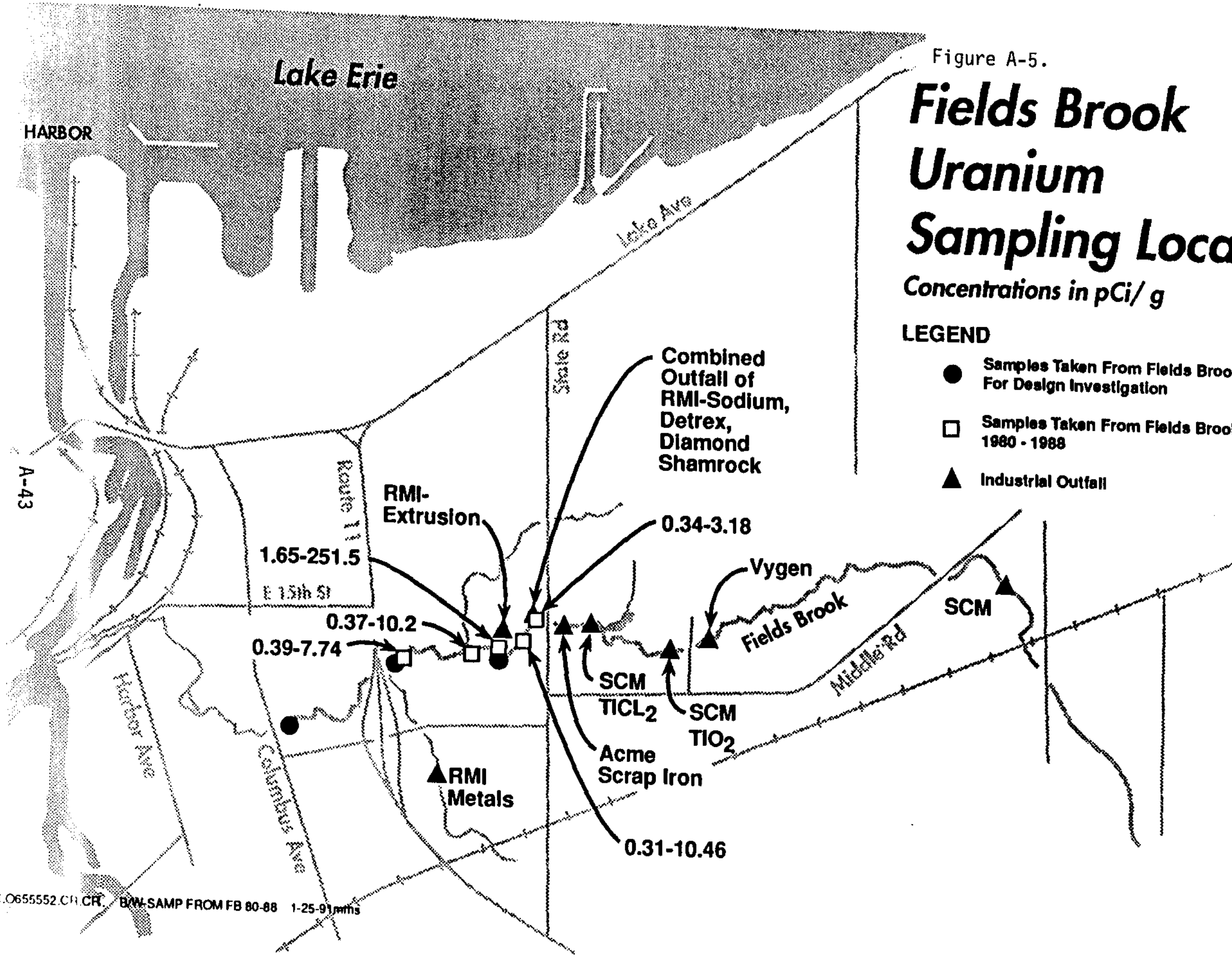


Figure A-4 Cesium 137 Levels at Sample Locations
Concentrations in pCi/g

Figure A-5.

Fields Brook Uranium Sampling Locations

Concentrations in pCi/ g



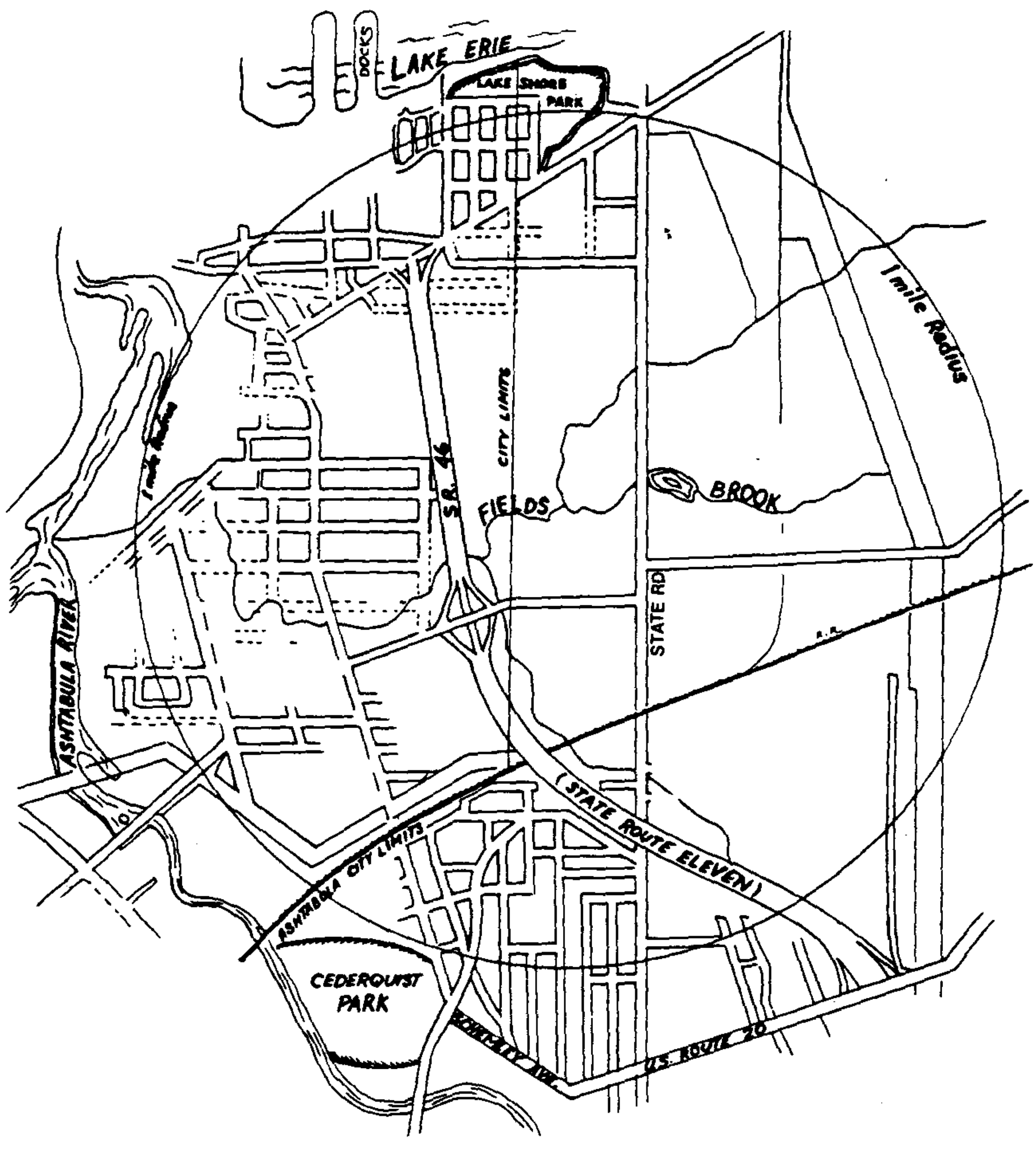


Figure A-6. Map of Ohio Department of Health Cancer Surveillance study area.