MAUMEE RIVER BASIN
AREA OF CONCERN
REMEDIAL ACTION PLAN

Volume 1

Investigation Report

Maumee River
REMEDIAL ACTION PLAN

Toledo Metropolitan Area
Council of Governments
123 N. Michigan Ave
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October, 1988

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LOWER MAUMEE RIVER

REMEDIAL ACTION PLAN

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PREFACE

INVESTIGATION REPORT

The *Investigation Report* on the Lower Maumee River Basin is the supporting documentation that identifies the environmental problems and the water and related uses that are impaired as a result of the problems. It also identifies the known sources of the pollutants. This document is Volume I, the first of two phases in the development of the Remedial Action Plan (RAP).

The Maumee Basin AOC addressed in this document, has been identified as the area extending along the Maumee River from the Bowling Green water intake to the Maumee Bay, including the entire bay and nearshore waters from the Michigan state line to Crane Creek State Park in Ohio. The area includes direct drainage into these waters that are within Lucas, Ottawa and Wood Counties. This includes Swan Creek, Ottawa River (Ten Mile Creek), Duck Creek, Otter Creek, Cedar Creek, Grassy Creek, and Crane Creek. Figure 1 is a map of the area.

The AOC is an area of water quality impacts. In some cases, however, the sources of these impacts are outside of the Lower Maumee River boundaries. This is particularly true of the agricultural sources. Therefore, implementation of the RAP must not be limited to the AOC's boundaries, if significant water quality improvements are to be achieved. The focus of this document is on the Lower Maumee River Basin.

First, this report discusses existing water uses and includes current water quality and sediment quality data. It also describes intensive or short-term monitoring surveys which have occurred in the RAP area along with an analysis of the water quality and sediment quality data.

Secondly, this report describes ten different water pollution sources within the RAP area and the impacts of each of these sources. These include phosphorus sources, NPDES wastewater discharge permits for industrial and municipal sectors, package treatment plants, agricultural runoff, open water disposal of dredged materials, urban stormwater, home sewage disposal, active and closed landfills/dumpsites and pits, ponds and lagoons, and atmospheric deposition related to acid rain.

Lastly, key tables and maps are included with this document to assist the reader in reviewing the information. A glossary is included which defines various terms and agencies found within this document. The appendices have been printed as a separate document and are available upon request to TMACOG.

More than a hundred persons have had input into the preparation of this first phase work. The 74 member Remedial Action Plan Advisory Committee subdivided itself into six major subcommittees, bringing other persons into the process. These subcommittees included: Water Quality and Water Uses, Dredge Disposal, Agricultural Runoff, Home Sewage Disposal, Landfills and Dumps, and Public and Industrial Dischargers.

TMACOG assumes responsibility for the accuracy of this Investigation Report. Therefore, any errors or omissions should be directed to TMACOG.

Lower Maumee Basin

Remedial Action Plan

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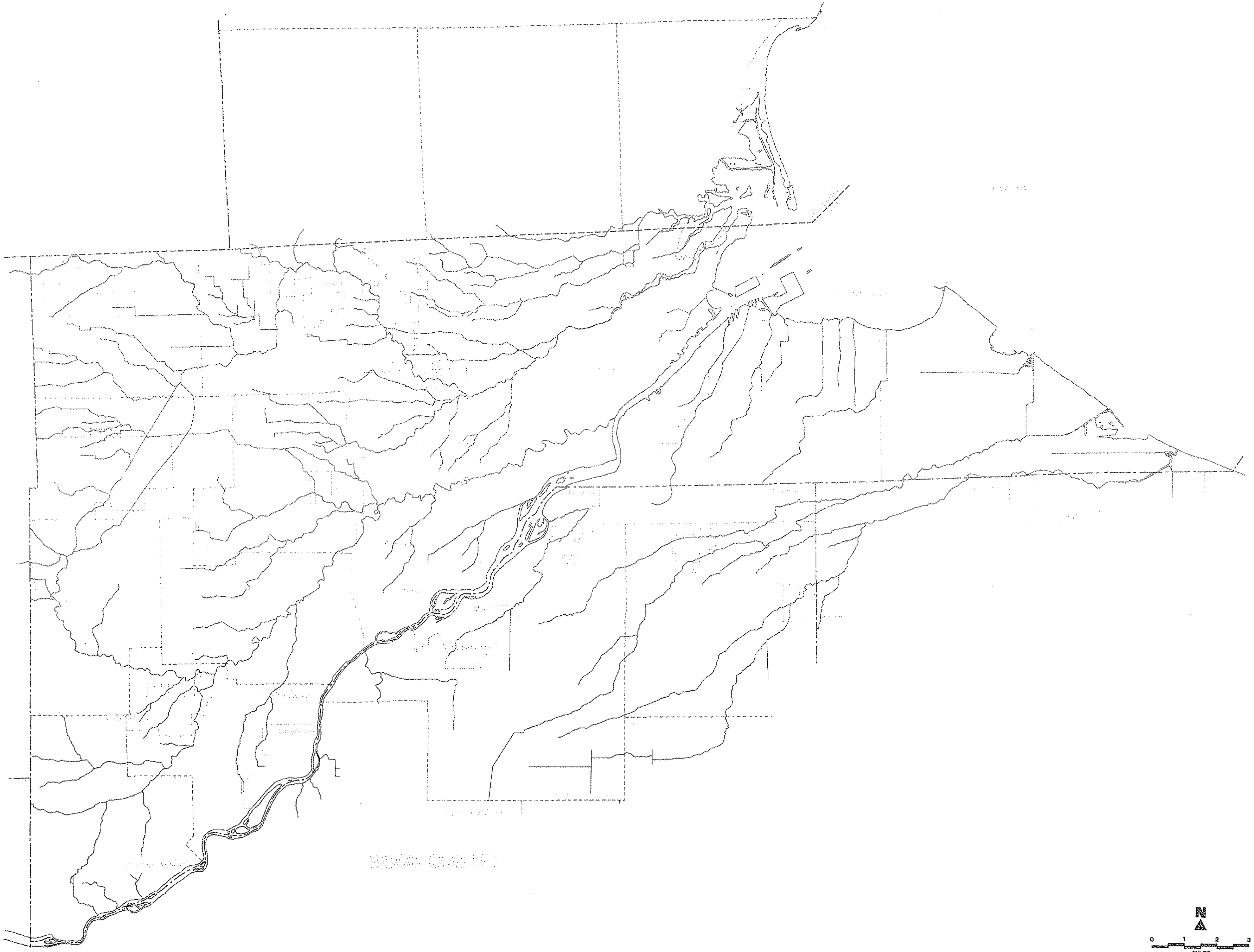

LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

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INTRODUCTION

The Lower Maumee River Area of Concern has a wide variety of pollution problems. Although there have been dramatic water quality improvements over the past decade, serious problems still exist that affect not only water quality itself, but also the area's fish, wildlife, wetlands and public uses. These problems are being caused by excess sediments, nutrients and toxics entering the system. The result has been the need to issue fish consumption advisories, curtailment of body contact water use, and increased stress for endangered species.

An Area of Concern (AOC) is an area recognized by the International Joint Commission where water uses are impaired or where objectives of the Great Lakes Water Quality Agreement or local environmental standards are not being achieved. Heavy metals and organic chemical contamination has led to the Lower Maumee River being classified as an Area of Concern.[1]

The Lower Maumee River AOC is one of 42 areas identified in the Great Lakes basin. In 1985, independent state members of the International Joint Commission's (IJC) Water Quality Board, identified four AOCs in Ohio: Ashtabula, Cuyahoga, Black and Maumee. Ohio EPA is the lead agency for the effort in Ohio. Such identification requires that Remedial Action Plans (RAP) be prepared for each of the AOCs, by the responsible jurisdictions. The RAP is an agreement between federal, state and local governments with the support of area citizens to restore the water quality and beneficial uses.

The requirement to develop RAPs also became a part of the Great Lakes Water Quality Agreement of 1987.[2] This agreement was signed in Toledo at the 1987 Biennial meeting of the IJC. It was determined at this time that RAPs should also include commitments to the IJC for implementation of the Great Lakes Water Quality Agreement of 1987.

The Maumee River contributes the largest tributary load of suspended sediments and phosphorus to Lake Erie. The major source is agricultural runoff upstream from the AOC. Phosphorus is considered the critical nutrient contributing to the cultural eutrophication of Lake Erie.

Sediment is the most prevalent nonpoint pollutant by volume and is a result of soil erosion. The problem stems from the predominance of agricultural land use, the extensive use of row crop agricultural systems, and the soil characteristics of the Maumee River basin. In spite of a low per acre erosion rate, the 1.2 million metric tons annually cause a significant water quality problem.

Nitrogen is an essential plant nutrient that is applied to cropland as a fertilizer. Nitrates are soluble and are carried to waterways with the runoff water, rather than with the sediment. Field tile effluent often carries nitrates to waterways. Nitrate concentrations have exceeded standards on the Maumee River, causing both Waterville and Bowling Green to have drinking water alerts during the spring and early summer.

The Maumee River is classified as either moderately or heavily polluted for heavy metals from a point at Rossford to the Maumee Bay, with the highest concentrations of most metals in the sediment found at or slightly above the mouth near Toledo's Wastewater Treatment Plant to River Mile 2 (vicinity of Norfolk Southern Railroad Bridge). Metals of concern include: chromium, copper, lead, nickel, zinc, manganese and arsenic.

Aquatic life use attainment for the Maumee River becomes non-attainment at Rossford (RM 9.4) and persists all the way into Maumee Bay. Arsenic seems to be the most significant industrial problem at RM 7.4. The combined sewer overflows begin at River Mile 4.7 (area of Portside) and become a real problem after the confluence with Swan Creek.

Below the Martin Luther King Bridge the Dissolved Oxygen is very low (fish cannot live without adequate DO values) and continues to the mouth. Ammonia and nitrites are elevated starting at the Norfolk Southern Railroad Bridge. Zinc is elevated above the mouth.

Documented investigation of fish species for the Maumee River show a 50% decline since 1981. Fish community composite and quality values drop 2 points from the Grand Rapids dam to the mouth. It is thought that the upstream movement of the Toledo WWTP plume and the numerous combined sewer overflow discharges are the cause of the low community values. From the Toledo WWTP into the Maumee Bay area of the Toledo Edison intake channel are displayed the lowest fish community values.

Then, too, are the categories of toxic pollutants of concern including poly-nuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and phthalates. These toxic chemicals, as well as the heavy metals, are known to biomagnify, bioaccumulate, or are suspected of causing cancer and are acutely toxic to aquatic organisms.

PAHs and phthalates have been found at detectable levels in the Maumee shipping channel. Studies of Toledo Harbor sediments that have been available for review have not shown sediment bound pesticides at levels high enough to arouse concern. Dioxins and furans, however, have not been studied. The PAH concentrations are at the lower end of the range of values for sites with cancer epizootics, pose a possible problem and must be of concern.

Bottom dwelling organisms avoid or cannot exist in areas which are highly contaminated with toxic compounds. They may however survive in areas where low levels of toxicants are found. This means that they are constantly exposed to these contaminants throughout their life spans. After accumulating toxicants, these organisms, if eaten, are the starting point for toxicants to move up the food chain to fish, then onto fish-eating birds and/or humans where they can accumulate.

Impacting water quality on the Ottawa River are the wall-to-wall dumps once sited in the floodplains which leak solvents, conventional pollutants and organic priority pollutants. The Dura Dump leachate, for example, contains high BOD, COD and organics, among which include PCBs. The City of Toledo has posted the area advising persons to avoid contact with the water, sediments and fish.

The degradation of Otter Creek is directly related to arsenic leaking from settling ponds created over thirty years ago. This creek has been a known "industrial sewer" for over twenty years, with oil soaked banks, and nickel and cyanide being detected in its waters. Swan Creek has poor water quality from its mouth to four miles upstream. Heavy metals, with the heaviest impact between Hawley Street and Collingwood Blvd., have helped to cause a 50% decline of fish species since 1981.

MAUMEE BASIN: DESCRIPTION AND USES

STREAM SEGMENTS OF THE MAUMEE RAP AREA

The Maumee and its tributaries are divided into a number of segments, according to their drainage areas. Each stream segment is classified as being a part of a major drainage basin. In the Maumee RAP Area, the basin is generally the Maumee River. A few streams in the RAP Area actually flow directly into the Maumee Bay/Lake Erie and are not tributary to the Maumee River. Within each basin, stream segments may be classified as part of a sub-basin. Each segment drains one or more watersheds.

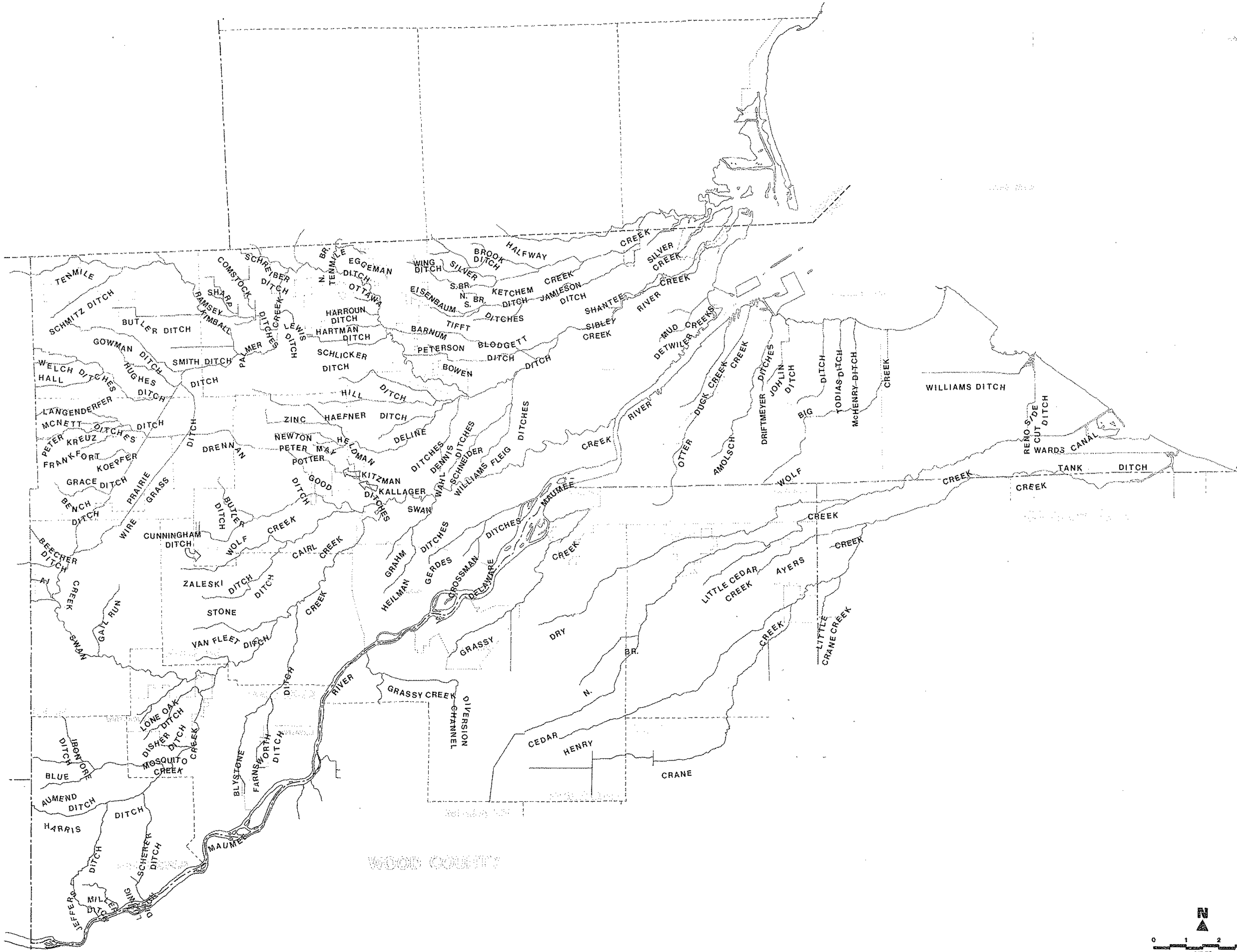
There are three systems in use for classifying watersheds. These are:

> Ohio EPA uses the *Planning and Engineering Data Management System for Ohio* (PEMSO) system. Each stream segment has a unique PEMSO number.
>
> TMACOG uses smaller watersheds, which are generally a subset of the PEMSO watersheds.
>
> The third system is *Land Resources Information System* (LRIS), developed for the 208 program, and further defined for the Lake Erie Wastewater Management Study (LEWMS).[3] LRIS watersheds are usually, but not always, the same as TMACOG's.

Stream segments are also categorized by their uses. They are assigned aquatic life use designations by the Ohio EPA, and each stream's water quality standards are based on its' use designations. All of the Maumee RAP Area streams are classified Warmwater Habitat (WWH), Agricultural and Industrial Water Supply, and Primary Contact Recreation (PCR). Any portions of the AOC that are within 500 yards of an existing public water supply intake are designated Public Water Supply.

A listing of RAP Area stream segments and their classifications is given in Table 1. The stream reaches are shown in Figure 2.

FIGURE 2: RAP AREA STREAM SEGMENTS



LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

TABLE 1
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUB-BASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Ai Creek BASIN: Maumee SUB-BASIN: Swan NOTES: Swan Creek, West Fork	TMACOG: 007 LRIS: 007 PEMSO: 410102 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	9.10
Ayres Creek BASIN: Lake Erie SUB-BASIN: Crane Creek NOTES:	TMACOG: 033 LRIS: 033 PEMSO: 1610302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	0.60
Blue Creek BASIN: Maumee SUB-BASIN: Swan NOTES:	TMACOG: 038,040 LRIS: 038,040 PEMSO: 410103 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	11.90
Cairl Creek BASIN: Maumee SUB-BASIN: Swan/Wolf NOTES:	TMACOG: 042 LRIS: 042 PEMSO: 410132 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	7.40
Cedar Creek BASIN: Lake Erie SUB-BASIN: Cedar NOTES:	TMACOG: 032 LRIS: 032 PEMSO: 1610303 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	8.50
Crane Creek BASIN: Lake Erie SUB-BASIN: Crane NOTES:	TMACOG: 033 LRIS: 033 PEMSO: 1610302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	12.70
Delaware Creek BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 013 LRIS: 013 PEMSO: 410133 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	2.50
Dry Creek BASIN: Lake Erie SUB-BASIN: Cedar Creek NOTES:	TMACOG: 032 LRIS: 032 PEMSO: 1610303 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	11.50
Duck Creek BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 015 LRIS: 015 PEMSO: 410133 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	3.00
Gail Run BASIN: Maumee SUB-BASIN: Swan NOTES:	TMACOG: 008 LRIS: 008 PEMSO: 410101 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	4.70
Grassy Creek BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 046,045 LRIS: 046,045 PEMSO: 410133 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	2.50
Halfway Creek BASIN: Maumee SUB-BASIN: North Maumee Bay NOTES:	TMACOG: 025,022,021 LRIS: 025,022,021 PEMSO: 410302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	3.50
Harris Ditch BASIN: Maumee SUB-BASIN: Swan/Blue NOTES: Swan Creek, South Fork	TMACOG: 075 LRIS: 075 PEMSO: 410103 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	5.60

TABLE 1, CONTINUED
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUB-BASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Henry Creek BASIN: Lake Erie SUB-BASIN: Crane Creek NOTES:	TMACOG: 033 LRIS: 033 PEMSO: 1610302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	9.00
Hill Ditch BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 202 LRIS: 202 PEMSO: 411331 STATE RESOURCE? No	HABITAT: WATER SUPPLY: RECREATIONAL: RAP? Yes	0.00
Lake Erie Watershed #1 BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 030 LRIS: 030 PEMSO: 411133 STATE RESOURCE? No	HABITAT: WATER SUPPLY: RECREATIONAL: RAP? Yes	0.00
Lake Erie Watershed #2 BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 031 LRIS: 031 PEMSO: 411364 STATE RESOURCE? No	HABITAT: WATER SUPPLY: RECREATIONAL: RAP? Yes	0.00
Lake Erie Watershed #3 BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 034 LRIS: 034 PEMSO: 411363 STATE RESOURCE? No	HABITAT: WATER SUPPLY: RECREATIONAL: RAP? Yes	0.00
Little Cedar Creek BASIN: Lake Erie SUB-BASIN: Cedar Creek NOTES:	TMACOG: 032 LRIS: 032 PEMSO: 1610303 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	2.50
Little Crane Creek BASIN: Lake Erie SUB-BASIN: Crane Creek NOTES:	TMACOG: 033 LRIS: 033 PEMSO: 1610302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	3.50
Maumee River, Mouth-Perrysburg BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 013,014,015,047 LRIS: 013,014,015,047 PEMSO: 410133 STATE RESOURCE? Yes	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	6.90
Maumee River, Perrysburg-Waterville BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 079, 044 LRIS: 079, 044 PEMSO: 410133 STATE RESOURCE: Yes	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	
Maumee River, Waterville-BG Water Intake BASIN: Maumee SUB-BASIN: Maumee River NOTES:	TMACOG: 078, 043 LRIS: 043 PEMSO: 410235 STATE RESOURCE? Yes	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	3.50
Mosquito Creek BASIN: Maumee SUB-BASIN: Swan/Blue NOTES:	TMACOG: 040 LRIS: 040 PEMSO: 410103 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	0.80
Ottawa River at Toledo (Berdan to UT) BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 005 LRIS: 005 PEMSO: 411331 STATE RESOURCE? Yes	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	3.50
Ottawa River at Toledo (Mouth to Berdan) BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 005 LRIS: 005 PEMSO: 411331 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	7.40

TABLE 1, CONTINUED
RAP AREA STREAM SEGMENTS AND USE DESIGNATIONS

STREAM, BASIN, AND SUB-BASIN	WATERSHED NUMBERS	STREAM SEGMENT USES	LENGTH (Miles)
Ottawa River at Toledo (UT to North Branch) BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 005,004 LRIS: 005,004 PEMSO: 411331 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	0.00
Otter Creek BASIN: Maumee SUB-BASIN: Maumee Bay NOTES:	TMACOG: 028 LRIS: 028 PEMSO: 1610364 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	6.00
Prairie Ditch BASIN: Maumee SUB-BASIN: Ottawa River NOTES:	TMACOG: 002 LRIS: 002 PEMSO: 410301 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	5.90
Reitz Road Ditch BASIN: Maumee SUB-BASIN: NOTES:	TMACOG: 078 LRIS: 078 PEMSO: 411235 STATE RESOURCE? No	HABITAT: WATER SUPPLY: RECREATIONAL: RAP? Yes	0.00
Shantee Creek BASIN: Maumee SUB-BASIN: North Maumee Bay NOTES:	TMACOG: 020 LRIS: 020 PEMSO: 410302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	4.60
Sibley Creek BASIN: Maumee SUB-BASIN: Ottawa NOTES:	TMACOG: 005 LRIS: 005 PEMSO: 411331 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	5.20
Silver Creek BASIN: Maumee SUB-BASIN: North Maumee Bay NOTES:	TMACOG: 023 LRIS: 023 PEMSO: 410302 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	7.30
Swan Creek (Mouth to Blue Creek) BASIN: Maumee SUB-BASIN: Swan Creek NOTES:	TMACOG: 012,010,041 LRIS: 012,010,041 PEMSO: 410132 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	22.20
Swan Creek above Ai Creek BASIN: Maumee SUB-BASIN: Swan Creek NOTES:	TMACOG: 008 LRIS: 008 PEMSO: 410101 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	7.93
Swan Creek above Blue Creek BASIN: Maumee SUB-BASIN: Swan Creek NOTES:	TMACOG: 039 LRIS: 039 PEMSO: 410131 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	8.40
Tenmile Creek above North Branch BASIN: Maumee SUB-BASIN: Ottawa River NOTES:	TMACOG: 001,003 LRIS: 001,003 PEMSO: 410301 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	34.80
Tenmile Creek, North Branch BASIN: Maumee SUB-BASIN: Ottawa River NOTES:	TMACOG: 006 LRIS: 006 PEMSO: 410301 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	6.50
Wolf Creek BASIN: Maumee SUB-BASIN: Swan NOTES:	TMACOG: 011 LRIS: 011 PEMSO: 410132 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	7.00
Wolf Creek BASIN: Maumee SUB-BASIN: Maumee Bay NOTES:	TMACOG: 029 LRIS: 029 PEMSO: 1610364 STATE RESOURCE? No	HABITAT: WWH WATER SUPPLY: AI RECREATIONAL: PCR RAP? Yes	2.80

EXISTING WATER USES

PUBLIC WATER SUPPLY

One of the surface water uses in the Lower Maumee River AOC is water supply. The primary use is for public water supply. Several industries use surface waters for industrial water supply as well.

As far as public water supply is concerned, two surface water bodies in the AOC are the sources of four public water supply systems. The Maumee River is the public water source for both the City of Bowling Green and the Village of Waterville. Lake Erie is the source for both the City of Oregon and the City of Toledo. According to 1980 population estimates, these four systems service a combined population of just over 524,000.

Three of the four public water supply systems are located in Lucas County. Most of the county is serviced by these systems except for Jerusalem, Richfield, Harding and Providence Townships and portions of Spencer and Swanton Townships. The three lower townships of Monroe County, Michigan and the northern portion of Wood County, Ohio are also serviced by these water supply systems. The Village of Whitehouse uses ground water as its public water supply source.

Oregon

The City of Oregon obtains its water supply directly from Lake Erie. The water is pumped from the low service pumping station in Jerusalem Township to the Water Treatment Plant (WTP) where approximately 8.0 million gallons per day (mgd) are purified and softened.

After treatment, a portion of the water is stored at the water treatment plant in a 1.5 million gallon (MG) reservoir and a 1.0 MG elevated tank at Coy Road. The rest is distributed to approximately 7,000 customers and serves a total population of 25,000 in Oregon and parts of Lucas, Wood and Ottawa Counties. Specifically, Oregon supplies water to the City of Oregon, the Village of Harbor View, the Village of Genoa and a portion of the City of Northwood.

Overall, the Oregon WTP has been able to maintain good water quality. Basically, the raw lake water is softened, disinfected and clarified before it is suitable for public use.

The three major water quality problems which cause the treatment plant the most trouble are sediments, turbidity and phosphates. Sediments and turbidity are problematic in the treatment process because they must be removed from the water. Therefore, the greater the amount of suspended sediment and turbidity, the greater the effort and cost required to remove them.

Phosphates create problems for the WTP because they stimulate algae growth. Algae blooms can cause taste and odor problems in potable water. When water containing increased numbers of algal cells or their metabolic and decay products (or other organic matter) is chlorinated for disinfection purposes, increased levels of trihalomethane result.[4,5,6]

Toledo

The City of Toledo obtains its water directly from Lake Erie. The water is pumped from the low service pumping station in Jerusalem Township to the Collins Park Water Treatment Plant in East Toledo. The Collins Park WTP purifies and softens approximately 120 mgd of lake water.

The Toledo water system constitutes the largest physical plant in the region for supplying treated water. Toledo supplies water to the entire county except Jerusalem, Richfield, Harding and Providence Townships, parts of Spencer and Swanton Townships and those areas serviced by the Oregon WTP. It also supplies water to portions of northern Wood County and the lower Townships of Monroe County, Michigan. Specifically, the Cities of Toledo, Sylvania, Maumee, Perrysburg, Rossford, Luna Pier and a portion of the City of Northwood receive their water from Toledo. In addition, the Villages of Holland, Ottawa Hills and Walbridge are served by Toledo. Toledo supplies water to just under 120,000 customers and services a total population of approximately 464,000.

Overall, Collins Park WTP has been able to maintain good water quality. The lake water is softened, clarified and disinfected before it is distributed as public supply. The water quality problems that give the treatment plant the most trouble are the same as those already mentioned with regard to the Oregon WTP, sediments, turbidity and phosphates. Occasional taste and odor problems stemming from excessive algae growth have been the primary problems for the treatment plant.[4,5,6]

Waterville

The Village of Waterville obtains its water supply directly from the Maumee River. The river water is pumped to the water treatment facilities where it is softened and purified. The WTP treats about 0.8 mgd.

The treated water is distributed to approximately 1,500 customers and serves a population of approximately 5,300 in the Village of Waterville and Lucas County. Specifically, portions of Monclova and Waterville Townships are serviced by this system in addition to the Village of Waterville. The current facilities will probably not be able to meet future needs without expansion. Therefore, the system may eventually be replaced by the Toledo system.

The river water is softened, disinfected and clarified before distribution. Generally, the water quality maintained by the treatment facility has been good. However, there have been cases, usually in the spring, when Nitrate and Trihalomethane levels have exceeded drinking water standards. The water quality problems which cause the most trouble for the WTP are sediment, turbidity, phosphates, nitrates and herbicides. These problems are discussed in the following section on the City of Bowling Green WTP.[4,5,6]

Bowling Green

The Bowling Green Water System is the only public water supply system in the AOC which is located in Wood County. Approximately 90% of the public water used in Wood County is provided by surface water. Of that 90%, 80% is supplied by the Maumee River.

Bowling Green obtains its supply directly from the Maumee River. The City of Bowling Green WTP has the capacity to soften and purify 6.0 mgd.

After treatment, the water is distributed to just over 5,000 customers and serves a population of approximately 30,000 in Wood County. Specifically, the City of Bowling Green and the surrounding area of Wood County, the Villages of Haskins, Tontogany, Portage and the Miltonville area along River Road are supplied by the Bowling Green water system.

The river water is softened, disinfected and clarified before it is distributed. The Bowling Green Water System has recognized water quality problems which are related to the water quality of the Maumee River. Primarily, sediment, turbidity, phosphates, nitrates and herbicides are the most problematic.

High levels of turbidity require great efforts for removal. Turbidity units can reach very high levels in the Maumee River, especially in the spring, fall and during storm events.

Nitrates and herbicides present a difficult problem for treatment because they cannot be removed from the water with current installed treatment technologies. The best that can be done by the WTP is to dilute the water to reduce the concentrations of these substances. Therefore, there are times when the Bowling Green water supply contains high levels of nitrates and herbicides. This occurs at those times when the Maumee River has high levels of these substances which normally happens in the spring. The City is considering building a reservoir which would help dilute high nitrate water and provide greater reserve capacity in the event of a chemical spill on the river or abnormally low flow preventing the plant from pumping from the river.

Bowling Green occasionally has trouble with trihalomethanes. This usually occurs when there are increased amounts of algae present in the Maumee River. Algae cause increased amounts of organic matter in water. Chlorination of this organic matter during the disinfection process increases the formation of trihalomethane.[4,5,6]

Summary

Generally speaking, the problems experienced by each of the public water supply systems can be attributed to sediment, nutrient and phosphorus loadings to the Maumee River. Non point sources are primarily responsible for these loadings. These non point sources include agricultural runoff and urban storm-water runoff.

A summary table which outlines the various characteristics of each public water systems has been provided (Table 2). The primary source of the information for the table was a TMACOG report, *Existing Water Supply Systems in the Toledo Metropolitan Area*[5], which was prepared in June, 1983. Additional information was obtained from the Ohio Department of Natural Resource (ODNR), report, *Northwest Ohio Water Supply Plan, 1985 Edition.*[4]

TABLE 2
SUMMARY OF PUBLIC WATER SUPPLY SYSTEMS IN THE RAP AREA

Characteristics	Oregon	Toledo	Waterville	Bowling Green	TOTAL
Source of Supply	Lake Erie	Lake Erie	Maumee River	Maumee River	
Est. Pop. Served	25,000	463,940	5,255	30,000	524,195
Customers Served	6,800	118,585	1,500	5,287	132,172
Area Served	Oregon, Harbor View, Genoa, Northwood*, Wood County*, Lucas County*, Ottawa County*	Toledo, Sylvania, Holland, Perrysburg, Ottawa Hills, Maumee, Walbridge, Rossford, Northwood*, Monroe County*, Wood County*, Lucas County*	Waterville, Monclova Township*, Waterville Township*	Bowling Green, Haskins, Tontogany, Wood County*, Miltonville Area#	
Type of Treatment	Softening & Disinfection	Softening & Disinfection	Softening & Disinfection	Softening & Disinfection	
Water Quality Problems	Turbidity, Sediments & Phosphates	Turbidity, Sediments & Phosphates	Turbidity, Nitrates, Sediments & Herbicides	Turbidity, Nitrates, Sediments & Herbicides	
Treatment Process					
Coagulation/ Recarbonization	Alum, Lime, Soda Ash	(Hydraulic Mixing) Alum, Lime, Soda Ash	Alum, Lime	Ferric Chloride, Lime	
Flocculation	Slow Mechanical Mix	Slow Mechanical Mix	Slow Mechanical Mix	Slow Mechanical Mix	
Filtration	Rapid Sand Filters	Rapid Sand Filters	Rapid Sand Filters	Rapid Sand Filters	
Taste & Order Control	Activated Carbon, Chlorine Dioxide	Activated Carbon, Chlorine Dioxide	Activated Carbon, Chlorine Dioxide	Potassium Permanganate, Chlorine Dioxide, Activated Carbon	
Corrosion Control & Stabilization	Phosphate Compounds	Phosphate Compounds, Carbon Dioxide	@	Carbon Dioxide	
Fluoridation	Sodium Silicofluoride	Sodium Silicofluoride	Sodium Fluoride	Hydroflusilicic Acid	
Disinfection	Chlorine	Chlorine	Chlorine	Chlorine	

* Portions of
\# Area along River Road
@ Unspecified

Source: TMACOG Report, "Water Supply Systems in the Toledo Metropolitan Area," June, 1983.

SPORT AND COMMERCIAL FISHING

The surface waters in the Area of Concern are used for sport and commercial fishing. The primary areas for sport fishing are the Maumee River and Maumee Bay, however, sport fishing occurs throughout the Area of Concern. Commercial fishing has been limited to the Bay.

Data on sport fishing in the Maumee River are collected by the ODNR, Division of Wildlife. Spring Creel Surveys are taken periodically. A summary of these surveys from 1975 to 1987 has been provided (Table 3). The increase of walleye caught in 1987 probably reflects the good year of spawning experienced in 1982.

Walleye and white bass are the principle sport fish in the Maumee River. The spring Walleye run is an important sport fishing event which has drawn people from as far away as Alaska. Sport fishing occurs all along the Maumee River. Other fish which can be found in the Maumee include yellow perch, channel catfish, smallmouth bass, sauger and white perch.

The ODNR, Division of Wildlife does not take Creel Surveys for other streams in the AOC, therefore, it would be difficult to estimate the number of sport fish caught in this area. However, sport fishing is widespread throughout the AOC. The selection of a fishing site is only limited by the sport fisherman's experience and imagination. Limited fishing occurs in the Ottawa River and Swan Creek. Sport fishermen are commonly found at private ponds and small lakes such as Evergreen Lake in the Oak Openings Metropark.

Both sport and commercial fishing occur in the Maumee Bay. The Western Basin of Lake Erie has been considered one of the best fishing locations on Lake Erie. It has been well known for its walleye fisheries, being called the walleye capital of the world. Although the Walleye fisheries had declined in the early 1970's, they have made a comeback since 1975. The ODNR, Division of Wildlife, collects sport and commercial fishing data for Maumee Bay and Lake Erie. ODNR grids 801 and 802 are at least partially located in the Area of Concern (Figure 3). Summary data on sport boat angler hours and harvest from 1980 to 1987 has been provided (Tables 4-6). A summary of commercial harvest have also been provided (Tables 7-9). Yearly variations are largely due to the number of surveys taken in a given year.

An indication of the importance of fishing as a water use in the Area of Concern might be obtained by looking at the number of fishing related organizations. To date, 8 sportsmen organizations and 11 charter boat services have been identified and it is likely that more exist.

A public health advisory was issued in 1987 and 1988, against consumption of carp and channel catfish taken from Lake Erie, which affects Maumee Bay and the estuarine portion of the Maumee River. PCB levels have been detected in these species which frequently exceed the U.S. Food and Drug Administration's (USFDA) tolerance limit of two parts per million in the edible portions. While compliance with the advisory is voluntary for sport fishermen, USFDA has charged commercial fisheries with ensuring that fish which may enter interstate commerce fall within federal tolerance limits for contaminants.

Fish kills are investigated by the ODNR Division of Wildlife. An annual report, *Water Pollution, Fish Kill, and Stream Litter Investigations,* is published, which summarizes the fish kills for the year. In the 1987 report, Table 2 ("Wild Animal Kills Resulting from Water Pollution Incidents Investigated in 1987) notes that 2,227 fish and invertebrates were killed in Swan Creek on July 30, 1987. The suspected pollutant was sewage.

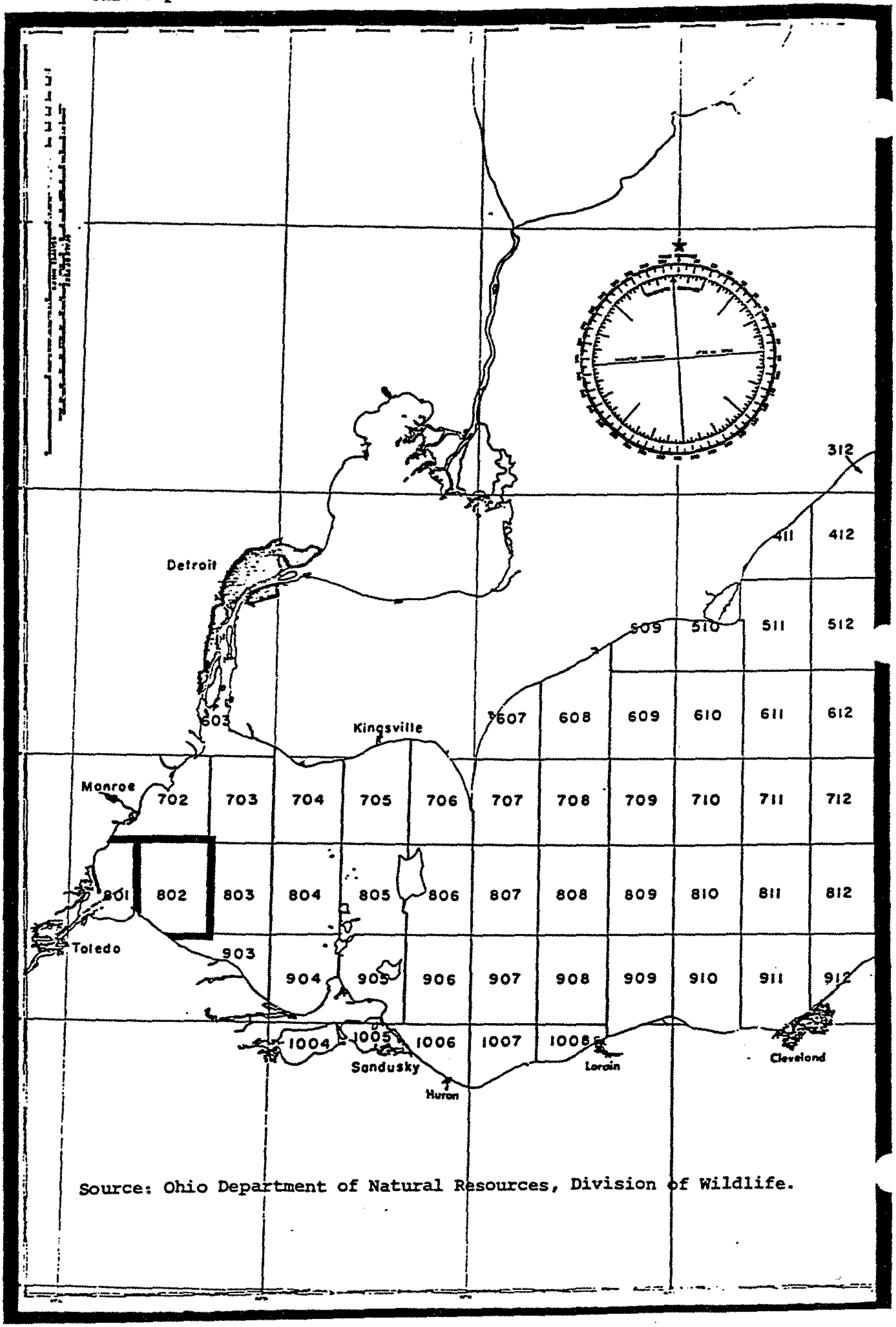
TABLE 3
SUMMARY OF ANGLER HOURS, CATCH AND CATCH RATES IN THE SPRING CREEL SURVEYS: MAUMEE RIVER FROM 1975-1987

	ANGLER HOURS			WALLEYE		WHITE BASS	
Year	Walleye*	White Bass@	TOTAL	Catch*	CPUE$	Catch@	CPUE$
1975	112,500	43,800	214,100	15,475	.14	36,731	.84
1976	36,700	81,600	186,800	5,336	.15	124,235	1.52
1977	41,600	40,800	125,700	6,163	.15	79,995	2.00
1978#	73,900	---	---	22,747	.29	---	---
1979#	184,800	---	---	33,614	.18	---	---
1980	155,800	46,700	230,800	38,442	.23	87,700	1.34
1981	161,700	93,200	298,200	21,415	.11	165,500	1.48
1982	201,400	133,100	368,900	37,300	.16	172,372	1.05
1983+	---	---	---	---	---	---	---
1984	143,200	59,900	210,100	28,899	.17	137,091	1.56
1985+	---	---	---	---	---	---	---
1986+	---	---	---	---	---	---	---
1987	247,000	56,100	339,500	69,871	.25	66,633	.75
TOTAL	1,358,600	555,200	1,974,100	279,262		870,257	

* Anglers Seeking Walleye.
@ Anglers Seeking White Bass.
# Walleye Fishery Only Surveyed.
+ No River Surveys were Conducted.
$ Catch Per Unit of Effort

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

Ohio Department of Natural Resources Wildlife Grid



Source: Ohio Department of Natural Resources, Division of Wildlife.

TABLE 4
SPORT BOAT ANGLER HOURS AND HARVEST 1980-87
GRID 801: MAUMEE BAY

Year	Angler Hours	Yellow Perch	Walleye	White Bass	Freshwater Drum	Channel Catfish	Smallmouth Bass	Other Fish	TOTAL HARVEST
1980	127,622	306,802	14,744	5,574	4,208	1,677	0	91	333,096
1981	4,313	2,702	0	4	65	71	0	124	2,966
1982	24,135	6,919	8,663	0	524	84	0	0	16,190
1983	8,524	0	3,400	0	0	0	0	0	3,400
1984	61,123	175,096	22,501	9,926	340	2,178	0	0	210,041
1985	0	0	0	0	0	0	0	0	0
1986	70,973	206,742	3,744	2,814	676	2,260	0	2,260	218,496
1987	31,788	65,157	1,132	16,489	650	2,302	0	0	85,730
TOTAL	328,478	763,418	54,184	34,807	6,463	8,572	0	2,475	869,919

TABLE 5
SPORT BOAT ANGLER HOURS AND HARVEST 1980-87
GRID 802: LAKE ERIE

Year	Angler Hours	Yellow Perch	Walleye	White Bass	Freshwater Drum	Channel Catfish	Smallmouth Bass	Other Fish	TOTAL HARVEST
1980	879,233	2,219,818	299,644	1,394	13,013	2,357	0	153	2,536,379
1981	0	0	0	0	0	0	0	0	0
1982	936,765	2,151,747	171,101	4,946	11,346	5,930	0	3,555	2,348,625
1983	214,710	248,315	28,426	43,778	1,276	1,942	0	0	323,737
1984	619,241	783,467	442,336	9,103	1,875	322	71	58	1,237,232
1985	283,056	503,427	126,506	1,472	2,392	3,658	0	2,364	639,819
1986	416,866	527,887	157,418	1,494	8,394	3,881	0	12,763	711,837
1987	331,105	341,588	148,754	8,268	4,889	2,113	0	0	505,612
TOTAL	3,680,976	6,776,249	1,374,185	70,455	43,185	20,203	71	18,893	8,303,241

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

TABLE 6
SPORT BOAT ANGLER HOURS AND HARVEST 1980-87
GRIDS 801 & 802: MAUMEE BAY AND LAKE ERIE

Year	Angler Hours	Yellow Perch	Walleye	White Bass	Freshwater Drum	Channel Catfish	Smallmouth Bass	Other Fish	TOTAL HARVEST
1980	1,006,855	2,526,620	314,388	6,968	17,221	4,034	0	244	2,869,475
1981	4,313	2,702	0	4	65	71	0	124	2,966
1982	960,900	2,158,666	179,764	4,946	11,870	6,014	0	3,555	2,364,815
1983	223,234	248,315	31,826	43,778	1,276	1,942	0	0	327,137
1984	680,364	958,563	464,837	19,029	2,215	2,500	71	58	1,447,273
1985	283,056	503,427	126,506	1,472	2,392	3,658	0	2,364	639,819
1986	487,839	734,629	161,162	4,308	9,070	6,141	0	15,023	930,333
1987	362,893	406,745	149,886	24,757	5,539	4,415	0	0	591,342
TOTAL	4,009,454	7,539,667	1,428,369	105,262	49,648	28,775	71	21,368	9,173,160

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife.

TABLE 7
COMMERCIAL HARVEST IN POUNDS 1983-86.
GRID 801: MAUMEE BAY

	1983	1984	1985	1986	TOTAL
Yellow Perch	339	11	---	---	350
Carp	107,900	106,650	83,030	53,500	351,080
White Bass	19,592	7,998	44,926	11,856	84,372
Channel Catfish	7,972	8,427	19,829	7,130	43,358
Drum	13,647	50	223	425	14,345
Bullhead	4,703	2,724	1,664	4,918	14,009
Buffalo	195	234	287	154	870
Goldfish	---	---	---	20	20
Suckers	---	30	363	180	573
Quillback	810	60	---	1,725	2,595
Gizzard Shad	---	---	2,424	---	2,424
White Perch	---	---	---	540	540
TOTAL	155,158	126,184	152,746	80,448	514,536

TABLE 8
COMMERCIAL HARVEST IN POUNDS 1983-86.
GRID 802: LAKE ERIE

	1983	1984	1985	1986	TOTAL
Yellow Perch	11,906	2,347	6,104	26,504	46,861
Carp	20,180	10,310	218,576	10,791	259,857
White Bass	124,100	204,770	205,081	72,805	606,756
Channel Catfish	6,684	10,739	15,012	6,767	39,202
Drum	31,657	12,975	18,966	22,793	86,391
Bullhead	5,112	10,177	15,195	9,904	40,388
Buffalo	3,459	5,757	7,163	4,107	20,486
Goldfish	---	414	1,011	275	1,700
Suckers	14,949	3,141	6,210	3,120	27,420
Quillback	11,395	13,041	10,904	7,691	43,031
Gizzard Shad	125	---	---	---	125
White Perch	14,755	42,208	38,019	27,993	122,975
TOTAL	244,322	315,879	542,241	192,750	1,295,192

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife

TABLE 9
COMMERCIAL HARVEST IN POUNDS 1983-86
GRIDS 801 & 802: MAUMEE BAY AND LAKE ERIE

	1983	1984	1985	1986	TOTAL
Yellow Perch	12,245	2,358	6,104	26,504	47,211
Carp	128,080	116,960	301,606	64,291	610,937
White Bass	143,692	212,768	250,007	84,661	691,128
Channel Catfish	14,656	19,166	34,841	13,897	82,560
Drum	45,304	13,025	19,189	23,218	100,736
Bullhead	9,815	12,901	16,859	14,822	54,397
Buffalo	3,654	5,991	7,450	4,261	21,356
Goldfish	0	414	1,011	295	1,720
Suckers	14,949	3,171	6,573	3,300	27,993
Quillback	12,205	13,101	10,904	9,416	45,626
Gizzard Shad	125	0	2,424	0	2,549
White Perch	14,755	42,208	38,019	28,533	123,515
TOTAL	399,480	442,063	694,987	273,198	1,809,728

Source: Unpublished data. Ohio Department of Natural Resources, Division of Wildlife

COMMERCIAL NAVIGATION

One of the most important uses of the Maumee River and Bay has been commercial navigation. The Toledo shipping channel which begins at river mile (RM) 7.0 near the I-75 bridge and extends out into the Maumee Bay to lake mile (LM) 18 is vitally important to the economic well being of the region and is the only commercial navigation route in the AOC (Figure 4). Toledo is the third largest port on the Great Lakes.[7] Its location makes it a logical turn around point for St. Lawrence Seaway traffic and it serves one of the largest rail centers in the nation.[8] Various goods are shipped to and received from domestic, Canadian and overseas locations. Summaries of domestic and Canadian and over-seas cargo shipped from the port from 1976 to 1986 have been provided (Tables 10 & 11).

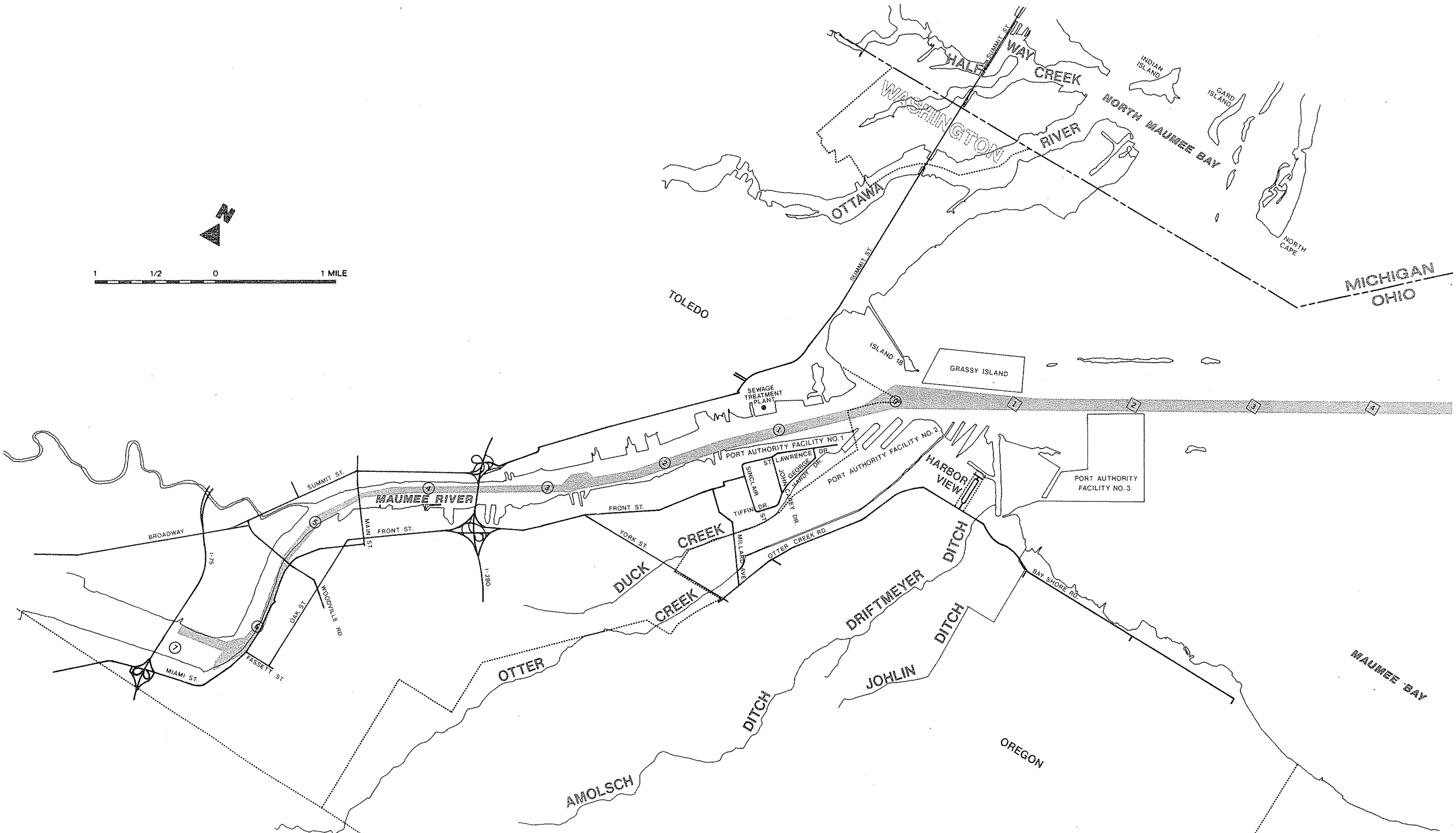
The channel is 18 miles long, 500 feet wide and 28 feet deep in the Maumee Bay. The Maumee River channel is 7 miles long, 400 feet wide and 27 feet deep.[7] Those depths are maintained by the U.S. Army Corps of Engineers (COE) through frequent channel dredging. Due to the heavy sediment loading to the Maumee River and the shallowness of the Western Lake Erie Basin (25 foot average)[7] sedimentation is the primary obstacle for navigation on the Maumee River and Bay.

The COE dredges approximately one million cubic yards of materials from the channel each year. Prior to 1975, those materials were disposed of in confined disposal facilities (CDF) or by open lake disposal. From 1975 to 1985, dredge spoils were placed in the currently active CDF, Facility #3, to protect the environment from contaminated sediments. In 1985, U.S. EPA approved of open lake disposal of materials dredged from less polluted areas of the channel if chemical analysis showed that the materials to be disposed of were similar to sediment in certain areas of the Western Basin where disposal had occurred in the past.[9]

Open lake disposal requires 401 certification from the Ohio EPA. The 1987 401 Certification stated that it is the intention of the Ohio EPA to condition future 401 certifications to eventually phase out open lake disposal. However, it is the responsibility of the City of Toledo and the Toledo-Lucas County Port Authority to develop reuse alternatives for dredged materials.

Shipping Channel in Toledo

INSERT FIGURE 4



MAUMEE RIVER SHIPPING CHANNEL

tmacog

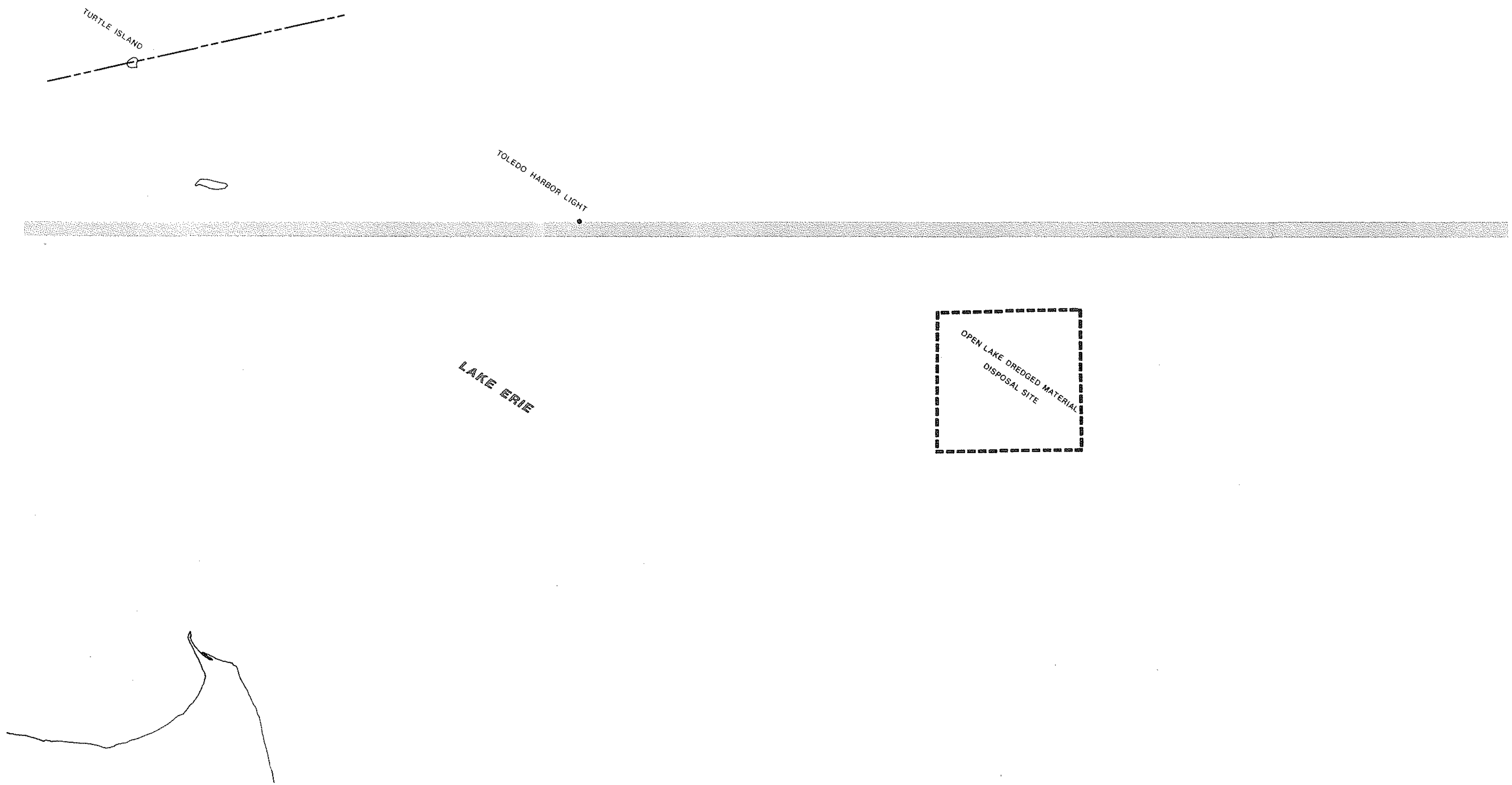

TURTLE ISLAND
TOLEDO HARBOR LIGHT
LAKE ERIE
OPEN LAKE DREDGED MATERIAL
DISPOSAL SITE

Table 10

SEAPORT STATISTICS: 1976-1986, FOR SEASON THROUGH DECEMBER 31

TOLEDO HARBOR DOMESTIC & CANADIAN CARGO (Short Tons)

Commodity	1976 Season	1977 Season	1978 Season	1979 Season	1980 Season	1981 Season
Coal	14,542,037	13,393,777	14,194,776	14,570,580	12,588,982	12,159,605
Iron Ore	4,804,137	3,541,824	5,649,765	5,331,354	2,784,646	3,956,278
Newsprint	48,024	56,324	44,307	47,923	37,900	38,820
Pig Iron	57,328	18,818	46,851	12,541	19,901	34,015
Salt	264,052	325,312	266,089	261,988	159,438	70,465
Cement	88,645	104,874	---	---	---	---
Grain	1,936,632	1,872,738	2,547,278	2,592,774	3,766,650	3,353,742
Petro.Prod.	862,398	804,733	793,179	879,412	609,794	390,143
Oth.Dry Bulk	116,609	122,100	211,677	260,231	548,089	854,121
Oth.Liq.Bulk	8,294	---	---	---	---	---
Gen. Cargo	---	---	---	---	---	---
TOTAL	22,728,156	20,240,500	23,753,922	23,956,803	20,515,400	20,857,189

Commodity	1982 Season	1983 Season	1984 Season	1985 Season	1986 Season	TOTAL
Coal	8,803,621	11,155,130	12,042,839	10,498,225	10,675,904	134,625,476
Iron Ore	2,653,474	2,889,808	3,559,609	2,940,010	3,178,676	41,289,581
Newsprint	---	---	31,434	21,050	12,880	338,662
Pig Iron	6,353	16,024	18,498	25,436	14,010	269,775
Salt	192,965	23,721	257,955	215,582	203,952	2,241,519
Cement	---	---	---	---	---	193,519
Grain	2,410,340	1,052,130	1,471,378	1,602,664	916,678	23,523,004
Petro.Prod.	339,636	575,059	384,677	420,874	206,382	6,266,287
Oth.Dry Bulk	740,966	703,250	890,556	951,027	899,262	6,297,888
Oth.Liq.Bulk	---	---	---	---	6,506	14,800
Gen. Cargo	---	---	1,259	---	---	1,259
TOTAL	15,147,355	16,415,122	18,658,205	16,674,868	16,114,250	215,061,770

Source: Toledo-Lucas County Port Authority.[10]

T. 11

SEAPORT STATISTICS: 1976-1986, FOR SEASON THROUGH DECEMBER 31

TOLEDO HARBOR OVERSEAS CARGO (Short Tons)

Commodity	1976 Season	1977 Season	1978 Season	1979 Season	1980 Season	1981 Season
Direct Grain Shipments	11,535,384	2,128,653	2,316,088	1,630,622	1,018,702	---
Dry Bulk	24,145	74,469	480,745	111,911	---	---
Fertilizer	---	---	---	---	66,966	---
Oth. Dry Bulk	---	---	---	---	149,439	---
Gen.& Misc. Cargo	494,102 (Fac.#1)	763,895 (Fac.#1)	532,416 (Fac.#1)	441,732 (Fac.#1)	181,189	---
Coal	---	---	---	---	---	---
Petrol. Prod.	---	---	1,013	---	---	---
Liquid Bulk	24,806 (Fac.#1)	30,195 (Fac.#1)	29,025 (Fac.#1)	27,385 (Fac.#1)	30,204	---
Military Cargo	---	---	---	---	---	---
TOTAL	12,078,437	2,997,212	3,359,287	2,211,650	1,446,500	

Commodity	1982 Season	1983 Season	1984 Season	1985 Season	1986 Season	TOTAL
Direct Grain Shipments	945,220	623,178	1,143,852	1,023,168	1,224,506	23,589,373
Dry Bulk	---	---	---	---	---	691,270
Fertilizer	85,435	52,808	61,062	71,678	82,519	420,468
Oth. Dry Bulk	59,153	9,769	6,208	12,761	67,495	304,825
Gen.& Misc. Cargo	135,120	248,713	285,900	226,044	300,246	3,609,357
Coal	---	---	23,659	21,959	69,663	115,281
Petrol. Prod.	---	---	---	---	---	1,013
Liquid Bulk	30,295	36,796	15,423	34,450	55,440	314,019
Military Cargo	---	---	---	---	4,673	4,673
TOTAL	1,255,223	971,264	1,536,104	1,390,060	1,804,542	29,050,279

Source: Toledo-Lucas County Port Authority.[10]

RECREATION

The use of surface waters for recreation is widespread throughout the AOC. According to state studies, Lake Erie is the number one location for water recreation in the area, as it is for the state.[11,12,13] In addition, the Maumee River and the Ottawa River are utilized for their recreational potential as well.

Water-based recreation activities play an important role in outdoor recreation in the AOC as does the aesthetic quality of the waters. Water based recreation has been divided into two categories, contact and non-contact activity. Contact activity has been defined as any water recreation activity which results in frequent or continuous body contact with the water. Such activities would include swimming, water skiing and sail boarding. Non-contact activity has been defined as any water recreation activity which does not result in coming into frequent or continuous body contact with the water. Sailing and power boating are examples of non-contact activities.

The principle water-based recreational activities in the AOC have been sailing, canoeing, power boating, fishing, swimming, sail boarding, jet skiing, waterfowl hunting, birding, and water skiing. According to the Ohio Water Quality Standards, all of the surface waters in the AOC have a primary contact use designation. Therefore, any of these water-based recreational activities could be performed on any surface water body in the area, assuming that it was large enough to handle the activity. Due to size alone, many activities have been limited to Maumee Bay and Lake Erie, the Maumee River and the Ottawa River.

The importance of the scenic value of the area's waters should not be overlooked. Two state parks and five metroparks are directly linked to the surface waters in the AOC. The state parks are located in the eastern portion of Lucas County along the shore of Maumee Bay and Lake Erie. The metroparks are located along the Maumee River, the Ottawa River and Swan Creek.

The Toledo area, based on current and projected recreation pressure, has been identified in the Lake Erie access study, ODNR, as a priority area for launch ramp projects, ODNR or public agency acquisition of boat access sites and shore based fishing projects.[12] The public has demonstrated a strong desire to use the waters in the AOC for recreation.

Natural Areas

The Maumee River watershed in the AOC provides a great diversity of vital habitats for at least one thousand species of plants and thousands of species of animal life ranging from the white tail deer to rare insects. This variety results from landforms which range from dry sand dunes to damp prairies and swamp woodlands. It is also a corridor for migrating birds. Eagle and osprey sightings occur in the area. Over 80 plants are listed as endangered or threatened species in the State of Ohio within the AOC. The future of their existence depends directly upon improvements in water and air quality in the area.

This habitat takes the form of green space which is under the stewardship of the following organizations: The Nature Conservancy, Metropark District of the Toledo Area, various municipal parks, and several divisions of the ODNR.

Significant archaeological findings have shown that the natural area has provided abundantly for human needs for at least 6,000 years.

A number of research projects by the Ohio State University and the Ohio Department of Natural Resources have shown the Maumee River to be an important spawning and nursery area for every species of game and forage fishes. Large numbers of walleye from both Lake Erie and Lake St. Clair congregate in the riffles between Perrysburg and Waterville to spawn every April. This same river section is used during May by a large spawning stock of white bass. The estuarine portion of the river is used as a spawning area by gizzard shad and freshwater drum from Lake Erie and is also an important nursery area for young white bass, gizzard shad and fresh water drum. Several studies have suggested that the Maumee River may be the single most important production area on Lake Erie for gizzard shad, which are critical forage for many commercial and sport fish species.

The decline of wetland habitat in the AOC is significant historically beginning in the late 1800s and continuing up to the present. Early accounts reported vast marshes along the Lake Erie shoreline stretching for miles inland. South of the Maumee River was a wet forest called the Great Black Swamp. Large wet prairies existed south of the river and north in west central Lucas County.

These wetland habitats served as natural storage areas for rainfall, allowing water to filter through soil maintaining the water table at a higher level than present day. Broad marshes allowed water to evaporate back into the atmosphere or to slowly flow in streams and rivers to Lake Erie. The affects of precipitation were moderated because water spread out over a large area of wet prairies, swamp forest and marshes.

With settlement came clearing and draining of wetlands. The underlying soil was criss-crossed with drain tiles and ditches which carried the runoff to streams and rivers. With the introduction of agriculture into the area excess water needed to be quickly drained away to streams to prevent flooded crops in fields.

The natural area has been drastically altered by agriculture and development. Removal of trees and draining and filling of wetlands have reduced the time water is allowed to remain in an area.

The effect is that more water enters streams at a faster rate carrying with it sediment. Frequent downstream flooding and increased erosion can be expected with further development. The brownish color of water in the rivers and streams of the AOC is caused by fine soil particles in suspension, resulting from erosion from agricultural run-off and developmental storm drainage sewers.

The value of preserving plants and natural areas in general, is both for what we know about them and for what we may learn from them in future years. Natural areas and resources have historically provided for basic human needs and life itself.

Lake Erie and Maumee Bay

Water-based recreational activities on Maumee Bay and Lake Erie consist of sailing, power boating, fishing, swimming, sail boarding, jet skiing and water skiing. The primary water quality problems have been sediment and nutrient loading which increase turbidity and algae growth. Boating and fishing are probably the most important recreational activities occurring on the Lake and Bay.

Maumee Bay State Park is located along the south shore of Maumee Bay adjacent to the City of Oregon. Camping and hiking are the principle activities at the park at this time. Shoreline fishing is another recreation activity which occurs at the park. There are plans to create a beach at the park which would facilitate swimming and related activities, although some concern over the water quality in the Bay has been expressed. The problem of suspended sediments has been the primary concern.

Crane Creek State Park is located at the extreme eastern corner of Lucas County and marks the eastern most limit of the AOC. The primary recreational activities at Crane Creek State Park are swimming, boating and related activities. Activities at the park are centered around the beach. The adjacent bird trail at Magee Marsh annually attracts thousands of visitors from many states.

Maumee River

Water-based recreational activities on the Maumee River are the same as those on the Bay and include canoeing. Certain stream segments are more appropriate for one activity than another. As described under sport and commercial fishing, fishing on the River normally occurs upstream from the Maumee-Perrysburg Bridge. Sailing and power boating occur from Perrysburg to the mouth of the Maumee River, as do the other water-based activities. Canoeing is popular both upstream and downstream from the Maumee-Perrysburg Bridge, with the up stream area being the most important. The lower portion of the River (RM 7) including areas just below RM 5, at the Swan Creek confluence near Portside, is considered polluted. This also happens to be one of the areas most impacted by combined sewer overflows (CSO). Despite the pollution, people swim, ski and sail board in this area.

The Maumee River, upstream from the Maumee-Perrysburg Bridge, is a State Resource Water because ODNR designated it as a scenic river. The Side Cut Metropark is located in this stream segment along the banks of the Maumee River south of the City of Maumee. The principle activities at the park include canoeing, wildlife observation, hiking and fishing. Blue Grass Island can be reached from the park which is an area often used for nature exploration and is world famous for Walleye fishing. The park is also an important source of historical information on the Maumee River and its impact on the development of the region.

Farnsworth Metropark is also located in this stream segment southwest of the Village of Waterville. Farnsworth is an important area for canoeing, wildlife watching and summer shore bird watching. The area around Farnsworth is important for duck hunting.

Ottawa River

Like the Maumee River, the Ottawa River is important for non-contact recreation such as sailing and power boating. Boating is mostly restricted to the area down stream from Suder Avenue due to the difficulty of getting large boats past that point. Smaller boats can make it upstream as far as Stickney Avenue and just beyond. The primary boating lanes are down stream from Suder Avenue to the Bay. The Ottawa River was one of the most important water skiing areas in the region, however, water skiing and other contact activities no longer occur to any large extent due to severe water pollution. The City of Toledo has posted the area near the Dura Landfill advising persons to avoid contact with the water, sediment and fish.

Farther up stream, the Ottawa River flows through the Wildwood Preserve Metropark north of the Village of Ottawa Hills. The major activities at the park include wildlife observation and hiking. The park also serves as an important wildlife corridor for animals such as deer.

Swan Creek

Due to water pollution problems and the physical characteristics of Swan Creek, contact and non contact recreational use of Swan Creek is uncommon. The upper reaches of Swan Creek however do have important aesthetic values. The Swan Creek Preserve Metropark is located in the western portion of the City of Toledo in a rapidly developing urban area. Swan Creek flows through this park and is its primary natural feature. The park is an important resource for the area not only because of its location, but also because it is probably the best example of flood plain habitat in the region.

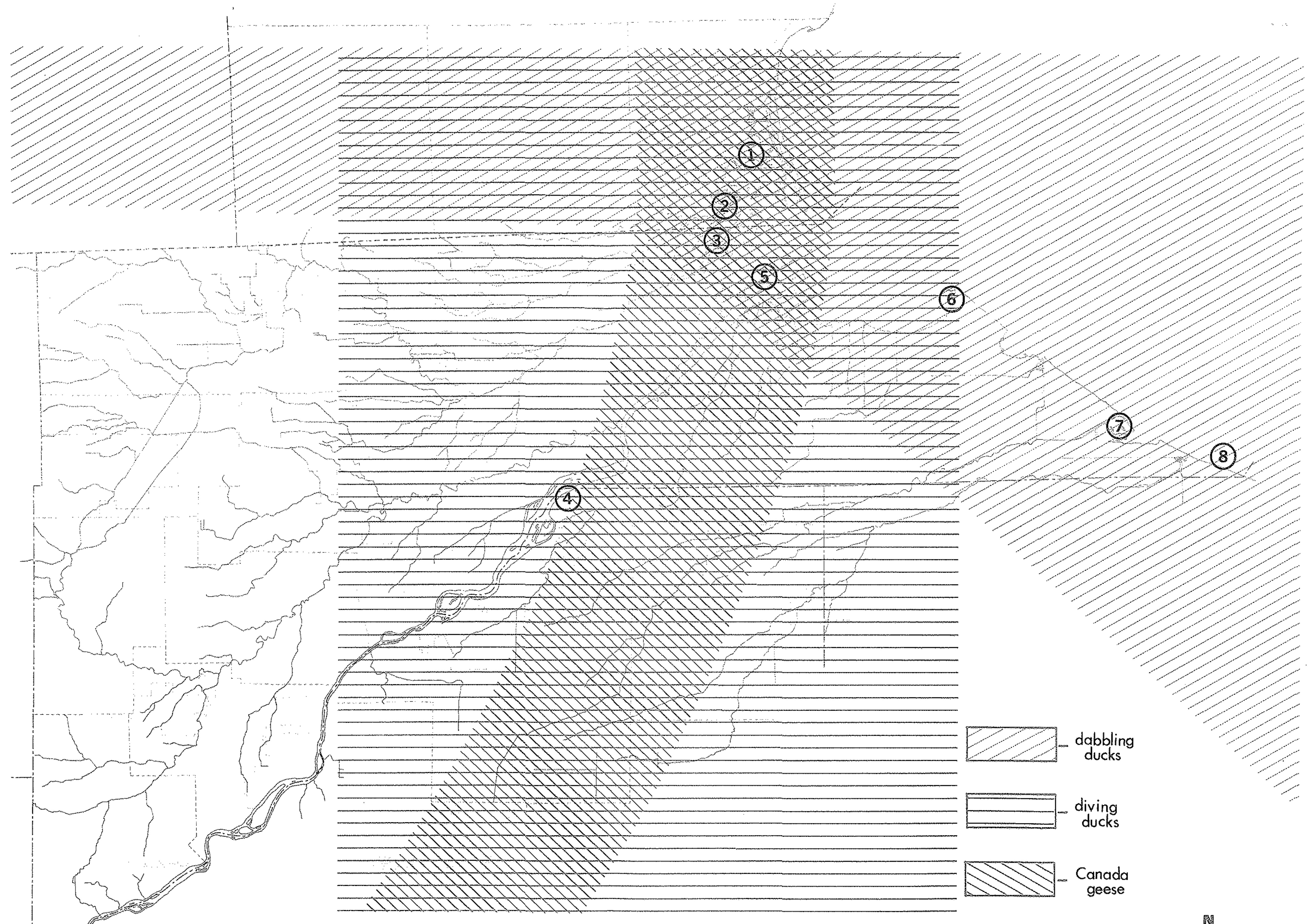
Swan Creek also flows through the Oak Openings Preserve Metropark in western Lucas

Coastal and Estuarine Marshes

The Maumee Bay lies at the mouth of the Maumee River and is formed by Little Cedar Point on the east and Woodtick Peninsula on the west. These two sand spits provide the shelter necessary for wetland development on their landward side. The former lies within the Cedar Point National Wildlife Refuge (administered as part of the Ottawa National Wildlife Refuge) and the latter lies partially within the Erie State Game Area (administered by the Michigan Department of National Resources). The Cedar Point marshes extend westward along the south shore of the bay to Maumee Bay State Park. Estuarine wetlands also occur along the Maumee River valley, between Rossford and the first bedrock riffles at Perrysburg, and in the lower reaches of the Ottawa River.[14]

The marshes in the bay are protected by dikes and are managed for waterfowl. The estuarine wetlands are more undisturbed wherein the water level is not controlled. At one time the Ohio shoreline of western Lake Erie in its natural state was generally a marsh area fronted by low barrier beaches. Today there are some 23 square miles of coastal and estuarine marshes remaining which are depicted in Figure 5. These eight areas as numbered on the map are described in Table 12.[14]

FIGURE 5
COASTAL MARSHES AND MIGRATION FLYWAYS



MAJOR FLYWAYS AND COASTAL & ESTUARINE MARSHES

LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

TABLE 12
COASTAL AND ESTUARINE MARSHES

Map No.	Name	Ownership	Size	Water Level Control
1	Woodtick Peninsula Marsh	SC/PM	L	Diked/Uncontrolled
2	North Maumee Bay Marsh	C/PM	L	Diked/Uncontrolled
3	Ottawa River Estuary	PM	S	Uncontrolled
4	Maumee River Estuary	PM	L	Uncontrolled
5	Toledo Harbor Wetlands (spoil area)	F/M PS	S	Diked
6	Cedar Point Marsh	F	L	Diked
7	Metzger Marsh	S	S	Diked
8	Ottawa Marsh	F	L	Diked

SC - Shooting Club
PM - Private, multiple owners
F/M - Federal/Municipal
F - Federal
S - State
PS - Private, single owner
L - Over 1,235.5 Acres (500 ha)
S - Under 1,235.5 Acres (500 ha)

Adapted from Appendix B, *The Ecology of the Coastal Marshes of Western Lake Erie: a Community Profile*, Biological Report 85(7.9), February 1987.

The major plant species thriving in the Maumee Bay marshes include narrow-leaf cattail, broad-leaved cattail, jewelweeds, swamp rosemallow, blue-joint grass and swamp milkweed. In the transition zone between open water and the cattail stands, soft-stem bulrush and three-square bulrush are the dominant species.[14]

Fish found in the Maumee Bay wetlands include: bowfin, carp, yellow perch, largemouth bass, white bass, green sunfish, yellow bullhead, gizzard shad and walleye.[14]

The most common waterfowl are mallard, black duck, green-winged teal, blue-winged teal, northern shoveler, and American coot. Tundra swans and snow geese also utilize the area for resting during spring migration. The historical occurrence of the rare Foster's tern has been reported for these wetlands (Campbell and Trautman 1936). A bald eagle nest is active on Little Cedar Point.[14]

These wetlands are also a part of two major flyways, the Atlantic and the Mississippi (see figure 5). Western Lake Erie marshes attract large numbers of migratory waterfowl, causing a crossing point of these two flyways, as shown on Figure 5. Basically, there are four distinctive flyways identified for North America. Each flyway has its own individual population of birds making the semiannual flights between breeding grounds and wintering grounds.[14]

Canada geese and diving ducks, including canvasbacks, redheads and scaup, come from

Canada geese and diving ducks, including canvasbacks, redheads and scaup, come from their breeding grounds on the great northern plains of central Canada on the Atlantic flyway to winter over in the Chesapeake and Delaware Bays. The dabbling ducks such as mallards, black ducks and bluewinged teals that have gathered in southern Ontario during the fall, cross western Lake Erie and proceed southwest to the Mississippi delta and the Gulf of Mexico coasts.[14]

Coastal marshes and stream mouths commonly attract migrating dabbling ducks, with the diving ducks concentrating on the open water shorelines. Canada geese and mallards also feed heavily on waste grains in agricultural fields.[14]

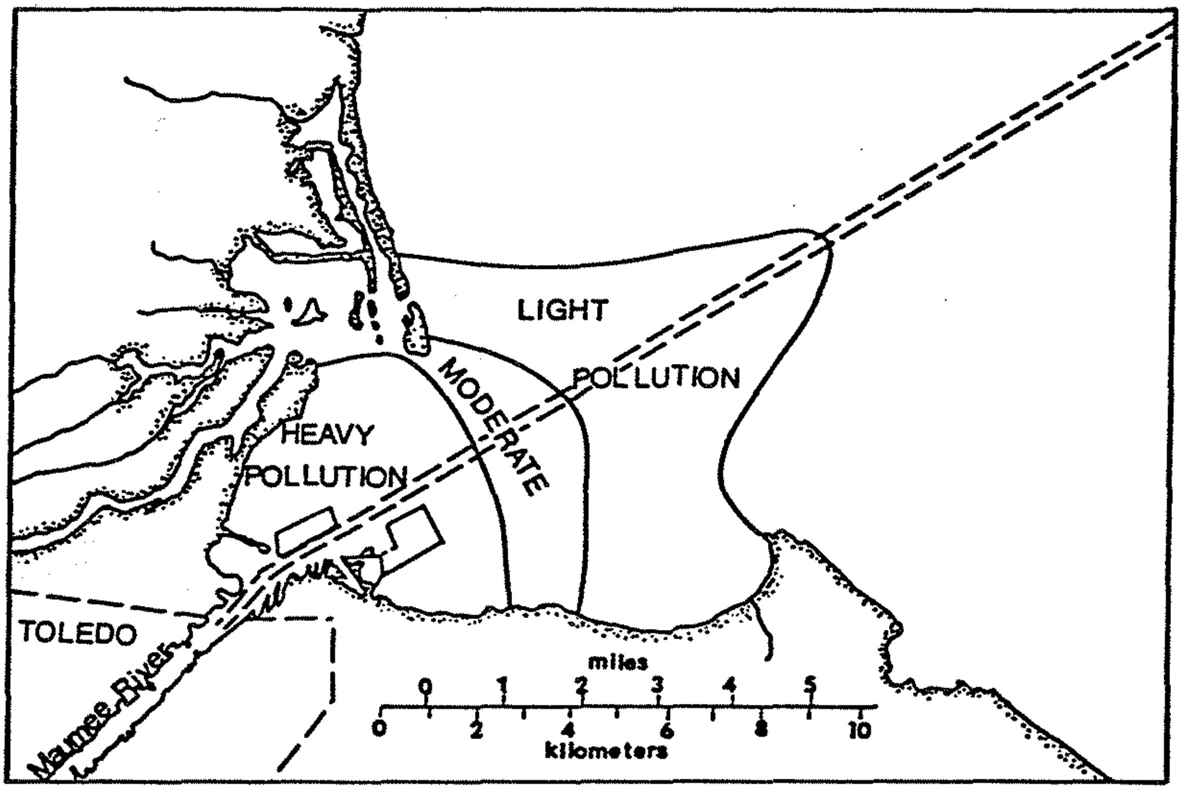
Wading birds such as herons and egrets arrive in the western Lake Erie region in early March and migrate southward in October. Upon their arrival, court- ships and nest building begin immediately. They usually forage on the shorelines of the tributary streams and coastal marshes, feeding upon fish and insects.[14]

Gulls and terns also use these coastal marshes, but the ring-billed gull are becoming more common and are now known to use the Toledo-Lucas County Port Authority Facility No. 3 (dredge disposal facility). Terns also use the diked spoil areas near the Toledo Harbor. Herring gulls are also prevalent and feed on dead fish, refuse and other organic debris along the shoreline, including landfills as their food supply.[14]

The estuarine and coastal marshes of Western Lake Erie serve as sinks for many of pollutants. Maumee Bay exhibits elevated numbers of tubificid worms, an indication of high organic pollution. Note Figure 6 which displays pollution zones in the Maumee Bay as indicated by concentration of tubificids (sludge worms) in the bottom sediments [14,15]. Turbidity throughout Maumee Bay and many of the estuarine and coastal marshes is high. The average concentration of suspended solids in Maumee Bay is 37 milligrams per liter (mg/l), but nearshore levels are generally over 50 mg/l.[14]

FIGURE 6

POLLUTION IN MAUMEE BAY AS INDICATED BY CONCENTRATION OF TUBIFICIDS (SLUDGE WORMS) IN THE BOTTOM SEDIMENTS. (WRIGHT 1955; PINSAK AND MEYER 1976).



LIGHT = 100 - 999 Tubificidae per square meter

MODERATE = 1,000 - 5,000

HEAVY = more than 5,000

Source: Maumee River Basin Level B Study.

WATER QUALITY STANDARDS

Most of the streams in the Maumee Basin RAP Area are classified as Warmwater Habitat, Agricultural Water Supply. The reaches of the Maumee in the immediate vicinity of the Bowling Green and Waterville intakes are classified as Public Water Supply. There are standards that apply for many water quality parameters depending on the stream reach's classification for habitation, water supply, and contact type. Table 13 gives the water quality standards that apply to *most* streams in the RAP Area. For an exhaustive listing of all water quality standards, refer to the Water Quality Standards in the Ohio Revised Code.[16]

TABLE 13
WATER QUALITY STANDARDS

Parameters for which Warmwater Habitat Standard is Critical

Water Quality Parameter	Average	Maximum
Free CN, μg/l	8.1	38
DO, mg/l (minimum values)	5.0	4.0
TDS, mg/l	1500	
Fe, total recoverable, mg/l	1.0	
Pb, total recoverable, μg/l	30	
MBAS, mg/l		0.5
Cl, residual, μg/l	11	19
Cr, hex., dissolvable, μg/l	10	19
Hg, total recoverable, μg/l	0.2	2.2
Oil & Grease, mg/l	10	
Phenol, μg/l	10	
P	*see note below*	
Polychlorinated biphenyls, (PCBs) μg/l		0.001
Ag, total recoverable, μg/l	1.3	Depends on $CaCO_3$
pH	Minimum	Maximum
	6.5	9.0

Standards that Depend on Hardness

	@ 200 ppm as $CaCO_3$	@ 400 ppm as $CaCO_3$
Cu, total recoverable, μg/l	29	55
Ag, total recoverable, μg/l	5.3	17
Zn, total recoverable, μg/l	495	880

Parameters for which Agricultural Water Supply Standard is Critical

Water Quality Parameter	Average	Maximum
Arsenic, As, total recoverable, μg/l		100
Beryllium, Be, total recoverable, μg/l		100
Cadmium, Cd, total recoverable, μg/l		50
Chromium, Cr, total recoverable, μg/l		400
Nickel, Ni, total recoverable, μg/l		200
Selenium, Se, total recoverable, μg/l		50

TABLE 13 continued

Phosphorus

There is no specific water quality standard for phosphorus. OEPA's *Water Quality Standards* state: "*Total phosphorus as P shall be limited to the extent necessary to prevent nuisance growths of algae, weeds, and slimes that result in a violation of the water quality criteria ... or, for public water supplies, that result in taste or odor problems. In areas where such nuisance growths exist, phosphorus discharges from point sources determined significant by OEPA shall not exceed a daily average of 1.0 ppm.. or such stricter requirements as may be imposed by OEPA ...*"

Ammonia: NH_3

NH_3 water quality standards depend on the temperature of the water, its pH, and what time of year it is. Related note: No NO_3 standard is given here, but OEPA requires the community to issue a drinking water warning when NO_3 level rises above 10 ppm.

	Dec.-Feb.	March-Nov.
@ pH 7.0 and 25°C	--	2.9 ppm
@ pH 8.0 and 0-10°C	3.3 ppm	2.4 ppm
@ pH 8.0 and 25°C	--	0.8 ppm
@ pH 7.5 and 25°C	--	1.8 ppm

These are *examples* of average NH_3 standards. Ohio Water Quality Standards contain full information in its 7-3. Maximum concentrations for NH_3 are presented in Table 7-5 of the Water Quality Standards.

Nitrate and Nitrite: $NO_3 + NO_2$

For most stream reaches in the AOC, the Agricultural Water Supply standard of 100 ppm would apply. For the reaches that are used for public water supply, the standard is 10 ppm.

Bacterial Standards

	Fecal Coliform #/1000 ml		*E. Coli* #/1000 ml	
	Avg	Max	Avg	Max
Bacterial:				
Bathing waters	200	400	126	235
Primary Contact	1000	2000	126	298
Secondary Contact	—	5000	126	576

Sediment Quality Guidelines

Metal	Non-Elevated	Slightly Elevated	Elevated	Highly Elevated	Extreme Elevated
As	< 13	>13	>18	>28	>47
Cd	< 0.38	≥0.38	≥0.60	≥1.03	≥1.90
Cr	< 9	≥9	≥11	≥16	≥24
Cu	< 15	≥15	≥19	≥27	≥44
Fe	< 27,724	≥27,724	≥36,112	≥52,887	≥86,439
Pb	< 21	≥21	≥28	≥43	≥73
Zn	< 83	≥83	≥108	≥156	≥253

Sediment metal guidelines are in units of are $\mu g/l$.

TABLE 13 continued

Pesticides

Pesticide	Public Water Supply[a], μg/l	Aquatic Life Habitat, μg/l
Aldrin[b]	0.000074[c]	0.01
Benzene Hexachloride	--	0.1
Chlordane	0.00046[c]	0.01
Chlorophenoxy herbicides		
2,4-D	100.0	--
2,4,5-TP (Silvex)[b]	10.0	--
Ciodrin	--	0.1
Coumaphos	--	0.001
Dalapon	--	110.0
DDT[b]	0.000024[c]	0.001
Demeton	--	0.1
Diazinon	--	0.009
Dicamba	--	200.0
Dichlorvos	--	0.001
Dieldrin[b]	0.000071[c]	0.005
Diquat	--	0.5
Dursban	--	0.001
Endosulfan	74	0.003
Endrin	1.0	0.002
Guthion	--	0.005
Heptachlor[b]	0.00028[c]	0.001
Heptachlor Epoxide	0.1	--
Lindane	0.019[c]	0.01
Malathion	--	0.1
Methoxychlor	100.0	0.005
Mirex	--	0.001
Naled	--	0.004
Parathion	--	0.008
Phosphamidon	--	0.03
Simazine	--	10.0
TEPP	--	0.4
Toxaphene	0.00071[c]	0.005

a Pesticides are not to exceed the concentrations in this table, or the Safe Drinking Water Act, whichever is more stringent.

b Use has been banned.

c For protection of human health from the potential carcinogenic effects, at a 10^6 incremental increase of cancer risk over the lifetime, due to exposure through ingestion of contaminated water and contaminated aquatic organisms.

EXISTING WATER QUALITY DATA: A Summary

The TMACOG *Inventory of Water Quality Monitoring Sites and Sampling Programs*[17] (1988) lists a large number of sampling sites in the Maumee Basin Area of Concern. The major monitoring programs are summarized below:

ON-GOING MONITORING PROGRAMS

Toledo Environmental Services Division (TESD)

The most substantial body of water quality data for the Toledo area is that analyzed by TESD. Water is sampled and analyzed from approximately monthly, to less than eleven to nine times per year. Parameters include conventional pollutants: BOD_5, P, NO_2, NO_3, NH_3, DO, Cl^-, SS, and bacterial counts.

TESD Monitoring Sites

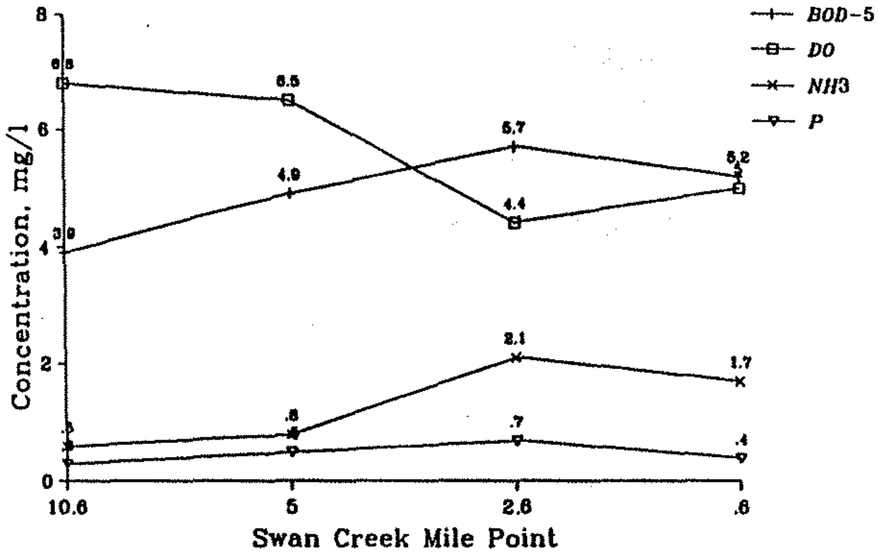
Maumee River:	8 stations from Mouth to Waterville
Otter Creek	1 station
Delaware Creek	1 station
Grassy Creek	1 station
Ottawa River	8 stations from Summit St to Sylvania Ave
Hill Ditch	1 station
Swan Creek	4 stations from St. Clair St. to Eastgate Road
Heilman Ditch	1 station
Silver Creek	1 station
Shantee Creek	1 station

TESD data are published in six-year intervals[18] and are not reprinted in this report. Figures 7-34 summarize the 1981-1986 data. There are four sets of graphs: Swan Creek, Tenmile Creek/Ottawa River, Maumee River, and other tributaries. There are eight graphs in each group. For Swan Creek (Figures 7-14), the graphs first display the 1981-86 average July Nutrients (BOD_5, DO, NH_3 and P) and average July Bacteria counts by concentration and river mile. July averages are used because low stream flows and high temperatures create "worse case" conditions. The second set displays the six year average for nutrients and bacteria counts by concentration and river mile. The third set displays the yearly concentrations for nutrients and bacteria counts for an upstream station, while the fourth set displays these same parameters for a downstream station which show the poorest water quality.

These data are then displayed for Ottawa River (Figures 15-22) and the Maumee River (Figures 23-30), applying the same format as used for Swan Creek. The graphs (Figures 31-34), display these same data for Otter Creek, Delaware Creek, Grassy Creek, Hill Ditch, Silver Creek, Shantee Creek and Heilman Ditch.

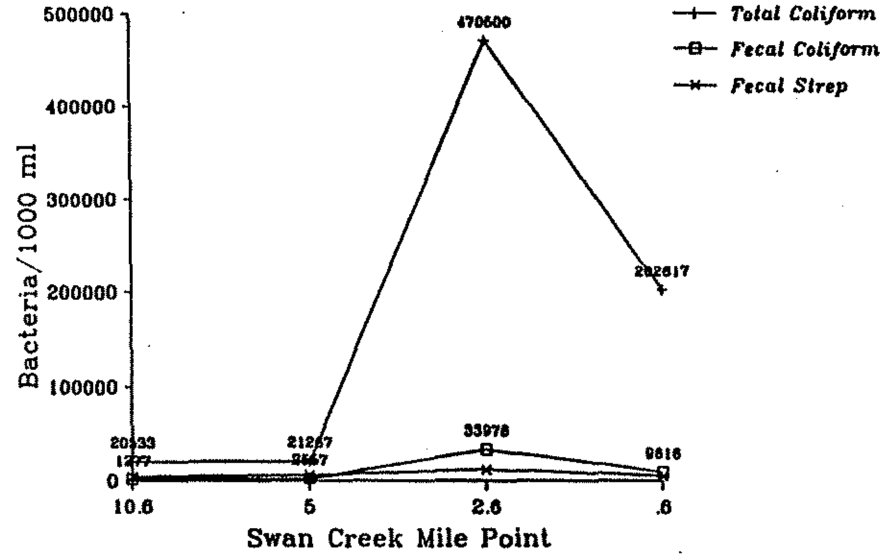
TESD DATA, 1981–1986: SWAN CREEK

Figure 7: July Nutrient Parameters



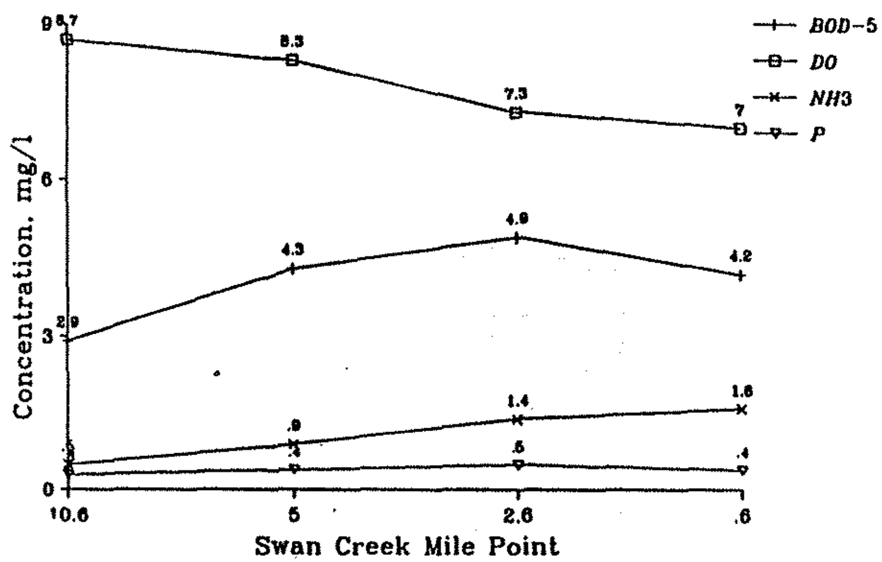
TESD DATA, 1981–1986: SWAN CREEK

Figure 8: July Bacteriological Parameters



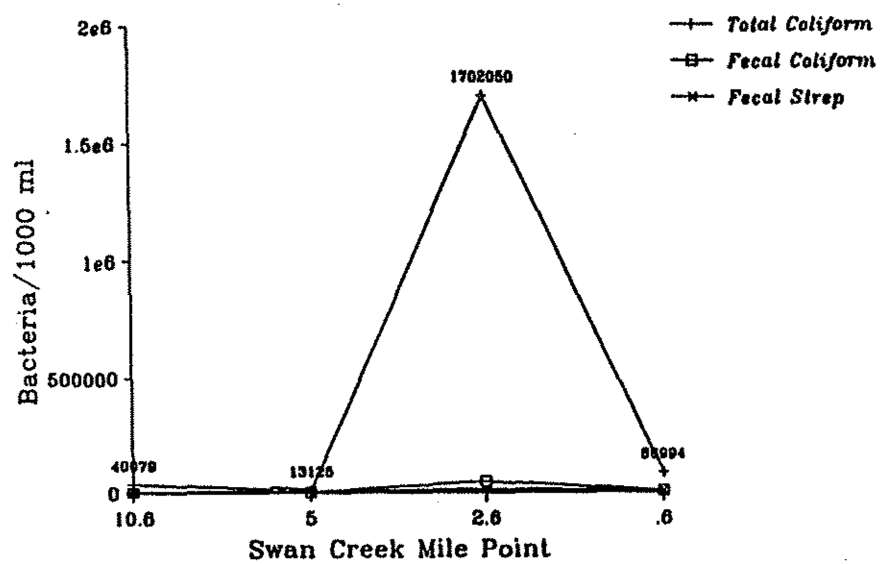
TESD DATA, 1981–1986: SWAN CREEK

Figure 9: Average Nutrient Parameters



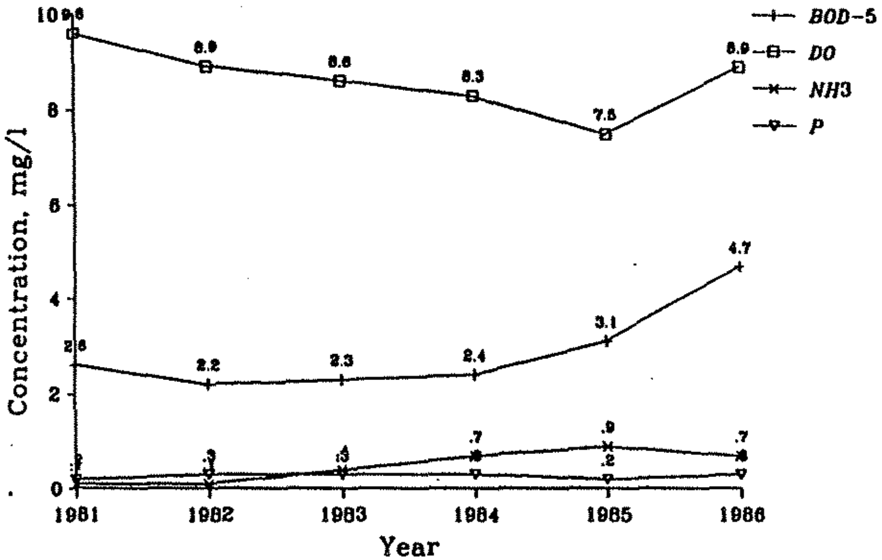
TESD DATA, 1981–1986: SWAN CREEK

Figure 10: Average Bacteriological Parameters



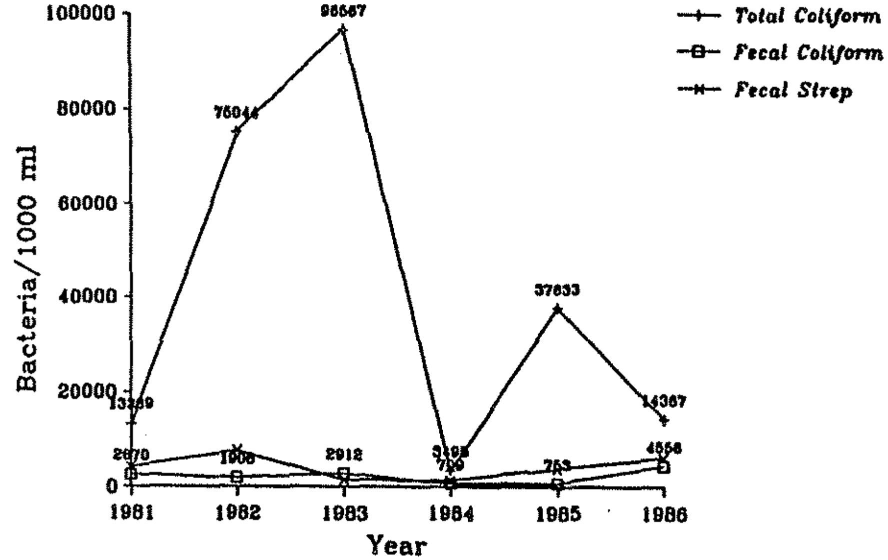
TESD DATA, 1981-1986: SWAN CREEK

Figure 11: Eastgate Rd. Nutrients by Year



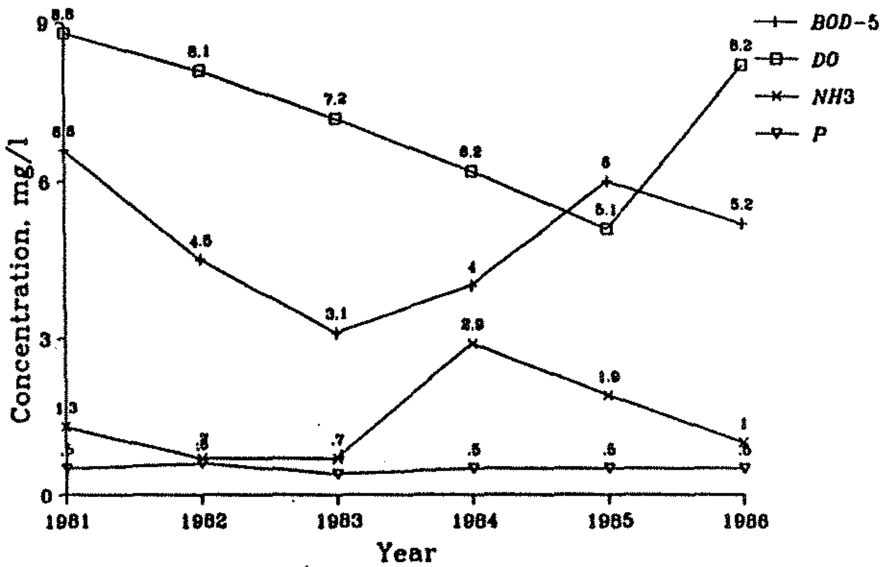
TESD DATA, 1981-1986: SWAN CREEK

Figure 12: Eastgate Rd. Bacteria by Year



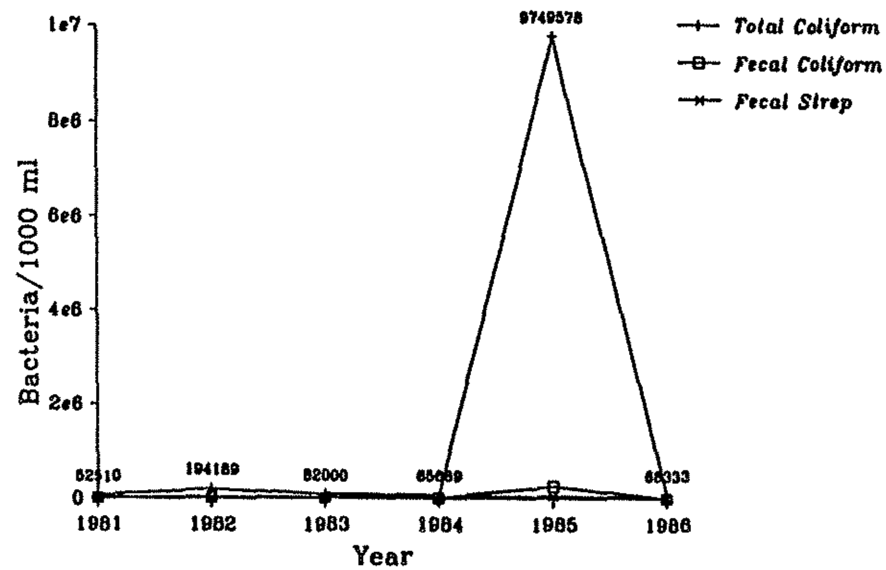
TESD DATA, 1981-1986: SWAN CREEK

Figure 13: Hawley St. Nutrients by Year



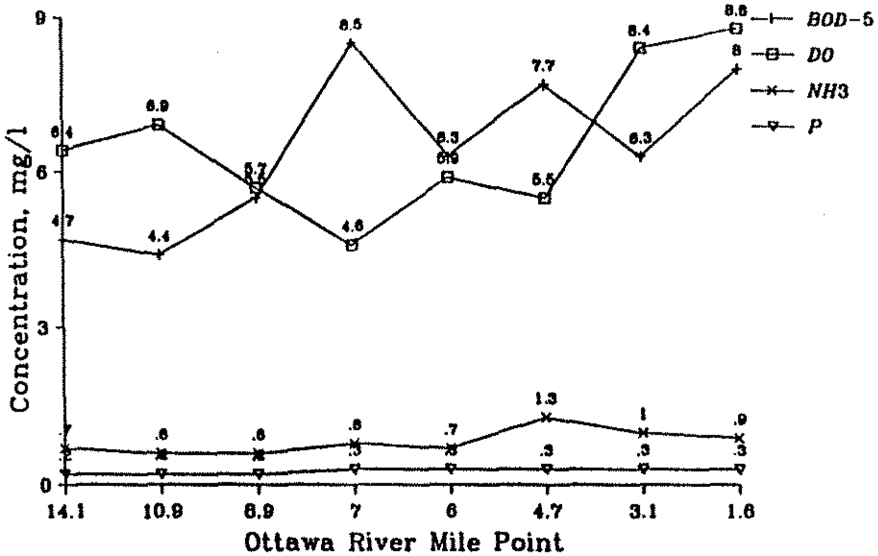
TESD DATA, 1981-1986: SWAN CREEK

Figure 14: Hawley St. Bacteria by Year



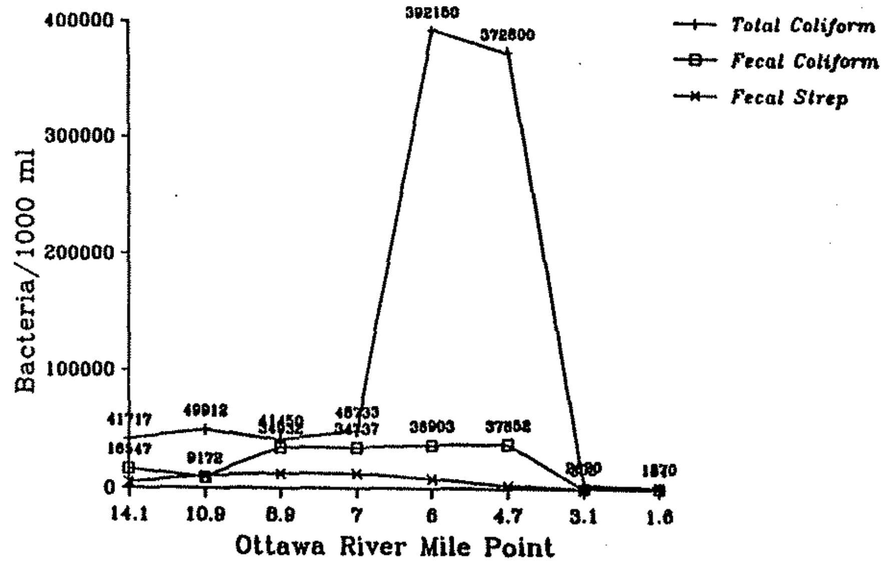
TESD DATA, 1981–1986: OTTAWA RIVER

Figure 15: July Nutrient Parameters



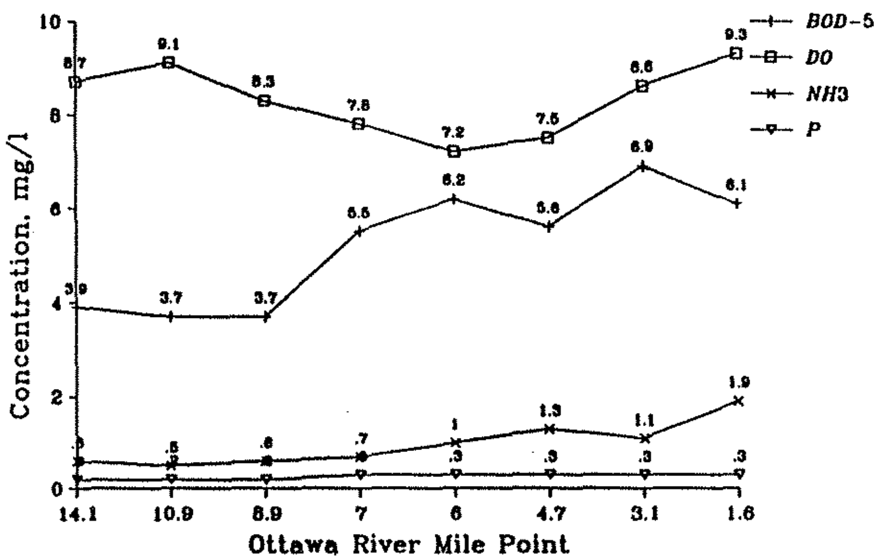
TESD DATA, 1981–1986: OTTAWA RIVER

Figure 16: July Bacteriological Parameters



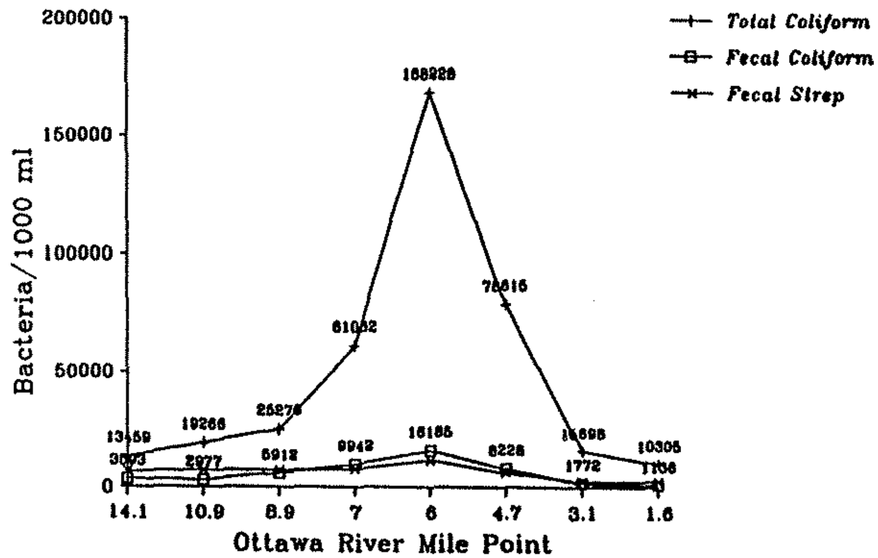
TESD DATA, 1981–1986: OTTAWA RIVER

Figure 17: Average Nutrient Parameters



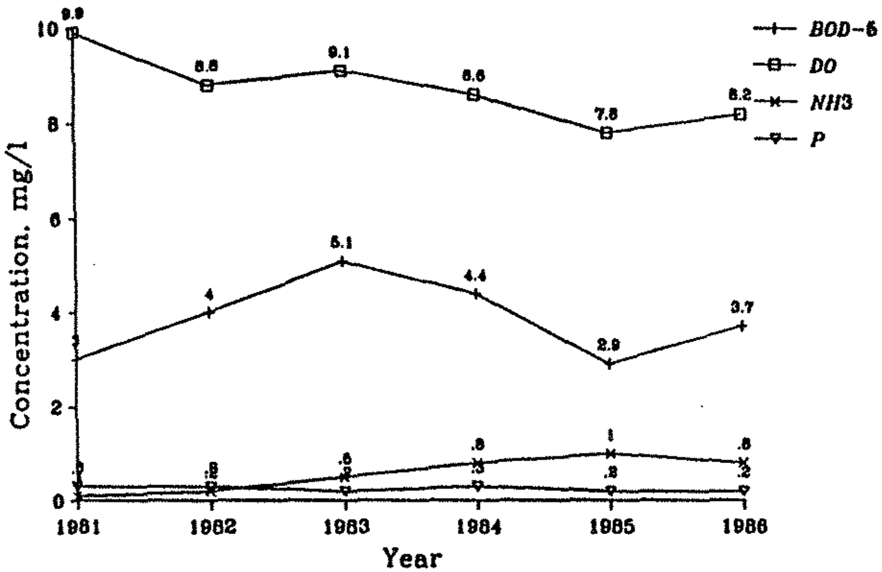
TESD DATA, 1981–1986: OTTAWA RIVER

Figure 18: Average Bacteriological Parameters



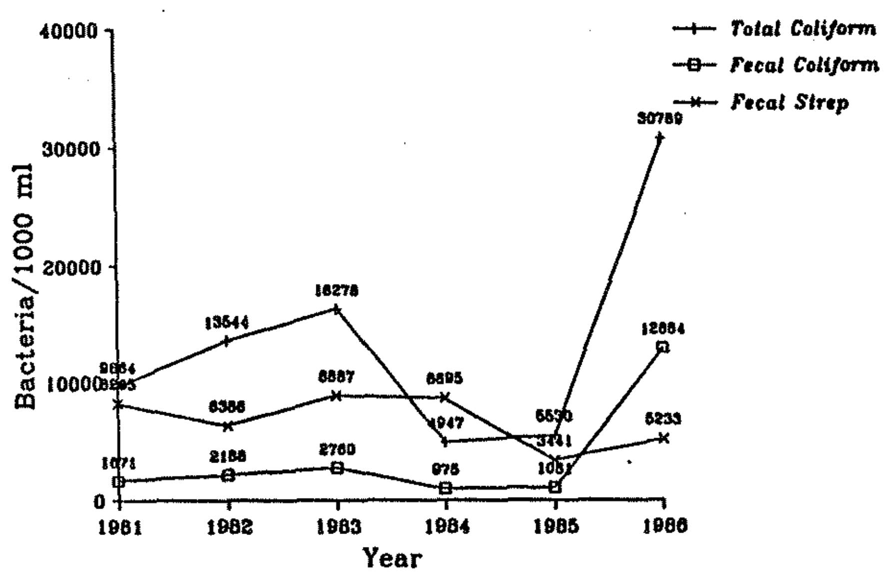
TESD DATA, 1981-1986: OTTAWA RIVER

Figure 19: Sylvania Ave Nutrients by Year



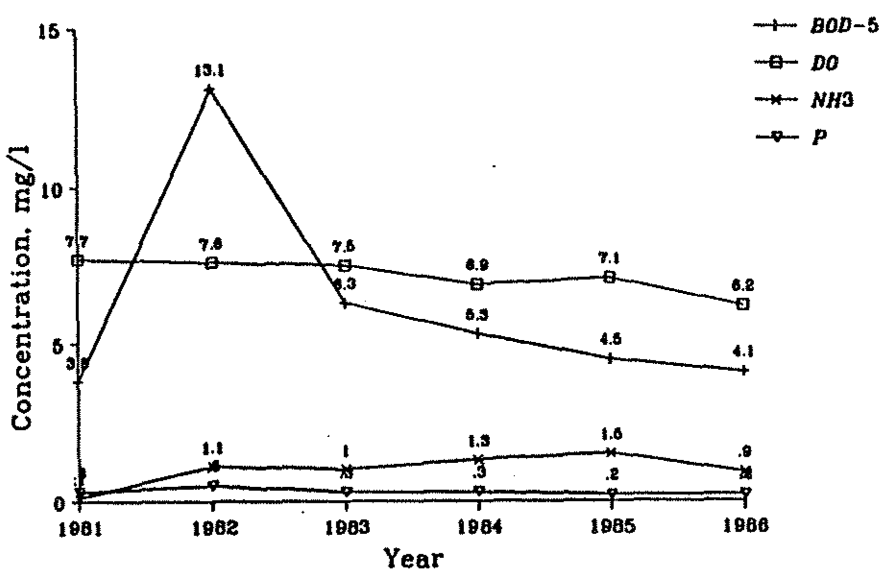
TESD DATA, 1981-1986: OTTAWA RIVER

Figure 20: Sylvania Ave Bacteria by Year



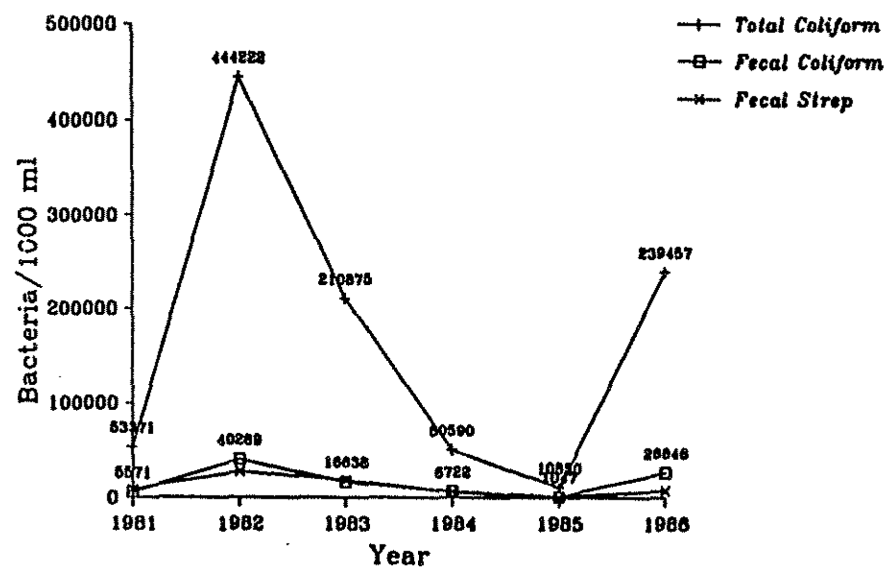
TESD DATA, 1981-1986: OTTAWA RIVER

Figure 21: Lagrange Nutrients by Year



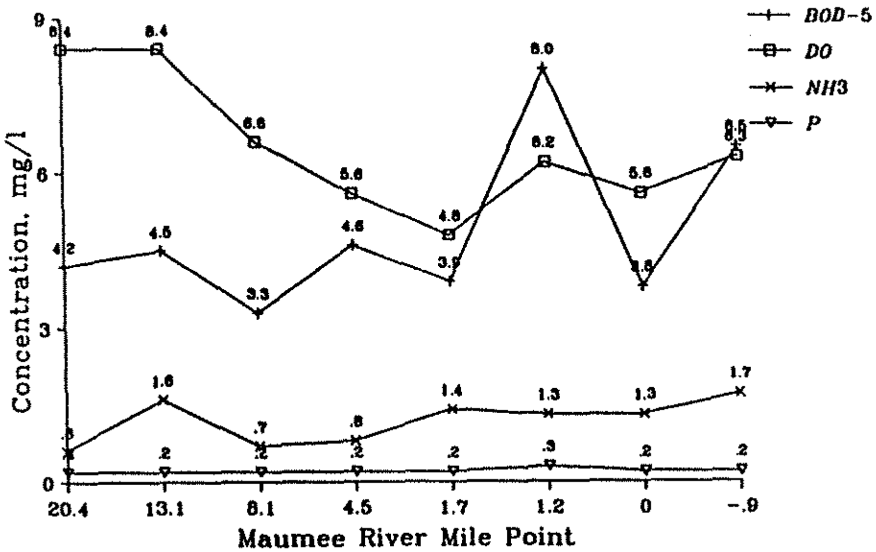
TESD DATA, 1981-1986: OTTAWA RIVER

Figure 22: Lagrange Bacteria by Year



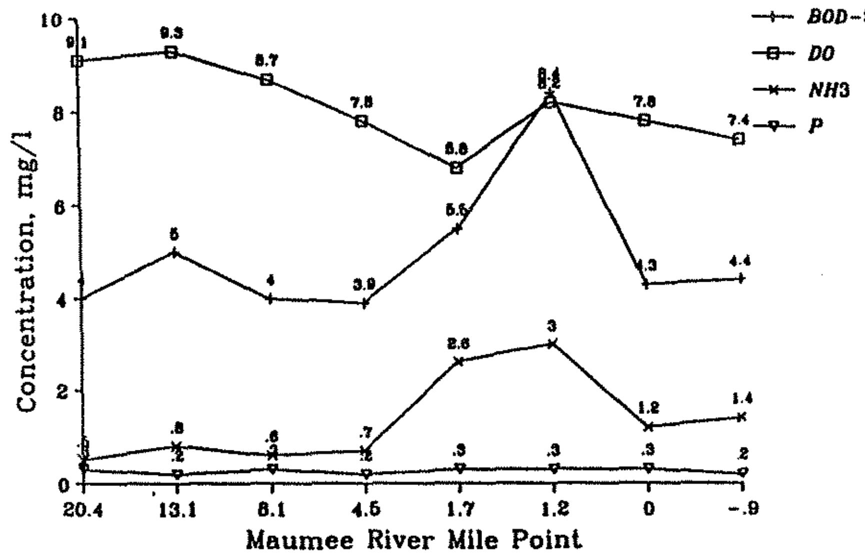
TESD DATA, 1981-1986: MAUMEE RIVER

Figure 23: July Nutrient Parameters



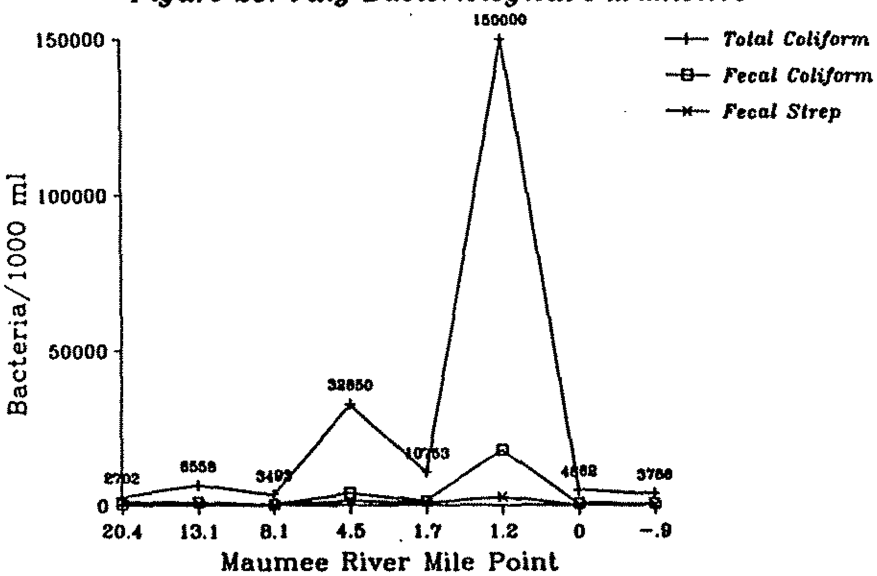
TESD DATA, 1981-1986: MAUMEE RIVER

Figure 24: Average Nutrient Parameters



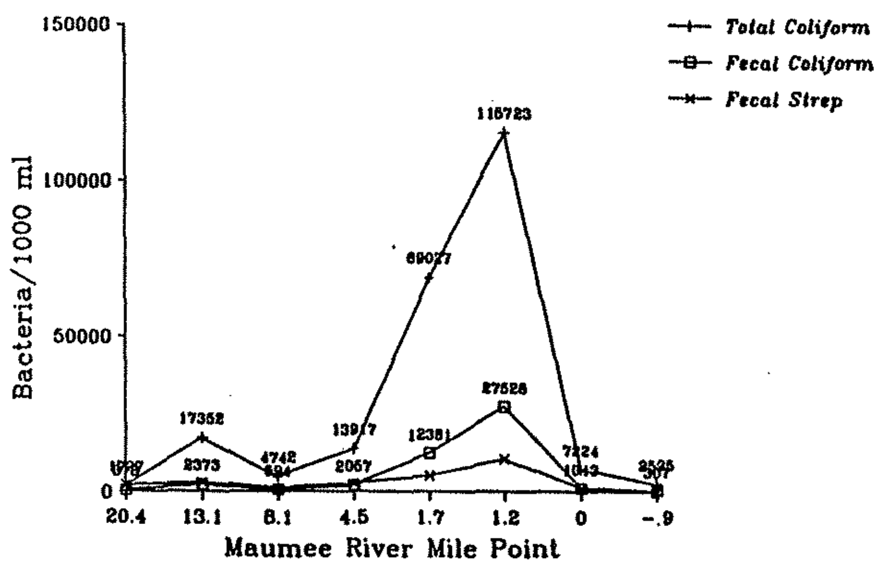
TESD DATA, 1981-1986: MAUMEE RIVER

Figure 25: July Bacteriological Parameters



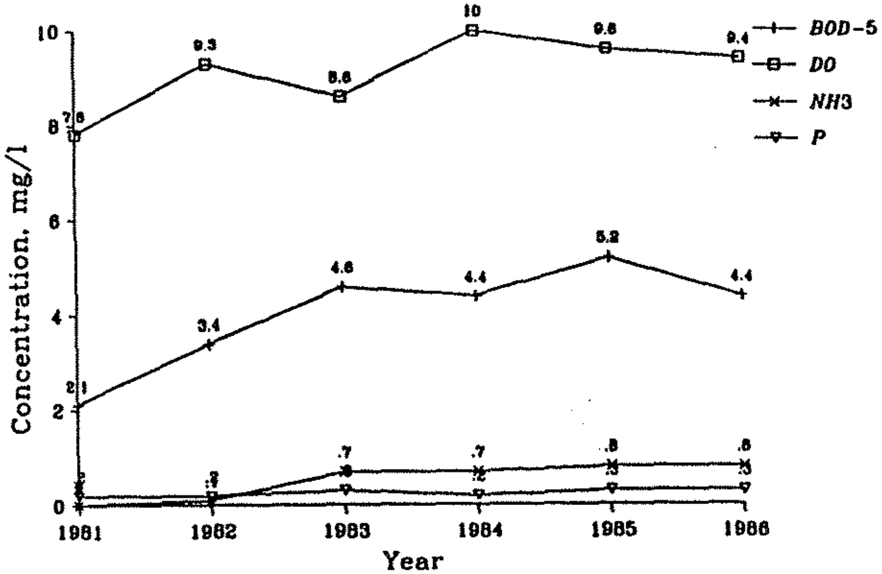
TESD DATA, 1981-1986: MAUMEE RIVER

Figure 26: Average Bacteriological Parameters



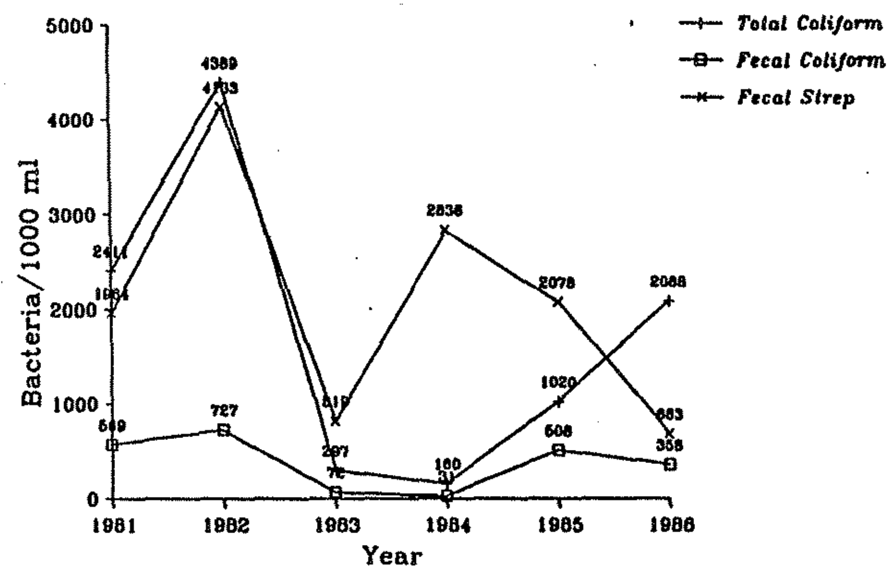
7 D DATA, 1981–1986: MAUMEE RIVER

Figure 27: Waterville Nutrients by Year



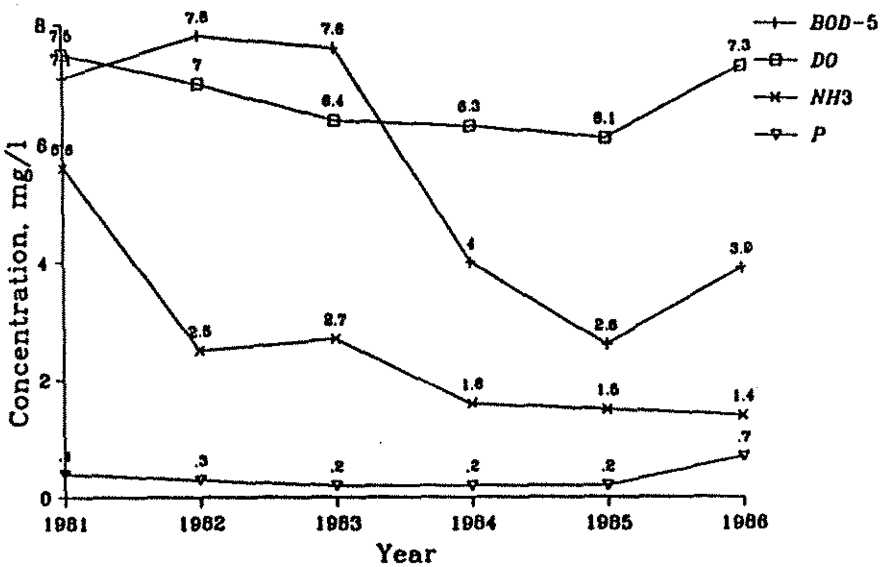
TESD DATA, 1981–1986: MAUMEE R. .R

Figure 28: Waterville Bacteria by Year



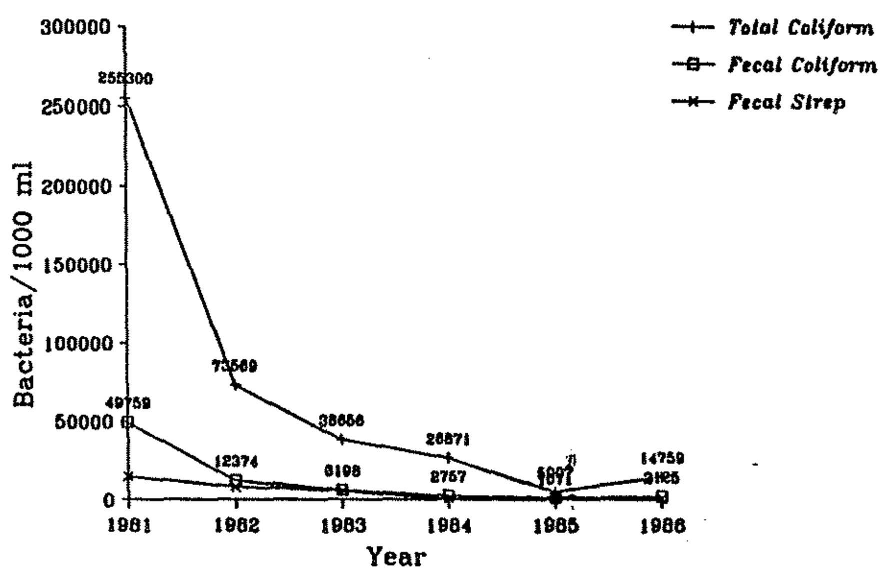
TESD DATA, 1981–1986: MAUMEE RIVER

Figure 29: TT Bridge Nutrients by Year



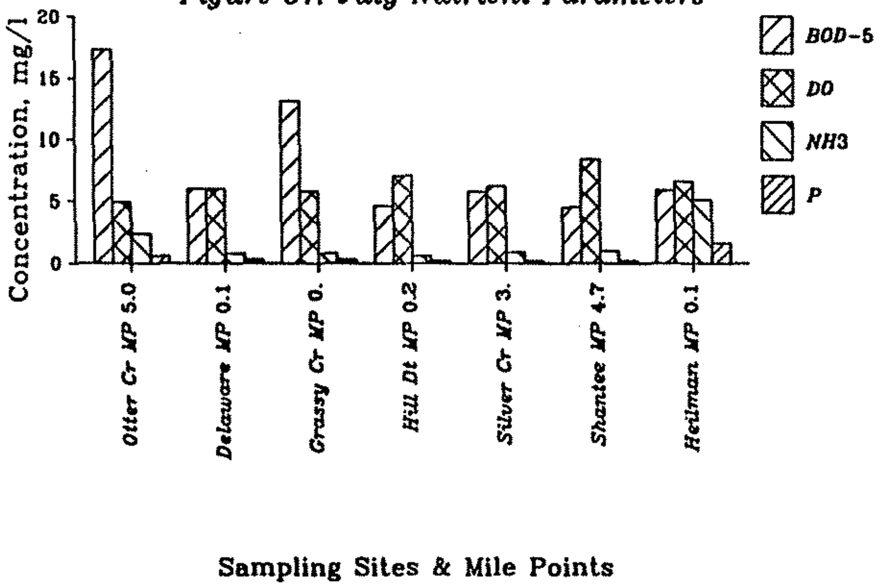
TESD DATA, 1981–1986: MAUMEE RIVER

Figure 30: TT Bridge Bacteria by Year



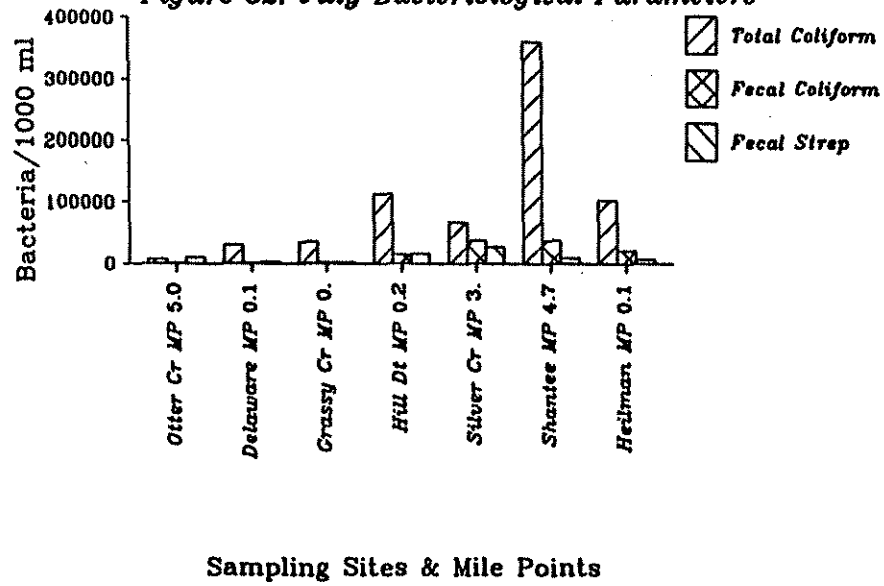
TESD DATA, 1981-1986: TRIBUTARY STREAM

Figure 31: July Nutrient Parameters



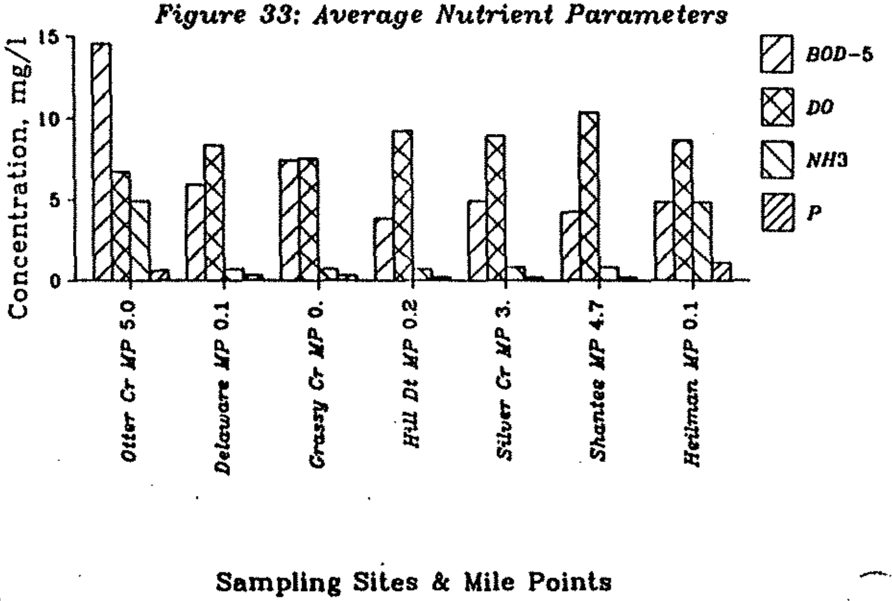
TESD DATA, 1981-1986: TRIBUTARY STREAM

Figure 32: July Bacteriological Parameters



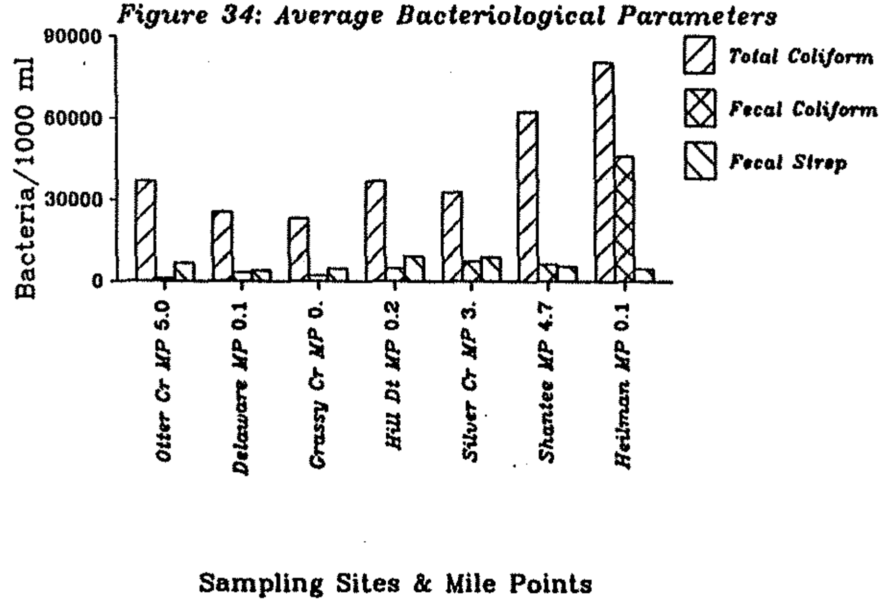
TESD DATA, 1981-1986: TRIBUTARY STREAM

Figure 33: Average Nutrient Parameters



TESD DATA, 1981-1986: TRIBUTARY STREAM

Figure 34: Average Bacteriological Parameters



United States Geological Survey (USGS)

USGS has an on-going sampling network, although the number of sites and amount of monitoring done has been decreasing over the years. Monitoring stations in the Maumee RAP Area include:

Maumee River	Mile point 22.8 above Waterville mile point 20.8 at Waterville mouth of the Maumee (discontinued 1975)
Ottawa River	mile point 10.8 at U.T. bridge (1977 only)
Crane Creek	near Curtice in Ottawa County; sampled semi-annually from 1980-82. Parameters: DO, Ca, Mg, Na, K, SO_4, Cl, F, TDS, TKN, NH_3, NO_3+NO_2, P, Fe, Mn.
Cedar Creek	mile point 6.9 at Curtice in Lucas County. Same monitoring details as Crane Creek site.

Only conductance, pH, temperature, and DO are sampled above Waterville. Conventional pollutants and metals (As, Ba, Cd, Cr, Cu, Fe Pb, Mn, Hg, Se, Ag, Zn) are monitored at the Waterville site; these parameters were also sampled at the two other discontinued sites.

Ohio State University Center for Lake Erie Area Research (CLEAR)

CLEAR does primarily open-lake and near-shore water quality studies. Their most intensive period of monitoring activity within the Maumee RAP Area was in 1975. Sampling that year included many sites in Maumee Bay and in the river itself as far upstream as Perrysburg (mile point 12). Sampling included conventional pollutants, and fecal coliform. It is no longer an on-going program.

Ohio EPA 305b Water Quality Inventories

Ohio EPA publishes a biannual report on the status of the various stream reaches in Ohio. The purpose of this report is to establish whether Ohio surface waters are meeting the "fishable, swimmable" criteria of the Clean Water Act (CWA). The 1986 305b report's assessment of water quality for Maumee/Ottawa River Basin is shown in Table 14.

TABLE 14
1986 305b ASSESSMENTS OF WATER QUALITY

Use Attainment		ALL STREAMS Miles	ALL STREAMS % Total	PRINCIPAL STREAMS Miles	PRINCIPAL STREAMS % Total
Meets CWA Criteria:	Yes	564	25	373	49
	Partial	287	12	180	24
	No	153	7	65	8
Total evaluated		1004	44	618	81

The area covered by the biennial report includes the Maumee Basin in Ohio which is substantially larger than the RAP Area. It includes all of Fulton, Henry, Defiance, Paulding, Putnam, Van Wert, and Allen Counties, and large portions of Lucas, Wood, Hancock, Auglaize, and Mercer Counties. The Ottawa River mentioned refers to the Ottawa River that flows through Lima, not the Ottawa River in Lucas County known locally as Tenmile Creek.

The 305b study summarizes the conditions of stream segments in the RAP Area. These summaries are shown in Table 15 by stream reach and includes the stream designations and the Clean Water Act (CWA) use attainment. Cedar and Crane Creeks, which the 305b classifies as being in the Portage River Basin, were not evaluated.

TABLE 15
1986 305b SUMMARIES

STREAM	MILE POINTS	REACH	COND.	CWA	DESG
Maumee	14.1-37.7	Maumee-Perrysburg Bridge-Napoleon	Good	Yes	WWH
Maumee	7.2-14.1	Estuary reach	Fair	Part.	WWH
Maumee	0.0-7.2	Ship channel	Fair	Part.	WWH
Maumee Bay			Fair	Part.	ELEH
Swan Creek	14.0-41.2	I-475 to headwaters	Fair	Part.	WWH
Swan Creek	0.0-14.0	Mouth to I-475	Poor	No	WWH

Heidelberg College River Studies Laboratory

The Water Quality Laboratory at Heidelberg College has contributed significant research on the movement and loadings of sediment, nutrients, and more recently pesticides in the Maumee River Basin. Utilizing the data available from the U.S. Geological Survey at the Waterville Survey Station and data collected by the Water Quality Laboratory,[3] they have analyzed sediment, phosphorus, nitrogen, chlorides, and 19 different pesticides. These data provide a record of water quality conditions in the Maumee River and have been collected continuously throughout the years which allows for the development of loading data. These data have been used extensively in the Agricultural Pollution Abatement section of this report. Major reports of these data are included in several documents available from the Water Quality Laboratory.[19, 20, 21]

INTENSIVE OR SHORT-TERM MONITORING SURVEYS

There has been a substantial body of water quality data collected since 1970 through various one-time sampling programs.

Maumee Basin Biological Water Quality Report (BWQR)

Ohio EPA has established five different classes for its biological criteria (fish) for determining water quality use designations and attainment of the Clean Water Act (CWA) goals. Class I (Exceptional) and Class II (Good) meets CWA goals. Class III (Fair), Class IV (Poor) and Class V (Very Poor) do not meet CWA goals. For formal use attainment assessment, Ohio EPA uses both fish (IBI and IWB) indices and invertebrates (ICI). For full attainment, all three indices must meet the criteria. For partial attainment, at least one index meets the criteria with the other two indicating at least fair performance. For non-attainment, none of the indices meet criteria or one or two indicate very poor or poor performance.

As a part of its Biological and Water Quality Report, Ohio EPA analyzed sediments for heavy metal concentrations in early 1987 at certain stations on the Maumee River (Grand Rapids Dam, Eagle Point Colony, Cherry Street Bridge and Toledo WWTP), Swan Creek (at Collingwood Blvd.), Ottawa River (Lagrange Street and Stickney Avenue), Otter Creek (Oakdale Avenue, Wheeling Street, and Millard Avenue), and Duck Creek (York Street).

A summary of water quality data collected for the BWQR is presented in Table 16. BWQR data is plotted by river miles in Figures 35 to 43. Parameters are plotted for the three major streams: Swan Creek, Tenmile Creek/Ottawa River, and the Maumee River. There are three figures for each: Invertebrate Community Index (ICI), Macroinvertebrate Densities, and Sediment Metals.

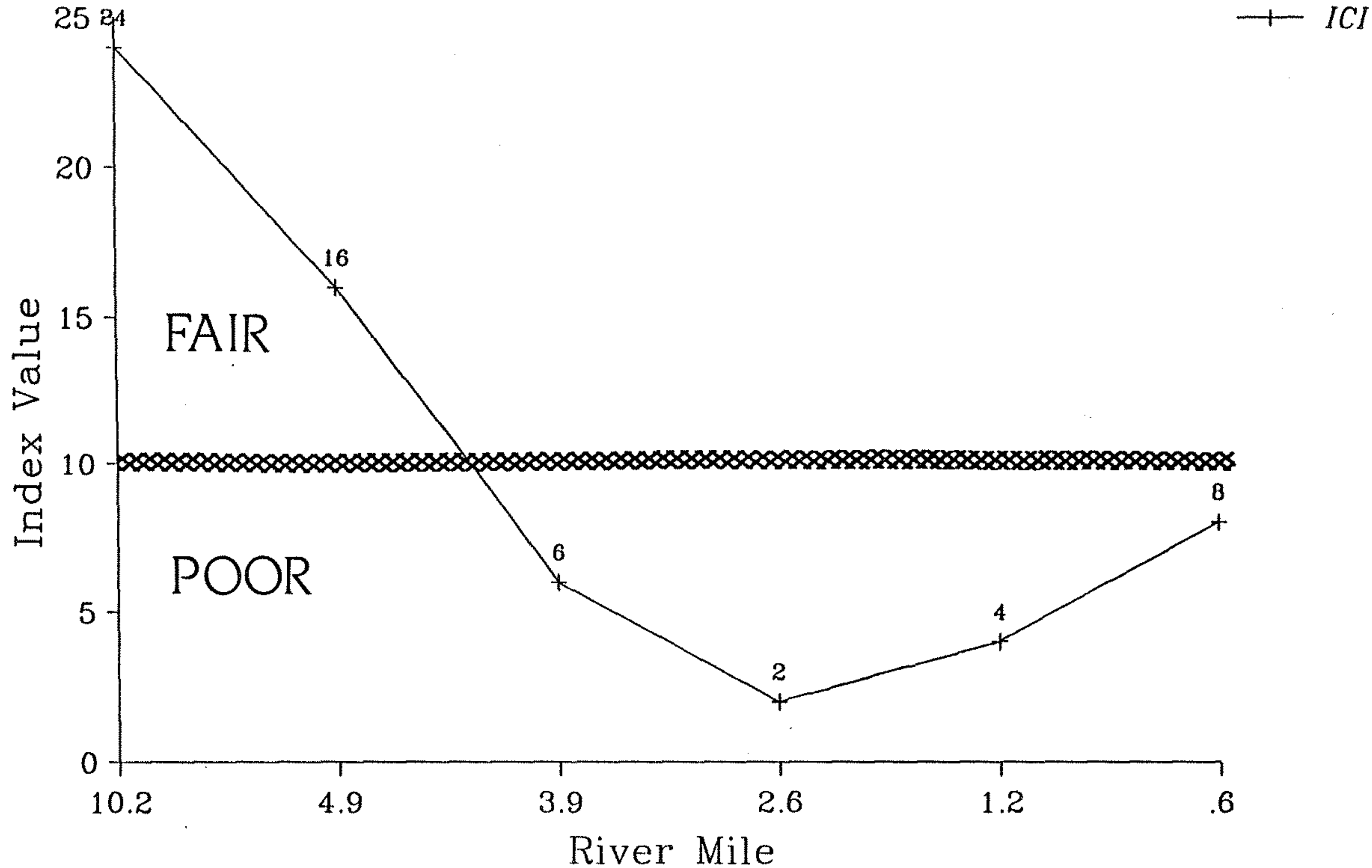
The ICI and Macroinvertebrate Densities get to the heart of measuring a stream's water quality. They indicate the ability of the stream to sustain life. High values for these indices indicate good water quality. The sediment metal data is a measure of accumulated metals at the bottom of the stream. The metals tested are toxic, so low values indicate a good environment for bottom-dwelling animals.

TABLE 16
LOWER MAUMEE BIOLOGICAL WATER QUALITY REPORT

STREAM	LOCATION	RATING	BANK	MILE	ICI	DENSITY	Cd	Cr	Cu	Pb	Ni	Zn	As
Maumee	Grand Rapids Dam	Good		32.1	42	1697	.24	5.9	5.3	15.3	4.8	24.5	
Maumee	Woodcock Island	Excellent		25.1	52	1384							
Maumee	SR 64	Excellent		20.9	54	1627							
Maumee	US 20	Good		15	24	544							
Maumee	Maple St. Boat Launch	Good	S	13.6	20	405							
Maumee	Carey St. Boat Launch	Marginally Good	N	13.3	14	467							
Maumee	Eagle Point	Fair		9.4			.95	43.2	36.3	52.3	44.8	178	21.5
Maumee	Walbridge Park	Marginally Good	N	8.8	18	913							
Maumee	Libbey-Owens-Ford	Fair	S	7.3	12	688							
Maumee	I-75	Marginally Fair	N	7.2	8	440							
Maumee	Cherry St. Bridge	Marginally Fair	N	4.7	8	544	1.52	33.4	65.3	108	34.4	190	10.1
Maumee	Consaul St.	Fair	S	3.6	14	706							
Maumee	Riverside Park	Marginally Fair	N	3.1	10	387							
Maumee	Harrison Marina	Marginally Fair	N	1.5	6	579							
Maumee	Bay View Park	Marginally Good	N	.7	16	1166	1.46	57.2	45.5	52.5	46.2	384	12.9
Swan Creek	Eastgate Road	Fair		10.2	24	369							
Swan Creek	Detroit Ave.	Fair		4.9	16	199							
Swan Creek	Champion St.	Poor		3.9	6	602							
Swan Creek	Hawley St.	Poor		2.6	2	602							
Swan Creek	Collingwood Blvd.	Poor		1.2	4	489	1.39	27.2	18.6	165	29.8	285	13.5
Swan Creek	Mouth	Poor		.6	8	748							
Duck Creek	Wheeling Road	Very poor		3	0	145							
Duck Creek	York Street	Poor		2.1	12	190	.6	14	21.2	72.8	14	115	13.9
Duck Creek	Port Authority	Poor		.4	4	43							
Otter Creek	East Broadway	Fair		7.2	15								
Otter Creek	Oakdale Ave.	Very poor		6	0	0	.52	32	30	49	22	170	26.1
Otter Creek	Wheeling Road	Very poor		4	0	166	.66	149	46	142	26	163	14.4
Otter Creek	Millard Ave.	Very poor		2	0	1623	.53	54	71	68	19	129	7.7
Otter Creek	Mouth	Very poor		.3	0	299							
Tenmile Creek	Centennial Road	Fair/marg. good		5.1	28								
Tenmile Creek	Sylvania Ave.	Fair/marg. good		4.1	35								
Tenmile Creek	Old Post Road	Marginally Good		1	36								
Ottawa River	Sturbridge Road	Fair		18.5	24	382							
Ottawa River	Centennial Hall, UT	Fair		11	14	297							
Ottawa River	South Cove Blvd.	Poor		9	6	272							
Ottawa River	Berdan Ave.	Poor		7.4	6	365							
Ottawa River	Lagrange St.	Poor		6.9	4	551	1.77	72.2	71.4	195	53.4	333	6.2
Ottawa River	Stickney Ave.	Poor		4.9	2	388	.52	23.4	87.2	116	21.2	124	4.3
Ottawa River	US 24-A	Poor		1.6	6	616							
Cedar Creek	US 20	Good		20	34	90							

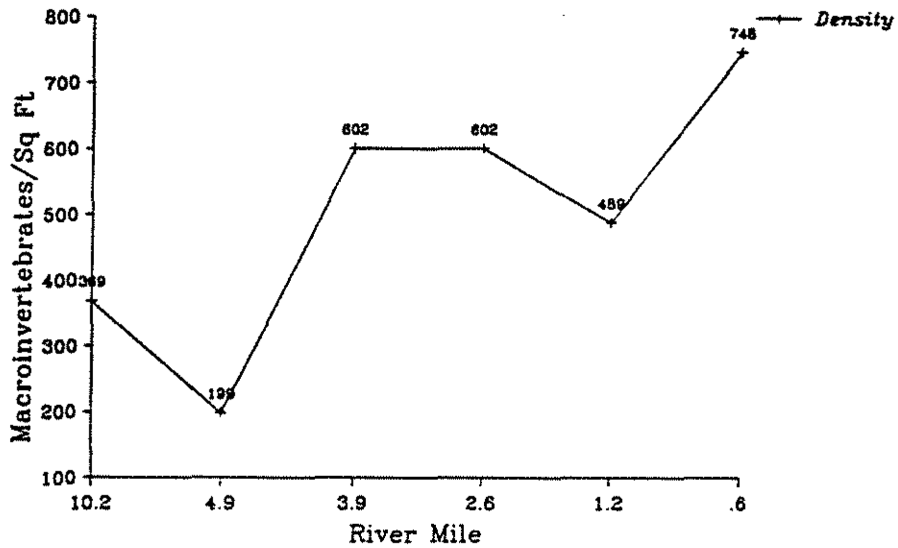
MAUMEE BWQR: SWAN CREEK

Figure 35: Invertebrate Community Index



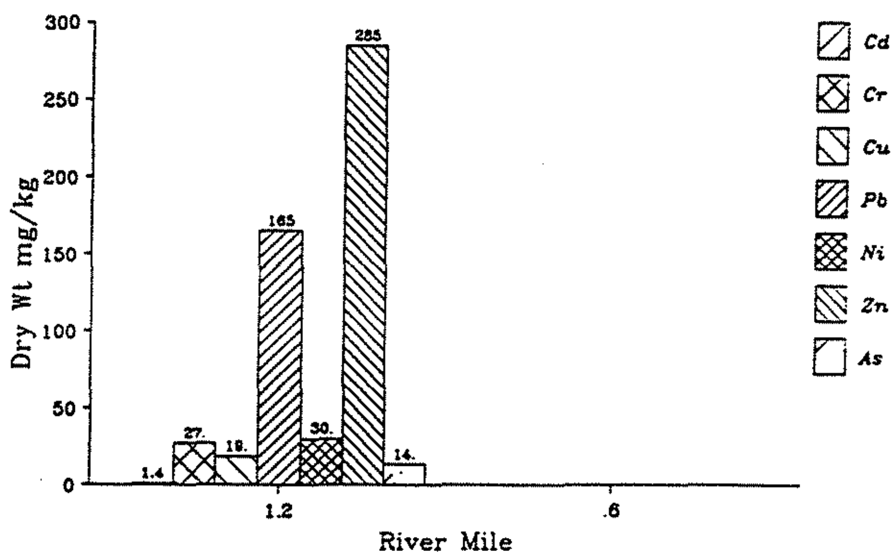
MAUMEE BWQR: SWAN CREEK

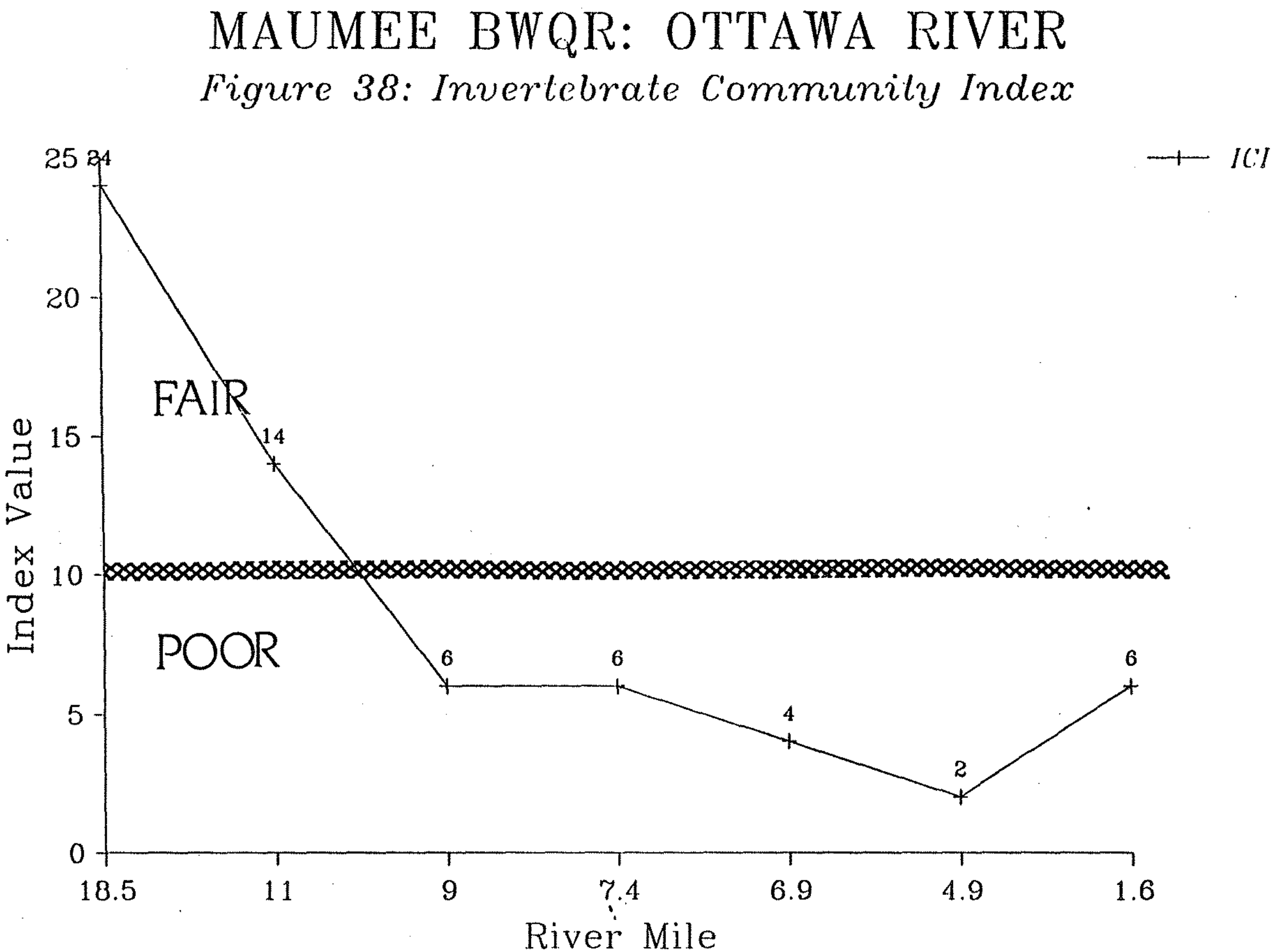
Figure 36: Macroinvertebrate Densities



MAUMEE BWQR: SWAN CREEK

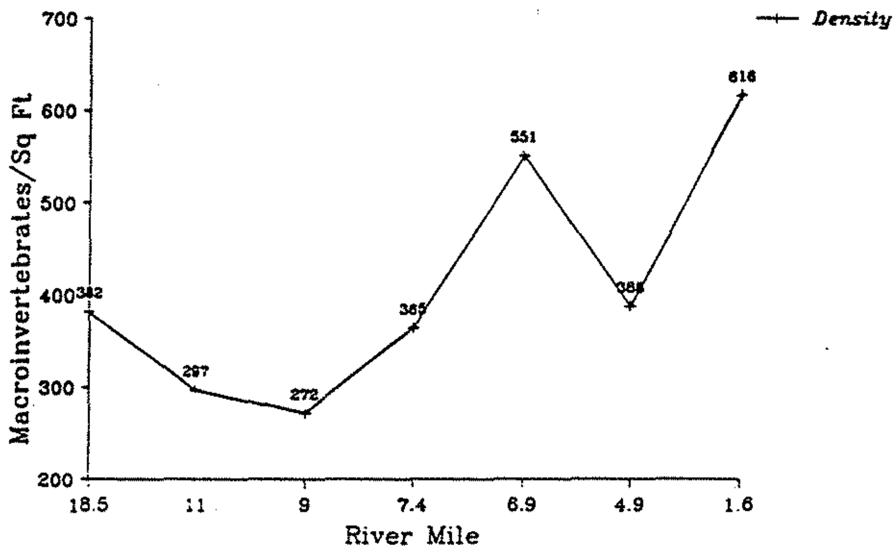
Figure 37: Sediment Metals




MAUMEE BWQR: OTTAWA RIVER
Figure 38: Invertebrate Community Index
ICI
Index Value
25
20
15
10
5
0
24
14
6
6
4
2
6
FAIR
POOR
18.5
11
9
7.4
6.9
4.9
1.6
River Mile

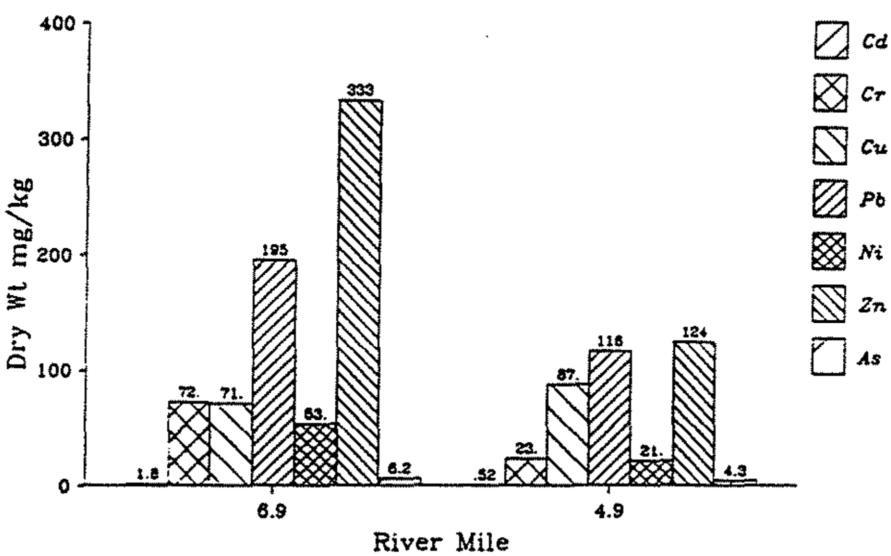
MAUMEE BWQR: OTTAWA RIVER

Figure 39: Macroinvertebrate Densities



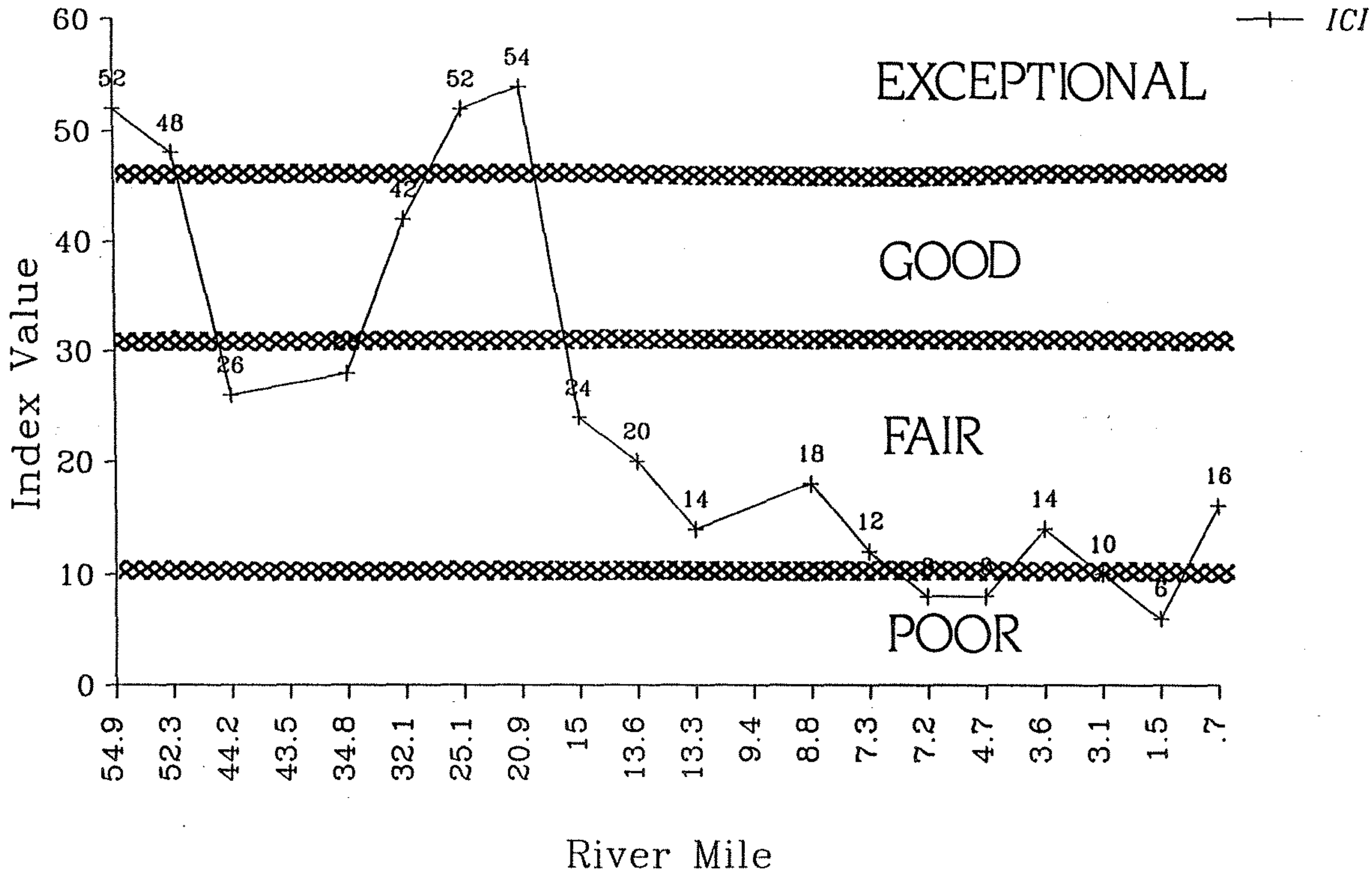
MAUMEE BWQR: OTTAWA RIVER

Figure 40: Sediment Metals



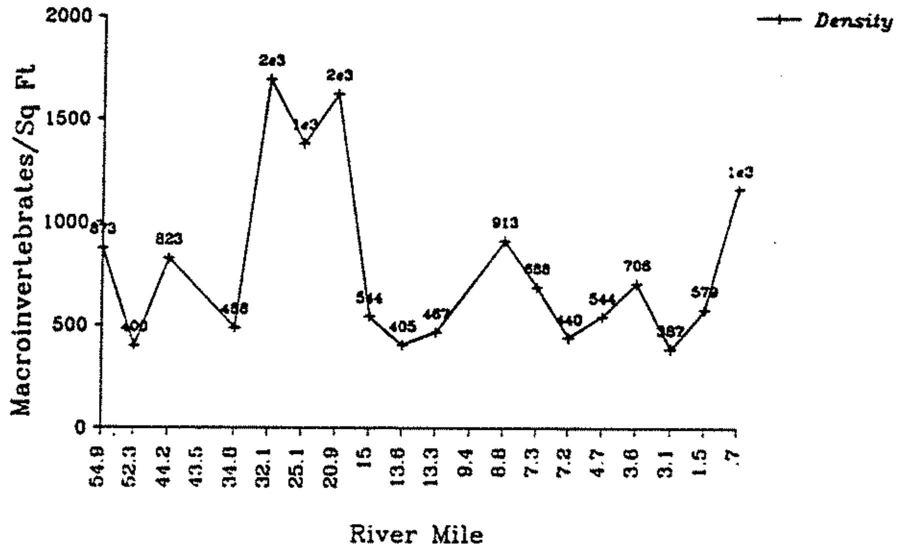
MAUMEE BWQR: MAUMEE RIVER

Figure 41: Invertebrate Community Index



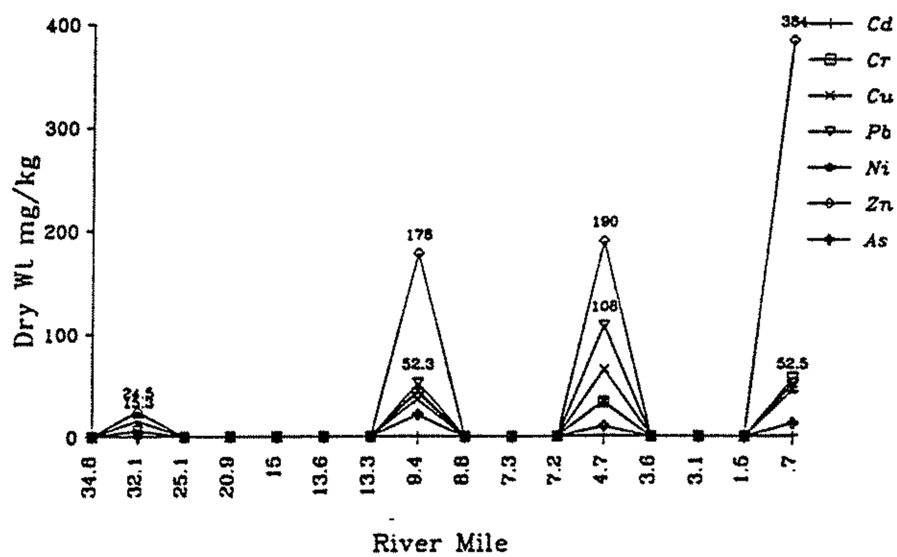
MAUMEE BWQR: MAUMEE RIVER

Figure 42: Macroinvertebrate Densities



MAUMEE BWQR: MAUMEE RIVER

Figure 43: Sediment Metals



Ohio EPA also analyzed sediment samples from the Maumee River, Swan Creek, and the Ottawa River for a variety of volatile organic compounds. The complete sampling records are presented in Appendix A. Table 17 gives the sediment data in summary form, listing only those samples where detectable amounts of the volatile organics were found. A summary of the draft *BWQR Report* is presented in Appendix G. It presents Ohio EPA's field observations and a discussion of the data in greater detail.

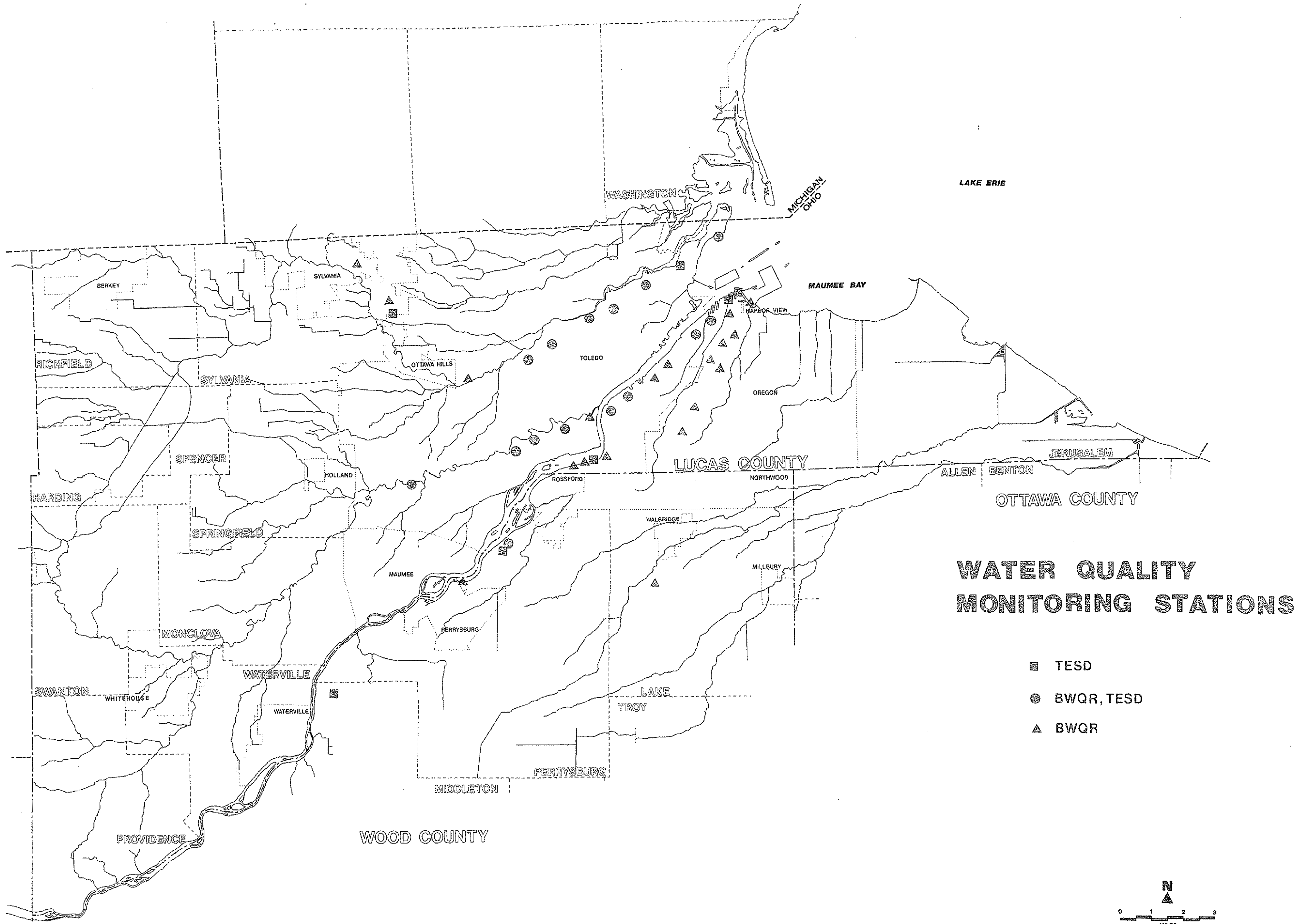
TABLE 17
BWQR SEDIMENTS: PRIORITY POLLUTANT DATA

CAS Number	Volatile Compound	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg	Conc µg/kg
	Stream ⟹	Maumee	Maumee	Maumee	Swan	Swan	Otter	Otter	Otter	Ottawa	Ottawa
	River Mile ⟹	9.4	4.9	1	1.2	1.2	5.9	4	2.1	6.4	4.9
	Station ⟹	Eagle Pt	Cherry St	WWTP	Collingwood	Collingwood	Oakdale	Wheeling	Millard	Lagrange	Stickney
67-64-1	Acetone		44			38	49				
108-05-4	Vinyl Acetate					39					
79-01-6	Trichloroethene				19						
108-88-3	Toluene	1300							320		
108-95-2	Phenol								890		
106-44-5	4-Methylphenol			1400					1700		
91-57-6	2-Methylnaphthalene		790								
83-32-9	Acenaphthene		1400			5300					
132-64-9	Dibenzofuran		1300			4900					
86-73-7	Fluorene		2500			7500					
85-01-8	Phenanthrene		11000	1000		29000	8700	2300		2800	4100
120-12-7	Anthracene						1900	830			
206-44-0	Fluoranthene		11000	2100		26000	12000	3500		6600	5400
129-00-0	Pyrene		7300	1900		22000	7500	3700	710		4900
85-68-7	Butylbenzylphthalate										4300
56-55-3	Benzo(a)anthracene		3500	1000		11000	5000	1800			3200
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)							650			
218-01-9	Chrysene		4000	1000		8800	3400	1700			2800
117-84-0	Di-n-octyl Phthalate			1200							3600
205-99-2	Benzo(b)Fluoranthene		1900	2000		6500	3900				
207-08-9	Benzo(k)Fluoranthene		2500	880		4400	2700				
50-32-8	Benzo(a)Pyrene		2300	950		4800	2500	1000			1800
193-39-5	Indeno(1,2,3-cd)Pyrene		1500	910			2200	680			1700
53-70-3	Dibenz(a,h)Anthracene		970	890			1000				
191-24-2	Benzo(g,h,i)Perylene		1800	1100			2600	750			1800
53469-21-9	Aroclor-1242					1600					2500

Figure 44 shows the sampling sites for both TESD and Ohio EPA for the major waterways. The "square" indicates only TESD sites, the "circle" indicates both agencies, while the "triangle" indicates the sampling sites for the BWQR investigative team.

INSERT FIGURE 44 HERE

Sampling site



LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

tmacog

U.S. Army Corps of Engineers 1983 Toledo Harbor Sediment Analyses

In 1983, Floyd Browne Associates and Aquatech, under contract from the U.S. Army Corps of Engineers, collected and analyzed sediments from Toledo Harbor. These data collected under this project are presented in Table 18.[22] Included in this table are the severity ratings for various parameters when applying either the Ohio EPA guidelines or the US EPA guidelines. Figures 45-48 show how the parameters tested vary by river (or lake) mile. Figure 45 shows Phenol, Hg, CN, and Cd; Figure 46 shows As, Cr, Pb, Cu, and Ni; Figure 47 shows Zn, NH_3, Mn, P, and TKN; and Figure 48 shows Fe and COD.

TABLE 18
US ARMY CORPS OF ENGINEERS, 1983
TOLEDO HARBOR SEDIMENT DATA

PARAMETER	Abbrev.	R-7-M	R-6-M	R-5-M	R-4-M	R-3-M	R-2-M	R-1-M	0-M	L-1-M	L-2-M	L-3-M	L-4-M	L-5-M	L-6-M	L-7-M
There are no sediment guidelines for the following parameters:																
Tot Solids, %	TS	44.7	43.1	53.3	47.4	38	39.9	52.8	39.5	36.7	53.5	34.7	51.7	47.7	32.3	38
Phenols	Phenol	.1	.1	.3	.1	.1	1.3	.3	.2	.1	.3	1.4	.1	.1	.1	.1
US EPA has established sediment guidelines for the following parameters:																
Vol. Solids, %	TVS	6.14	5.22	5.61	5.94	6.55	6.99	5.8	5.48	6.69	4.21	5.1	4.31	4.43	6.19	4.85
Severity		C	C	C	C	C	C	C	C	C	A	C	A	A	C	A
Mercury	Hg	.2	.1	.4	.1	.2	.1	.2	.3	.2	.1	.1	.1	.2	.2	.3
Severity		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Cyanide	CN	.18	.92	2.1	.27	.37	1	1.6	2.5	.8	.52	.05	.32	.28	.46	.49
Severity		C	E	E	E	E	E	E	E	E	E	A	E	E	E	E
Nickel	Ni	48	51	47	57	54	61	59	59	53	38	50	41	42	49	38
Severity		C	E	C	E	E	E	E	E	E	C	E	C	C	C	C
Ammonia-N	NH3-N	191	139	132	150	170	275	716	260	236	133	169	146	192	205	116
Severity		C	C	C	C	C	E	E	E	E	C	C	C	C	E	C
Manganese	Mn	488	510	382	480	491	482	467	504	580	382	576	481	434	555	445
Severity		C	E	C	C	C	C	C	E	E	C	E	C	C	E	C
Total P	P	952	1030	1030	1200	1210	1340	2120	1470	1050	827	869	749	804	812	900
Severity		E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
TKN	TKN	988	1980	1570	1650	1740	847	1630	2540	2410	1510	2550	1570	1820	1330	2050
Severity		A	C	C	C	C	A	C	E	E	C	E	C	C	C	E
COD	COD	76000	73200	54400	61700	60900	82700	84700	91900	95600	56400	102000	77700	76600	95000	77600
Severity		C	C	C	C	C	E	E	E	E	C	E	C	C	E	C
Ohio EPA has established sediment guidelines for the following metals:																
Cadmium	Cd	1.4	1.4	1.6	1.2	1.8	2	4	2.2	2	1.2	1.4	1	1.2	1.6	1.2
Severity		D	D	D	D	D	E	E	E	E	D	D	C	D	D	D
Arsenic	As	13.2	18	8.5	16.4	12.3	18.6	9.9	18.2	12.4	10.3	13.8	11.6	10.5	13.4	11.8
Severity		B	C	A	B	A	C	A	C	A	A	B	A	A	B	A
Chromium	Cr	28	26	26	29	34	43	71	50	34	23	30	22	24	31	24
Severity		E	E	E	E	E	E	E	E	E	D	E	D	E	E	E
Lead	Pb	22	28	55	37	40	42	135	36	29	19	27	20	25	26	24
Severity		B	C	D	C	C	C	E	D	D	A	B	A	B	B	B
Copper	Cu	38	39	46	53	46	51	76	52	43	30	43	35	35	40	31
Severity		D	D	E	E	E	E	E	E	D	D	D	D	D	D	D
Zinc	Zn	140	145	149	158	184	213	303	211	161	106	142	106	120	142	112
Severity		C	C	C	D	D	D	E	D	D	B	C	B	C	C	C
Iron	Fe	31100	32600	20300	31800	34900	37000	30200	33100	32600	23000	30500	24500	25300	30400	22900
Severity		B	B	A	B	B	C	B	B	B	A	B	A	A	B	A

Except where noted, units are mg/kg.

Key to Severity Ratings:

	Ohio EPA Guidelines	US EPA Guidelines
A	Non-Elevated concentration	Non-Polluted
B	Slightly Elevated concentration	
C	Elevated concentration	Moderately Polluted
D	Highly Elevated concentration	
E	Extreme Elevated concentration	Heavily Polluted

MAUMEE RIVER SEDIMENTS
US Army COE, 1983

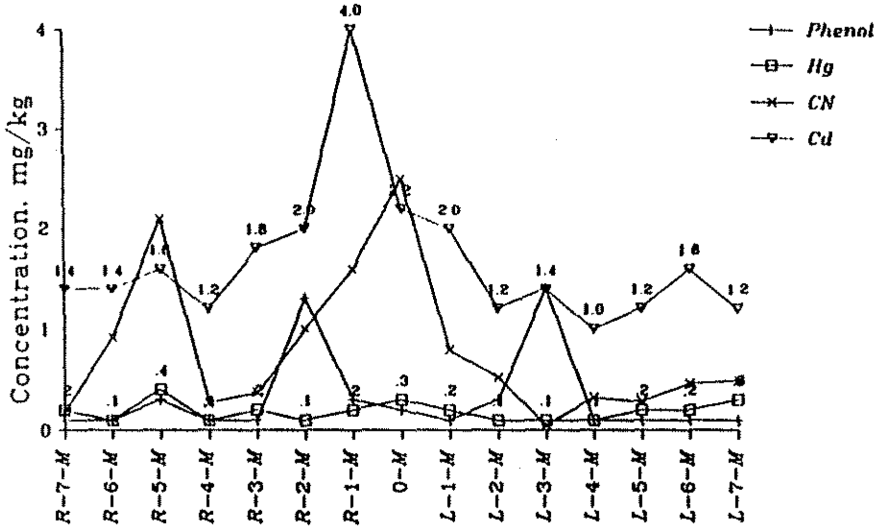


Figure 45

MAUMEE RIVER SEDIMENTS
US Army COE, 1983

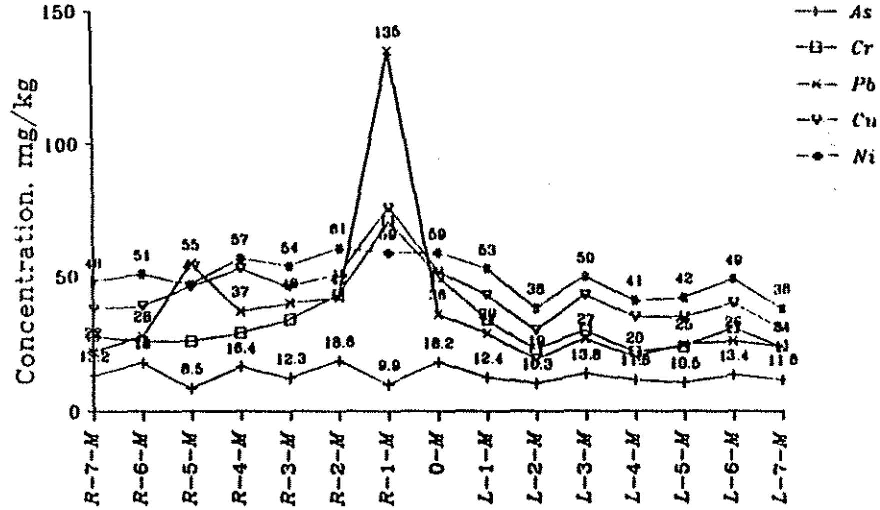


Figure 46

MAUMEE RIVER SEDIMENTS
US Army COE, 1983

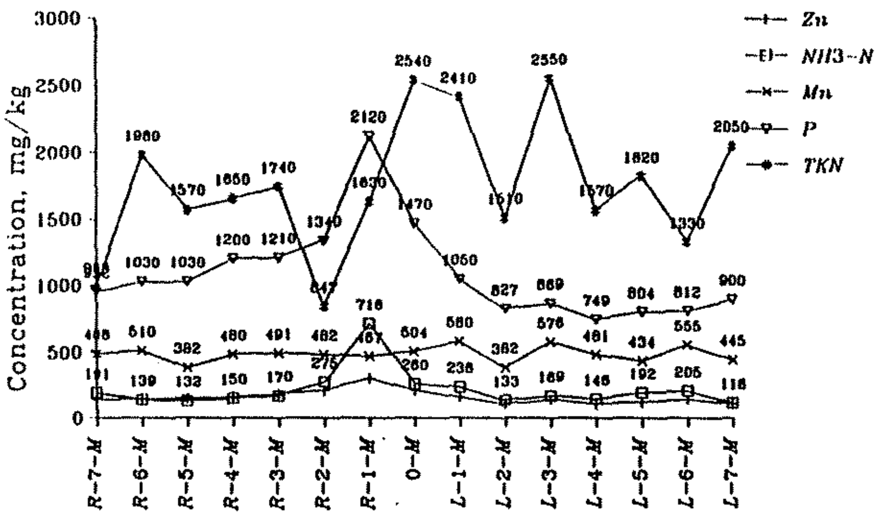


Figure 47

MAUMEE RIVER SEDIMENTS
US Army COE, 1983

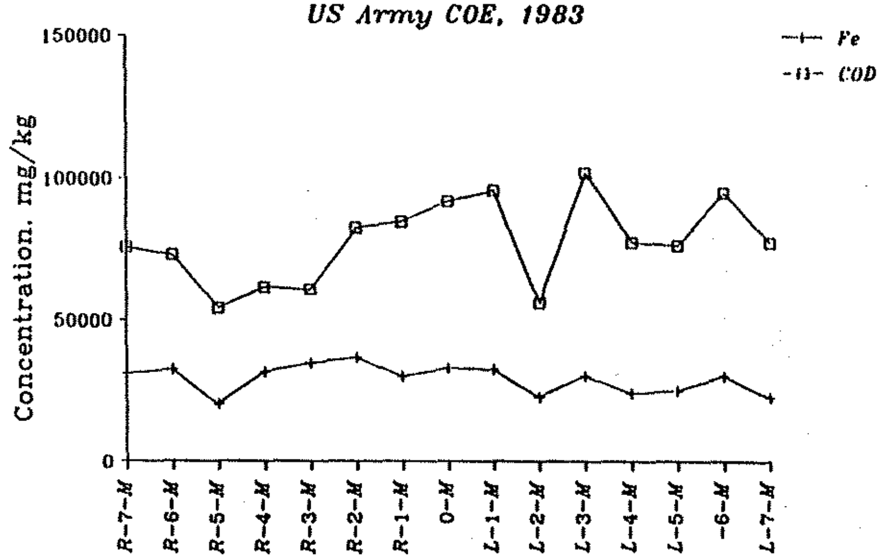


Figure 48

Facilities Plans

Facilities Plans are the first step in an application for Construction Grant funding from EPA. They include an assessment of the present situation in the study area, including water quality, and a forecast of future needs. Many Facilities Plans involved stream sampling to document water quality problems, especially septic tank discharges or other problems which new sewers or treatment plant improvements would alleviate.

Lucas County Facilities Plan

Finkbeiner, Pettis, and Strout performed water quality sampling on many streams in western Lucas County for the *Lucas County Plan Update*[23]. On the smaller ditches, data collected for the Facilities Plan are still the only samples on record. The parameters tested, for the most part, were NH_3-N, BOD_5, DO, Fecal Coliform, and Fecal Strep. Data for each station includes the ratio of coliform to strep, which is used for a basis for determining whether bacterial contamination is due to animal wastes or human wastes. Many violations of water quality standards were noted, but will not be reiterated here. The data is available in Appendix G of the Facilities Plan. Since 1981, portions of the problem areas have been sewered, and it is probable that water quality violations in those areas have been eliminated.

Table 19 is an updated summary of this facilities plan data. The sampling points listed are:

a. Points at which water quality violations were found in 1981, and

b. Are still unsewered, or are immediately downstream from unsewered areas, and

c. Indicated (in 1981) that contamination was due to human wastes.

TABLE 19
LUCAS COUNTY FACILITIES PLAN:
WATER QUALITY MONITORING FOR 1983 UPDATE

SITE NO	STREAM	APPROXIMATE LOCATION	PARAMETER VIOLATED	NOTES
1	Tenmile Cr	Sylvania & Mitchaw	NH_3, FC	
2	Tenmile Cr	Sylvania & Silica	FC	
3 *	Ottawa River	Sylvania W of Corey	FC	Bentbrook to be sewered
5 *	Tenmile Cr	Centennial & Silica	FC	
9 *	Smith Dt	Central & King	FC	
11	Smith Dt	Bancroft E of McCord	FC	Subdiv upstrm sewered
12*	Vanderpool Dt	Bancroft & King	FC	
13*	Heldman Dt	Dorr & King	FC	
16*	Heldman Dt	Nebraska & McCord	NH_3, FC	Immediate area sewered
17*	Heldman Dt	McCord SE of Nebraska	NH_3, FC	Immediate area sewered
20*	Haefner Dt	Dorr & McCord	FC	
24*	Butler Dt	Old St Line & Irwin	FC	
28*	Butler Dt	Airport E of Crissey	NH_3, FC	
29*	Kujowski Dt	Crissey S of Airport	FC	
30	Cunningham Dt	Crissey N of Garden	FC	
31	Zaleski Dt	Eber & Salisbury	FC	
32	Wolf Cr	Albon & Airport	FC	
33	Wolf Cr	Gunn & Airport	FC	
34	Wolf Cr	Off Airport W of Holloway		
38*	Good Dt	Angola @ I-475	NH_3, FC	
39*	Butler Dt	Old St Line W of Crissey	FC	
45*	Wiregrass Dt	Soul Rd E of Wilkins	FC	
46*	Wiregrass Dt	Wilkins @ 20A	FC	

*In designated area planned for sanitary sewer service in *Areawide Water Quality Management Plan*

Fish kills, cited by a 1979 ODNR report, are also mentioned in the *Lucas County Facilities Plan Update*. They occurred in 1976 on Wolf Creek, due to a chlorine solution, and in 1976 on Swan Creek due to a municipal sewage discharge.

Additional sampling was conducted in 1985 for a Facilities Plan update[24], which was written to apply for funding to construct sanitary sewers for the Dorcas Farms and South Hill Park subdivisions in Springfield Township, northeast of Holland. As yet, these sewers have not been built, so these samples, which are summarized in Table 20, may still be considered current.

TABLE 20
LUCAS COUNTY FACILITIES PLAN:
1985 MONITORING FOR DORCAS FARMS & SOUTH HILL PARK

SITE NO	1983 SITE NO	STREAM	APPROXIMATE LOCATION	SAMPLE NO	BOD_5	DO	NH_3	FC
1	38	Good Dt	Angola W of I-475	1	164.0	1.6*	26.3*	2,600,000*
			Below S Hill Park	2	46.0	2.9*	13.9*	550,000*
				3	24.0	1.8*	7.4*	1,600,000*
				AVG	78.0	2.1*	15.8*	1,583,333*
2	n/a	Good Dt	Above Wolf Creek	1	5.4	7.8	.4	380
				2	4.8	7.4	.0	120
				3	2.1	7.2	.4	320
				AVG	4.1	7.5	.3	273
3	n/a	Wolf Cr	Below Good Ditch	1	1.4	8.4	.0	1,200
				2	2.0	8.4	.0	630
				3	1.6	8.0	.1	630
				AVG	1.7	8.3	.1	820
4	n/a	Swan Cr	Below Wolf Creek	1	1.1	8.6	.0	680
				2	1.8	7.4	.0	560
				3	1.4	8.0	.1	460
				AVG	1.4	8.0	.0	567

*A water quality violation based on 2000 fecal coliform/100 ml, 0.5 ppm NH_3, and 5.0 ppm DO. There is no water quality standard for BOD_5, but in clean water, it should be close to 0.

Good Ditch flows through the subdivisions, and sampling site #1 is immediately downstream. Houses in the development presently use septic systems, and failures of these systems are widespread and well-documented. The sampling data clearly show pollution from untreated sewage.

Toledo Facilities Plan

The *Toledo Facilities Plan* was written in a number of volumes. It included separate volumes for different phases of sewerage system improvements, and there was a *Combined Sewer Overflow Study* (CSO) written in 1978[25], and updated in 1987.

The 1978 study included the following water quality monitoring:

1. Rainfall quantity vs. overflow quantity from various combined sewage regulators.

2. Sediments were collected at five sites along Swan Creek from the mouth to Byrne Road; and at six sites on the Maumee ranging from river mile 0 to river mile 8. Samples were analyzed for BOD_5, COD_5, P, TKN, Organic Nitrogen, NH_3, NO_2, NO_3, Oil & Grease, Fe, and Zn.

The *Tenmile Creek Facilities Plan*[26] included similar sediment sampling at four sites on Tenmile Creek, ranging from mile point 6.2 to mile point 15.0. Parameters tested were BOD_5, COD_5, P, TKN, Organic Nitrogen, NH_3, NO_2, NO_3, Oil & Grease, Fe, and Zn.

Oregon Facilities Plan

Seven ditches and creeks were sampled for the 1974 *Oregon Facilities Plan*.[27] Drainage areas sampled were Amlosch/Driftmeyer Ditches, Heckman Ditch, Big Ditch, Tobias Ditch, and Wolf Creek. Fifteen samples were taken between 12/3/73 and 6/26/74. Parameters recorded were Cond., DO, BOD_5, P, Total Coliform, Fecal Coliform, Fecal Strep., Turb., Cl, NH_3, NO_2, and NO_3.

Additional sampling was done for the Harbor View Area update of the *Oregon Facilities Plan*.[28] Samples were collected at five sites, catch basins or ditches, and analyzed for DO, BOD_5, SS, P, fecal coliform, and fecal strep. One site had a DO of 4.4 ppm, and another had 5.1 ppm; the other three were under 1.5 ppm. Fecal coliform counts ranged from 25,000 to 1.1 million. BOD_5 ranged from 1.0 ppm to 148 ppm. These parameters indicated the presence of sewage.

Ohio EPA collected grab samples from seven ditches or storm sewers in July, 1981 following thunder storms. The only parameter analyzed was fecal coliform. Two sites had counts under 100. One was 360 bacteria/100 ml; and the other four ranged from 1000 to 360,000. These samples also indicate sewage.

Luckey Facilities Plan

One grab sample was taken at each of 27 sites in local streams and ditches. Parameters analyzed were BOD_5, fecal coliform, and DO. These samples showed the presence of sewage in the streams. The Village of Luckey presently has a combined sewerage system. The system collects dry-weather sewage flows and treats the wastewater in a lagoon WWTP, which is operated by the Village. This system was placed in operation in late 1987.

Maumee Combined Sewer Overflow Study

Maumee's combined sewer overflows were studied in detail in this report. This study is discussed in more depth in the section under CSOs.

The TMACOG 208 Program

When the Clean Water Act (PL 92-500) was originally enacted in 1972, funding was included to perform intensive water quality assessment and planning. Water quality parameters analyzed included SS, C, N, P, CODs and BODs of various durations and fecal coliform. One site in the Maumee Basin was monitored in 1974, and eight sites in 1975-76.

Maumee Bay Environmental Quality Studies

In 1974 and again in 1977, detailed investigations of the environmental conditions of the Maumee Bay were conducted by a team of researchers directed by Dr. Peter Fraleigh of the University of Toledo. These studies represented an examination of Maumee Bay before and after the construction of the Confined Disposal Facility (Facility #3) in Maumee Bay at the mouth of the River. The studies examined water quality, water mixing patterns, sedimentation and erosion patterns, and the biological characteristics of the Bay. Major reports of the studies are:

The Maumee Bay Environmental Quality Study 1974-Final Report, Toledo Lucas Port Authority, September 1975.

The Maumee Bay Environmental Quality Study 1977-Final Report, Toledo Lucas County Port Authority, January 1979.

BOD, bacteria counts, nitrogen compounds (NO_3, NO_2, NH_3, TKN), and phosphorus compounds are "conventional pollutants," and are commonly used to test for sewage. Nitrogen and phosphorus parameters are also commonly measured to determine the effects of agricultural runoff on a stream. Most of the water quality collected in the Maumee basin consists of tests for these "conventional" pollutants.

The USGS station at Waterville provides a long history of water quality data for the Maumee as it comes into the Toledo area. TESD data provides a similar history for water quality in the Toledo area. The BWQR monitoring covered many of the same parameters, but also took at detailed look at the streams' biology, and sampled sediments.

TOLEDO ENVIRONMENTAL SERVICES DATA

Discussion of TESD Data

TESD sampling includes the "conventional" pollutants: solids, phosphorus, BOD_5, nitrogen compounds, bacteria counts, conductivity, chloride, and pH. The sampling program is geared toward detecting pollution from untreated sewage. The reason for this is to record the effects of CSOs, which have long been known as a major source of pollution in Toledo streams.

Swan Creek

Bacteria Counts

The average July bacteria counts were less than the year-round averages for Swan Creek. The creek reaches its worst around MP 2.6 (Hawley St). At this point the annual average total coliform was over 1.5 million, and the July average was around 500,000. Fecal coliform counts were also high (50,000 annual average and 34,000 July average). Bacteria counts decreased below MP 2.6.

Pollution Counts

Annual average DO ranged from 9.7 ppm at MP 10.6 (Eastgate Rd), down to 7 ppm at MP 0.6 (St. Clair St). July averages showed the lowest reading at MP 2.6, of 4.4 ppm. DO increased to 5.0 ppm at MP 0.6.

NH_3 showed a marked increased at MP 2.6 for July averages. Annual average NH_3 also showed a steady increase heading downstream.

Average phosphorus concentrations were in the range of 0.4 to 0.5 ppm, and did not seem to change much from station to station. For July averages, phosphorus peaked at 0.7 ppm at MP 2.6.

Year-to-Year Comparisons

Upstream at Eastgate Road, BOD_5 was nearly constant from 1981-4, and showed increases in 1985 and 1986. Downstream at Hawley St, it decreased in 1982 and 1983. At Eastgate, DO decreased each year from 1981-5, and showed a marked improvement in 1986, but at Hawley, the pattern was the same.

At Eastgate, NH_3 showed a constant increase from 1981-5, and dropped in 1986. At Hawley, there were small increases in 1982 and 1983, and a large one in 1984. NH_3 decreased in 1985 and 1986 overall. Phosphorus was fairly constant at both stations.

Bacteria counts showed big peaks at Eastgate in 1982 and 1983, and a smaller peak in 1985. At Hawley, there was a large peak in 1985, but counts were relatively constant the other years.

Tenmile Creek/Ottawa River

Bacteria Counts

Bacteria counts peaked at MPs 6 (Lagrange St) and 4.7 (Stickney Ave). July averages for total coliform at these points were close to 400,000. Annual average peaked at MP 6 with a count of around 150,000. Fecal coliform showed less of a sharp peak; July averages at four consecutive stations (MP 8.9, 7, 6, and 4.7) were over 30,000.

Pollution Counts

Annual average DO ranged from 9.1 ppm at MP 10.9 (UT Bridge), dropped to 7.2 at MP 6, and increased back to 9.2 at MP 1.6 (Summit St). The lowest DO readings were found at MP 7. Below MP 3.1 (Suder Ave), DO was over 8 ppm. BOD_5 averaged 3-4 ppm above MP 7 (Berdan Ave), where it increased sharply. All averages below MP 7 were over 5 ppm.

NH_3 ranged from 0.2 ppm at MP 14.1 (Sylvania Ave) to 1.9 ppm at MP 1.6. Phosphorus remained steady at 0.2 to 0.3 ppm at all stations. The patterns for July averages were similar.

Year-to-Year Comparisons

Upstream at Sylvania Ave, BOD_5 increased in 1982-3, dropped in 1984-5, and rose again in 1986. Downstream at Lagrange Street, there was a big peak in 1982, and steady decreases in 1983-6. At Sylvania, DO showed fluctuations from year to year, but appear to be slowly decreasing over the six-year period. Lagrange showed the same pattern in DO.

NH_3 showed a general increase at Sylvania, with a slight decrease in 1986. This pattern was repeated at Lagrange. Phosphorus remained constant at both stations.

Bacteria counts showed increases in 1982 and 1983, improvement the next two years, and a big peak in 1986 at Sylvania. At Lagrange, there was a big peak in 1982, then improved, but still had a high count the next year; more decreases in 1984-5, and a peak back to 1983 levels in 1986.

Maumee River

Note: Sampling at MP 1.2 (NE corner WWTP) was discontinued after 1983. No samples were taken at this site in July or August 1981-3. June, 1982 data is used in Figures 23 and 25.

Bacteria Counts

The Maumee River also showed a sharp peak in bacterial counts. The peak stations were MP 1.2 with an annual average count of 115,000 total coliform, and 10,000 fecal coliform.

Pollution Counts

For annual averages, BOD_5 and NH_3 both peaked at MP 1.2 (8.4 ppm and 3.0 ppm, respectively). One station upstream at MP 1.7 (Toledo Terminal bridge), both parameters were notably higher than further upstream. Below MP 1.2, both parameters dropped sharply.

DO reached its lowest level (6.6 ppm) at MP 1.7, and increased to 8.2 ppm at MP 1.2. Further downstream, average DO was over 7 ppm.

Year-to-Year Comparisons

Upstream at Waterville, BOD_5 appears to show a general increase without big peaks. In 1986 levels were lower than 1985, however. Near the mouth (Toledo Terminal bridge), BOD_5 shows a declining trend instead, with an especially large drop in '84. There was an increase in 1986. DO at Waterville appears to show a slight general increase, although with a peak average DO of 10 ppm in 1984. The trend appears reversed near the mouth, with drops in DO from 1982-1985, and improvement in 1986.

At Waterville, NH_3 was low in 1981-2, and showed a marked increase in 1983, which was maintained in 1984-6. Near the mouth, NH_3 showed a general decline, with a big drop in 1982. Concentrations were lower than upstream.

At Waterville, P was steady throughout the period. At the mouth, P remained fairly steady through the period, although with a peak in 1986.

Bacterial counts at Waterville showed large variations with no noticeable trend. Generally all three bacterial parameters (total coliform, fecal coliform, and fecal strep) follow the same pattern, with total coliform showing the highest numbers and greatest fluctuations. In 1986, however, total coliform and fecal strep decrease at Waterville, while fecal coliform showed a sharp increase. Near the mouth, there appears to be a very clear trend. Bacterial counts showed a sharp decrease in 1982, and continued dropping in 1983-5. In 1986 there was a slight increase again.

Tributaries

Bacteria Counts

The annual average fecal coliform counts for all sampling stations exceeded 1000, the average standard for warmwater habitat primary contact streams. Otter Creek, Delaware Creek, and Grassy had average fecal coliform counts under 2000 for July (the maximum standard), which the other stations exceeded that limit as well. Hill Ditch had an average July fecal coliform count of 15,000; Silver Creek had 37,000; Shantee Creek had 37,000; and Heilman Ditch had 21,000.

Pollution Counts

Otter Creek and Grassy Creek both showed high BOD_5 levels, and lower DO than the other creeks. Grassy Creek had an average BOD_5 of 14.5, and a July average of 17. DO averaged about 7 ppm, and 4.9 ppm in July. Grassy Creek BOD_5 averaged 7.4 ppm, and was 13.1 ppm in July. DO averaged 7.5 ppm, and was 5.8 ppm in July. The other creeks had 5 to 6 ppm BOD_5, without a significant July peak.

NH_3 was in the 0.7 to 0.8 ppm range for all creeks except Otter and Heilman, which averaged close to 5 ppm. None of the creeks showed a July peak; Otter Creek's July NH_3 level dropped to 2.1 ppm. All creeks had P concentrations in the 0.2 to 0.3 ppm range, except Otter (0.6 ppm) and Heilman (1.1 ppm). Heilman was the only creek to show a July peak for phosphorus, which was 1.7 ppm. By comparison, a major sewage treatment plant's effluent is required to contain less than 1.0 ppm P.

Trends from TESD Data

Table 21 compares the year-to-year increases and decreases in the average BOD_5, DO, NH_3, P, and fecal coliform values at the upstream and downstream stations.

TABLE 21
TESD DATA: WATER QUALITY TRENDS

	1982	1983	1984	1985	1986
SWAN CREEK					
Eastgate BOD_5	-	+	+	+	+
Hawley BOD_5	-	-	+	+	-
Eastgate DO	-	-	-	-	+
Hawley DO	-	-	-	-	+
Eastgate NH_3	+	+	+	+	-
Hawley NH_3	-	x	+	-	-
Eastgate P	+	+	-	-	+
Hawley P	+	-	+	+	x
Eastgate Fecal coliform	+	-	-	-	+
Hawley Fecal coliform	+	-	-	+	-
OTTAWA RIVER					
Sylvania Ave BOD_5	-	+	-	-	+
Lagrange BOD_5	+	-	-	-	-
Sylvania Ave DO	-	+	-	-	+
Lagrange DO	-	-	-	+	-
Sylvania Ave NH_3	+	+	+	+	-
Lagrange NH_3	+	-	+	+	-
Sylvania Ave P	-	-	+	-	x
Lagrange P	+	-	x	-	x
Sylvania Ave Fecal coliform	+	+	-	+	+
Lagrange Fecal coliform	+	-	-	-	+
MAUMEE RIVER					
Waterville BOD_5	+	+	-	+	-
TT* Bridge BOD_5	+	-	-	-	+
Waterville DO	+	-	+	-	-
TT Bridge DO	-	-	-	-	+
Waterville NH_3	+	+	x	+	x
TT Bridge NH_3	-	+	-	-	-
Waterville P	x	+	x	+	x
TT Bridge P	-	-	x	x	+
Waterville Fecal coliform	+	-	-	+	-
TT Bridge Fecal coliform	-	-	-	-	+

KEY:

\+ This parameter showed *improvement* from the previous year
\- This parameter showed *lower water quality* than the previous year
x This parameter showed *little or no change* from the previous year

* TT = Toledo Terminal rail bridge over the Maumee River

The Maumee Basin BWQR gives substantially the same picture of water quality in area streams as the TESD data. In general, the three major streams (Maumee River, Ottawa River, and Swan Creek) have their best water quality upstream of the RAP Area, continually decline until just above the mouth of the stream,and then show some improvement. The point where each of these streams is most severely degraded, according to BWQR data, corresponds closely to the "worst point" shown by TESD data. This is not absolutely true for every parameter sampled, but overall, the generalization holds. For additional detail, refer to Figures 35-43, which graph the BWQR data for each of the three major streams; and Appendix A, which gives the BWQR data.

BWQR Sediment Samples

There are no specific standards for pollutant concentrations in stream sediments. US EPA, Ohio EPA and the Ontario MOE offer guidelines for metals, nutrients, and PCBs, but none for the volatile organics found in the BWQR samples of November, 1986.

Table 22 displays the results of Ohio EPA's analyses of the 1986 sediment sampling at eleven locations for seven heavy metals, when applying the US EPA Sediment Quality Guidelines. Only cadmium is classed as "non-polluting" at all locations. None of these metals are considered a pollution factor upstream at the Grand Rapids Dam. As shown, the other three locations on the Maumee River are classed "heavily polluted" for arsenic, with the Cherry Street Bridge location classed as "heavily polluted" for both lead and copper, with the Toledo WWTP location classed as "heavily polluted" for zinc. Chromium, copper, lead, nickel and zinc are classed as "moderately polluted" at the remainder locations.

For Swan Creek at the Collingwood Blvd. location, lead, zinc and arsenic are classed as "heavily polluted", chromium and nickel as "moderately polluted", and copper as "non-polluting".

For the Ottawa River, classed as "heavily polluted" are copper, lead, nickel and zinc for the Lagrange Street location, with the Stickney Avenue location similarly classed for copper and lead. Chromium is classed an "non-polluting" for the Stickney Avenue location, with the remaining metals for these two locations on the Ottawa River being classed as "moderately polluted".

For Otter Creek, the Wheeling Street location is classed as "heavily polluted" for chromium, lead and arsenic, with the Oakdale Avenue location similarly classed for arsenic, and Millard Avenue for copper. Copper is classed as "non-polluting" for the Oakdale Avenue location, with the remaining metals for these three locations on Otter Creek being classed as "moderately polluted".

Duck Creek at York Street is classed as "heavily polluted" for arsenic, with zinc and lead as "moderately polluted", and the remaining three metals as "non-polluting".

TABLE 22
RATING OF HEAVY METALS IN SEDIMENT BY STREAM LOCATION
(by US EPA Classification)

STREAM	LOCATION	RM	Cd	Cr	Cu	Pb	Ni	Zn	As
Maumee	Grand Rapids Dam	32.6	NP	NP	NP	NP	NP	NP	--
Maumee	Eagle Point	9.4	NP	MP	MP	MP	MP	MP	HP
Maumee	Cherry Street	4.9	NP	MP	HP	HP	MP	MP	HP
Maumee	Toledo WWTP	1.0	NP	MP	MP	MP	MP	HP	HP
Swan Creek	Collingwood Blvd.	1.2	NP	MP	NP	HP	MP	HP	HP
Ottawa River	Lagrange Street	6.4	NP	MP	HP	HP	HP	HP	MP
Ottawa River	Stickney Avenue	4.9	NP	NP	HP	HP	MP	MP	MP
Otter Creek	Oakdale Avenue	5.9	NP	MP	NP	MP	MP	MP	HP
Otter Creek	Wheeling Street	4.0	NP	HP	MP	HP	MP	MP	HP
Otter Creek	Millard Avenue	2.1	NP	MP	HP	MP	MP	MP	MP
Duck Creek	York Street	2.1	NP	NP	NP	MP	NP	MP	HP

Key

HP	Heavily Polluted
MP	Moderately Polluted
NP	Non-polluted

Source: Table C-5, Biological and Water Quality Report, Ohio EPA

<u>BWQR Fish Indices</u>

As a part of the Biological and Water Quality Report conducted by Ohio EPA in the summer of 1986, investigators based on electrofishing collections, compared fish species documented in the Maumee River study area as reported in Trautman (1981).[29] Trautman reported 87 different species in 1981, with Ohio EPA reporting 50, finding four new species, with 41 missing species. The four new species were: smallmouth buffalo, ghost shiner, mosquitofish, and white perch.

The investigative team reported for Swan Creek 39 species compared to Trautman's 75, with three new species, totaling 36 missing species. For the Ottawa River, Trautman had reported 79 species in 1981, with the investigative team reporting 44 species, five new species, totaling 38 missing species. For Duck and Otter Creeks, Trautman reported 62 species, with the investigative team reporting 25, one new species, totaling 38 missing species.

This investigative team reported the percentage of fish with external anomalies for Swan Creek. The investigation began at Eastgate Road (RM 10.2) where faunal conditions were the best, going downstream to St. Clair Street (RM 0.5). Eastgate Road is upstream from all listed permitted dischargers with results being 9.3% light blackspot, 0.6% light anchor worm, and 0.9% lesions. The Detroit Avenue station (RM 4.9), the point of the upstream lake effect on Swan Creek, results were: 3.1% light blackspot, 1.5% heavy blackspot, and 3.1% deformities. Above the Roller Dam (RM 4.4) results were: 7% light blackspot, 0.6% deformities, 1.4% eroded fins, and 0.8% lesions. At Champion Street (RM 3.9), where the combined sewers begin, results were: 0.7% light blackspot, 0.7% heavy blackspot, 1.7% light anchor worm, 0.7% deformities, 1.7% eroded fins, 2.9% lesions, and 0.7% other. At

Hawley Street (RM 2.6), still in the combined sewer area, the results were: 1.5% light anchor worm, 1.5% eroded fins and 1.5% lesions.

The investigative team reported that fish community conditions were poor in all of these areas of Swan Creek with RMs 2.6 and 1.2 being very poor. Collingwood Blvd. (RM 1.2) the results were: 6.2% lesions and 1.8% external parasites. At St. Clair Street (RM 0.5), near the mouth where the Maumee River dilutes Swan Creek, the results were: 0.4% light anchor worm, 1.2% lesions, and 0.8% other.

The mean fish community indices based on electrofishing samples for both Duck Creek and Otter Creek as conducted by the investigative team indicated Class V or very poor, except for the near the mouth of Duck Creek which was poor, or Class IV.

The investigative team in its fish report for the Maumee River started upstream at RM 45.7 (downstream of Napoleon WWTP and Campbell Soup Co.), where fish community values were high (IWB=9.0, IWB2=8.7), though the team states that the community composition and quality were not that exceptional. At RMs 38.5 and 33, upstream of the Grand Rapids dam (RM 32.2), community values displayed a significant drop (IWB=6.9 and 6.7, IWB2=6.5 and 6.5 respectively).

The next four sites were located amongst the rapids, RMs 31.5, 26.7, 19.8 and 17.2, the community values were amongst the highest these (IWB=9.2, 8.8, 9.0 and 8.6, IWB2=9.0, 8.6 and 8.1 respectively). At RM 13.7, below the Perrysburg WWTP (RM 14.5) and at the point of the beginning of the lake effect, the community values dropped nearly a full point (IWB=7.5, IWB2=7.1). It is reported that the community values remained near this level at RMs 9.4, 7.4, 7.3 and 4.7. However, species composition did change at RM 4.7 downstream of Swan Creek. The IWB ranged from 7.8 to 7.1 while IWB2 ranged from 7.5 to 6.4.

The next five downstream stations (RMs 3.6, 3.3, 1.5 and 0.6), an area where strong seiche activities move pollution plumes both up and downstream, the IWB ranged from 7.2 and 6.4 and IWB2's ranged from 6.5 and 5.5, approximately a full point below those sites just upstream. It was thought that the upstream movement of the Toledo WWTP plume and the numerous combined sewer overflow discharges are the cause of the low community values.

The report states that the Toledo WWTP also effects the Maumee Bay wherein the Maumee Bay area (0.1 Toledo Edison intake channel and 0.0 southeast of Grassy Island disposal area) displayed the lowest community values, while site 0.4 in the Bay, farthest from the WWTP showed the best community values in the bay area.

Fish Tissue Sampling

Biological monitoring is a valuable tool for determining water quality because it provides a direct measure of the effects of pollutants on aquatic life. Fish tissue sampling answers the question of what pollutants, and how much, are being taken into the food chain. Fish which contain unacceptable levels of PCBs, heavy metals, or other toxics, cannot be used for human consumption. Even if people do not eat the contaminated fish, however, the toxics will stay in the food chain, and may ultimately find their way to the dinner table. Table 23 gives details of fish tissue sampling done in the Lower Maumee from 1976 to date.[30]

TABLE 23
PCB CONTENT OF FISH TISSUE, LOWER MAUMEE RIVER

YEAR	SAMPLE NUMBER	SPECIES	SAMPLE TYPE	RM	LOCATION	TOTAL PCBs (ppm)
1985	85	Rock bass	W.B.C.	20.6	Waterville	0.5
1985	87	Carp	W.B.C.	20.6	Waterville	1.0
1985	89	Carp	W.B.C.	20.6	Waterville	0.2
1978	--	Carp	W.B.C.	20.6	Waterville	0.3
1986	61	Green sunfish	W.B.C.	4.7	Maumee ?	3.9
1986	56	Yellow perch	W.B.C.	0.7	Cullen Park	4.0
1986	57	Carp	W.B.C.	0.7	Cullen Park	6.8
1985	83	Carp	W.B.C.	0.7	Cullen Park	3.0
1985	84	Bluegill	W.B.C.	0.7	Cullen Park	1.0
1978	--	Carp	W.B.C.	0.7	Cullen Park	4.8
1986	58	White perch	W.B.C.	0.0	Maumee Mouth	7.0
1986	59	Channel catfish	F.	0.0	Maumee Mouth	3.8
1986	60	Carp	W.B.C.	0.0	Maumee Mouth	5.5
1982	--	Carp	W.B.C.	0.0	Maumee Mouth	11.5
1979	--	Spottail shiner	W.B.C.	0.0	Maumee Mouth	3.3
1979(b)	--	Spottail shiner	W.B.C.	0.0	Maumee Mouth	2.9
1979	--	Northern pike	W.B.	0.0	Maumee Mouth	4.9
1979(b)	--	Northern pike	W.B.	0.0	Maumee Mouth	4.9
1979	--	Carp	W.B.C.	0.0	Maumee Mouth	5.9
1979	--	Yellow perch	W.B.C.	0.0	Maumee Mouth	2.1
1976	--	Carp/Catfish	W.B.C.	0.0?	Maumee Mouth?	5.4
			SWAN CREEK			
1986	62	Carp	W.B.C.	0.5	Swan Creek	5.9
			TENMILE CREEK			
1986	73	Carp	W.B.C.	4.1	Tenmile Creek	6.8
			OTTAWA RIVER			
1986	74	Largemouth Bass	W.B.C.	1.6	Ottawa River	12.0
1986	76	Carp	W.B.C.	1.6	Ottawa River	25.4
1986	75	Carp	W.B.C.	Dst	Stickney Ave	15.1

a. Data rounded to the nearest tenth; W.B.C. = whole body composite sample; F = fillet sample; RM = river mile.
b. Sample analyzed twice.

Ohio EPA has established guidelines for sediment quality for seven metals, but there are no guidelines for COD, Volatile Solids, TKN, NO_3, Oil & Grease, CN, Ni, Mn, Ba, Hg, or PCBs in sediments. US EPA has one set of guidelines for these parameters,[31] the Ontario Ministry of the Environment (MOE) has another set,[32] and the IJC has yet another.[33] Wisconsin also has a set of guidelines. There are significant differences between these sets of guidelines. Whether or not sediments are "polluted," or how polluted they are can depend on which set of guidelines is being used.

The US EPA and Ontario MOE guidelines for sediment quality parameters[31] not covered by Ohio EPA guidelines are presented in Table 24.

TABLE 24
US EPA AND ONTARIO MOE
GUIDELINES FOR SEDIMENT QUALITY
FOR GREAT LAKES HARBORS

	US EPA CLASSIFICATION			MOE LIMIT
	Non-Polluted	Moderately Polluted	Heavily Polluted	
Volatile Solids (%)	< 5	5 - 8	> 8	6
COD	< 40,000	40,000-80,000	> 80,000	50,000
TKN	< 1000	1000-2000	> 2000	2000
Oil & Grease (Hexane Solubles)	< 1000	1000-2000	> 2000	1500
NH_3	< 75	75 - 200	> 200	100
CN	< 0.1	0.1 - 0.25	> 0.25	0.1
P	< 420	420 - 650	> 650	---
Ni	< 20	20 - 50	> 50	25
Mn	< 300	300 - 500	> 500	---
Ba	< 20	20 - 60	> 60	---
Hg			≥ 1	0.3
Total PCB			≥ 10	0.05

All units are mg/kg dry weight unless otherwise indicated.

US Army Corps of Engineers shipping channel sediment data collected in 1983 show a serious heavy metal contamination problem. The metals of particular concern are Cd, Cr, Pb, Cu, Mn and Ni. In nearly all cases, the concentrations of these parameters are highest at and slightly above the mouth of the Maumee, between RM-2 and LM-1. Most parameters show some improvement past the mouth, in the Bay (LM-2 and beyond).

Table 27 displays the concentration levels of metals as found in the 1983 shipping channel sediments when applying the Ohio EPA sediment guidelines and the concentration levels of the remainder parameters for these same sediments when applying the US EPA sediment guidelines.

TABLE 25
CONCENTRATION LEVELS OF METALS AND CHEMICALS
IN 1983 SHIPPING CHANNEL SEDIMENTS

Arsenic (As)	Non-elevated to Elevated
Cadmium (Cd)	Highly to Extreme Elevated
Chromium (Cr)	Extreme Elevated
Copper (Cu)	Highly to Extreme Elevated
Iron (Fe)	Non-elevated to Slightly Elevated
Lead (Pb)	Non-elevated to Elevated
Zinc (Zn)	Elevated to Highly Elevated
Cyanide (CN)	Heavily Polluted
Chemical Oxygen Demand (COD)	Polluted to Heavily Polluted
Mercury (Hg)	Non-Polluted
Manganese (Mn)	Polluted to Heavily Polluted
Nickel (Ni)	Polluted to Heavily Polluted
Nitrate (NO_3)	Polluted to Heavily Polluted
Phosphorus (P)	Heavily Polluted
Total Kjeldahl Nitrogen (TKN)	Polluted to Heavily Polluted
Volatile Solids (VS)	Moderately Polluted

SUMMARY OF TOXIC POLLUTANTS

This section is concerned with those chemicals which are known to biomagnify, bioaccumulate, or are suspected of causing cancer as well as those which are acutely toxic to aquatic organisms. Categories of toxic pollutants of concern, in the AOC, include polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalates, and metals. Other categories of toxics which have not been studied in the Toledo Area include the dioxins and furans. Studies of Toledo Harbor sediments have not shown sediment bound pesticides at levels high enough to arouse concern, at least in the data available for review.

The Great Lakes International Surveillance Plan, 1986, states that, "The chemical contaminants issue, especially persistent toxic substances, is the major focus of the 1978 Great Lakes Water Quality Agreement and the monitoring and surveillance plans. The effects of toxic substances on the health of the Great Lakes ecosystem, including man, are not well understood. However, some obvious problems including closed fisheries, fish morphological abnormalities, fish kills, and impairment of reproduction and deformities in aquatic birds have been well documented. Present levels of certain substances are adversely affecting growth and reproduction in some Great Lakes biota, and contaminant levels in many top predator fish still exceed the guidelines for human consumption set by public health agencies in Canada and the United States." [1] To understand where and how these substances interact, both biotic and abiotic components of the system must be scrutinized. It is important to know the quantities and distribution of chemical contaminants and to identify the sources and fates of contaminants.

The 1986 Plan goes on to say that, "The Lake Erie Basin is the most seriously impacted of all the Great Lakes, having a total of eight Areas of Concern (including both Connecting Channels)." There is a lack of thorough quantitative pollution data bases for any of these areas (except Raisin River). "It has been documented that the most conspicuous problem found in the Areas of Concern centers around sediment contamination." [1] The current knowledge and understanding of geochemical and biological processes, and their contaminated sediment problems, are limited.

Further, the 1986 Plan states that, "The Maumee River contributes over 50% of the total non-point tributary loading to Lake Erie (excluding the Detroit River). It is the most important source of agricultural nutrients and suspended sediment to the lake and particularly to the Western Basin. Records of metal and organic contaminants, as well as nutrients preserved in the sediments, measure the change in status of the lake since before the beginning of man's influence. However, due to the widespread occurrence and activity of benthic organisms in recent lake sediments and generally low sedimentation rates, annual contributions of material are mixed with older sediments so that on the average two decades of input are smeared together (Robbins, 1983). As a result of this mixing, changes in the state of the Great Lakes can be detected in the sedimentary records only on multi-decade time scales. However, in certain areas of Lake Erie sedimentation rates are so high that the time resolution may be as low as 3 to 5 years. This means that the changes in the status of Lake Erie may be more closely monitored using these areas having high sedimentation rates." [1]

Nriagu and Simmons in their 1984 study found that the Total Suspended Matter (TSM) in Lake Erie (4-8 mg/l) is greater than any of the other Great Lakes. In the upper lakes 90% of the PAH is in the dissolved phase, but in nearshore areas of Western Lake Erie a substantial fraction of the PAH is associated with particles. Resuspension of sediments from the western basin of Lake Erie is extensive but release rates of sediment contaminants are unknown. [34]

Lake Erie inputs are less than the other Great Lakes except Ontario. The atmosphere is the largest source of PAH to the Great Lakes. Atmospheric inputs of benzo(a)pyrene (BaP) to Toledo area waters had been declining steadily until 1979, the last year for which there was available data. [34] Table 26 displays Nriagu and Simmons findings for 1982 PAH levels in Lake Erie.

TABLE 26
1982 PAH LEVELS IN LAKE ERIE

	Sediment ng/g(ppb)	Atmospheric input (metric tons per year)
phenanthrene	345±92	1.5
anthracene	?	1.5
fluoranthene	569±442	?
pyrene	391±91	2.6
BaP	255±52	2.5
Ba Anthracene	?	1.5
Perylene	?	1.5

Source: Nriagu and Simmons, 1984, p. 200-201

Frank, et al, 1977, found that in Lake Erie, the Western Basin sediments had the highest concentration of PCB (660 ng/g [ppb]). This amount is twice the level of PCB in sediments of the Central Basin and Eastern Basin of Lake Erie.[35] Nriagu and Simmons found that PCB concentrations are highest in areas of recent sedimentation and lowest in areas of scour where faster water currents prevent sediment accumulation. For Lake Erie waters an average PCB concentration of 27 ng/l has been reported. From 1968 - 1976 the average PCB concentration in Lake Erie fish was 0.88 μg/g (ppm) with a range from 0.1 to 9.3 μg/g. [34]

The 1986 Plan states that, "Heavy metal contamination problems associated with Lake Erie have been recognized for many years. For example, mercury concentration of Lakes Erie and St. Clair from 1950 - 1970 led to a ban of commercial fishing in both systems during the early 1970's. Nriagu, *et al.*, 1979 estimated loading of Cu, Pb and Zn into Lake Erie from various sources and found over 1 x 10^6 kg/yr of Cu and Pb and over 3 x 10^6 kg/yr of Zn to be retained in the lake annually. A significant portion of the load was attributed to sources originating from the Detroit River Connecting Channel System. In addition, metal contamination problems have been identified at numerous smaller tributaries entering Lake Erie's southern shore. Metal and organic contamination has led to the classification of six tributaries as Areas of Concern. As a result, the dispersion of metals into the open lake remains a concern and needs to be addressed." [1]

Lead concentrations in sediment tend to be highest in depositional zones and least in shallow nearshore zones. One exception is the "plume" of high sediment lead concentration emanating from Toledo. Levels of lead in Lake Erie waters range from 0.46 to 3.5 μg/l. Concentrations in sediments average 154$\pm$43 mg/kg. [34]

Carbon uptake in plants is a measure of growth or photosynthesis. Munawar and Thomas, 1984, found that standard elutriates of Toledo Harbor sediments caused significant inhibition of C^{14} uptake by ultraplankton (5-20 μm) in algal fractionation bioassays (AFB). Such phytoplankton are abundant, have very short generation times, and are fragile and sensitive to environmental perturbations. They are also primary producers - the food source upon which the rest of the aquatic food web is ultimately dependent. [36]

All Toledo standard elutriates caused significant inhibition of the ultra-plankton C^{14} uptake compared to the control (a reduction of 29% to 35% at a 20% elutriate concentration. (A standard elutriate was prepared by mixing one part sediment (v) with 4 parts (v) of filtered (.45 μm) lake water. This was then agitated 30 minutes by air, settled for one hour, and filtered (.45 μm). The liquid filtrate was then used in the AFB tests.) [36]

Mac and Willford, 1986, found that Toledo Harbor sediments (see Table 27) contained 0.210 μg/g (ppm) PCBs, most of which resembled Aroclor 1248. In a bioassay, there was no death of fathead minnows exposed to Toledo Harbor sediments and in a similar test of earthworms 36% died, although these were all in one tank in which an increase in temperature and a decrease in oxygen concentration occurred.

TABLE 27
PHYSICAL AND CHEMICAL CHARACTERISTICS OF TEST SEDIMENTS

	Physical Composition (% dry wt)				Contaminants (μg/g dry wt)		
Sediment	Sand	Silt	Clay	Volatile Solids	Oil & Grease	PCBs	Hg
Toledo Harbor	23.8	35.5	40.7	13.1	3700	0.210	0.314

Source: Mac and Willford, 1986, p.86

"Preliminary review of PCBs in fathead minnows exposed to the Toledo Harbor sediments, Mac and Willford (Table 2) suggested a slight increase in residues during the exposure. However, the apparent increase was not statistically significant. Interpretation of the results was confounded by the finding of relatively high background levels of PCBs (pre-exposure = 4.46 μg/g) in the fathead minnows used for testing. The presence of elevated background concentrations of PCBs in the fish most likely interfered with accumulation of PCBs as compared to that noted in earthworms." [37]

"Residues of Hg in fathead minnows showed no significant change after exposure to Toledo Harbor sediments. These results thus confirmed those results obtained with earthworms indicating no significant accumulation of Hg from Toledo Harbor sediments." [37]

"The bioaccumulation test is but one of several procedures available for evaluating sediments and, in dredging operations, for helping in evaluation of disposal options. The test appears to be most valuable in determining the bioavailability of contaminants present in sediments that are not considered highly contaminated or acutely toxic to aquatic organisms. When a particular sediment greatly exceeds bulk criteria for accumulable contaminants or is acutely toxic to organisms, there is little need or value in performing a bioaccumulation test."[37]

"Toledo Harbor sediments represent the type of materials for which bioaccumulation tests appear useful. Although the sediments contained relatively low levels of PCBs (0.21 $\mu g/g$), the earthworms accumulated 2.56 $\mu g/g$ during a 10-day exposure. Even though we were unable to confirm significant accumulation of PCBs in the fathead minnows, we nevertheless believe that the test was successful in demonstrating the potential for bioaccumulation of PCBs by earthworms. The information thus should be helpful for use in selecting appropriate disposal options for dredged sediments that will protect against significant accumulation of contaminants in the tissues of organisms."[37]

McFarland and Peddicord, 1986, studied the potential for bioaccumulation from Toledo Harbor sediments. The four organisms tested were fathead minnows, golden shiner, Japanese Medaka, and Asiatic clams. When challenged with Toledo Harbor sediments, no priority pollutants other than phthalates were detected in tissues of these organisms, and these may have been from laboratory contamination. Also, fewer than 6% mortalities occurred during bioassays on the four test species. Table 28 displays the results of their analyses of Toledo Harbor sediments related to levels of organic priority pollutants.[38]

McFarland and Peddicord, 1986 concluded that polynuclear aromatic hydrocarbons (PAH) were the compounds most likely to be bioaccumulated from Toledo Harbor sediments. Based on fluoranthene (a PAH) concentration in sediments (1.5 ppm) they calculated a thermodynamically-defined bioaccumulation potential for fluoranthene of 80.6 ppm in animal lipids. This translated to the following body burden for test animals:

Corbicula (2.4% lipid)	Medaka (9.8% lipid)	Fathead (.5% lipid)	Shiner (1.5% lipid)
1.94 ppm	7.90	4.03	1.21

No PAH were found in actual tissue. This can be explained by the fact that, unlike chlorinated hydrocarbons with similar octanol/water partition coefficients, PAHs are quickly broken down by the organisms mixed function oxidase system. Tissue residues of PAH are inversely correlated with the mixed function oxidase activity of an organism.[38]

Chapman, et al, 1986, conducted bioassays with Toledo Harbor sediment on several organisms. "Prater-Anderson test series indicated little or no acute mortality of either *Daphnia* or *Hexagenia* exposed to the Toledo sediment system; although *Hexagenia* suffered 20% mortality in Toledo sediments, control mortality was 13% indicating a possible problem with organism vitality."[39]

In beaker tests *Daphnia* mortality was 14 and 0% in freshly-prepared test systems with sediments from Toledo and Porter Lake control, respectively. However, after sitting for one week, the systems produced essentially no *Daphnia* mortality during the second bioassay. "One can speculate that aged samples and elutriates tend to be closer to equilibrium than unequilibrated unmixed sediment-water systems. This could be the common thread linking the results of these toxicity tests; equilibrated systems lacked the toxicity of newly-interfaced sediment and water. Would this phenomenon have occurred if we had used

Toronto to Toledo Harbor water? Would these harbor waters have been toxic in their own chemistry?"[39] Table 28 displays the levels of organic priority pollutants found in the analyses of Toledo Harbor sediments by McFarland and Peddicord and Chapman, *et al.*

TABLE 28
ORGANIC PRIORITY POLLUTANTS IN TOLEDO HARBOR SEDIMENTS
(in parts per million)

	McFarland and Peddicord, 1986	Chapman, et al, 1986
Methylene chloride	0.036	
Dichlorobiphenyls (PCB)	0.120	
Trichlorobiphenyls (PCB)	0.220	
Tetrachlorobiphenyls (PCB)	0.680	
Pentachlorobiphenyls (PCB)	0.100	
Hexachlorobiphenyls (PCB)	0.180	
Total PCB	1.300	
BIS (2 ethylhexyl) phthalate	8.800	8.500-10.600
Acenaphthene (PAH)		0.100
Acenaphthylene (PAH)		0.062-0.065
Fluorene (PAH)		0.089.0.160
Naphthalene (PAH)		0.140-0.610
Anthracene (PAH)	0.98	0.077
Fluoranthene (PAH)	1.500	0.210-0.600
Phenanthrene (PAH)	0.980	0.480-0.610
Benzo(a)anthracene		0.670-0.730
Benzo(k)Fluoranthene (PAH)		1.100-5.909
Chrysene (PAH)		1.000-5.909
Pyrene (PAH)	2.000	0.580-0.870
Benzo(ghi)perylene (PAH)		0.600
Benzo(a)pyrene (PAH)		0.600-0.770

To determine whether the concentration levels for PAHs in the Toledo Harbor sediments should be of concern, TMACOG forwarded the 1983 Corps of Engineer's data results (see Table 29) to Dr. Paul Baumann, U.S. Fish & Wildlife. These data included the Corps station number by lake and river mile along with the concentrations for the following chemicals: Phenanthrene, Fluoranthene, Pyrene, B(a)A, Chrysene B(k)F and B(a)P. Baumann stated in written communication that "PAH concentrations at these sites are at the lower end of the range of values for sites with cancer epizootics. However, I would consider these concentrations to pose a possible problem and to be of concern."[40]

Further, Baumann stated, "Since PAHs are not very soluble in water and stay in sediment close to the point source (concentrations after decline as a log function from the point source), and especially since RM 1 values are often higher than RM 2 or RM 3 values but lower than RM 4 values, it appears as if you have at least two separate point sources, one near RM 1 and one near RM 4. With additional sampling and some checking of what industries have outfalls in these areas (any coke plants associated with steel companies?), you should be able to track down the sources."[40]

Table 29 lists only those chemicals that *were* detected in Toledo Harbor sediments. It also gives the river or lake monitoring station at which the chemical was detected, the concentration found, and detection limits for the testing procedures used.

TABLE 29
TOLEDO HARBOR CHEMICAL SEDIMENT ANALYSES
US ARMY CORPS OF ENGINEERS DATA

CHEMICAL	DETECTION LIMIT	CORPS STATION	CONCENTRATION mg/kg (dry wt. basis)
Bis(2ethylhexyl)Phthalate	0.20	LM3	0.24
		LM2	0.23
		LM1	0.42
		MOUTH	1.69
		RM1	0.22
		RM2	1.20
		RM3	0.49
		RM4	1.50
		RM5	0.94
		RM6	0.48
Phenanthrene (PAH)	0.10	RM1	0.15
		RM2	0.17
		RM3	0.10
		RM4	1.45
		RM5	0.35
Anthracene (PAH)	0.10	RM4	0.10
Fluoranthene (PAH)	0.10	RM1	2.70
		RM2	0.25
		RM4	3.03
		RM5	0.79
		RM6	0.26
Pyrene (PAH)	0.10	RM1	1.24
		RM4	2.24
		RM5	0.62
		RM6	0.20
Benzo(a)Anthracene (PAH)	0.10	RM4	1.01
Chrysene (PAH)	0.20	RM4	1.43
Benzo(k)Fluoranthene (PAH)	0.20	RM4	0.77
Benzo(a)Phrene (PAH)	0.20	RM1	0.74
		RM4	0.62

Table 30 displays a comparison of the analytic results of these four studies of the Toledo Harbor sediments with the Great Lakes International Surveillance Plan, 1986, analysis of heavy metals on Western Basin sediments. Cyanide and PCB levels, where available, are also included in the table.

TABLE 30
COMPARISON OF TOLEDO HARBOR AND WESTERN BASIN SEDIMENTS
(in parts per million)

	Western Basin Background Levels GLWQB	Toledo Harbor Munawar & Thomas	Toledo Harbor Chapman, et al	Toledo Harbor McFarland & Peddicord	Toledo Harbor Mac & Willford
Hg	0.1	0.130-0.625	-	0.63	0.314
Pb	28.0	49.0-88.0	62.0	65.0	-
Zn	70.0	166.0-285.0	23.0	220.0	-
Cu	30.0	34.0-55.0	47.0	50.0	-
Cd	2.0	-	4.0	2.8	-
Mn	600.0	-	-	-	-
As	N/A	11.0-17.0	-	-	-
Cr	N/A	117.0-177.0	100.0	57.0	-
Ni	N/A	30.0-36.0	83.0	48.0	-
Cyanide	N/A	-	-	2.7	-
PCB	N/A	0.279-0.678	-	-	0.210

One of the problems with the existing sediment data in Toledo Harbor is that most of it comes from areas of the harbor that are periodically dredged by the Corps of Engineers. We perceive a need to sample the harbor and tributaries in a uniform manner covering areas previously unsampled for priority pollutants. Sampling should be thorough enough to allow the plotting isopleths. Tributaries to Toledo Harbor which are likely sources of priority pollutants such as the Maumee River, Ottawa River, and Otter Creek should also be sampled.

Unfortunately, nationwide sediment quality criteria currently do not exist. It is our understanding that EPA at the national level is developing national sediment quality criteria, but a final document is 1-3 years away. However, some preliminary attempts at criteria development have been completed. The EPA has developed guidelines for the pollution classification of Great Lakes harbor sediments for evaluation of dredged material disposal. As part of EPA's evaluation process for the development of sediment criteria, a paper entitled "A Discussion of PCB Target Levels in Aquatic Sediments" has been prepared by Mr. Jay Field of the Ocean Assessments Division, National Oceanic and Atmospheric Administration. The conclusion in this paper is that although toxic effects may occur at lower levels, a sediment concentration of 0.1 ppm PCBs appears to be a reasonable preliminary target level for use in assessing environmental hazards from PCB contamination and the need for remedial action. This compares to an average value of 0.21 to 1.3 ppm for the area of Maumee Bay dredged for navigation. Although national sediment quality criteria have not been completed, it appears that the sediments of the AOC are of concern and may be above future criteria levels.

Summary of Toxic Pollutants

1. Toxic substances have caused injuries to Lake Erie. There is at the present time a health advisory against eating carp or channel catfish from Lake Erie due to high PCB levels (over 2 ppm) in their flesh.

2. Sediment contamination is the most conspicuous problem in all the AOCs. There is a lack of thorough quantitative pollution data for the Toledo AOC.

3. A larger portion of Lake Erie PAHs are associated with particles than any of the other Great Lakes. Sediments in the Western Basin of Lake Erie have twice the PCB levels of the Central Basin and Eastern Basin. Contaminant release rates from resuspended sediments are unknown.

4. Some of Lake Erie's metal pollution originates on Lake Erie's southern shore. A "plume" of high sediment lead levels emanates from Toledo.

5. Chapman, 1986, speculated that equilibrated sediment/water systems are less toxic than newly interfaced sediment and water. This has direct bearing on the effects of dredging and other disturbances of bottom sediments. Further study could be required.

6. Laboratory studies by Munawar and Thomas, 1986, indicate that Toledo sediment elutriate caused up to 35% reduction in algae growth when diluted to 20% of its original strength.

7. Mac and Willford, 1986, demonstrated that earthworms accumulated PCBs from Toledo Harbor sediments. The AOCs contribution to Lake Erie's PCB pollution problem requires further study and quantification.

8. Most of the data here reviewed comes from the navigation channel and may not adequately reflect pollutants in other parts of the AOC.

RAP AREA WATER QUALITY: OVERVIEW & CONCLUSIONS

The *Maumee Basin BWQR* provides a clear summary of how good or bad the water quality is at many points along each major stream. Each segment is rated for its water quality, and the sampling points range from "very poor" to "excellent."

The BWQR graphs give a clear picture of water quality along Swan Creek, the Ottawa River, and the Maumee. In all three cases, water is cleanest far upstream. The Maumee River upstream water quality (the Napoleon area around river mile 50) was excellent, Tenmile Creek upstream water quality was fair to marginally good and Swan Creek was rated as fair. The streams get progressively worse as they approach and enter Toledo. All three show some recovery near their mouths, which may be due to the occasional inflow of relatively clean water from Lake Erie.

The data provided by other sampling programs supports the BWQR's conclusions. The TESD data provides substantially the same picture of water quality, and the US Army Corps of Engineers' sediment data points to the same problem areas along the major streams.

One of the things the BWQR data misses is the seasonally high concentration of NO_3 in the Maumee which occurs in the spring and fall. However, the BWQR was not designed to measure seasonality. NO_3 in the Maumee at these times of year often makes the water unacceptable as a public water supply source.

The USGS/Heidelberg University data collected at the Waterville station on the Maumee provides a record of water quality as it enters the RAP Area. It includes a substantial body of information on water quality parameters associated with agricultural runoff, which are not monitored anywhere else in the RAP Area.

The majority of other studies are focused on documenting specific known water quality problems. The Facilities Plans, for example, provide information on CSO problems, malfunctioning package plants, and failed septic systems. They are especially useful in determining severe effects of untreated sewage on small streams. In terms of the greater Lake Erie Basin, these problems are not significant, but pose a serious health threat, and are disastrous to the water quality of local streams.

In addition, the Invertebrate Community Indices, fish tissue data, and sediment analyses show violations of the "swimmable-fishable" goals of the Clean Water Act for the tributaries to the Maumee Bay. Further, there is the inability to meet the specific objectives of the Great Lakes Water Quality Agreement for these lower stream reaches due to toxic pollutants.

Aquatic life use attainment for the Maumee River becomes non-attainment at RM 9.4 and persists all the way into Maumee Bay. The fish species investigation in 1986 for both the Maumee River and Swan Creek show a 50% decline since 1981. The fish community composite and quality values drop 2 points on the Maumee River from upstream at the Grand Rapids dam to the Swan Creek confluence. From there these values drop another point to the mouth.

PAHs and phthalates have been found at detectable levels in the Maumee River shipping channel sediments, wherein the PAH concentrations could pose a possible problem and must be of concern. Studies of the Toledo Harbor sediments have not shown sediment bound pesticides at levels high enough to arouse concern. Dioxins and furans have not been studied.

Impacting water quality on the Ottawa River are the wall-to-wall dumps which leak conventional and organic priority pollutants. The degradation of Otter Creek is directly related to arsenic leaking from settling ponds, with oil soaked banks, and nickel and cyanide being detected in its waters.

In terms of the greater Lake Erie Basin, phosphorus is considered the critical nutrient contributing to eutrophication. Ohio EPA's Phosphorus Reduction Strategy for the Lake Erie Basin states that a total loading reduction of 1365 tons P/year needs to be achieved[33]. This is for the entire Lake Erie Basin in Ohio, in which, the Maumee Basin is one of the major sources. Total phosphorus loadings to the basin from various sources in the RAP Area are estimated and displayed in Table 31.

TABLE 31
TOTAL PHOSPHORUS LOADINGS FROM RAP AREA SOURCES

PHOSPHORUS SOURCE	ESTIMATED LOADING Tons P/year
Agricultural Runoff	1197
POTWs	189
Urban Runoff	21
Package Plants	9
CSOs	Insufficient data
Industrial Wastewater	Refer to Appendix I
Home Sewage Disposal	Insufficient data
Landfills & Dumpsites	Insufficient data
Atmospheric Deposition	Insufficient data
TOTAL:	**1416**

WATER POLLUTION SOURCES

INDUSTRIAL WASTEWATER DISCHARGES

Industrial wastewater dischargers cover a broad range of types of facilities. Examples include treated chemical discharges from plating operations, cooling water from power generating stations, quarry dewatering from crushed stone producers, lime sludge from municipal water treatment plants, and treated process wastes from diverse manufacturers, such as food processing, automotive, plastics, and glass. Some NPDES permits fall into more than one category. For example, a manufacturer may have process wastes, site runoff, and a package sewage treatment plant. An NPDES permit deals with this situation by issuing discharge standards for three different outfall points.

At present, there are 60 NPDES permits in the Maumee RAP Area which breakdown as follows:

- 0 Agricultural
- 2 Electric Utility
- 30 Industrial and Miscellaneous
- 2 Landfill
- 4 Quarry & Crushed Stone Producer
- 18 Municipal and other Sewage Treatment Plants
- 4 Municipal Water Treatment Plants

Out of these 60 permits, the status is as follows:

- 24 or 40% were not current on January 1, 1988
- 42 or 70% are active
- 4 or 6% are being sewered
- 1 or 1% are revoked or inactive
- 12 or 20% are expired

An "Active" permit is presently in operation. "Being sewered" means that the permit is active, but a sewer line is being built which will eliminate the discharge. A permit that is "Revoked" has been revoked by Ohio EPA because the facility is no longer discharging. "Inactive" means the facility is not presently discharging. "Expired" means the facility is in operation and discharging, but the permit has not yet been renewed.

There are presently no Findings and Orders for industrial NPDES dischargers in the Maumee Basin RAP Area. A list of NPDES Permits in the RAP Area, with notes on their present status and compliance, is given in Table 32. The source of these notes is from discussion with personnel of Ohio EPA NW District Office and Toledo Environmental Services Division, and the files of those agencies.

A complete listing of NPDES permits is given in Appendix C.

Ohio EPA is considering issuing NPDES permits for stormwater runoff to other facilities that presently have no permits. One is the Evergreen Landfill, in Northwood. Others are the truck stops in the Interchange-Five area of Lake Township, in Wood County. The truck stops and their effect on local streams will be evaluated after the sanitary sewer to serve the area has been completed in Summer, 1988.

TABLE 32
NOTES ON NPDES DISCHARGERS

NPDES DISCHARGER	STREAM	RM	NOTES
ASHLAND OIL COMPANY NPDES: 2IG00006*ED OLD NAME:	Maumee River	1.8	Permitted to treat ship ballast, but does not receive much, usually 2 to 4 times/year. Stormwater, 17,300 gpd, is treated separately.
BENTBROOK FARMS NPDES: 2PG00002 OLD NAME:	Ten Mile Creek	--	
BOWLING GREEN WTP NPDES: 2IW00010 OLD NAME:	Maumee River	22.8	Presently backwash solids are being discharged to the Maumee River. Backwash lagoons are being designed, and in the future, backwash water will be recycled. New permit is being processed.
CSX-CHESSIE-PRESQUE ISLE NPDES: 2IT00013 OLD NAME: C&O, Chessie	Maumee River	0.1	Has had oil leak problems in the past. No information is available on the sewage treatment plant. A new permit is being processed, and the facility will be inspected before issuance.
CSX-CHESSIE-WALBRIDGE TERMINAL NPDES: 2IT00002*CD OLD NAME: C&O, Chessie	Cedar Creek	--	Site runoff is treated, which includes a lot of oil and grease. Effluent quality is good.
CENTENNIAL MANOR NPDES: 2PY00000*DD OLD NAME:	Ten Mile Creek	2.0	
CHARTER HOUSE INN NPDES: R 725 *AD OLD NAME:	Crane Creek	--	
CONRAIL NPDES: 2IT00015*AD OLD NAME: Penn Central	Unnamed Tributary	--	********** Problem Discharger ********** This facility has massive oil problems. Discharge goes to an unnamed tributary of the Maumee. The receiving stream is, in effect, being used to treat the runoff. There are baffles across the stream, which are used to trap the oil. They are located about 30 or 40 feet above a culvert the stream enters before flowing into the Maumee.
CONRAIL-STANLEY YARD NPDES: 2IT00007*CD OLD NAME:	Cedar Creek	--	********** Problem Discharger ********** There was a major oil spill from this facility in March '88, and oil in the effluent is a continuing problem. The treatment lagoons are old, and need improvements for better control.
DIVERSI TECH GENERAL NPDES: 2IQ00012*BD OLD NAME:	Ottawa River	6.0	Has had oil problems in effluent in the past. New oil separator has been installed, with a Permit To Installed being submitted after the fact. A white solid (resin) in the effluent has been an occasional problem (TESD notes: twice in the past ten years). Toxic organics (in low concentrations) have been found in the effluent. The present NPDES permit does not have limits for these chemicals. Ohio EPA expects to add them the next time the permit is renewed.
DOEHLER-JARVIS/FARLEY, PLANT 2 NPDES: 2IC00021*FD	Shantee Creek	--	********** Problem Discharger ********** Effluent includes a milky-white discharge (machine coolant). Both TESD and Ohio EPA have received complaints about this facility.
DUPONT DE NEMOURS, FORMALDEHYDE PLANT NPDES: 2IF00017*CD	Ottawa River	4.8	There was at one time a formaldehyde leak to the stormwater lagoon (the NPDES Permit for this facility is for non-contact cooling water). Since that time, the lagoon has been eliminated. Ohio EPA plans reinspection.
DUPONT DE NEMOURS, PAINT PLANT NPDES: 2IF00016*DD	Blodget Ditch	--	Effluent quality is good.
FONDESSY ENTERPRISES NPDES: 2IN00013*CD OLD NAME: Envirosafe	Otter Creek	2.3	One outfall had a problem with NH3 violations several years ago, but is now meeting effluent limits. Runoff covered by this permit is from the truck area, not the landfill. Landfill runoff goes to Otter Creek. Runoff from the Land Farm collected and taken to a storage tank, sampled, and discharged to the Toledo sewer system. It is sampled and discharged to the Toledo sanitary sewer system and is subject to Toledo's pretreatment program. The land farm is located at Cedar Point & Wynn, and was used for disposal of oily wastes. This practice has been discontinued. Wastes are collected, trucked, and sampled by Millren.

FRANCE STONE CO., SILICA PLANT NPDES: 2IJ00039*FD	Ten Mile Creek	2.0	This facility is in compliance with its NPDES permit.
FRANCE STONE CO., WATERVILLE NPDES: 2IJ00047	Maumee River	22.2	This facility is in compliance with its NPDES permit. Old permit records had the address as 600 S. River Road, while the '87 Toledo phone book says 700 River Rd. I'm leaving the old phone number in the database; the best the new phone book has to offer is a number for the lab, which is 878-9606.
FULLER'S CREEKSIDE ESTATES NPDES: 2PH00000*BD	Shantee Creek	--	
GENERAL MILLS NPDES: 2IH00093*BD OLD NAME:	Jamieson Ditch	--	********** Problem Discharger ********** Effluent has shown violations of BOD, SS, and pH limits. BOD has shown some improvement. The problem comes from organic matter from the air pollution control equipment on the roof. This material is washed off the roof by rain, and results in a high-BOD wastewater.
HARBOR VIEW, VILLAGE OF NPDES: 2PA00012*CD OLD NAME:	Maumee Bay	--	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued. See discussion under POTWs for details.
HASKINS WWTP NPDES: 2PA00026*CD OLD NAME:	Liberty Hwy. Ditch	21.6	This facility is in compliance with its NPDES permit. Haskins WWTP is at RM 1.0 of Liberty High Rd Ditch. It empties into the Maumee at RM 21.6.
HYDRA-MATIC NPDES: 2IC00026*CD OLD NAME: GMC Chevrolet	Silver Creek	--	State of the art stormwater system. This facility is in compliance with its NPDES permit.
JEEP CORPORATION NPDES: 2IC00022 OLD NAME:	Ottawa River	7.6	New NPDES Permit is being drafted. Process waste goes to Toledo sanitary sewer. This permit is for site runoff. There are other outfalls (runoff) that are not covered by the permit. High water levels in the Ottawa River cause stream water to backflow into the treatment system. There is a lot of garbage (litter) in the stream at this site. It comes not from Jeep, but its employees
KERN-LIEBERS USA NPDES: 2IC00056 OLD NAME:	Wolf Creek	4.1	This facility is in compliance with its NPDES permit. Ohio EPA is processing a draft permit for renewal.
KING ROAD SANITARY LANDFILL NPDES: 2IN00079*AD	Ottawa River	4.5	********** Problem Discharger ********** Ohio EPA enforcement actions are pending on this facility. OEPA's Draft Plan of Study for the Maumee BWQR notes that NH3 discharged here is 'highly elevated.' Contamination of local groundwater has been documented. This facility is an old dump. When closed, the dump was covered with sand, which allows rain water to infiltrate. In places, the cover has worn away, leaving garbage exposed on the surface. Because of the lack of impermeable cover, there is no runoff from the site. Rain water soaks into the dump and enters the Ottawa River as leachate, which contains high concentrations of BOD and NH3. What needs to be done: * Hydrogeological study of the area * City water for residents * Clay cap on the old dump * Fence to prohibit new dumping
LIBBEY OWENS FORD - PLANTS #4 AND #8 NPDES: 2IN00030*DD	Otter Creek	6.6	********** Problem Discharger ********** Even though this plant is no longer producing, it still has an active NPDES permit. There is leachate from the lagoon through weep-holes. The lagoon has been dewatering faster than expected, and flow from weep-holes has gradually decreased. Leachate running out of banks is collected and discharged to the Toledo sanitary sewer system. The problem is that Otter Creek runs through an old, leaky sewer under the lagoon. This facility formerly produced laminated car glass. Leachate contains phthalate esters, dienoctyl Phthalate, and 2-m-butyl Phthalate. Monitor for As also, but none has been found. LOF's plans call for 1] dewatering the lagoon at this site, 2] divert Otter Creek so that it will no longer flow under the lagoon. Time frame for completion of this work is march, 1989.

NOTES ON NPDES DISCHARGERS, CONTINUED

LIBBEY OWENS FORD FLOAT GLASS PLANT #6 NPDES: 2IN00030*ED	Maumee River	6.9	********** Problem Discharger ********** An outfall from this facility discharging to the Maumee at the Rossford Marina was discovered in Fall, 1987. Samples from this effluent contained Arsenic. A system of perforated collection tiles was completed in September, 1988. The leachate is be pumped to the Toledo sanitary sewer system.
LINCOLN GREEN SUBDIV. NPDES: N 704 *AD OLD NAME:	Potter Ditch	--	
LIQUID CARBONIC CORP. NPDES: 2IN00069 OLD NAME:	Otter Creek	1.9	Discharge is from package sewage treatment plant, which is oversized for the number of employees. But the site is unsuited for a septic system.
MARATHON OIL COMPANY NPDES: 2IG00024*BD OLD NAME:	Driftmeyer Ditch	--	This facility is in compliance with its NPDES permit.
MAUMEE RIVER WWTP NPDES: 2PK00000*DD OLD NAME:	Maumee River	18.2	This facility is in compliance with its NPDES permit.
MEDUSA PORTLAND CEMENT COMPANY NPDES: 2IN00032	Tenmile Creek	5.3	Medusa Cement shut down in '82 or '83, but may have resumed operations. Hasn't reapplied for a discharge permit.
MIDLAND-ROSS SURFACE COMBUSTION DIV. NPDES: 2IN00072*	Williams Ditch	--	This facility is in operation, but may have eliminated its discharge.
NORFOLK SOUTHERN RR NPDES: 2IT00005*BD OLD NAME: N&W RR	Duck Creek	--	This facility is in compliance with its NPDES permit. The wastewater from this facility is runoff containing oil. A treatment lagoon is used.
OAK OPENINGS - FALLEN TIMBERS PLAZA NPDES: 2PP00003*CD	Murbach Ditch	--	
OAK OPENINGS INDUSTRIAL PARK NPDES: 2PH00013*CD	Kujawski Ditch	--	This facility is in compliance with its NPDES permit.
OAK TERRACE NPDES: 2PH00014*CD OLD NAME:	Butler Ditch	--	This facility is in compliance with its NPDES permit.
OREGON SOUTH SHORE PARK WWTP NPDES: 2PB00007*CD	Maumee Bay	--	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued.
OREGON WTP NPDES: 2IW00220*BD OLD NAME:	Berger Ditch	--	This facility is in compliance with its NPDES permit.
OREGON WWTP NPDES: 2PD00035*ED OLD NAME:	Maumee Bay	--	This facility is in compliance with its NPDES permit.
OWENS-ILLINOIS, LIBBEY PLANT 27 NPDES: N 275 *AD	County Ditch #1139	--	Ohio EPA is processing a new permit for this facility. A reinspection is planned.
PERRYSBURG WWTP NPDES: 2PD00002 OLD NAME:	Maumee River	14.5	This facility is not in compliance with its NPDES Permit. Findings and Orders have been issued. See discussion under POTWs.
PETROLEUM FUEL & TERMINAL CO. NPDES: 2IG00013 OLD NAME: Shell, Apex	Maumee River	2.2	This facility is in compliance with its NPDES permit.
PLASKON ELECTRONIC MATERIALS NPDES: 2IF00000*CD OLD NAME: Allied Chem.	Delaware Creek	1.2	This facility is in compliance with its NPDES permit.
REICHERT STAMPING NPDES: 2IS00008*ED OLD NAME: Tol. Steel Tube	Ten Mile Creek	5.1	This facility is in compliance with its NPDES permit.
STANDARD OIL - HILL AVE TERMINAL NPDES: 2IB00010*CD	Fleig Ditch	11.1	This facility has occasional effluent quality problems, but is generally in compliance with its NPDES Permit. The effluent has been sampled for organic chemicals. None were found.

STANDARD OIL - TOLEDO REFINERY NPDES: 2IG00007*OD	Maumee Bay	0.4	This facility is in compliance with its NPDES permit. Package sewage treatment plant(s), tributary to the main treatment plant may be in use here.
STONECO - LIME CITY PL. NPDES: 2IJ00052*CD OLD NAME: Maumee Stone Co.	Dry Creek	--	This facility is in compliance with its NPDES permit. Sewage was once treated with a package plant here. It has been replaced by a septic system.
STONECO - MAUMEE PLANT NPDES: 2IJ00048*CD OLD NAME: Maumee Stone Co.	Graham Ditch	--	This facility is in compliance with its NPDES permit.
SUN PETROLEUM - MARINE TERMINAL NPDES: 2IG00009*CD OLD NAME:	Maumee River	6.5	This facility is in compliance with its NPDES permit.
SUN PETROLEUM - TOLEDO REFINERY NPDES: 2IG00003*FD	Otter Creek	4.9	********** Problem Discharger ********** There have been overflow bypasses from this facility. Effluent sampling has found oil, phenol, Cr, Sulfide. A new Permit for this facility will be issued in 1989.
TELEDYNE INDUSTRIES NPDES: 2IC00001*BD OLD NAME:	Silver Creek	--	This facility is in compliance with its NPDES permit.
TOLEDO BAY VIEW PARK WWTP NPDES: 2PF00000*GD	Maumee River	1.4	This facility is in compliance with its NPDES permit. See discussions under POTWs and CSOs for detailed information.
TOLEDO COKE NPDES: 2ID00011 OLD NAME: Koppers	Maumee River	1.7	This facility is in compliance with its NPDES permit.
TOLEDO COLLINS PARK WTP NPDES: 2IE00260*BD OLD NAME:	Duck Creek	3.4	This facility is in compliance with its NPDES permit. There was a major spill of backwash (lime) sludge in the past, which is in the process of being excavated from Duck Creek: 6000-8000 cy in '87, and 9000 cy planned for '88. The backwash lagoons are nearly full of sludge, and will be excavated: 20-30 kcy '88, 70 kcy in '89, and 90 kcy for each of the next three years.
TOLEDO EDISON - ACME STATION NPDES: 2IB00001*CD	Maumee River	4.0	This facility is in compliance with its NPDES permit.
TOLEDO EDISON BAYSHORE PLANT NPDES: 2IB00000*ID	Driftmeyer Ditch	--	This facility is in compliance with its NPDES permit. Besides cooling water and sewage, the Bayshore plant also has ash ponds, which are rarely used. They exist, and Toledo Edison has them on the discharge permit only in case of emergency. Exception: the bottom ash pond is in constant use.
UNION 76 TRUCK STOP AND RESTAURANT NPDES: R 724 *AD	Crane Creek	--	
WATERVILLE WTP NPDES: 2IV00080*BD OLD NAME:	Maumee River	21.1	This facility is in compliance with its NPDES permit.
WHITEHOUSE WWTP NPDES: 2PB00062*CD OLD NAME:	Discher Ditch	--	This facility is not in compliance with its NPDES Permit. See discussion under POTWs for details. An interceptor to tie Whitehouse into the Lucas County sanitary sewer system is expected to be in use by the end of 1988.
WOODSIDE TERRACE TRAILER PARK NPDES: S702*BD	Wolf Creek	--	
ATLANTIC RICHFIELD, INC.	--	--	Inactive facility
GERKEN MATERIALS	--	--	Inactive facility
NORTHERN ASPHALT PAVING CO.	--	--	Inactive facility

LOF Comments on NPDES Discharges

LOF, in cooperation with the City of Northwood, has for some time been working toward the diversion of the major branch of Otter Creek from its current path beneath the former settling ponds. The settling ponds were established to hold grinding and polishing materials utilized in the glass manufacturing process at the LOF East Toledo Facility. LOF anticipates concluding its agreement with the City of Northwood for the diversion in the very near future, with work beginning soon after that.

While it is true that constituents from the liquid effluent in the settling ponds enter Otter Creek, LOF does monitor this discharge monthly, and that data is reported to both Ohio EPA and U.S. EPA, Region V. Due to the nature of this discharge, it is thought that the impact is minimal as shown by the NPDES samples.

The draft report specifically notes the presence of phthalates in the discharge. This is true, however, the levels of phthalates recorded by the NPDES monitoring are thought to be too low to have a significant impact on water quality. In fact, some monitoring reports have recorded no detectable levels of phthalates.

Another subject mentioned in the report is a discharge from the former settling ponds at the Rossford Float Glass Plant #6. These settling ponds are very similar in nature to those at the East Toledo Facility, which were described previously. LOF applied for, and has received from Ohio EPA, a Permit-to-Install for an Aggregate Drainage Collection System at the Rossford facility. This system will collect a discharge from the former settling ponds and direct it to the Rossford wastewater treatment facility. Construction of this system is well underway, with a projected completion date of early August, 1988.

MUNICIPAL WASTEWATER DISCHARGES

There are twelve municipal sewage treatment plants, or "Publicly-Operated Treatment Works" (POTWs) in the RAP Area. These include city, county, and village sewage treatment plants, plus package plants that serve suburban or rural developments. The RAP Area POTWs are given in Table 33, with 1986 effluent data. This table includes information on what treatment plant served each area in 1986, and what treatment plant is planned to serve the area in 2005. Table 33 also includes present and projected populations, flow rates, and BOD_5, SS, and P discharges in tons per year (tpy). Projected discharges for BOD_5, SS, and P assume that the plants will produce the same quality effluent in 2005 as they did in 1986.

Phosphorus Loadings

As noted in Table 31, the total phosphorus discharge from RAP Area POTWs in 1986 was 188.5 tons. Many of the plants in the table are shown as discharging zero phosphorus. That is not because their effluent contains no phosphorus, but because these smaller plants are not required to monitor it. Using an estimated effluent phosphorus concentration of 2 ppm for extended aeration plants with filters, and 4 ppm without filters, the actual total phosphorus discharge would be higher than 188.5 tons per year. TMACOG has calculated that smaller plants contribute at least 9.4 tons per year (see section on Package Sewage Treatment Plants).

TABLE 33
MAUMEE BASIN RAP AREA POTWs
Populations and Discharge Loadings

SANITARY SEWER SERVICE AREA	1980 & 2005 POP.	DSGN, 1986, & 2005 FLOWS	1986 & 2005 BOD LOADS	1986 & 2005 TSS LOADS	1986 & 2005 P LOADS
** LUCAS COUNTY **					
Bentbrook Farms *** 1986: Bentbrook Farms WWTP 2005: Maumee River	1980 POP: 1,654 2005 POP: 1,831 1986 Flow: 72 gpcd	CAPACITY: 0.06 mgd 1986: 0.12 mgd 2005: 0.13 mgd	1986: 16.2 tpy BOD 2005: 18.0 tpy BOD	1986: 16.4 tpy TSS 2005: 18.2 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Fuller's Cr Est *** 1986: Fuller's Creekside Estates 2005: Toledo	1980 POP: 714 2005 POP: 714 1986 Flow: 378 gpcd	CAPACITY: 0.10 mgd 1986: 0.27 mgd 2005: 0.00 mgd	1986: 5.8 tpy BOD 2005: 5.8 tpy BOD	1986: 5.8 tpy TSS 2005: 5.8 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Lincoln Green *** 1986: Lincoln Green Subdivision 2005: Maumee River	1980 POP: 2,352 2005 POP: 2,861 1986 Flow: 68 gpcd	CAPACITY: 0.17 mgd 1986: 0.16 mgd 2005: 0.00 mgd	1986: 5.1 tpy BOD 2005: 6.2 tpy BOD	1986: 5.1 tpy TSS 2005: 6.2 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Lucas County 1986: Maumee River WWTP 2005: Maumee River	1980 POP: 33,397 2005 POP: 40,257 1986 Flow: 163 gpcd	CAPACITY: 15.00 mgd 1986: 9.01 mgd 2005: 12.42 mgd	1986: 127.2 tpy BOD 2005: 155.4 tpy BOD	1986: 209.1 tpy TSS 2005: 255.4 tpy TSS	1986: 11.5 tpy P 2005: 14.0 tpy P
Oak Openings 1986: Oak Openings Industrial Park 2005: Maumee River	1980 POP: 0 2005 POP: 0 1986 Flow: 67 gpcd	CAPACITY: 0.18 mgd 1986: 0.11 mgd 2005: 0.00 mgd	1986: 3.8 tpy BOD 2005: 4.7 tpy BOD	1986: 4.7 tpy TSS 2005: 5.8 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Oak Terrace 1986: Oak Terrace WWTP 2005: Maumee River	1980 POP: 0 2005 POP: 0 1986 Flow: 70 gpcd	CAPACITY: 0.00 mgd 1986: 0.10 mgd 2005: 0.00 mgd	1986: 0.7 tpy BOD 2005: 0.7 tpy BOD	1986: 1.2 tpy TSS 2005: 1.1 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Oregon ** 1986: Oregon WWTP 2005: Oregon DuPont	1980 POP: 31,763 2005 POP: 38,365 1986 Flow: 114 gpcd	CAPACITY: 8.00 mgd 1986: 4.31 mgd 2005: 5.41 mgd	1986: 40.9 tpy BOD 2005: 49.4 tpy BOD	1986: 79.0 tpy TSS 2005: 95.8 tpy TSS	1986: 6.2 tpy P 2005: 7.4 tpy P
Oregon S Shore 1986: Oregon South Shore WWTP 2005: Oregon DuPont	1980 POP: 1,400 2005 POP: 1,670 1986 Flow: 350 gpcd	CAPACITY: 0.23 mgd 1986: 0.49 mgd 2005: 0.00 mgd	1986: 27.0 tpy BOD 2005: 32.3 tpy BOD	1986: 22.1 tpy TSS 2005: 26.4 tpy TSS	1986: 1.4 tpy P 2005: 1.8 tpy P
Toledo ** 1986: Toledo Bay View WWTP 2005: Toledo	1980 POP: 388,194 2005 POP: 388,851 1986 Flow: 234 gpcd	CAPACITY: 102.00 mgd 1986: 91.15 mgd 2005: 91.48 mgd	1986: 2,737.3 tpy BOD 2005: 2,741.9 tpy BOD	1986: 6,123.6 tpy TSS 2005: 6,133.8 tpy TSS	1986: 157.6 tpy P 2005: 157.9 tpy P
Whitehouse 1986: Whitehouse WWTP 2005: Maumee River	1980 POP: 2,819 2005 POP: 3,915 1986 Flow: 113 gpcd	CAPACITY: 0.29 mgd 1986: 0.32 mgd 2005: 0.00 mgd	1986: 8.0 tpy BOD 2005: 11.1 tpy BOD	1986: 10.9 tpy TSS 2005: 15.3 tpy TSS	1986: 3.1 tpy P 2005: 4.3 tpy P
** WOOD COUNTY **					
Haskins 1986: Haskins WWTP 2005: Haskins	1980 POP: 568 2005 POP: 723 1986 Flow: 105 gpcd	CAPACITY: 0.10 mgd 1986: 0.06 mgd 2005: 0.08 mgd	1986: 0.7 tpy BOD 2005: 0.9 tpy BOD	1986: 0.5 tpy TSS 2005: 0.7 tpy TSS	1986: 0.0 tpy P 2005: 0.0 tpy P
Perrysburg * 1986: Perrysburg WWTP 2005: Perrysburg	1980 POP: 17,612 2005 POP: 26,010 1986 Flow: 160 gpcd	CAPACITY: 2.75 mgd 1986: 3.00 mgd 2005: 4.48 mgd	1986: 119.2 tpy BOD 2005: 177.8 tpy BOD	1986: 241.8 tpy TSS 2005: 360.6 tpy TSS	1986: 8.7 tpy P 2005: 13.1 tpy P
** TOTAL PHOSPHORUS LOADING, 1986 **					188.5 tpy P

* The Perrysburg plant is being expanded to 5.4 mgd

** Toledo and Oregon each own and operate one package plant not listed here, because these plants do not have NPDES permits. The Oregon plant is a 5000 gpd unit that serves the City Municipal Building on Seaman Road. The Toledo plant is a 40,000 gpd package plant that serves the House of Correction in Waterville Township.

*** This plant is soon to be replaced with a tap to the Lucas County sanitary sewer system. All three facilities listed are presently in the design or bid phase.

NOTE: Zero population denotes no information available. Zero flow for 2005 means this plant is expected to be abandoned by then.

Further details are given on these facilities in Appendix E.

Ohio EPA has current Findings and Orders issued for a number of POTWs. Holders of NPDES permits are required under the Clean Water Act to be in compliance with their permits by July 1, 1988. That is the deadline for all Findings and Orders. Current Findings and Orders are detailed in Table 34.

TABLE 34
POTW FINDINGS AND ORDERS

SERVICE AREA/FACILITY	OWNER/OPERATOR	NPDES NO.	ORDERS TO:	DATE	
Harbor View	Harbor View	2PA00012*CD	Build or tap into system	1985	
Interchange-Five Area	Wood Co S.D. #120	None		1986	To be sewered
Maumee	Maumee	None	CSOs	1985	4-Phase CSO project
Oregon S. Shore Park	Oregon	2PB00007*CD	Effluent Limits	1986	
Perrysburg	Perrysburg	2PD00002*DD	Effluent Limits	1985	Expand WWTP
Whitehouse	Whitehouse	2PB00062*BD	CSOs, effluent limits	1987	To tap into County system

Status Of Facilities With Findings And Orders

Harbor View

Harbor View has sanitary sewers, but cannot use them. The City of Oregon received a grant for a Facilities Plan for Harbor View and the surrounding portions of Oregon. The Facilities Plan[28] recommended construction of an interceptor sewer to serve the area. HUD awarded a grant to the Village of Harbor View for construction of local sanitary sewers, among other improvements, but EPA did not award a grant for construction of the interceptor.

Interchange-Five Area

Sanitary sewers to serve the Interchange Five area are being designed. These sewers will connect to the existing Wood County sanitary sewer system. Wastewater will receive treatment at the Toledo Bay View WWTP.

Luckey

The Village of Luckey has constructed interceptor sewers and a sewage treatment lagoon system. They went into operation in late 1987.

Maumee

The City of Maumee is separating its combined sewers in four-phases, spaced at three-year intervals. The first phase has been completed. The separation program is scheduled for completion in 1996. This construction program will result in the elimination of 90% of the combined sewage bypasses. User fees, direct assessments and City funds will be used to finance the estimated $4 million cost of these improvements.

The existing combined sewer will serve as a sanitary sewer, and will be smoke tested to remove as many "clean water connections" (downspouts) as possible. The regulators will remain in place with slide gates controlling overflow to the river. It is estimated that a 10% inflow component from foundation drains will remain in the system. The construction schedule by district is as follows:

White Street District	1987
Sackett Street District	1990
Allen Street District	1993
Duane Street District	1996

Oregon South Shore Park

The subdivision of South Shore Park in Oregon is served by sanitary sewers and its own treatment plant. The system, however, has a severe inflow problem, and the plant is overloaded by excess flow. The City of Oregon plans to construct an interceptor along Bayshore Road to connect South Shore Park to the main wastewater treatment plant on DuPont Road. When the Bayshore Road interceptor is built, the South Shore Park treatment plant will be abandoned. Construction of this interceptor will also be necessary to extend service to the Harbor View area.

Perrysburg

Perrysburg is expanding its treatment plant from 2.75 mgd to 5.4 mgd. The expansion of the primary treatment facilities has been completed; expansion of the second treatment facilities is in progress. Vacuum-assisted drying beds have also been added to the plant to improve sludge-handling capabilities.

Whitehouse

The *Whitehouse Facilities Plan*[41] calls for the Village of Whitehouse to abandon its existing sewage treatment plant, and tie into the Lucas County system. The Village of Whitehouse has submitted plans to Ohio EPA for construction of an interceptor to tie into the County system. Construction will be completed in 1988.

PACKAGE SEWAGE TREATMENT PLANTS

Package treatment plants frequently cause water quality problems. These are privately and publicly-owned treatment plants that serve mobile home parks, marinas, or restaurants in an unsewered area that produce too much wastewater for a septic tank. There are quite a few package plants in the Swan Creek watershed, especially around Toledo Express Airport, and on the fringes of the Toledo and Lucas County sewer systems.

Package plants are not a large source of pollution, in terms of the overall Great Lakes Basin. They are estimated to contribute roughly 1% of the phosphorus which reaches Lake Erie.[42] However, an improperly operated package plant can have a severe effect on its receiving stream, resulting in a local health problem.

Past Work

TMACOG staff has worked with OEPA and County Health Departments in the past on constructing inventories of package plants, and working with the owners and operators of the facilities to improve performance.

Problem Summary

Most package plants use the "extended aeration" process, which is similar to the "conventional activated sludge" process commonly used by municipal sewage treatment plants. Package plants cause problems for a number of reasons, which are discussed below. The discussion below should be taken as a broad generalization. There are nearly a hundred package plants in Lucas County, and some of them *are* well-operated and maintained.

LACK OF TRAINING AND IMPROPER OPERATION

The extended aeration treatment process is complicated, and unless the operator has received training, he probably will not understand it. Operating a package plant usually falls to a janitor, the manager, or the owner, depending on the particular situation. In most cases, the person operating the package plant has not had any training at all.

For municipal sewage treatment plants and other treatment facilities which have NPDES permits, the Operator is required to have a License; obtaining that License includes taking courses and passing tests. Most package plants are not required to have NPDES permits for the reason that there are too many around to keep track of, let alone inspect and regulate. Ohio EPA *does* issue NPDES permits for package plants under five conditions, however:

1. If the plant is operated by the County, or a municipality,
2. If the facility requires an NPDES permit for another wastewater discharge,
3. If the package plant is a known and continuing problem,
4. If the facility is PUCO regulation, and
5. If it is a State operated facility.

LACK OF MAINTENANCE

The maintenance problem is closely-related to the operation problem. Failure of the plant operator to understand proper operation directly results in many maintenance problems. Another maintenance problem is that the work tends not to get done for the simple reason that most people consider working on the sewage plant an unpleasant job. Unless somebody from EPA or the Health Department comes around to remind them, they tend not to do it.

LACK OF ENFORCEMENT

Ohio EPA has responsibility for enforcement for package plants. The main problem is that there are a lot of package plants around. Just keeping track of them has been a problem. Lack of staff to do field inspections and write letters has also been a problem.

Under a law passed in 1985, the County Health Department may contract with Ohio EPA to perform inspections and charge license fees for package plants under 25,000 gpd. Wood County has signed such a contract, but Lucas and Ottawa Counties have not. Lucas County, however, uses nuisance abatement and health statutes to conduct inspections, and attempts to visit plants monthly. They do not inspect plants which have NPDES permits. Enforcement actions remain the responsibility of Ohio EPA.

<u>Phosphorus</u>

In most cases, there is no data on what a given package is discharging, in terms of quantity of flow or nutrients. However, work *has* been done on what the effluent quality of an extended aeration package plant "typically" is. WPCF[43] and EPA[44] suggest figures of 2 ppm with filters and 4 ppm without. However, these values were obtained using trained plant operators. For purposes of estimating phosphorus loadings from package plants in the RAP Area, a figure of 4 ppm P will be used.

Using an estimated total package plant effluent volume of 2.09 mgd (see Appendix D), the total phosphorus contribution would be 12.7 tons/year. Deducting package plants listed in Appendix D which are *also* POTWs (Oak Terrace, Oak Openings Industrial Park, Bentbrook, Fuller's Creekside Estates, and Lincoln Green: see Appendix B) leaves a contribution of 9.4 tons P/year for the remaining plants. This number is an approximation, intended to put the phosphorus loading from this source in perspective with the other sources.

AGRICULTURAL RUNOFF WATER POLLUTION

The croplands of the Maumee River Basin are major sources of sediment, phosphorus, nitrate and pesticide loadings to the Maumee River System. These pollutants originate primarily upstream of the AOC and are transported to the lower Maumee River and Lake Erie where they negatively affect water quality.

We are fortunate to have an extensive record of sediment and nutrient loads for the Maumee River. The U. S. Geological Survey water quality monitoring site at Waterville Ohio has been in existence since 1950. The drainage area above the gauge is 6,330 square miles.[45]

Sediment and nutrient loads for the Maumee have been reported by the Water 2Quality Laboratory of Heidelberg College as shown in Table 35.

TABLE 35
HISTORICAL SEDIMENT & NUTRIENTS FOR THE MAUMEE AT WATERVILLE
(in metric tons)

YEAR	SUSPENDED SOLIDS	TOTAL PHOSPHORUS	SOLUBLE REACTIVE PHOSPHORUS	NO_3+ NO_2 NITROGEN
1982	1,280,000	2,820	576	28,400
1983	947,000	2,080	286	26,200
1984	1,080,000	2,660	389	35,450
1985	897,000	1,900	128	24,100
1986	1,221,000	2,434	---	30,800

Source: Heidelberg College Water Quality Lab

The extent to which these loads are attributable to non-point sources and particularly agriculture has been the topic of several significant studies and reports. Studies performed by TMACOG, the U.S. Army Corps of Engineers Lake Erie Wastewater Management Study, Pollution from Land Use Activities Reference Group (PLUARG) of the International Joint Commission, Great Lakes National Program Office, and Water Quality Laboratory of Heidelberg College have documented the magnitude and nature of the problems affecting the Maumee River. In addition, the Ohio EPA has prepared the *State of Ohio Phosphorus Reduction Strategy for Lake Erie* which in turn is included in the *United States Task Force Plan for Phosphorus Load Reductions from Non-Point and Point Sources on Lake Erie, Lake Ontario, and Saginaw Bay.*

The conclusions of these numerous studies provide the basis for our knowledge of the fact that agriculture is a major source of pollutants (sediment, phosphorus, nitrogen, pesticides) to the Maumee River. Phosphorus and sediment have received the majority of the attention because phosphorus has been identified as the key limiting nutrient in Lake Erie and sediment has been identified as the vehicle for transporting phosphorus. Nitrogen and pesticides have both received greater attention in recent years as public health issues.

Each of the pollutants originating from agricultural sources in the Maumee River and their impacts are discussed in the following sections of this report.

Sediment

Sediment is considered to be the most prevalent non-point source pollutant by volume. By Ohio law (Agricultural Pollution Abatement and Urban Sediment Pollution Abatement Law), sediment is defined as "solid material", both mineral and organic, in suspension and being transported, or moved from its site of origin by air, water, gravity, or ice and has come to rest on earth's surface either above or below sea level." Therefore, soil particles are not considered sediment until they are detached and are being transported or have come to rest on the earth's surface.

Soil erosion is the removal and loss of soil from the land by rainfall, flowing water or wind action. Sedimentation is the resulting build-up of this soil in the downstream areas and Lake Erie.

Soil erosion rates (per acre) in the Maumee River Basin are generally low, but because of the amount of land in agriculture, erosion from cropland poses a major pollution problem. The fine textured soils of the Maumee Basin are easily displaced and washed away by the rain. The sediment load in the Maumee River at high flow has been measured to exceed 150 thousand tons per day. The average annual sediment load from the Maumee River is 1.2 million tons per year, but it can accumulate to nearly 2 million tons per year.

There are numerous problems created by suspended and deposited sediment. These problems include:

1. Increased treatment costs of water supplies due to increased levels of suspended sediment. The taste and odor of the treated water can also be affected by these increased levels;

2. The reduced aesthetic quality of water for recreation purposes;

3. Reduced light penetration caused by turbidity which reduces photosynthesis thereby preventing aquatic plant growth, disrupting the food chain and impairing biological systems;

4. Decreased visibility in the water which affects the ability of fish to feed as well as create a safety hazard for boaters, swimmers, and water skiers; and

5. Provides a vehicle for the transport of phosphorus and other pollutants.

6. Cause species extirpations and impacts on biological communities.

Deposited sediment problems include:

1. Navigation problems in Toledo Harbor and the necessity to provide annual maintenance dredging of 1 million cubic yards per year.

2. Impaired biological systems due to covering of the bottom spawning and feeding areas of fish. In addition, deposited sediment reduces the productivity of many species of aquatic organisms which are food for fish.

3. Filled drainage ditches which require expensive ditch maintenance and environmentally destructive channelization and modification to restore usage.

The Lake Erie Wastewater Management Study was conducted by the U.S. Army Corps of Engineers pursuant to Section 108 of the Clean Water Act of 1972. The LEWMS used the Land Resources Information System (initially developed by TMACOG) to calculate existing Potential Gross Erosion for the Lake Erie Basin. The Maumee River Basin in its entirety was identified as having 2,596,736 acres of cropland which contributed 9,092,447 tons of potential gross erosion, or an average of 3.5 tons of soil loss to the acre under 1978 conditions.[46]

The *State of Ohio Phosphorus Reduction Strategy for Lake Erie* (1985) divided the Lake Erie drainage area (Ohio portion only) into 34 hydrologic groups. Table 36 identifies 14 of these hydrologic groups that make up the Maumee River Basin in Ohio.[33] Table 34 shows that there was 3,322,095 total acres in the Ohio portion of the Maumee River Basin and the Lower Maumee River Area of Concern in 1980. These were estimated to yield 6,384,071 tons of sediment at the edge of the field or 1.9 tons/acre/year.

This difference between the Ohio Strategy and the LEWMS is likely the result of higher levels of erosion in the Indiana and Michigan portions of the basin and a difference in methodology. In either instance, both studies support the concept that there are many acres with low levels of erosion which add up to a substantial contribution of sediment to the streams and rivers of the Maumee River Basin.

These calculations of Potential Gross Erosion by the LEWMS and for the Ohio Phosphorus Strategy have been designed to develop a relationship between soil erosion on the croplands and the sediment that is actually transported to Lake Erie and its tributaries. The calculation of Potential Gross Erosion reflects the soil loss from the field. The transport of the soil particles may or may not continue for some distance until it actually arrives downstream. The sediment delivery ratio reflects the percentage of material that actually is transported to an area of deposition. The LEWMS calculated the sediment delivery ratio for the Maumee as 9.2%.[47] The Ohio Phosphorus Strategy calculated a delivery ratio of 13.7% for the Maumee.[33]

TABLE 36
SEDIMENT AND PHOSPHORUS AFFECTING THE MAUMEE AOC

BASIN NAME (Ohio Basins Only)	TOTAL AREA (ACRES)	1980 GROSS EROSION (TONS/YR)	1980 PHOS YIELD (MT/YR)
Ten Mile Creek (Ottawa River)	107,134	140,722	118
Maumee River Mainstem	181,444	235,881	185
Maumee River Mainstem	203,296	327,952	182
Maumee River Mainstem	308,683	461,697	290
Tiffin River	357,200	626,537	337
Auglaize River Mainstem	251,952	636,346	236
Little Auglaize River	261,142	680,900	316
Auglaize River Headwaters	249,105	571,666	275
Blanchard River	490,220	788,072	364
Ottawa River	233,700	515,773	256
Maumee River Mainstem	129,748	357,212	140
St. Mary's River	289,600	642,317	312
St. Joseph River	151,347	216,764	106
Lake Erie Direct (partial)*	107,517	182,232	111
TOTAL	3,322,095	6,384,071	3,234

* Includes 46% of Group 14 watersheds from the Ohio Phosphorus Strategy. This includes all of the drainage between Crane Creek and the Maumee River.

Source: State of Ohio Phosphorus reduction Strategy for Lake Erie (1985).

Phosphorus

The phosphorus associated with sediment, as well as the phosphorus from other sources such as urban runoff, combined sewer overflows and industrial and municipal discharges, has been identified as the principle limiting nutrient in the cultural eutrophication of Lake Erie. It is also responsible for eutrophic conditions in the Lower Maumee River, Maumee Bay and the tributaries of both.

Eutrophication is a natural aging process generally describing the fertility (mainly aquatic plant productivity) of lakes. Over time, a lake will become filled with sediment and organically derived material from streams draining its watershed and from atmospheric deposition. These processes occur naturally and will fill in a lake on a geologic time scale. However, man's activities within a drainage basin can alter the natural processes in a watershed and accelerate this (extinction) process. This latter situation is referred to as cultural eutrophication to distinguish it from the natural process of aging of a lake.

Cultural eutrophication is caused by the excessive loads of aquatic plant nutrients (usually phosphorus) to natural waters. These nutrients, in turn, can produce nuisance growths of algae and higher aquatic plants which interfere with man's use of the water. While some lakes are naturally eutrophic, in that they receive a sufficient supply of phosphorus and nutrients from other sources to produce nuisance growths, an increased nutrient load to a water body has most often been associated with an intensification of human activity in the drainage area surrounding the water body.

A major focus of the Lake Erie Wastewater Management Study was to assess the relative importance of point source and non-point source contributions of phosphorus and other pollutants. Their conclusion was that even after the major wastewater treatment plants had achieved the 1 mg/l standard for phosphorus, there would still be a need to reduce phosphorus contributions to Lake Erie from non-point sources by 47% in order to upgrade the Western and Central Basins of Lake Erie to a stable trophic condition. Such improvement would generally be associated with improved water quality in that the fertility levels would be moderated and nuisance growths would be eliminated.

The Water Quality Agreement of 1983 between the United States and Canada includes Annex III which establishes a phosphorus loading target for Lake Erie of 11,000 metric tons per year. It also called upon the United States and Canada to prepare strategies to achieve this load reduction. The *United States Task Force Plans for Phosphorus Load Reductions to Lake Erie, Lake Ontario, and Saginaw Bay* establishes a total Lake Erie reduction of 1700 metric tons of which Ohio is responsible for 1,390 metric tons.

Ohio has prepared the *Phosphorus Reduction Strategy for Lake Erie* which sets out Ohio's plan to reduce 1390 metric tons of phosphorus. Agricultural sources are considered to contribute about 64% of the total phosphorus load to the Lake. Therefore, they have been assigned 64% of the reduction, or 890 metric tons/year of phosphorus. The strategy identifies 112 watersheds in the Lake Erie Basin that are to receive priority treatment with conservation tillage. To meet the required reductions, conservation tillage practices are to be adopted on 50% of these acres.

The Maumee River Basin contains 57 of these watersheds which are divided into watershed groups according to the Planning and Engineering Data Management system for Ohio (PEMSO) developed by OEPA (Table 37). These watersheds contain 1,095,979 acres of cropland which contribute 1,197 metric tons of phosphorus. The strategy proposed that this contribution would be reduced by 447 metric tons. This is about half of the required Ohio phosphorus reduction from agriculture.

Achieving this reduction will improve water quality in the lower Maumee River and Maumee Bay as well as Lake Erie. However, most of this problem originates upstream from the AOC and will have to be addressed in these upstream areas.

TABLE 37
PROPOSED PHOSPHORUS REDUCTIONS
FOR PRIORITY WATERSHEDS BY PEMSO WATERSHED GROUP
Maumee River Basin

PEMSO WATERSHED Group #	CROPLAND Acres	AGRICULTURAL PHOSPHORUS M Tons	PHOSPHORUS REDUCTION M Tons
1. Ten Mile Creek	51,364	74	26
2. Maumee River Mainstem	90,468	116	41
4. Maumee River Mainstem	56,005	41	20
5. Tiffin River	159,418	132	63
6. Auglaize River Mainstem	78,059	73	28
7. Little Auglaize River	143,374	146	54
8. Auglaize River Headwaters	140,398	139	55
10. Blanchard River	74,189	161	42
11. Maumee River Mainstem	46,549	55	21
12. St. Mary's River	192,277	181	69
14. Lake Erie Direct (Partial)	63,878	78	28
TOTAL	1,095,979	1,197	447

Source: State of Ohio Phosphorus Reduction Strategy for Lake Erie (1985)

Nitrogen

Nitrogen is an essential plant nutrient and is applied to cropland as a fertilizer. Nitrogen is also a nutrient for aquatic plants although it is less of a limiting factor than phosphorus, and therefore, has not received the same level of attention in water quality control strategies. The concentrations of nitrate nitrogen increase during runoff events. However, nitrates are soluble and are carried to the waterway with the runoff rather than adsorbed to sediment as is phosphorus. Tile effluent often carries nitrates to the waterways.

Dr. David Baker of Heidelberg College reports that the nitrogen export rate for the Maumee River Basin is 19 kg/hectare/year (17.1 lb./acre/year) and that this is much higher than national averages. This represents an amount equal to about 50% of the amount of fertilizers applied by farmers in the basin each year and represents a significant loss to these farmers.

Table 35 shows that the annual load of nitrate/nitrite nitrogen in recent years has ranged from 24,100 metric tons to 35,450 metric tons. The 1982 water year which has been selected as a typical or average year for the Great Lakes had an annual load 28,400 metric tons of nitrate/nitrite nitrogen.

Nitrate nitrogen levels in the Great Lakes have been increasing. Lake Erie has experienced an increase of 7.95 ppb/year over the period of 1970 to 1986. The International Joint Commission has expressed concern about this increase and has recommended that research be performed to identify the effects of these increases.

Nitrate concentrations have exceeded the 10 mg/l standard on the Maumee River.This usually occurs during the spring when fertilizer application and runoff events are likely.

The standard was exceeded 92% of the time during May, June or July. Peak concentration for the period of time ranged from 10.3 to 12.3 mg/L. Public health concerns about nitrate nitrogen have constituted the major effect of these events. The solubility of nitrate nitrogen adds to the public health concerns about nitrates because they are difficult to remove through the standard drinking water treatment process. As a result, drinking water alerts have been issued for communities that utilize the Maumee River for their drinking supply.

Pesticides

A recent report by the Water Quality Laboratory of Heidelberg College entitled *Lake Erie Agro-Ecosystem Program: Sediment, Nutrient, and Pesticide Export Studies* (prepared for the Great Lakes National Program Office) is the most thorough review of pesticide loads in the Maumee River. A summary of the situation as reported in this document follows.

During spring and early summer, the concentrations of many currently used pesticides increase in Lake Erie Tributaries. In general, the concentrations of herbicides are much higher than the concentration of insecticides, and concentrations of both are generally proportional to their usage. The herbicide concentrations in these rivers appear to be higher than in many other rivers draining cropland. The effects of these herbicides on ambient water quality remain uncertain. Because of the low acute toxicity, the relatively low persistence and the insignificant bioaccumulation of most herbicides, direct toxic effects on animal life in streams and rivers appear unlikely. However, the concentrations of herbicides observed in these streams are within the range where effects on both algal and higher aquatic plant communities could be expected. Such effects may already be manifest in the existing algal and rooted aquatic plant communities in this region's streams and rivers, and within their associated wetlands and bays. Changes in these plant communities could affect the fish and invertebrate communities in streams and rivers. Also the herbicide concentrations could possibly induce behavioral responses in animals that could be detrimental to these communities.

Most of the pesticides present in streams occur primarily in the dissolved state rather than attached to the sediments. Consequently, the removal of sediments at drinking water treatment plants does not remove most pesticides. Since other aspects of conventional water treatment, such as chlorination, do not remove or alter these compounds, finished tap water has very similar concentrations of these pesticides to those found in the raw water. At present, the U.S. Environmental Protection Agency has not established maximum contaminant levels in drinking water for any of the herbicides monitored in these studies, even though this set of herbicides makes up about 85% by weight of the herbicides used in Ohio. Standards for several of the major herbicides should be set by the federal government in the near future.

For the present several states are establishing their own drinking water standards and the National Agricultural Chemicals Association has also suggested interim health guidance levels for some compounds (NACA 1985). The concentrations of herbicides in Lake Erie tributaries do exceed some of these guidelines, for relatively short periods of maximum concentration. Activated carbon can be used to remove these compounds at water treatment plants and research is underway to evaluate other possible treatment techniques.

Table 38 contains information about the concentrations of pesticides in the Maumee River at Waterville (at the upstream end of the Area of Concern) and their extrapolated loads to the lower Maumee River. The accuracy of the load estimates is dependent on the frequency and representiveness of the pesticide samples and the flow data. Infrequent pesticide samples are more often the limiting factor than is inadequate flow data.

TABLE 38
PESTICIDE CONCENTRATIONS AND EXTRAPOLATED LOADS

PESTICIDE	TRADE NAME	1983 Conc. ppb	1983 Load kg	1984 Conc. ppb	1984 Load kg	1985 Conc. ppb	1985 Load kg
Siamazine	Princep	0	0	0.185	290.95	0.165	67.33
Carbofuran	Furadan	0.175	245.95	0.188	509.38	0.046	27.41
Atrazine	Aatrex	1.751	2476.11	2.975	4807.74	1.902	727.89
Terbufos	Counter	0.001	2.35	0	.53	0.001	0.34
Fonofos	Dyfonate	0	0	0.002	6.45	0	0.53
Metribuzin	Sencor, Lexone	0.443	700.06	0.448	1816.42	0.254	125.68
Alachlor	Lasso	1.046	2053.38	1.756	5251.98	0.472	264.131
Linuron		0.036	46.86	0.040	54.96	0.013	19.81
Metolachlor	Dual	1.308	1763.06	1.574	3056.82	1.316	618.73
Cyanazine	Bladex	0.662	1160.87	1.146	2888.98	0.322	137.28
Penoxalin		--	59.91	--	118.51	--	0

Concentration is the "Time Weighted Mean Concentration" and is calculated for the time period of April 15 to August 15.

Source: Lake Erie Agro-Ecosystem Program: Sediment, Nutrient, and Pesticide Export Studies[48]

OPEN WATER DISPOSAL OF DREDGED MATERIAL

The Corps of Engineers (COE) annually conducts maintenance dredging of the Toledo Harbor in order to maintain the depth of the shipping channel. This dredging produces between 800,000 to 1,000,000 cubic yards of dredged material annually. In recent years (since 1970s), about 90 to 95% of the material was placed in one of the confined disposal facilities (CDF) at the mouth of Maumee Bay. In September 1984, the COE proposed to change operations to open lake dispose of about 60% of the dredged material from the Maumee Bay portion of the channel (and upper 2 miles of river channel) due to cleaner sampling. The remainder of the more polluted material was to be placed in the CDF.

US EPA found that portions of the material were suitable for open lake disposal with the following stipulation:

> "Potentially adverse impacts of open-water disposal should be minimized by locating the open-water disposal sites in areas where the sediment will remain in-place and where biological productivity is relatively low."[49]

Ohio EPA has provided annual Section 401 Water Quality Certifications (required for dumping operations) with special stipulations. In 1985 and 1986 the COE was required by Ohio EPA to conduct monitoring operations and the Toledo-Lucas County Port Authority and the City of Toledo were to explore alternatives for the reuse and or disposal of the material other than open lake disposal. In 1987, the annual 401 certification also included the following stipulations:

> The Ohio EPA intends to impose the following conditions on any future 401 Certifications to dredge the federal navigation channel at Toledo harbor from lake mile 2 outward over the next four years. These conditions will be imposed provided the lake channel sediments remain classified by USEPA as suitable for open lake disposal.
>
> 1988 - The Corps shall open lake dispose an amount not to exceed 90% of the material dredged from the lake channel. The Toledo-Lucas County Port Authority and the City of Toledo are responsible for identifying reuse alternatives for at least 10% of the dredged material. This volume shall either be placed in a confined disposal facility, with the commitment that an equal amount be removed from a confined disposal facility prior to 1989 lake channel dredging, or used in a (direct) reuse project.
>
> 1989 - Same as 1988 except that the open lake disposal is restricted to 70% of the material and 30% is to be subjected to reuse alternatives.
>
> 1990 - Same as 1988 except that open lake disposal is restricted to 50% of the material and 50% is to be reused.
>
> No open lake disposal of dredged material will take place after 1991. The Toledo-Lucas County Port Authority and the City of Toledo are responsible for identifying reuse alternatives for 100% of the dredged material. This volume shall either be placed in a confined disposal facility, with the commitment that an equal amount be removed from a confined disposal facility prior to the following year's lake channel dredging, or used in a direct reuse project.[50]

Differences of Opinion

There are several effects of open water disposal that have or may have negative impacts on the Area of Concern. These effects have been described and documented by various sources, however, there are still considerable differences in opinion over the extent of the impacts. Therefore, COE comments on the problems summarized below have been included.

COE Comment: Open lake disposal is considered to be environmentally suitable for disposal at the present disposal site by USEPA. Furthermore, the most recent and most specific studies and testing indicates that overall there may be no measurable negative impacts due to lake disposal. It even seems likely that lake disposal could have beneficial effects related to covering polluted bottom areas and in providing better contoured underwater habitat for fish.

Local Comment: The material does not stay at the disposal site but is dispersed by the currents and wave action. The current open lake dump site was previously used as a part of a 155 acre site one which material was dumped. The COE reports that 3,840,000 cubic yards were dumped on the site from 1965 to 1975. When the site was put back into use in 1985, water depths ranged from 20 - 24 feet which were very similar to the area surrounding the dump site. Had the 3,840,000 cubic yards that were placed on the site remained, then it would have formed a column rising 15.5 feet off the bottom and would result in water depths that averaged about 7 feet. Since this is not the case, and the material is gone, it is evident that it erodes away over a relatively short period of time.[51]

COE Comment: Soundings clearly indicate that material dumped from 1965 - 1975 is basically still there. The dump site depths are not similar to the surrounding bottom (see attached sketch). Calculations of depths (above) are in error due to an error in area (640 acres vs. 155 acres). Several years of capacity remain at the present site.

Local Comment: Material from the Lake portion of the shipping channel is not similar in physical composition to the lake bottom surrounding the dump site: more silt (46% in dredged material compared to 27% in lake sediments near the disposal site); more clay (29% to 13% in lake sediments); and much less sand (25% in dredged material and 69% in lake bottom sediment). The dredged material is also higher in phosphorus.[52] Therefore, the erosion and resuspension of the dredged materials resulting in the bottom sediments of the surrounding areas to be covered with lower quality dredged material.

COE Comment: The physical characteristics of dredge material varies somewhat from area to area and depending on how deep the dredge is dredging. The bottom of the Bay is certainly similar in some aspects to the dredge material because most, if not all, of the material in the Bay originally came from the same upland sources of the Maumee River. Both dredge and bottom material have also been subject to much of the same pollutant sources. Thus it seems more correct to say that both are similar than not similar overall.

SUSPENDED PARTICULATES / TURBIDITY

Local Comment: During the dumping operations, a turbidity plume is created that is persistent for the duration of dumping operations and extends well beyond the one square mile of the dump site. This turbidity plume has been observed by numerous individuals and has been extensively photographed. This corresponds with the fact that dissolved solids violated water quality standards during dumping operations.[53]

COE Comment: Turbidity plumes need further study as to how much material is transported or suspended. Even a trace of material may be visible and the Corps position is that practically all the material goes immediately to the bottom. Remaining quantities at the disposal site support this.

Local Comment: Laboratory tests have shown that 24% of the material remains in suspension after 24 hours.[54] A 1972 study has shown that the current moving across the Western Basin of Lake Erie will move 0.3 feet/second.[55] Therefore, the material could move 25920 feet or 4.9 miles in 24 hours. Herdendorf has shown the average velocity of Detroit River water flow in western Lake Erie is approximately 0.5 feet/second.[56] This also demonstrates that the material can be spread around the Western Basin.

COE Comment: Hopper dredge disposal as done in the Bay with a split-hull dredge does not leave the amounts suspended as with an agitated laboratory sample. The dredge load "slides" to the bottom essentially in bulk. Most, if not essentially all, of the material is still in place after 20 years in site #2 so actual resuspension after 24 hours appears to be drastically lower than the 24% from lab testing. The remaining material in site #2 also undermines the conjecture that substantial amounts of resuspended material are transported for miles around the Bay. Survey lines one-quarter mile from site #2 also showed no change from 1985 to 1987 thus indicating no detectable movement of material.

WATER QUALITY

Local Comment: Pursuant to the provisions of the Section 401 Water Quality Certification issued by Ohio EPA, the COE conducted monitoring of water quality conditions on the dump site and in surrounding water in both 1985 and in 1986. A change in pH that violated Lake Erie Water Quality Standards was reported for 1985.[57] The 1986 monitoring program detected several violations of Lake Erie Water Quality Standards both on and off the dump site, including copper, cadmium, iron, mercury, and dissolved solids.[53] This was acknowledged by COE.[58] The 1986 monitoring program has also shown several impacts on water quality conditions around and off the dump site.[59, 60] In addition, an early algal bloom was identified by Robert Stevenson of the Toledo Division of Water. This was the earliest recorded at the Toledo Water Intake since 1976. He attributes this to the dumping of dredged material.[60]

COE Comment: The Corps interpretation of the monitoring of 1985 and 1986 was that there were no violations that could be attributed to the disposal operations. One violation noted above was from sampling done before disposal started. Other apparent violations were not true violations because simultaneous remote reference results indicated that conditions were no worse at the disposal site than at the remote reference sites. Algae blooms are common to Maumee Bay and it is only conjecture to attribute these to dredge disposal miles away. A Corps bioassay report on the Bay is to be complete in April 1988. This hopefully should clarify some environmental misunderstandings.

Local Comment: The effect of the open water disposal on phosphorus loads has also been a topic of study. Bioavailable phosphorus concentrations in the Lake portion of the shipping channel are higher than those of the surrounding Lake according to work performed by DePinto.[54] Annual loading of bioavailable phosphorus is 101 metric tons/year or 28% of the average annual Maumee River load.[52]

COE Comments: Annual loadings of bioavailable phosphorous is .4 to .6% not 28% as reported above (per CENCB-ED from DePinto research).

EFFECT ON MUNICIPAL WATER SUPPLIES

Local Comment: City of Toledo has repeatedly stated that the current dump site is within an area where current will carry the material to the water intake and requested that the dump site be moved further to the East and North. Stevenson has stated that water from the dump site does arrive at the water intake.[60] This conforms to the prediction of movement of the material over a 24 hour period that was described above. Movement of the material may carry toxics or other organic chemicals whose limits are below the level of sensitivity of testing performed by the COE.[61]

COE Comment: As stated previously this is largely conjecture, and data needs to be developed on resuspension and its effect on phosphorous levels.

CDF Alternatives

An economically feasible and environmentally acceptable site or method for future disposal of dredged materials that are unacceptable for open-lake disposal will be required within two to five years. Within this time period, the existing active 242-acre CDF will be filled to capacity.

Disposal alternatives that have been mentioned for consideration include: upland use of the dredged material at Maumee Bay State Park, Buckeye Basin Greenbelt Parkway, and various old landfill sites; construction of a CDF along the east side of Woodtick Peninsula to prevent the continued erosion of the peninsula and provide some protection to the marshes, marinas, and other lands west of the peninsula; increasing the height of the dike around the active 242-acre CDF or around the old Island 18 (Grassy Island) CDF to increase disposal capacity; or constructing a new CDF at one of the four potential alternative locations adjacent to the navigation channel.

The preferred action identified by the COE in the Draft Environmental Impact Statement involves the construction of a new lake shore CDF (Alternative 1C) bounded on the northeast and southeast sides by the existing 242-acre CDF, on the south side by the Port Authority CDF, and on the west and northwest sides by a 4,265 foot long dike to be built to a top elevation of 23.5 feet above the LWD elevation of 568.6 feet (IGLD, 1955). The new CDF would occupy about 176 acres of Maumee Bay and would provide about 162 acres of disposal area.

As long as the water quality of the lower Maumee River is significantly degraded, rapid mixing of river and bay waters appears to be important in minimizing the zone of influence of the river water in Maumee Bay. It is expected that water quality in the lower Maumee River will continue to improve, but the process will be a very gradual one. A new CDF at three of the sites considered, or even an expansion of Grassy Island to the northwest would result in reduced mixing in the "shadow zone" of the CDF. Even the construction of a CDF at the preferred site near the existing active CDF will have some impact on mixing by eliminating the 176-acre embayment area as a mixing zone and shifting the mixing zone to the north of the site.

The impacts of this construction on mixing might be greater if it were not for two ameliorating factors. First, much of the river flow does not pass by the preferred site due to an average withdrawal rate of about 1149 cfs by the Toledo Edison Bayshore Power Plant, the mouth of whose intake canal is located at the southwest corner of the proposed CDF site. Comparing this average withdrawal rate to the discharge frequency data for the Maumee River at Waterville indicates that for the period of June through August, the river flow exceeds the power plant withdrawal rate less than 50 percent of the time. Thus, for perhaps half of the time during the summer months, water may be moving from the bay across the face of the site to the power plant intake, rather than from the river into the bay area. The second ameliorating influence is the additional water mass mixing produced by winds and seiches. The resulting movement of water masses can cause bay water to move several miles into the lower Maumee River. Thus, even when river flow rates substantially exceed the withdrawal rate of the power plant, the site will often be under the influence of bay water due to a wind or seiche induced movement of bay water up into the Maumee River estuary area.

The preferred site was selected primarily due to the fact that the amount of diking required, and thus the cost of construction, would be much lower than at any other location in Maumee Bay. Even the most efficient of designs for a 176-acre CDF at another location, such as an extended semi-circular CDF expansion of the northwest side of Grassy

Island, would require a dike approximately 60 percent longer than the one proposed. Only the most serious of water quality impacts or the elimination of the most unique of fish and wild-life habitats might have precluded the selection of this site for construction of a new CDF. The water quality impacts of this alternative should be relatively minor, and the fish and wildlife resources of the site are significant but not unique.

Environmental Conditions

In 1986, the Ohio EPA conducted an extensive biological and water quality survey of the lower Maumee River, with some additional fisheries surveys in Maumee Bay. The data are presently being analyzed by the agency. A preliminary data set of surface and bottom DO readings were taken on 8 to 10 dates between July 14 and October 8, 1986. The combined mean for River Mile 1.0 is about 5.1 ppm (range 3.3 to 6.3 ppm), for River Mile 0.5 about 5.4 ppm (range 3.6 to 7.3 ppm), and for the mouth near Presque Isle about 5.5 ppm (range 3.1 to 7.5 ppm). These values are somewhat higher than values from earlier studies indicating that some improvement in water quality has occurred between the early 1970's and the mid-1980's.

While Maumee Bay has historically been influenced by the degraded water quality of the lower river, and this influence has been increased by the construction of the 242-acre CDF, the aquatic community of the site and of the rest of Maumee Bay is not a depauperate assemblage. The application of the pollution classification of Wright (1955)[62] to benthic invertebrate data indicates that the area southeast of the navigation channel is lightly polluted, the navigation channel and the area northwest of the channel is moderately polluted, and the area near the Toledo Sewage Treatment Plant discharge is heavily polluted (see Figure 6).

Just as the water quality in the bay has apparently improved and will continue to improve, the sediment quality also appears to have improved significantly. A prime example would be that the dredged sediments from Lake Mile 2 to Lake Mile 8 are now considered suitable for open-lake disposal. Another indication of this change is the change in the benthic community of the bay. In 1930, 1961, and 1982, a series of stations throughout the western end of the western basin of Lake Erie were sampled for benthic macrofauna. From 1930 to 1961, the stations in and near Maumee Bay either remained at high level of pollution or became much more polluted, as evidenced by the number of oligochaets per square mile and by loss of pollution intolerant organisms such as *Hexagenia* mayfly nymphs.

By 1982, the trend had dramatically reversed itself, at least concerning the numbers of oligochaets. The 1930 survey results are presented in Wright (1955)[62] and the 1961 survey results in Carr and Hiltunen (1965).[63] The 1982 data Manny, Hiltunen and Judd (unpublished)[64] are preliminary, have not yet been statistically analyzed, and are subject to some modification. Note that while the density of oligochaets has decreased at stations in and near Maumee Bay, the densities at most stations further offshore have remained relatively the same or increased.

CDF Impact on Fish Habitat

In spite of obvious water quality problems in the lower Maumee River and in Maumee Bay, these areas serve as valuable nursery habitat and perhaps spawning habitat for white bass and other sport and commercial species such as walleye, yellow perch, freshwater drum, and channel catfish. Mizera (1981) found the average density of larval white bass in Maumee Bay was more than five times greater than the average density east of the bay and more than seven times greater than the average density north of the bay.[65] A similar pattern was found for freshwater drum. For larval walleye, the density found in Maumee Bay was slightly greater than that north of the bay but considerably less than that east of the bay. The density of yellow perch larvae in the bay was high but was slightly below that of the other two areas. Heniken (1977) also found somewhat similar patterns of larval distributions in his summarization of data from 1975 and 1976 for the Ohio portion of the western basin.[66]

Based on the larval surveys of 1975 and 1976, Heniken (1977)[66] indicates that gizzard shad production in the Ohio portion of the western basin appears to be centered mainly in Maumee Bay and that concentrations often exceeded 1,000 per 100 square mile. Gizzard shad are the most important forage species for walleye in the western basin of Lake Erie.

The data show that the preferred CDF site presently consists of a diversity of valuable aquatic habitats and that without the implementation of the proposed project, the value of these habitats would continue to increase with the improvement of water quality in the lower Maumee River. The value of these resources is sufficient to qualify their loss as significant, and that loss should be appropriately mitigated.

The propose CDF will neither take on the appearance of an island nor add diversity to the area. It will reduce the diversity that presently exists in the CDF peninsula by reducing the shoreline length of the peninsula and eliminating the varied aquatic habitats in the existing 176-acre embayment. It is unlikely that the short-term increased utilization of the CDF area by water birds during the filling phase will outweigh the long-term loss of use of the existing 176 acres of Maumee Bay by herons, egrets, and particularly by diving ducks.

The proposed CDF is but one in a series of CDFs that have been constructed in Maumee Bay and the lower Maumee River. With the construction of the proposed CDF, almost 5 percent of the surface area of Maumee Bay will be occupied by CDFs. The cumulative impacts to fisheries have been significant and there has been no mitigation of fish habitat losses resulting from the construction of any of these existing CDFs. If a CDF is constructed at the preferred site, a combination of in-kind and out-of-kind mitigation could partially offset fish habitat losses and such mitigation should be made a part of the project.

URBAN RUNOFF

Urban runoff encompasses combined sewer overflows, as well as a significant non-point source of pollution. Any type of street debris that is small and light enough to be washed away by a heavy rain will end up in Lake Erie in some form, sooner or later. Contaminants in urban runoff cover a broad range, but typically include pollutants washed out of the air by rainfall, animal droppings, construction sediment, leaves, litter, salt, and oil. Some of these occur naturally; the pollution problem results from the high rate of runoff from urban areas.

A number of studies on the problems and possible solutions to urban runoff pollution have been conducted. Subjects investigated include urban soil sediment, and street cleaning. Urban runoff is higher in suspended solids than sanitary sewage; the BOD is lower than in sewage, but not low enough for runoff to be considered clean water.

In developed urban areas, rainwater runs off of roof tops, sidewalks, and streets, and becomes polluted as it dissolves or washes away debris. Any debris on the street or sidewalk sooner or later ends up in a nearby stream. There are two ways to reduce urban runoff pollution from developed areas. Collect the water and treat it, or reduce the sources of pollutants by keeping debris from being washed into storm sewers to start with. This is a matter of urban housekeeping.

In newly developing areas, there are special problems related to sediment and debris from construction sites. While of limited duration, the impact of large quantities of sediment can be substantial.

Urban runoff is a significant source of nutrients: it is estimated[32] to contribute 0.8 lb of available phosphorus per urbanized acre per year. This estimate was based on runoff samples taken from urban areas in the Great Lakes region. On the basis of this loading, it was estimated that for the Swan Creek watershed[42] phosphorus loadings from urban areas total roughly 13% of agricultural runoff. This would make urban runoff the second largest source of phosphorus in the sub-basin. Applying the 0.8 pound of available phosphorus per urbanized acre per year, a total of 3,922 pounds or 21 tons, is the estimated phosphorus loadings per year for the RAP area. These calculated loadings are displayed in Table 39 by municipality and by TMACOG watershed.

TABLE 39
ESTIMATED URBAN RUNOFF PHOSPHORUS LOADINGS

MUNICIPALITY	TOTAL HECTARES	TOTAL ACRES	URBAN HECTARES	URBAN ACRES	LB. PHOSPHORUS	TMACOG WATERSHED(S)
LUCAS COUNTY						
Berkey	1,052	2,599	52	128	103	1
Harbor View	4	10	4	10	8	28
Holland	112	277	84	208	166	9
Maumee	2,536	6,266	1,236	3,054	2,443	10, 41, 47, 79
Oregon	7,432	18,364	1,776	4,388	3,511	28, 29
Ottawa Hills	448	1,107	308	761	609	6
Sylvania	1,464	3,618	808	1,997	1,597	3
Toledo	21,704	53,631	14,840	36,670	29,336	2, 6, 10,13,14,15,22,23,25,26,30
Waterville	568	1,404	232	573	459	41, 43, 44
Whitehouse	792	1,957	200	494	395	39, 40
TOTAL	36,112	89,233	19,540	48,283	38,627	
WOOD COUNTY						
Haskins	408	1,008	64	158	127	122
Luckey	160	395	80	198	158	83
Millbury	248	613	72	178	142	115
Northwood	2,052	5,070	496	1,226	980	43
Perrysburg	1,076	2,659	676	1,670	1,336	121, 122
Rossford	728	1,799	432	1,067	854	115
Walbridge	264	652	164	405	324	28, 29, 32
TOTAL	4,936	12,197	1,984	4,902	3,922	
TOTAL FOR AREA	41,048 Acres	101,430 Acres	21,524 Acres	53,186 Acres	21 Tons P/Yr	

Apart from the estimate that urban runoff yields 0.8 pound of Phosphorus per acre per year to Lake Erie, no other monitoring or sampling data specifically aimed at urban runoff is known in the Maumee RAP Area.

Salt for deicing streets is a potential source of water pollution from urban runoff. If present in high enough concentrations, salt can be toxic to aquatic life. No data is available to indicate whether deicing salt causes problems in the Toledo area.

Present Urban Runoff Control Practices

Typically, there are no urban runoff control practices in use in the older, developed urban areas. However, the City of Toledo and Lucas County enforce site drainage design regulations for new development. These regulations limit the allowable discharge rate of stormwater to a storm sewer. Any flow above the rate at which runoff occurred from a 25 year storm before development must be retained.

Retention/detention basins, and rooftop and parking lot stormwater storage are frequently used, as are swales and oversized ditches with restricted outlets. Design standards call for the use of passive stormwater control facilities that will work without having to be operated; e.g., the outlet from a retention basin is controlled by a small outlet to restrict flow, rather than a valve. Also, a valve can be easily removed by the owner, defeating the purpose of the basin.

- There are some problems and shortcomings with the present regulations. They are not stringently enforced. Regulation may be no more than paying a fee for a permit.

- Training of inspection personnel is a problem. Better awareness of the purpose of these stormwater facilities, especially relating to water pollution control, would be beneficial.

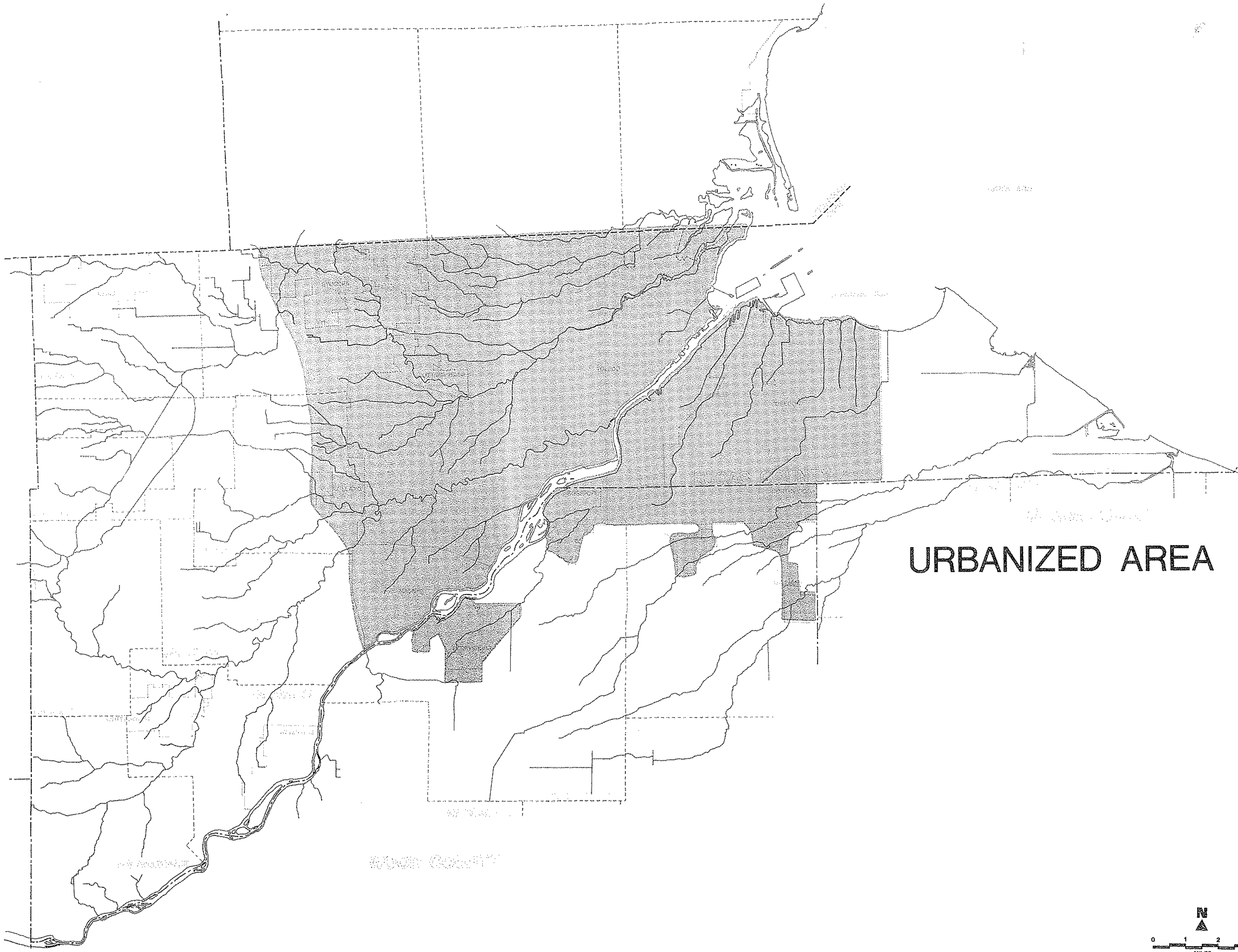
- There is no enforcement for proper maintenance of stormwater control facilities.

Proposed NPDES Permit Requirements for Storm Sewers

US EPA[67] has been developing NPDES requirements for separate storm sewer outfalls over the past several years. The regulations developed required communities to classify storm sewers as "Group I" or "Group II," depending on the type of area drained by the sewer, and the likelihood of contaminated runoff. The filing deadline for permit applications was set at December 31, 1987. The area affected by the regulation was defined as "*the most current criteria established by the Bureau of Census.*" A map showing the areas classified as "urbanized" by the 1980 Census[68] is included as Figure 49. However, a lawsuit was filed, and in December, 1987, a Court of Appeals threw out the regulation (CFR 2/12/88[67]). The issue of how to regulate stormwater discharges has been remanded to US EPA for further rule making.

EPA intends to issue new regulations codifying storm water provisions found in sections 401, 405, and 503 of the Clean Water Act of 1987 in the near future. Details and proposed rules will published for public comment in the *Federal Register.*

FIGURE 49
**** INSERT MAP OF URBANIZED AREAS HERE ****



LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

Combined Sewer Overflows

Storm runoff causes a serious pollution problem resulting from combined sewer overflows, or "CSOs." Almost every town has areas where sewage and runoff use the same, or "combined" sewers. During a storm, runoff overloads these sewers, and causes a mixture of rainwater and raw sewage to overflow into the nearest creek.

This is a serious problem, not only because of the pollution it causes, but also because it's difficult and expensive to correct. During a heavy rain, the amount of storm water flowing through the sewers is likely to be much greater than the amount of sewage.

Designing a sewage treatment plant for this peak flow rate would be expensive, and would be significantly oversized for normal flow rates. But if this peak flow surge is allowed to go through the treatment plant, it can upset the treatment processes and keep the plant from doing a good job of treating sewage for days or weeks afterward.

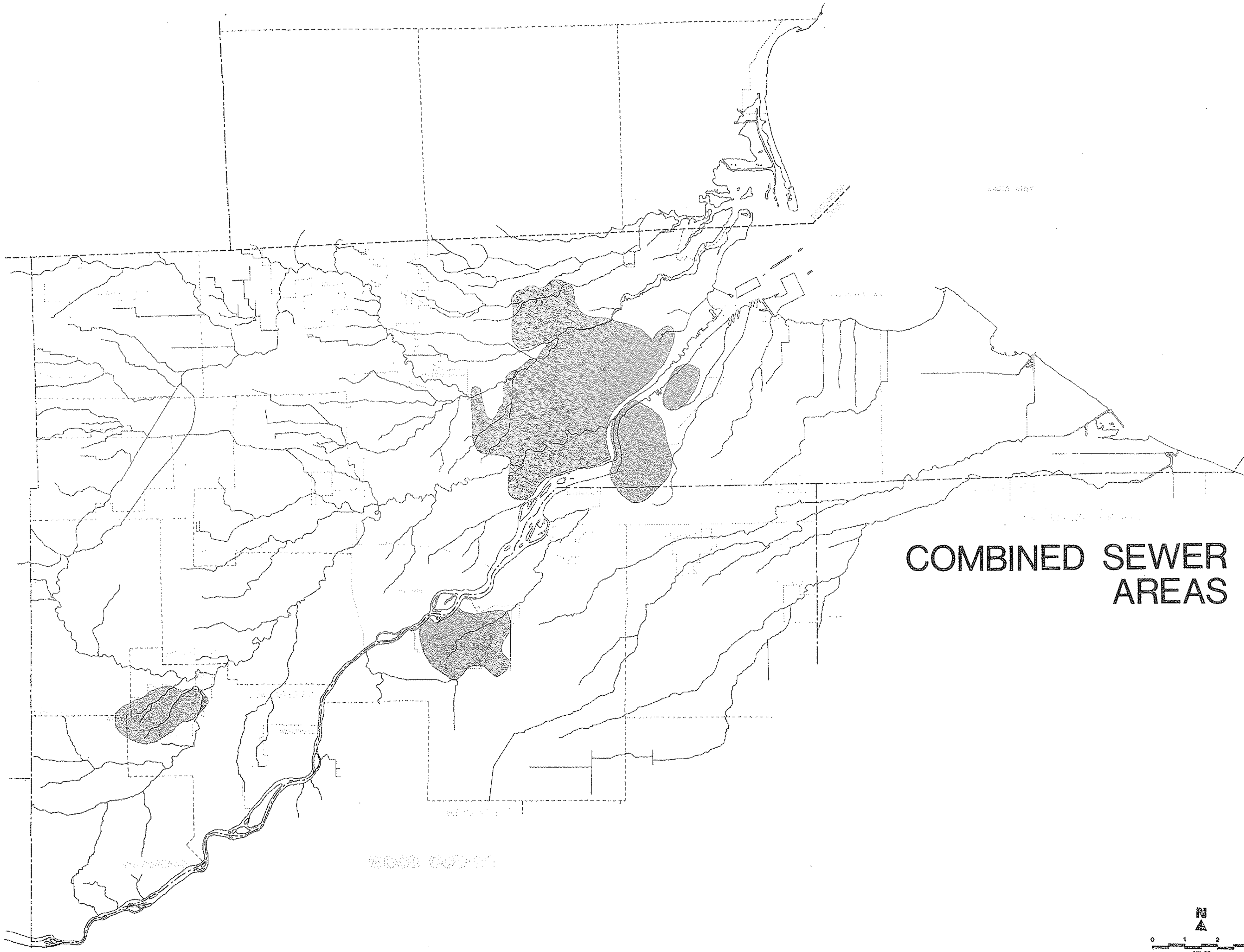
The best way to eliminate pollution from CSOs, from a purely environmental standpoint, is to build a separate system of storm sewers. It is standard practice to do so in new developments, and has been for many years, but in the older parts of every town, combined sewers are the rule. Separating the sewers for even a small town could cost in the millions of dollars and would require digging up the streets. These are two big reasons why separate sewer systems are rarely added to existing neighborhoods.

US EPA does not award construction grants for CSO abatement projects, but allows individual states the alternative of setting aside up to 20% of total grant money statewide for otherwise nonfundable projects. In Ohio, 5% is earmarked for CSOs. The City of Toledo has been a major benefactor of this program, receiving a grant of $6.3 million for Phases I and II or its CSO abatement project.

The municipalities in the Maumee Basin Area of Concern which have CSOs are Toledo, Maumee, Northwood, Perrysburg, and Whitehouse. Areas served by combined sewer systems are shown in Figure 50. Listings of these overflow points are given in Tables 40 through 44. In Toledo, 8902 acres are tributary to the CSO regulators;[25,69,70] in Maumee, 456 acres;[71] and in Perrysburg, 882 acres.[71]

Most of Northwood is served by separate sanitary sewers. The western portion of the city is served by combined sewers. The *Northwood Facilities Plan*[72] notes: *Wet weather from the combined sewer, which bypasses the existing intercepting manhole at Andrus Road and Sheffield Place, discharges into the Maumee River through a storm sewer of the City of Toledo. The two discharge points (overflow from Regulator No. 9 and the storm sewer) are located approximately 300 feet apart.*

FIGURE 50
CSO areas



COMBINED SEWER OVERFLOW AREAS

LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

Toledo Combined Sewer Overflows

Toledo's combined sewer system presently has 34 overflow points to the Maumee River, the Ottawa River, and Swan Creek. The problems associated with these overflows are well-known, and have been documented in past studies.[70,73] They severely degrade water quality, and are aesthetically offensive.

Combined sewer overflows are controlled by float-operated gates called *regulators*. They are designed to direct all sewage flow to the treatment plant during normal conditions. They should bypass only when the sewer system is overloaded with stormwater. However, regulators can experience problems which cause them to bypass during dry weather.

Toledo has experienced problems with river water entering the sanitary sewer system through the regulators. This phenomenon occurred when northeast winds caused the river levels to rise. In 1987, Toledo began installing tide gates on the regulators. Most are now in place. It is too early to tell whether the new tide gates will show a significant improvement in water quality.

Toledo's regulators experience other problems as well.[73] One is that most of them are below Lake Erie's mean annual flood elevation. Another is debris, which causes the regulator gate to stick in the open position, and continue bypassing when it shouldn't. The regulators can experience problems from collapse of pipelines and other mechanical failures. The regulators are inspected an average of about 12-15 times per year. Also, telemetering equipment records the status of each regulator, and how many hours each day the discharge gate is open.

Toledo plans a 9-phase CSO abatement program for these areas, to be completed in 1996. Phases 1 and 2 will be a downtown combined sewage tunnel for storing surge storm flows. The downtown tunnel will catch a 0.2" first flush, which is estimated to contain 85% of the pollution. Similar smaller tunnels will be built along Swan Creek as phases 3 and 4, will be designed to catch a first flush of 0.55".

Other rehabilitative work is included in the CSO abatement program. The tide gates are now in place on nearly all of the regulators. Repairs and/or improvements will be made to a number of the regulators. Some sewer separation will also be done. Once the present 9-phase program is complete, Toledo plans to reevaluate the situation to determine whether improvements are needed for the remaining CSO areas along the Maumee.

A listing of Toledo's CSO points is given in Table 40, and a summary of regulator bypasses for October 1986-February 1987[73] is presented in Table 41.

TABLE 40
CITY OF TOLEDO COMBINED SEWAGE REGULATORS

Regulator No.	Name	Stream	R.M.	Size, "	Drainage Area Sanitary (Acres)	Storm	Location
4	Paine	Maumee (E)	3.2	84	380.2	296.0	2201 Front @ Paine
5	Dearborn	Maumee (E)	4.1	90	523.7	352.0	1547 Front @ Dearborn
6	Main	Maumee (E)	4.82	60,54	207.8	174.7	Main @ Sports Arena
7	Nevada	Maumee (E)	5.8	60	581.6	608.0	609 Nevada @ Miami
8	Fassett	Maumee (E)	6.5	48	116.9	104.6	1152 Miami @ Fassett
9	Oakdale	Maumee (E)	6.85	93	638.2	467.1	1435 Miami @ Oakdale
22	New York	Maumee (W)	2.37	60	116.8	44.9	212 New York @ Summit
23	Columbus	Maumee (W)	2.85	48,102	675.9	204.9	214 Columbus @ Summit
24	Gales	Maumee (W)	3.25	30	27.6	27.5	216 Galena @ Summit
25	Ash	Maumee (W)	3.6	48	75.7	101.9	200 Ash @ Summit/I-280
26	Magnolia	Maumee (W)	4.2	48	143.3	121.2	210 Magnolia @ Summit
27	Locust	Maumee (W)	4.66	75,60	141.2	111.5	215 Locust between Water & Summit
28	Jackson	Maumee (W)	4.9	72	630.2	630.2	216 Jackson between Water & Summit
29*	Adams	Maumee (W)	4.98	24			215 Adams @ Portside
30	Jefferson	Maumee (W)	5.2	60	435.9	440.3	215 Jefferson between Water & Summit
31	Bostwick	Maumee (W)	0.07	36			315 Monroe @ Summit
32	Williams	Maumee (W)			70.3	59.9	
33	Maumee	Maumee (W)	7.5	60	345.5	343.6	502 Maumee @ Orchard
41	Knapp	Swan Cr.	0.8	48	77.3	57.8	328 St. Clair @ Williams
42	Erie	Swan Cr.	0.93	24	40.2	37.5	42 Erie St @ Hamilton
43	Hamilton	Swan Cr.	1.1	60	292.7	349.8	Hamilton & Ant. Wayne Tr.
44	City Park	Swan Cr.	1.58	30	37.9	22.2	City Pk, S. of bridge
45	Ewing	Swan Cr.	1.9	48	261.9	220.2	Ewing & Hamilton
46	Hawley	Swan Cr.	2.65	60	508.3	470.9	Hawley, S. of bridge
47	Junction	Swan Cr.	3.15	96	867.4	841.3	Pere West, E. of Gibbons St.
48	Hillside	Swan Cr.	3.45	24	190.5	49.3	Hillside & Chester St
49	Woodsdale	Swan Cr.	4.3	--	547.3	17.9	Woodsdale & South St.
50	Highland	Swan Cr.	4.22	--	230.6	209.3	Fearing St. in Highland Pk.
61	Lagrange	Ottawa R.	6.45	60	555.2	167.1	3503 LaGrange @ Manhattan Blvd
62	Windermere	Ottawa R.	6.7	--	958.3	865.6	202 Manhattan @ Windermere
63	DeVilbiss	Ottawa R.	6.8	72	933.7	921.4	3646 Detroit @ Phillips
64	Lockwood	Ottawa R.	7.75	114			3627 Lockwood @ I-475
65	Ayres	Ottawa R.	8.65	54	283.5	213.4	2584 Ayres @ S. Cove
66	Monroe	Ottawa R.	9.2	36	3763.0	0	3708 Monroe @ S. Cove W. of bridge

* Data refers to old regulator, which was replaced by a new unit at the end of Adams Street.

TABLE 41
TOLEDO REGULATOR BYPASSES, 10/86-2/87

Receiving Stream	No. of Regulators	October 1986	November 1986	December 1986	January 1987	February 1987
Maumee East	6	1400	1255	2376	2081	626
Maumee West	11	2089	3156	2668	2769	2871
Swan Creek	9	2404	2019	2627	2463	2028
Tenmile Creek	6	96	44	50	0	0

Maumee Combined Sewer Overflows

The City of Maumee published its CSO study in 1982.[71] It included detailed analysis of the overflow with regard to correlation between rainfall quantity, intensity, combined sewage bypasses, and their effect on the water quality of the Maumee River. While the primary focus of this study was the City of Maumee, it also included sampling on the Perrysburg side of the river. Samples were collected at two outfalls in Perrysburg, and three in Maumee. Rainfall data was collected in Maumee at four locations to correlate the response of the combined sewer system in terms of measured overflow. Sampling included primary sites (quality and quantity discharged), and secondary sites (quality only). Results of this sampling indicated high levels of BOD_5 and nutrients, and high bacteria counts.

The Maumee CSO Study concluded that rainfalls as low as 0.05" resulted in bypasses. These bypasses resulted in violations of the fecal coliform standards for the Maumee River, but did not have a serious impact on dissolved oxygen. The study recommended the City of Maumee proceed with a sewer separation program. A list of Maumee combined sewage regulators is given in Table 42.

TABLE 42
CITY OF MAUMEE COMBINED SEWAGE REGULATORS[71]

Regulator No. Name	Stream	Size, Inches	Drainage Area Sanitary Storm (Acres)	Location
1	Maumee	12		Broadway & Ford
2	Maumee	18	38	Wayne & Kingsbury
3	Maumee	20	136	Broadway & Conant
4 *	Maumee	15	39	Broadway & Elizabeth
5	Maumee	12		Front & Ford
6 *	Maumee	24		Front & Kingsbury
7 *	Maumee	20		Front & Conant
8 *	Maumee	15		Front & Gibbs
9	Maumee	12		Key & River Rd
10*	Maumee	36	113	Waite & Sackett

* The City of Maumee's combined sewer system includes 10 regulators. Combined sanitary and storm water overflows to the Maumee at six locations: these are 33", 60", 20", 18", 15", and 60" inches in diameter, starting at the one furthest upstream. Those regulators marked with an asterisk (*) are directly above outfalls.

Perrysburg Combined Sewer Overflows

The City of Perrysburg's CSO study was prepared in 1982.[74] River sampling data showed significant CSO-related increases in fecal coliform bacteria concentrations, but no serious impacts on dissolved oxygen and other water quality parameters. The study included the development of combined sewer network and receiving water quality models to evaluate various CSO control alternatives.

The *Perrysburg CSO Study* concluded that rainfall as low as 0.05-inch resulted in CSOs. The study recommended the capture and conveyance of CSOs to a swirl concentrator with chlorination facilities. The treated CSO would then be discharged to the Maumee River. Considering problems experienced with swirl concentrators during the years since the preparation of the CSO study, the City currently favors a combined sewer system separation project. Such a separation project would reduce the average annual CSO volume to the Maumee River by 90%.

The City of Perrysburg's discharge permit[74,75] lists overflows and bypasses as shown in Table 43.

TABLE 43
CITY OF PERRYSBURG, OHIO
BYPASS AND OVERFLOW POINTS

OEPA STATION NO.	DESCRIPTION	RECEIVING STREAM
D702002	Louisiana Ave - Water St.	Maumee River
D702003	Elm St. north of Front St.	Maumee River
D702004	Cherry St. - Water St.	Maumee River
D702005	Gorman View Subdivision	Grassy Creek
D702006	Hickory St. along Grassy Creek	Grassy Creek
D702007	Louisiana Ave. along Grassy Creek	Grassy Creek
D702008	Elm St. along Grassy Creek	Grassy Creek
D702009	West Boundary at Second	Blocked. No discharge

Whitehouse Overflow Points

Like Perrysburg, the Village of Whitehouse's treatment plant does not have adequate capacity to treat combined sewage. Average 1986 flow was 0.32 mgd, not including bypassed sewage, to the 0.29 mgd WWTP. Whitehouse's sewer system suffers from a severe inflow/infiltration (I/I) problem.

The storm sewers are connected indirectly to the sanitary sewer system. Within the system are 8 overflow points where storm flow may be diverted to the sanitary line. Seven overflow locations discharge storm water to Disher Ditch; One overflow discharges to Lone Oak Ditch.

The Village of Whitehouse has submitted plans for construction of an interceptor sewer to tie into the Lucas County sanitary sewer system. When this project it complete, Whitehouse will be served by the Lucas County WWTP, and will abandon its existing WWTP. The Village is working toward the goal of eliminating all CSOs by the end of 1989. The Village of Whitehouse's CSO points are listed in Table 44.

TABLE 44
VILLAGE OF WHITEHOUSE CSO POINTS

Regulator No. Name	Stream	Size	Location
Texas St.	Disher Ditch	8"	Texas St. S. of Waterville St.
Field Ave.	Disher Ditch	18"	Weckerly, East, Field Streets
Gilead St.	Disher Ditch	15"	South, Toledo, Maumee, Providence, Gilead Streets
Heller Rd.	Disher Ditch	12"	Heller S. of Waterville St.
Texas St.	Lone Oak Dt.	8"	Texas N. of Shepler
Gilead St.	Disher Ditch	15"	Waterville St & Alley NE of Providence St.
Providence St	Disher Ditch	10"	Providence St. S. of Otsego St.
Otsego St.	Disher Ditch	10"	Providence St. south of Otsego St.

HOME SEWAGE DISPOSAL

As reported in the *Groundwater Quality Baseline Report*[76], June 1982, individual home sewage disposal systems affect groundwater quality. The Lucas County Health Department reported leachate problems in the following areas within the county:[77] See Figure 51.

Sylvania Township:

Area bounded by Michigan line, Whiteford Road, Alexis Road and Sylvania corporation limits.

Area bounded by King Road on west, Gower Road on east, Brint Road on south, Sylvania corporation limits on north.

Winterhaven Road and area near the intersection of Centennial and Sylvania-Metamora Roads.

Villa Farms Subdivision bounded by Central Avenue on the north, Centennial Road on east.

Monclova Township

Coder Road Area, Village of Monclova

Springfield Township

South Hill Park, Dorcas Farms, Layer Road, Village of Holland, Culley Road, Haven Park and Fairhaven Subdivisions, Devonshire Lane Subdivision.

Spencer Township

Most of township

Jerusalem Township

All areas subject to flooding.

City of Oregon

Entire area from Lallendorf Road east to City limits.

Three of the above identified problem areas, Sylvania and Springfield Townships and the City of Oregon, are of significant concern due to projected population increases. While public sewers have been targeted for these areas, facility planning must be stepped up. With implementation of the Western Lucas County Facility Plan and related segmented plans, many troublesome areas can be eliminated with tie-in to public water and sewers.

These improvements will eliminate some package treatment plants and improve water quality in minor receiving streams. Because of the costs and cutbacks in federal funding, delays in bringing these areas on-line will continue to thwart the effect of public health improvements. Conditions will continue to worsen in areas where densities are high and existing on-site systems are failing. The soil and groundwater conditions are such that at best, with a strong operation and maintenance program, the situation could be stabilized, but not significantly improved. It is imperative that those areas targeted for facility treatment system be given highest priority to reduce the health risks associated with contaminated surface and groundwater conditions.

A second area of concern is in areas which are not targeted for correction in the near future. These are areas in eastern Lucas County and extreme western Lucas County outside of sewered areas, and are not near any sewer system. These on-site systems will continue to be a problem and like the on-site systems in the targeted areas of high density and priority, a sound operation and maintenance program would help, but often will not overcome the soil conditions, densities, lot size and high water table problems which are part of the landscape. Development bans are difficult to enforce and at times met with strong opposition.

The third area of concern is development in areas where soil and conditions warrant development bans or areas where systems are failing because of poor site selection in the past. These situations have resulted largely from inappropriate planning decisions and often left the health department in a reactive position rather than in a guidance and advisory role for the development.

Table 45 displays the number of septic systems and privies by minor civil division within Lucas County, including 1980 population with forecasted 1990 population and the percent change between these two decades, along with the status of active 201 facility projects as of June 1983. These statistics were taken from Table 3 and Table 8 of the TMACOG publication *Home Sewage Disposal Priorities,* December 1983.[77]

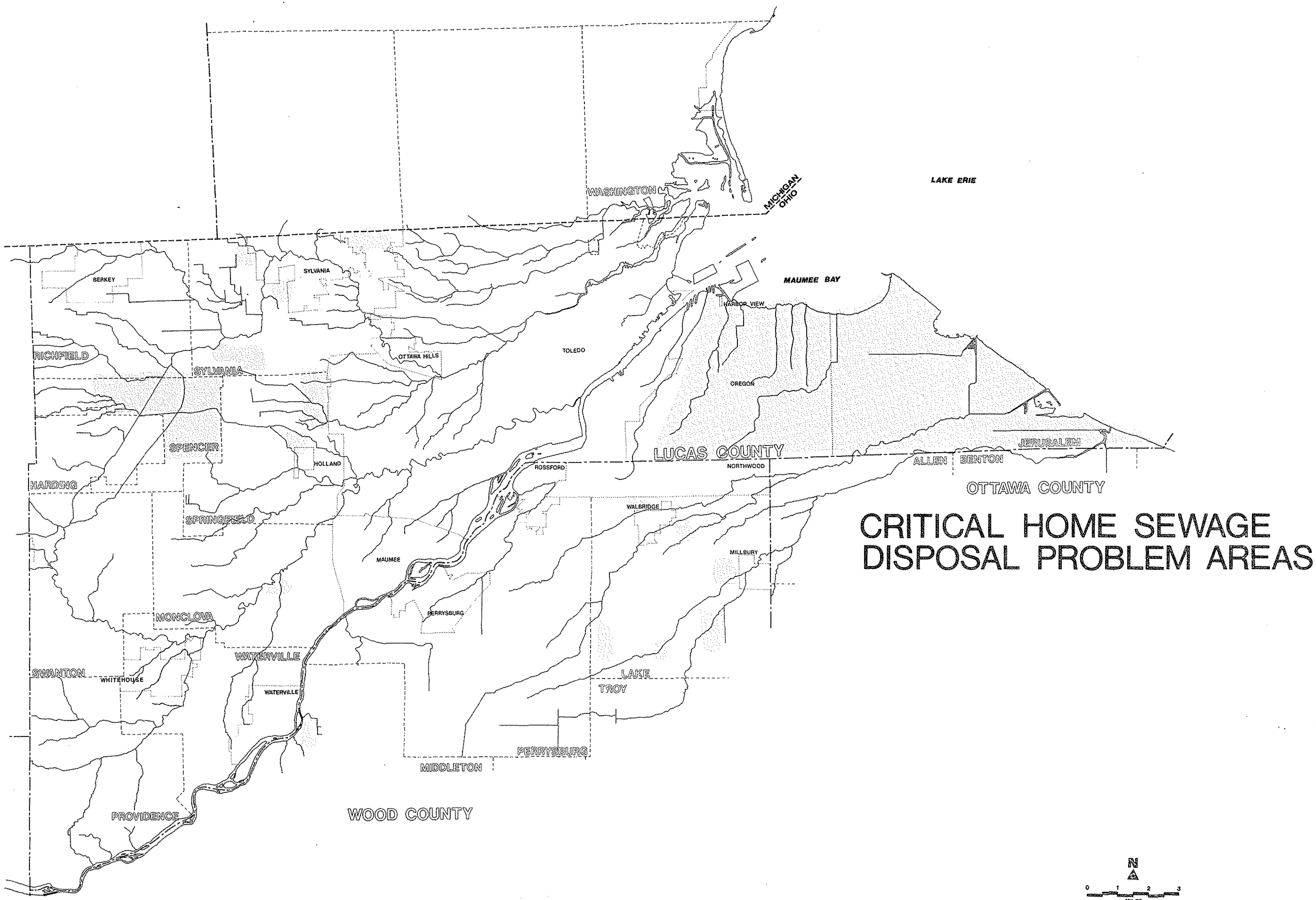
Wood County and Ottawa County

The Wood County Health Department experienced a 6% decline of on-site systems from 1970 to 1980. This has resulted from many unsewered communities being sewered and much of the new development being confined to sewered areas. Although bans in some areas have been enforced, problems areas still exist and have increased. The area of major concern within Wood County is largely confined to the urbanizing areas of Lake Township which are outside of sewer districts and in sewered areas where final tie-ins have not been enforced. These areas are specifically include: Tracy Road, Millbury, areas along I-280 and Stony Ridge within the RAP study area.(See Figure 51)

Health departments for both Wood and Ottawa Counties have reported problems for individual home sewage disposal systems in areas of shallow rock (less than 4 feet to bedrock) throughout their counties. Improper water well construction and abandoned water wells also cause localized problems affecting groundwater.

Table 46 page displays the number of septic systems and privies by those minor civil divisions within the AOC for Wood and Ottawa Counties, including 1980 population with forecasted 1990 population and the percent change between these two decades, along with the status of active 201 facility projects as of June 1983. These statistics were taken from Table 6 and Table 11 for Wood County from Table 4 and Table 9 for Ottawa County of the TMACOG publication *Home Sewage Disposal Priorities*, December 1983.[77]

insert Figure 51
Critical Home Sewage Disposal Areas



CRITICAL HOME SEWAGE DISPOSAL PROBLEM AREAS

LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

tmacog

TABLE 45
LUCAS COUNTY STATISTICS BY MINOR CIVIL DIVISION
AND POTENTIAL CONCENTRATIONS OF ON-SITE SYSTEMS
(by Year-Round Housing Units)

	Septic	Other	1980	1990a	% Chg.	To be[b] Sewered	Sewered
Harbor View Village	52	7	164	154	-6.1	Step 1*	+
Harding Township	188	7	631	639	1.3	Step 1(pt.)*	
Jerusalem Township	1,101	26	3,327	3,376	1.5		
Maumee City	69	5	15,747	16,072	2.1	Step 1*	x
Monclova Township	903	25	4,285	4,467	4.2	Step 1*	
Oregon City	1,396	45	18,675	20,111	7.7	Step 1*	x(pt.)
Ottawa Hills Village	40	7	4,065	4,126	1.5	Step 2* x	
Providence Township	828	20	2,702	2,917	8.0	Step 1 (pt.)*	
Richfield Township							
Berkey Village	96		306	319	4.2		
Twp. balance	347	l	1,095	1,044	-4.5	Step 1 (pt.)*	
Spencer Township	446	36	1,744	1,758	0.8	Step 1 (pt.)*	
Springfield Township							
Holland Village	292	2	1,048	1,139	8.7	Step 1*	
Twp. balance	2,311	37	15,043	17,440	15.9	Steps 1 & 2*	
Swanton Township	975	43	3,379	3,453	2.2	Step 1 (pt.)*	
Sylvania Township							
Sylvania City	191	12	15,527	18,226	17.4	x	
Twp. balance	3,844	46	17,534	18,698	6.6	Steps 1,2&3*	x(pt.)
Toledo City	750	426	354,635	336,565	-5.1	Steps 1&2*	x
Washington Township	167	4	4,000	4,159	4.0	Steps 3*	x(pt.)
Waterville Township							
Waterville Village	18	--	3,884	4,537	16.8	Step 1*	x
Whitehouse Village	100	l	2,137	2,640	23.5	Step 1*	x
Twp. balance	494	8	1,813	2,030	12.0	Step 1 (pt.)*	

1980 Census, STF 3A Table 108[68]

\+ - Sewers constructed, but not connected to treatment facility.
a - TMACOG Draft Population Forecast for Lucas County 1985 through 2010.
b - TMACOG Status of Active 201 Facility Projects June 1983.
* - Out of Funding Range to receive USEPA grants in the next five years according to the Northwest District Office Ohio EPA.

(Excerpts from Table 3 and Table 8 - Home Sewage Disposal Priorities, December 1983, TMACOG)

TABLE 46

SEGMENTS OF WOOD AND OTTAWA COUNTIES WITHIN AOC DEALING WITH STATISTICS BY MINOR CIVIL DIVISION AND POTENTIAL CONCENTRATIONS OF ON-SITE SYSTEMS (by Year-Round Housing Units)

	Septic	Other	1980	1980a	% Change	To be[b] Sewered	Sewered
WOOD COUNTY:							
Lake Township							
Millbury village	15	--	955	1,452	52		
Walbridge village	44	--	2,900	2,941	1.4	under construction	
Twp. balance	1,099	23	7,044	8,306	17.9	Step 3 (pt.)*	x(pt.)
Middleton Township							
Haskins village	22	--	568	655	15.3		x
Twp. balance	594	30	1,880	2,409	28.1		
Northwood city	150	37	5,495	6,730	22.5		x
Perrysburg city	60	--	10,215	11,559	13.2	Step 1&2*0	x
Perrysburg Township	1,325	77	10,651	14,235	33.6	Step 1 (pt.)*	x (pt.)
Rossford city	8	--	5,978	6,235	4.3	Step 1*	x
Troy Township							
Luckey village	263	8	895	932	4.1	Step 1*0	
Twp. balance	861	33	2,663	3,088	16.0	Step 1 (pt.)*	
OTTAWA COUNTY:							
Allen Township							
Clay Center Village	91	6	327	336	2.8	Plan of Study*	
Twp. balance	878	23	2,995	3,319	10.8	Plan of Study*	
Benton Township							
Rocky Ridge Village	130	3	457	472	3.3		
Twp. balance	667	28	1,989	2,050	3.1		

1980 Census, STF 3A Table 108[68]

a - TMACOG Draft Population Forecast for Wood & Ottawa Counties 1985 through 2010, December 1983

b - TMACOG Status of Active 201 Facility Projects June 1983.

* - Out of Funding Range to receive USEPA grants in the next five years according to the Northwest District Office Ohio EPA.

0 - Proceeding without Federal Funds.

(Excerpts from Tables 4, 6, 9 and 11 - Home Sewage Disposal Priorities, December 1983, TMACOG)

ACTIVE AND CLOSED LANDFILLS/DUMPSITES

As reported in the Groundwater Quality Baseline Report,[76] June 1982, active and closed landfills and/or dumpsites affect groundwater quality. In past years, many dumpsites were created by private companies and local governments. Every political subdivision has had its dumpsite, usually in a low area along a stream just at the edge of its most populated area. These dumps were not designed to prevent leaching of chemicals and liquidized substances into surface waters or groundwater. These dumps are often sources of groundwater contamination and are not monitored for their impact. The location of some dumpsites are not even known today and periodically one is found because the buried material has moved upward to the surface, or someone begins to dig a garden, or children find a leachate seep or spring to play in.

Within the past twenty years, the practice has been to site "sanitary" landfills with dependence upon clay soils to prevent leachate problems. They were still sited along a stream applying the trench and fill method, with no consideration that seasonal high water table could be within one to five feet of the surface. Underdraining with leachate collection systems were not required. In many instances during excavation, groundwater had to be pumped with collapsible hoses in order to place the solid wastes in a dry trench. Leachate is generated by the infiltration of precipitation and surface runoff.

Past operational permits generally concentrated upon daily cover of the trench. Therefore, information on old sites is at best sketchy due to the fact that monitoring wells were not required. Today, however, monitoring wells and methane venting is required for new sites, or when a new cell is being established at a currently operating landfill.

Only two industrial landfills were identified in the 1981 Ohio EPA Open Dump Inventory. The National Castings Midland Ross Corporation contains a 2 acre onsite landfill that contains only foundry sand. The landfill is 2,500 feet from the Maumee River.

The second site is the Rossford Landfill, a 26 acre parcel located 25 feet from Grassy Creek within the City of Rossford. The city employs the trench method using 10 acres overall. Its use is restricted to Rossford residents and businesses. There is an indication that contaminants are leaching into surface water and the Ohio EPA Northwest District Office believes that the site warrants further investigation. It has no leachate collection system, groundwater monitoring plan or methane gas detection system. Depth to seasonal high water table is 1 foot.

Although it was excluded from this Ohio EPA list, there are abandoned ponds on Libbey-Owens-Ford Company property from which leachate is infiltrating Otter Creek via deteriorated sewer lines which run underneath the abandoned site. These grinding sand settling ponds, or lagoons, covered 50 acres and were used to settle fine particles of silica and felt waste products from the polishing and grinding of glass. They were abandoned prior to December 1971 and were covered with a layer of clay and are most likely unlined. It is important to note that no monitoring information from these sites is available for analysis. However, the Ohio EPA Northwest District Office reports that the leachate discharging from the Libbey-Owens-Ford waste glass settling ponds in Rossford contains arsenic.

Licensed Solid Waste Landfills

There are currently seven landfill sites in the AOC which are licensed by its respective local health department to operate. Two of these, the National Castings Landfill and the Rossford Landfill, are discussed above. The other five are described briefly following the table which displays them. These are all listed in Table 47 and displayed in Figure 52.

TABLE 47
LIST OF LICENSED SOLID WASTE LANDFILLS

License #	Health Department	Landfill	Map #	Status
48-00-01	Lucas County	Fondessy Enterprises* Landfill York St & Otter Creek Rd Oregon, Ohio	A	Closed #1
48-00-05	Lucas County	Westover Landfill 820-920 Otter Creek Rd Oregon, Ohio	B	Closed
48-00-09	Lucas County	Toledo Edison Co. Bay Shore Ash Landfill Oregon, Ohio	C	Active
48-00-06	Toledo	Hoffman Road Landfill 4545 Hoffman Road Toledo, Ohio	D	Active
48-01-06	Toledo	National Casting Landfill Midland Ross Corp. 1414 East Broadway Toledo, Ohio	E	Active
87-00-01	Wood County	Evergreen Landfill Waste Management 2625 E. Broadway Northwood, Ohio	F	Active
87-00-02	Wood County	Rossford Landfill 8250 Wales Road Rossford, Ohio	G	Active

* Envirosafe Services of Ohio

Fondessy Landfill

A 135 acre parcel located in the Otter Creek watershed in Oregon is operated as a hazardous waste site by Envirosafe Services of Ohio, Inc. It was first operated as a landfill for solid wastes for municipal and industrial disposal in the 1960's. Since the early 1980's the site has accepted only hazardous waste for disposal. These earlier solid waste cells known as landfill areas 1 and 2 and the Millard Avenue Landfill have no leachate collection system or synthetic liners. Cell F, designed for hazardous wastes, has no synthetic liner but does have a leachate collection system. However, newer cells have both. In November 1981 the Ohio Hazardous Waste Facility Board granted permission to dispose of certain types of hazardous wastes at the site under a Part A Interim Status provision under RCRA.

Two raw water supply lines owned and maintained by the City of Toledo traverse the site. The first of these water lines was installed in 1940, before the facility existed. This line is made of 78-inch coated steel pipe, lying between 11 and 21 feet below the ground surface. The second water line was installed in 1964, using 60-inch precast, prestressed concrete pipe. Together the lines deliver an average of 73 million gallons of water per day to the

Collins Park Water Treatment Plant serving over one-half million people in the Toledo metropolitan area. The company maintains monitoring trenches along the water lines.

In 1983, Conversion Systems, Inc., a subsidiary of the IU International Company, acquired the Fondessy facility. The parent company later reorganized to place Fondessy under the management of Envirosafe Services, Inc., which continues to operate the site as a hazardous waste disposal facility. In the spring of 1988, NEOAX, a Hartford, Connecticut firm, acquired more than 90% of the IU International stock.

Westover Landfill

A small parcel permitted to establish operations in the floodplain of Otter Creek, it is now closed. It received municipal wastes from the residents of the City of Oregon and also industrial sludges, solvents, and paint wastes from the Dana Corporation, Johns-Manville, and two refineries, Sun and Standard. A severe leachate problem developed, with a leachate collection system being recently installed. Therefore, seepage only occurs when erosion problems opens an access for it. But erosion control systems are being installed.

Bay Shore Ash Pit

The Toledo Edison Company operates a monofill for its flyash at its location on Bay Shore Road adjacent to Maumee Bay.

Hoffman Road Landfill

A 262 acre parcel located south of the Ottawa River within the City of Toledo, with permit approval granted for Phase I in 1974. A second permit was approved in 1983 for above-grade filling to 30 feet, which relates to Area D. Generally, there are four "areas" of construction, with areas "A" and "C" considered above grade fill only, with area "B" consisting of above and below grade fill yet to be constructed. An increase in elevation was submitted in the form of a Permit-to-Install in December of 1986. An Ohio EPA Memo dated April 3, 1987 discusses the hydrogeologic and surface drainage of the site. Briefly, the Memo indicated a problem with high water table showing a mounding effect from filled cells and a discharge effect from excavated cells, and concerns with the relatively higher permeability soils in the upper 20 to 25 feet which indicate the potential for leachate migration. As a consequence of these findings, area "B" will be required to have a leachate collection system, if leachate is detected on the site, or is draining from the site. In addition, a groundwater monitoring plan, a methane gas monitoring plan and synthetic liners are required.

Evergreen Landfill

A 265 acre parcel located in the Otter Creek watershed in Northwood, Ohio, was established in the mid-1950's as the Benton Landfill. The site was purchased by Ohio Waste Systems a subsidiary of Waste management in the mid-1970's. In December 1981 the Ohio Hazardous Waste Facility Approval Board granted permission to dispose of certain types of hazardous wastes at the site under a Part A Interim Status provision under RCRA. In November 1985, the company withdrew its application for Part B status, and now only again functions as a solid waste disposal facility. None of the cells at the site have synthetic liners and only recently has a leachate collection system been installed. It has an active methane gas monitoring system, and is working to upgrade its groundwater monitoring system.

The Ohio EPA Northwest District Office reports that there is a staff gauge at the Evergreen Landfill. There are unusual water level fluctuations going on in the bedrock wells following storm events. The purpose of the gauge is to record water level rises in the bedrock immediately following the occurrence of rain. This monitor or staff gauge was installed by the United States Geological Survey, Columbus District Office, in connection with the Northwood Investigation of this site. Waste Management is currently conducting an additional investigation of the site.

Closed Dumpsites

With the assistance of the Northwest District Ohio EPA, the local health departments, the Toledo Environmental Services Division, and TMACOG files, a list of the known landfills and dumps are presented in Table 48 by watershed. It is as complete a list as possible. Included with the listing is the current known status of each of the sites. Many of the sites need further investigation and remedial action plans to correct problems.

There are 49 known closed dumpsites within the AOC. Each received during its active life different types of wastes and each has different types of problems. Many were located in low areas or floodplains along the Maumee River, the Ottawa River, Swan Creek, Otter Creek, etc. These closed sites are listed in Table 48 by watershed areas along with current known status and Map number locations as displayed in Figure 52:

TABLE 48
LIST OF CLOSED DUMPSITES BY WATERSHED

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
1	Maumee	Manhattan Dump now known as Miracle Park 2020 Manhattan Blvd. 21-34 acres, closed 1976 Deeded to Toledo in 1976	Demolition Dump had underground fires from alumina oxide powder, but no fire hazard today; past leachate migration, none at present; has vegetative cover, but closure status is uncertain
2	Maumee	Treasure Island Landfill Manhattan, New York & Counter Streets 150 acres, closed 1965	Industrial & Municipal Wastes Had chemical & underground fires; but no fire hazard today; Magnesium was the cause of the fires; has a 6" to 12" clay caps. Planned to become a park. Consideration is being given to to add flyash from Toledo Edison Co. to enhance such development.
3	Maumee	South Avenue Dump at the Maumee River 50 acres in low area. Operated 1950 to 1957 - constructed over the fill are the Anderson & Cargill Grain Elevators, Ohio Bell & Kuhlman Concrete	Mixed municipal and industrial wastes with heavy metals and organics. Cargill installed sumps 20 to 30 feet deep in 1983, was discharging to Maumee River, but, holding tanks are being installed in order to treat the discharge.
4	Maumee	NL Industries aka Bunting Brass & Bronze, 715 Spencer 10 acres, 1916 to 1980 currently Eagle-Picher Bearing Co.	Presumed storage of drosses which would contain heavy metals

TABLE 48 continued

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
5	Maumee	Gulf Oil Refinery 2935 Front Street 2.75 acres sediments & sludges, 1953 to 1981 4 acre landfarm 4 separator ponds	Hazardous Wastes - Principal concerns are the landfarm with leaded sludge, followed by weathering area, the landfill and sludge pit areas
6	Maumee	Owens-Illinois, Inc. Libbey Plant 27 940 Ash Street 1883 to present	In 1800s some 10,000 cu. ft. of old furnaces and other waste materials are buried at the site containing arsenic & chromium
7	Maumee	Florence Street	Was an open dump
8	Maumee	St. Mary's Street	Was an open dump
9	Maumee	Columbus Street	Was an open dump
10	Maumee	Buckeye Street	Was an open dump
11	Maumee	Mulberry Street	Was an open dump
12	Maumee	Buckeye Basin	Was an open dump
13	Swan	Western Avenue	
14	Swan	Angola Road Mobile Home Park constructed over site	Leachate contains iron
15	Swan	Arlington Avenue	
16	Swan	Swan Creek Landfill Glendale at Swan Creek	Demolition Dump
17	Swan	Scott Park	
18	Swan	Holland Village	
19	Swan	Springfield-Monclova Twps.	
20	Swan	Swanton Township	
21	Swan	Providence Township	
22	Swan	Spencer Township	
23	Otter	Sun Oil of Pennsylvania 1819 Woodville Road 1940-1950 tank bottoms contaminated with lead disposed in 37 pits within the dikes of the tank farm.	Contents of 37 pits later excavated and disposed of in onsite landfill adjacent to tank farm; monitoring wells are in place.
24	Otter	Union Oil co. of CA (UNOCAL) 1840 Otter Creek Road Operated as refinery until 1967 when sold to SOHIO, but still operated a petroleum products storage terminal	Concern for tank diked area to retention pond which is for oil and water separation, an NPDES permit is in preparation.

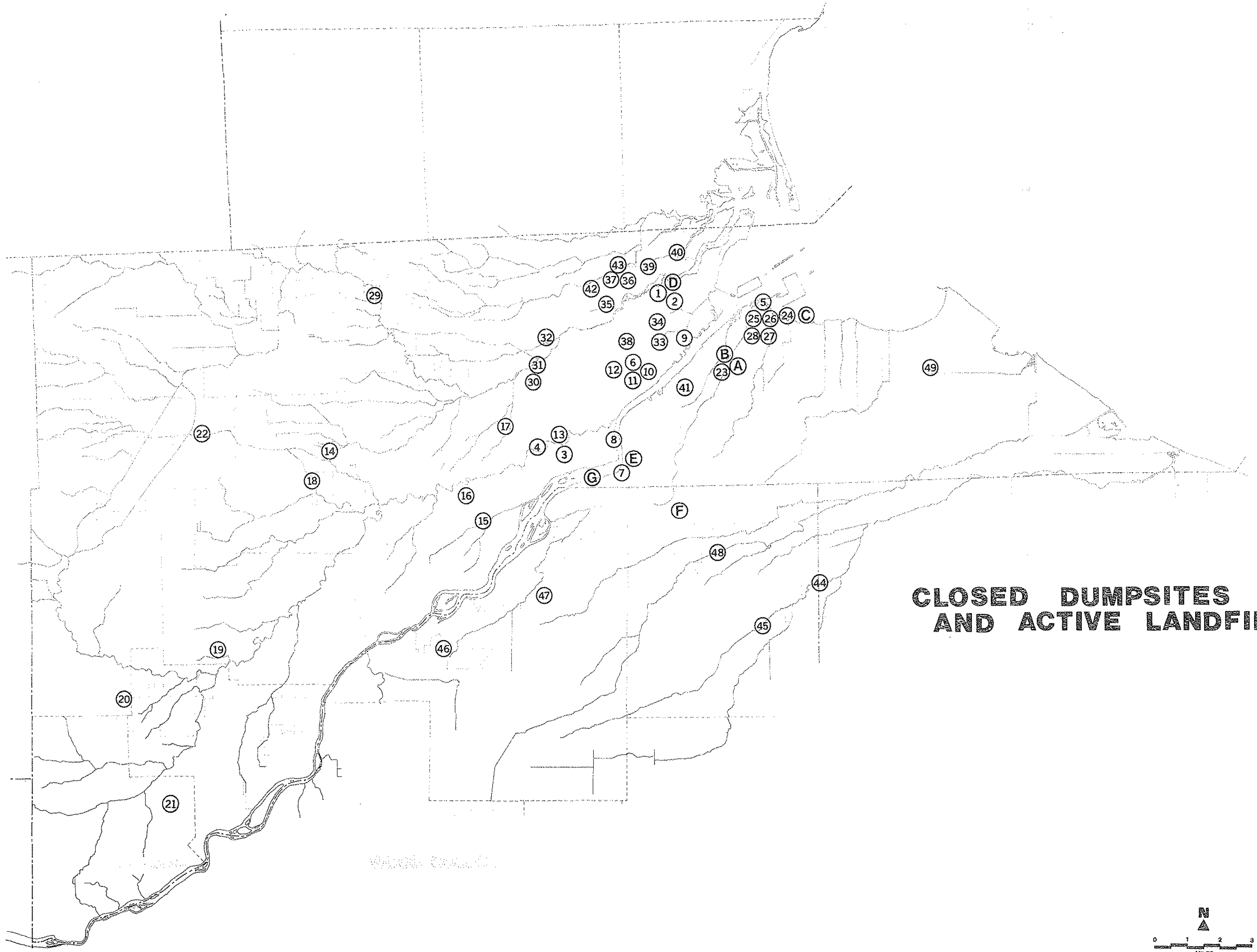
TABLE 48 continued

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
25	Otter	Heist Corporation 3816 Cedar Point Road In 1981, old oil sludge pit in depressed area filled in.	Problems surfaced again in 1983 with black oily sludge breaking through earth cover; problem corrected but began oozing again in 1985 - no known offsite discharge currently
26	Otter	Standard Oil Co. (SOHIO) 4100 Cedar Point Road 1970s start of 5 acre landfarm for sludges, emulsions; leaded tank bottoms buried in small pits within tank farm.	Monitoring operation in place; all stormwater is collected and treated.
27	Otter	Westover 820 Otter Creek Road Municipal wastes, industrial sludges, solvents & paint wastes	Leachate collection system recently installed and erosion control system being developed
28	Otter	Fondessy Landfill #1 site west of Otter Creek Rd. demolition wastes	Monitoring operation to be expanded
29	Ten Mile	King Road Landfill 3535 King Road, 44 acres Operated by Lucas County from 1954 to 1976	Groundwater contamination from leachate migration containing metals--cadmium, chromium, lead, enforcement action pending
30	Ottawa	Owens-Illinois, Inc. Technical Center 1700 North Westwood On-site Landfill	Chromium and lead sludges; test borings performed show no contamination discovery
31	Ottawa	Owens-Illinois, Inc. Hilfinger Site 1800 North Westwood Hilfinger landfilled on-site electroplating & metal finishing wastes. Closed in late 1970s.	Soil had been contaminated by heavy metals--chromium, arsenic, cadmium, nickel, zinc. Clean up completed with polyethylene liner and monitoring wells. Currently a parking lot.
32	Ottawa	South Cove Blvd.	
33	Ottawa	Willys Park	Part of North Cove Blvd. AMC investigation
34	Ottawa	Joe E. Brown Park Manhattan Blvd.	Presently a ball field
35	Ottawa	North Cove Landfill North Cove & Drexel Dr. Operated by AMC as land-fill from 1941 to 1970. Industrial residues i.e. solvents & sludges, now owned by City of Toledo	During installation of a sanitary sewer west of site in 1979, hydrocarbon fumes were encountered. Groundwater sampling performed indicating presence of hydrocarbons and low boiling solvents. AMC is planning to conduct a remedial investigation/feasibility study.

TABLE 48 continued

MAP #	WATERSHED	SITE NAME	CURRENT KNOWN STATUS
36	Ottawa	Sheller-Globe Corp., Armored Plastics, Lint & Dura Avenues Approx. 100 drums of Paint Residues disposed	Solvent portion believed to have evaporated leaving only residue.
37	Ottawa	Tyler Street Dump Operated by City of Toledo, located end of Tyler St. north of Ottawa River Municipal & industrial wastes	Leachates to Ottawa River
38	Ottawa	Stickney Avenue Landfill Owned by American Motors Corp. located southeast of Ottawa River Industrial wastes i.e. solvents & sludges	Leachates to Ottawa River composed of low conventional pollutants and organics
39	Ottawa	Dura Dump, 55 acres Operated by City of Toledo Located northwest of river Municipal, Industrial and Demolition Wastes - Opened 1952, closed 1980.	Leachates to Ottawa River containing PCBs, organics. Under investigation with a remedial action plan being developed.
40	Ottawa	DuPont Waste Lagoon Matzinger Road 2% formaldehyde solution	Lagoon filled in. Site drainage patterns unknown, but no discharge to river.
41	Duck Creek	Consaul Street Dump Operated by City of Toledo from 1948-1966, now site of Parkway Mobile Home Park solvents & paint sludges	Leachate collection system to sanitary sewer; water table within 6 feet of surface Methane Gas Venting; ongoing Ohio Dept of Health Study
42	Silver/ Shantee	Jackman Road	Was an open dump
43	Silver/ Shantee	NL Industries/Doehler-Jarvis/Farley Metals Inc. 5400 N. Detroit Avenue Toledo, Ohio	Past on-site storage for Plating Sludges
44	Crane	Millbury Village	Leachate problem; solid wastes
45	Crane	Asman Dump St. Rt. 795 & Fostoria Rd.	Leachate problem; solid and hazardous waste
46	Grassy	Perrysburg Township	
47	Grassy	Perrysburg City St. Rt. 795 & Glenwood Rd.	
48	Cedar	Walbridge-Lake Township	
49	Wolfe	Jerusalem Township	

Figure 52
MAP OF DUMPS AND LANDFILLS



CLOSED DUMPSITES AND ACTIVE LANDFILLS

LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

TMACOG

Underground Storage Tanks

The federal definition of an Underground Storage Tank (U.S.T.) is any tank including underground piping connected to the tank that has at least 10 percent of its volume underground. Not included in this definition are the tens of thousands of unregulated domestic heating oil tanks or other private fuel tanks. Several types of underground tanks are currently exempt from federal regulation:

> farm and residential tanks holding less than 1,100 gallons of motor fuel used for non-commercial purposes;
>
> tanks storing heating oil burned on the premises where it is stored;
>
> tanks on or above the floor of underground areas, such as basements or tunnels;
>
> septic tanks and systems for collecting storm water and waste water;
>
> and flow-through process tanks.

Hazardous waste tanks are regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA). Waste oil tanks may eventually also be regulated under Subtitle C. The great majority of U.S.T.s nationwide (more than 96 percent) contain petroleum fuels; the remainder store raw chemicals. U.S.T.s are found virtually everywhere in the industrialized world. US EPA estimates that approximately one quarter of the U.S.T.'s leak.[78]

In Ohio more that 70,000 commercial U.S.T.s currently in use are registered with the State Fire Marshal. Because the registry is still being developed, the Fire Marshal's Bureau of Underground Storage Tank Regulation estimates that there are actually close to 100,000 U.S.T.s in Ohio subject to regulation. As of May 1988, the registry was still incomplete. There are 2,834 U.S.T.s for Lucas County, 879 for Wood County, and 284 for Ottawa County. Because U.S.T.s are associated with business and industry, it appears that they are found in higher concentrations in areas of greater population.[78]

Statewide, there have been more than 1,800 leaks from U.S.T.s reported to Ohio EPA since 1978. Ohio EPA's Office of Emergency Response reports that during this period there have been 50 reported leaks for Lucas County, 22 for Wood County, and 12 for Ottawa County. The majority (65 to 75 percent) of U.S.T. leaks came from tanks at gas stations.

Leaking U.S.T.s occur in every locale. Leaks are typically very small compared to tank size, and traditional inventory control measures such as the graduated dipstick pole and tallying volumes of liquid withdrawn are not accurate enough to detect most leaks. U.S.T.s have contaminated groundwater and surface water, saturated soil with gasoline or other flammable or toxic substances, and created fire and explosion hazards when vapors enter buildings through foundation cracks or sump pumps. Gasoline from U.S.T.s in developed areas frequently is first discovered in utility company manholes, where it can destroy wiring and cause an explosion due to the concentration of gasoline vapors and a health hazard for workers due to the concentration of residual benzene in a confined space.[78]

Pits, Ponds and Lagoons

The Ohio EPA conducted a statewide assessment and inventory of surface impoundments during 1978 and 1979. The purpose was to determine their polluting effect upon underground drinking water sources. This project was referred to as the Surface Impoundment Assessment (SIA). By definition, surface impoundments include any earthen pond, pit or lagoon used for the storage, treatment or disposal of wastewaters and other fluids related to industrial, municipal, agricultural, mining, and oil and gas related activities.

With the assistance of the Northwest District Ohio EPA, TMACOG examined the SIA file for the Counties of Lucas, Wood and Ottawa. A list of the known pits, ponds and lagoons as listed in this SIA file are presented in this section by watershed in Table 49. It is as complete a list as possible. Included with the listing is the Map #, watershed name, Facility Identification No., the number of impoundments at the site, the purpose of the impoundment, the age at the time of the survey, the size of impoundments, the recorded gallons per day if known, and the scored groundwater contamination potential rating (GWCPR). The highest groundwater contamination potential rating a site could receive is "29" while the lowest is "1". The NPDES number is also included if such number had been assigned.

There are 36 sites which includes some 68 impoundments within the AOC. None of the impoundments as shown in the SIA file were lined by today's standards, nor were monitoring wells in place for water quality sampling purposes. Generally, this ten year old SIA file indicated that it was "unknown" whether the impoundment had an adverse affect by seepage to water quality of drinking water wells in the area. The SIA was based on a file review by Ohio EPA. The groundwater contamination potential ratings were not based on field observations. A map (Figure 53) displaying these impoundment sites follows the table.

TABLE 49
LIST OF IMPOUNDMENTS BY WATERSHED

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
1	Maumee	09581858MUN00236 NPDES OH003719 Waterville Water Treatment 16 North Second Street Waterville, OH 43566	(SIC 4941) 1 impoundment waste storage sludge 4 years; 0.03 acres	13
2	Maumee	09581858IND00274 NPDES OH0002631 Johns-Manville Products Corp. 6055 River Road Waterville, OH 43566	(SIC 3222) 3 impoundments wastewater stabilization 13 years; 0.12 acres, total - 0.35 acres 120,000 gallons/day	17

TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
3	Maumee	09581858IND00275 NPDES OH0054011 Johns-Manville Products Corp. U.S. 24 & Dutch Road Waterville, OH 43566	(SIC 3222) 3 impoundments wastewater stabilization 13 years; 0.15 acres, total - 0.5 acres 36,000 gallons/day	16
4	Maumee	09577000IND00866 Consolidated Dock, Inc. Western Division 636 Paine Avenue Toledo, OH 43605	(SIC) 1 impoundment wastewater retention 3 years: 0.06 acres Note from SIA file: stormwater runoff = salt piles, coal, slag, etc.	19
5	Maumee	09577000IND00207 NPDES OH0002810 Gulf Oil Co. U.S. Div. Gulf Oil Corp. 2935 Front Street Toledo, OH 43697 (Ceased operation)	(SIC 2911) 4 impoundments waste treatment settling; 15 years 0.5 acres, total - 1.0 acres; 864,000 gals/day	16
6	Maumee Bay	09558730IND00239 NPDES OH0002925 Toledo Edison Co. 4701 Bay Shore Road Oregon, OH 43616	(SIC 491) 3 impoundments wastewater settling 4 years; 31 acres, total - 50 acres 3,100,000 gallons/day	17
7	Maumee Bay	09558730MUN00244 NPDES OH0041815 Oregon Water Supply 935 North Curtice Road Oregon, OH 43616	(SIC 4941) 1 impoundment waste storage of sludge; 18 years 1.5 acres	18
8	Swan	09584770IND00863 American Can Co. 10444 Waterville-Swanton Rd. Whitehouse, OH 43571	(SIC 3411) 1 impoundment wastewater retention 4 years; 0.5 acres; 30,000 gallons/day	17

TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
9	Otter	17341328IND00225 NPDES OH0002453 Libbey-Owens-Ford Co. 811 Madison Avenue Toledo, Ohio 43624 1701 East Broadway Toledo, OH 43605	(SIC 3211) 4 impoundments waste treatment settling 30 years; 21 acres, total - 67 acres LAST YEAR OF OPERATION 1966 Note from SIA file- Abandoned & capped (with clay) "sand ponds" with leachate problems, LOF pond "J"	16
10	Otter	09577000IND00226 NPDES OH0002453 Libbey-Owens-Ford Co. 1701 East Broadway Toledo, OH 43605 (Ceased operation)	(SIC 3211) 2 impoundments waste treatment settling; 6 years 7.5 acres, total - 19.5 acres	14
11	Otter	09577000IND00206 NPDES OH0002763 Sun Oil Co. of Penn. Toledo Refinery P.O. Box 920 Toledo, OH 43693	(SIC 2911) 3 impoundment waste treatment equalization 29 years; 7.5 acres, total - 8.5 acres 3,600,000 gallons/day	16
12	Otter	09577000IND00894 NPDES OH0058581 Phillips Petroleum Co. 275 Millard Avenue Toledo, OH 43605	(SIC 3624) 4 impoundment wastewater settling 10 yrs; 0.26 acres, total - 1.04 acres	13
13	Otter	0957700IND00892 C.H. Heist Corp. 3805 Cedar Point Road Toledo, OH 43694	(SIC 299) 3 impoundments waste storage 7 years; 0.03 acres, total - 0.09 acres	14
14	Otter	09558730IND00223 NPDES OH0058629 Commercial Oil Services, Inc. 3600 Cedar Point Road Oregon, OH 43616 (Ceased operation)	(SIC 2999) 3 impoundments waste disposal 13 years; 0.18 acres, total - 1.43 acres	18

TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
15	Otter	09558730IND00865 Bills' Road Oil Services 3500 York Street Oregon, OH 43616	(SIC 2899) 2 impoundments waste disposal 9 years; 0.12 acres, total - 0.25 acres	17
16	Otter	09558730IND00249 NPDES OH0053864 Fondessy Enterprises, Inc. 876 Otter Creek Road Oregon, OH 43616	(SIC 2999) 1 impoundment waste disposal 11 years; 1.2 acres	17
17	Otter	09577000IND000208 NPDES OH0002461 Standard Oil of Ohio Toledo Refinery P.O. Box 696 Toledo, OH 43694	(SIC 2911) 2 impoundments waste storage oil sludge 33 years; 2 acres, total - 10 acres	16
18	Ten Mile	09576022IND00278 NPDES OH0058521 Northern Ohio Asphalt Paving 7920 Sylvania Avenue Sylvania, OH 43460	(SIC 2952) 1 impoundment wastewater settling 2 years; 0.25 acres 144,000 gallons/day	17
19	Ten Mile	09572452IND00276 NPDES OH0033715 Medusa Cement Co. P.O. Box 310 Silica Plant Sylvania, OH 44350	(SIC 3241) 1 impoundment wastewater settling 6 years; 0.25 acres 500,000 gallons/day	15
20	Ottawa	09577000IND00233 Cleveland Metal Abrasive Co. 2351 Hill Avenue Toledo, OH 43607	(SIC 3291) 1 impoundment waste treatment settling; 6 years 0.03 acres 460,800 gallons/day Note from SIA file - 2 cell settling - av. flow value is design flow.	16

TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
21	Ottawa	09577000IND00864 Incorporated Crafts, Inc. 3905 Stickney Avenue Toledo, OH 43608	(SIC 2899) 2 impoundments waste disposal 14 years; 1.5 acres, total - 3 acres	17
22	Ottawa	09577000IND00891 Royster Co., Inc. Creekside Avenue P.O. Box 6986 Toledo, OH 43612	(SIC 2875) 1 impoundment waste water retention 28 years; 2 acres note - surface runoff pond was developed to collect discharge	15
23	Duck	09577000MUN00249 NPDES OH0030759 Toledo Water Treatment Plant 600 Collins Park Avenue Toledo, OH 43605	(SIC 4941) 2 impoundments Waste Storage Sludge 26 years; 16 acres, total - 48 acres	16
24	Duck	09537478IND00277 NPDES OH0003000 Norfolk & Western Railway Ironville Yard 2750 Front Street Toledo, OH 43605	(SIC 4011) 1 impoundment wastewater retention 8 years; 0.5 acres	18
25	Duck	09577000IND00895 Westway Trading Corp. Ind Molasses Division Box 186, Station A 431 John Q. Carey Drive Toledo, OH 43605	(SIC 2875) 2 impoundments (SIA Sheet was missing from the file)	
26	Silver/ Shantee	09577000IND00234 NPDES OH0002640 General Motors Corp. 1455 West Alexis Road Toledo, OH 43612	(SIC 3714) 1 impoundment waste treatment retention; 20 years 0.75 acres 100,000 gallons/day	18

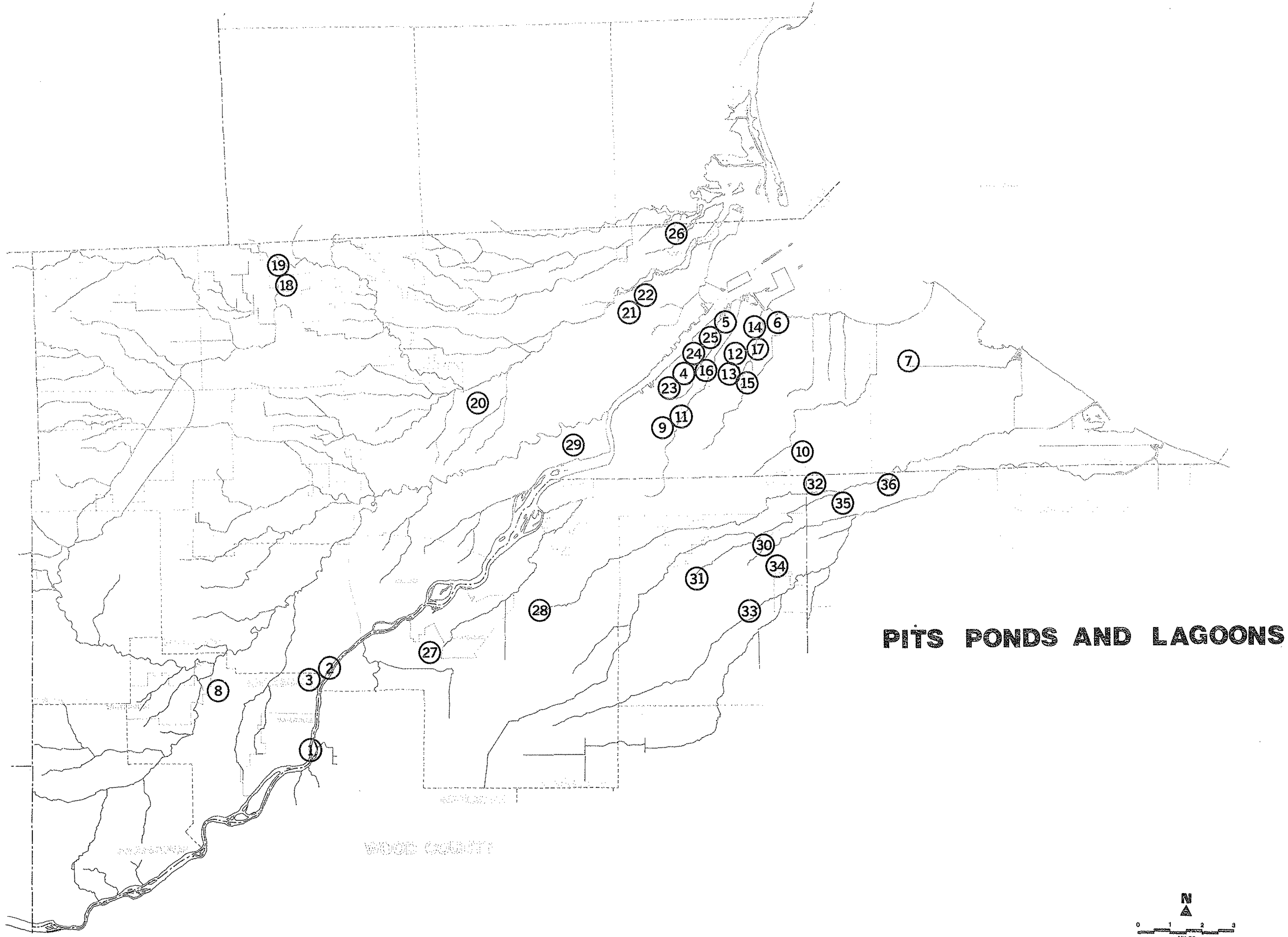
TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
27	Grassy	17362148IND00217 NPDES OH0003107 Owens-Illinois, Inc. P.O. Box 1035 Toledo, OH 43601 25875 U.S. Route 25 Perrysburg, OH 43551	(SIC 2893) 1 impoundment waste treatment polishing 12 years; 7 acres 20,000 gallons/day Note from SIA file - old DOT borrow pit - age uncertain	14
28	Cedar/ Crane	17343610IND00876 NPDES OH0003573 Maumee Stone Co. Perrysburg Plant 8812 Fremont Pike Perrysburg, OH 43551	(SIC 1422) 4 impoundments wastewater settling 14 years; 0.5 acres 138,000 gallons/day	23
29	Maumee	17351114IND00228 NPDES OH0057835 Penn Central Transportation 6 Penn Center Philadelphia, PA 19103 Stanley Diesel Shop 435 Emerald Avenue Toledo, OH 43602	(SIC) 1 impoundment wastewater retention 25 years; 7 acres 5,000 gallons/day Note from SIA file-old old borrow pit, age unknown	18
30	Cedar/ Crane	17380486IND00227 NPDES OH0002488 Chesapeake & Ohio Railway Co. P.O. Box 1800 Huntington, WV 25718 Walbridge, OH 43465	(SIC) 1 impoundment wastewater retention 9 years; 0.12 acres clay liner	15
31	Cedar/ Crane	17341328IND00910 NPDES OH0003212 Burndy Corporation Richards Avenue Norwalk, OH 06856 Toledo Facility P.O. Box 817 Toledo, OH 43601	(SIC 3471) 1 impoundment waste treatment retention 11 years; 0.25 acres 65,000 gallons/day Ceased operation in 1976	17

TABLE 49 continued

MAP #	WATERSHED	FACILITY IDENT. #	SIA FILE STATUS	GWCPR
32	Cedar/ Crane	17357190IND00880 Hirzel Canning Co. 411 Lemoyne Road Toledo, OH 43616	(SIC 2033) 3 impoundments wastewater aerated 11 years; 1.25 acres, total - 3.75 acres 30,000 gallons/day	16
33	Cedar/ Crane	1735020IND00908 Standard Oil Co. of Ohio 1800 L. Midland Bldg. Cleveland, OH 44115 1-280 & S.R. 795 Millbury, OH 43447	(SIC 299) 1 impoundment waste treatment retention 3 years; 0.02 acres bentonite modified liner	15
34	Cedar/ Crane	17350260IND00229 NPDES OH0003221 Molnar Packing Co. Pemberville Road Millbury, OH 43447	(SIC 2011) 1 impoundment wastewater aerated 7 years; 1.2 acres 7,050 gallons/day Note from SIA file - two celled lagoon	13
35	Cedar/ Crane	12301322IND00231 NPDES OH0003425 Permaglass Div. Guardian Industries Routes 51 & 795 Millbury, OH 43447	(SIC 0321) 1 impoundment waste treatment biologic 9 years; 2.3 acres 30,000 gallons/day	13
36	Cedar/ Crane	12319736IND00210 NPDES OH0002755 Stokely-Van Camp, Inc. 941 N. Meridan Street Indianapolis, IN 46206 at Curtice, OH 43412 (Ceased operation)	(SIC 2033) 2 impoundments waste treatment aerated; 26 years 2.5 acres, total - 4.4 acres range 150,000 to 269,000 gallons/day CEASED OPERATION in 1979 Note in SIA file - 2 lagoons inventoried, but 2nd lagoon partitioned to form 2 for a total of 3 lagoons.	17

Figure 53 Map of Pits, Ponds & Lagoons



LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

Water Quality Impacts

The Subcommittee's greatest concern deals with the Dura Dump, the LOF Grinding Sand Settling Ponds, and the King Road Landfill. Of obvious concern, too, are the wall-to-wall dumps once sited in the floodplains of the Ottawa River. The various closed sites have degrading impacts on water quality as shown when analyzing the Ohio EPA Water Quality Data Summary conducted during the summer of 1986.

The headwaters of the Ottawa River start in Michigan and flow through western Lucas County where it is known as the Ten Mile Creek. Upstream of the King Road Landfill at River Miles 5.2 and 5.1 (Centennial Road) the water quality is considered good, the primary influence being agriculture. The Dissolved Oxygen is 5.2 to 9.7 mg/l. Metals are near or below the detection limit, as are phenolic samples.

The King Road Landfill is located below River Mile 4.1 where water quality is considered fair to marginally good. This site was closed in 1976, with leachate problems developing in 1972. Heavy metals flowing from the site caused Lucas County to provide a municipal water line to those homes whose water wells were contaminated. Midwest Environmental Consultants has prepared an environmental assessment for the site, and has made recommendations for further investigations. Existing conditions at the site include loose garbage on the surface, insufficient grade, ponding of water, and serious erosion in many areas.

The North Cove Landfill site along the banks of the Ottawa River at River Mile 8.7, was formerly owned by American Motors. It operated from 1941 until 1970 where industrial residues were disposed of. During the installation of a sanitary sewer west of the site in 1979, hydrocarbon fumes were encountered. Groundwater sampling was performed and indicated the presence of hydrocarbons and low boiling solvents. A site assessment was done for the landfill and a remedial investigation/feasibility study is to be conducted by AMC.

Lake Erie dilutes the polluted Ottawa River from River Mile 4.9 to downstream. The Dura, Stickney and Tyler dumps all owned by the City of Toledo, are located along the Ottawa River wherein a lake estuary effect takes place. Also in the vicinity are three Combined Sewer Overflows, and discharges from DuPont and AMC. Leachate samples from the Stickney Avenue site contain low to moderate levels of conventional pollutants and very low levels of organic priority pollutants.

At the Dura Dump the leachate contains high BOD, COD and organics. Among these organic chemicals are PCBs. The range of concentration of PCBs in the Ottawa River Sediment from sampling taken October 1986 is 0.86 to 9.7 parts per million. One sample taken from the river bank was as high as 135 parts per million. The six leachate seeps to the Ottawa River have been calculated to be 60,000 gallons per day. The City of Toledo has initiated a Remedial Investigation/Feasibility Study being conducted by URS Corp. Actions have been to control leaching and runoff at the site. Clean up costs have been estimated to be $40 million.

The degradation of Otter Creek is directly related to the LOF site. At River Mile 5.9 (Oakdale Street) downstream of the LOF site, the Dissolved Oxygen is 1 mg/l, pH ranges from 8.6 to 10.2; Arsenic is 350 μg/l; Copper ranges from 17 to 30 μg/l. The water quality is considered to be very poor. Only upstream at River Mile 7.2, where Otter Creek is a small ditch-like stream, is the water quality considered to be fair.

At River Mile 5.7 (Pickle Road) there are noxious smelling chemicals, a reddish brown flocculent, hydrogen sulfide, etc., with the stream and banks at River Mile 4.0 (Wheeling Street) being oil soaked, with nickel and cyanide also being detected. The Sun Oil Refinery discharge is upstream at this point. At River Mile 2.1 (Millard Avenue), while the water quality is still degraded, it is slightly improved due to the Lake effect on Otter Creek. It is important to remember that Evergreen, Fondessy, and Westover sites each have leachate collection systems in place.

The ten dump sites on Swan Creek do not appear to have severe water quality impact but this may be due to lack of thorough investigation of sediments and fish sampling.

For the Maumee River, the Ohio EPA Northwest District Office reports that Jennison-Wright (J-W) has entered into a consent decree with OEPA on February 4, 1987. Pursuant to the terms of this agreement J-W has prepared a Remedial Investigation Work Plan (utilizing Woodward Clyde Consultants). This work plan was approved, with conditions by OEPA on January 27, 1988. A draft RI report is expected from J-W on July 25, 1988 (180 days from approval of the RIWP). J-W has not yet begun to complete the RI; however, work is expected to start in the near future. The RI is designed to provide a data-base for determining the best remediation alternative and extent of contamination.

Storm, sanitary, and treated process waters flow from the 26 acre site, located at 2332 Broadway, into the municipal sewer system. A 12" overflow from the city sewer flows through the J-W property into the Maumee River. The office parking lot, at 3463 Broadway, borders the Maumee's west bank. Contamination and remediation alternatives will be addressed by the RI/FS for this also.

RCRA Facilities

Hazardous waste regulations are implemented by Ohio EPA's Office of Solid and Hazardous Waste Management, and cover generation, storage, transportation, and treatment or disposal of hazardous wastes as defined in RCRA and the 1984 Hazardous and Solid Waste Amendments. Ohio's hazardous waste regulations were passed in 1980. Permits to operate hazardous waste facilities are issued by the Ohio Hazardous Waste Facility Board with monitoring and enforcement of the regulations being carried out by Ohio EPA.

Within the area of concern there are 13 different RCRA facilities licensed to operate as shown in Table 50. However, the Evergreen Landfill, operated by Ohio Waste Systems, a subsidiary of Waste Management, did operate as a hazardous waste facility until November 1985. The Fondessy Landfarm (Fondessy Enterprises Site #2) has not received refinery sludges for well over one year, with Ohio EPA recommending that the site be closed due to seasonal high water table and other problems.

TABLE 50
LIST OF RCRA FACILITIES

OHD #	Name	Address	
OHD045245271	Cast America Products	4243 South Ave.	43615
OHD005045992	Doehler-Jarvis Castings	5400 N. Detroit Ave.	43612
OHD005041843	E.I. Dupont deNemours	1930 Tremainsville	43613
OHD045243706	Fondessy *	876 Otter Creek Rd.	43616
OHD000721415	Fondessy * Landfarm Site #2	Cedar Point & Wynn	43616
OHD980279376	General Tire & Rubber	3729 Twining St.	43608
OHD980586804	S.M. Allen, Inc.	3903 Stickney Ave.	43608
OHD018354894	Sheller-Globe Corp.	Lint & Dura Aves.	43612
OHD063717565	Sheller-Globe Corp.	4444 N. Detroit Ave.	43612
OHD005057542	Standard Oil Co.	Cedar Point Road	43614
OHD004044128	American Cyanamid Co.	12600 Eckel Road	43551
OHD043642958	Motor Wheel**	212 Luckey Road	43443

* Now Envirosafe
** Formerly Goodyear

Status of Superfund Sites

There are no designated Superfund sites in the AOC at this time (i.e., no sites have been included in the National Priority List under Superfund/CERCLA). All the preliminary assessments, or the paper trail, have been done for the sites listed in the following table. This is the first step in potential Superfund listing. Those sites listed in the Table 51 have the possibility of being named hazardous waste sites. All the sites listed are considered unregulated sites and each has been ranked high (H), medium (M), Low (L), or no priority (0).

The Ohio EPA Northwest District Office reports that Allied Automotive Toledo Stamping, Owens-Illinois (Hilfinger), Phillips Petroleum, and Webstrand sites have been cleaned up. In cases where responsible companies can be identified, the EPA will try to get funding for cleanup from the businesses involved. The list of possible hazardous waste sites was compiled because of the federal Superfund Law, which required each company to report its hazardous waste activities of the past. The list not only includes these sites, but also sites reported by residents and anonymous tips.

Table 51 includes the US EPA assigned number, the site name and address where known, the US EPA Federal Investigation Team (FIT) ranking, and the Ohio EPA priority ranking.

TABLE 51
POSSIBLE HAZARDOUS WASTE SUPERFUND SITES

OHD #	Name and Address		FIT	Ohio EPA
OHD980678379 348-0024	Allen Charles Waste Removal Address Unreported (Transporter) Toledo	99999	L	L
Not Assigned 348-1027	Allied Automotive Toledo Stamping 525 Hamilton Street Toledo	99999		
OHD980823801 348-0045	Anderson's 439 Illinois Avenue Maumee	43537	M	L
Not Assigned 348-1029	Champion Spark Plug Address Unreported	99999		
OHD980611636 348-0175	City Owned Dump (AMC, North Cove) Foot of Drexel Dr. I-75 & Cove Toledo	43610	—	H
OHD000816843 348-0197	Commercial Oil Service, Inc. 3600 Cedar Point Road Oregon	43616	—	—
OHD980826119 348-0200	Consaul Street Landfill 2510 Consaul Street Toledo	43624	O	L
OHD043636463 348-0207	Coulton Chemical 6600 Sylvania Road Sylvania	43560	—	—
OHD020260188 348-0208	Coulton Chemical Corp. 1400 Otter Cheek Road Oregon	43616	L	L
OHD068081595 348-0211	Cousins Waste Management 2611 W. Center Toledo	43609	L	L
OHD990777930 348-0248	DuPont E.I. Denemours & Co., Inc. Matzinger Rd., P.O. Box 6568 Toledo	43612	L	M
Not Assigned 348-1031	Erie Coatings Address Unreported	99999		
OHD980613640 348-0286	Essex Group, Inc. 5101 Telegraph Road Toledo	43612	O	O
OHD045243706 348-0303	Fondessy 876 Otter Creek Road Oregon	43616	L	H

TABLE 51 continued

OHD #	Name and Address		FIT	Ohio EPA
Not Assigned 348-1034	Greise Brothers Address Unreported	99999		
OHD005052410 348-0365	Gulf Oil Co., Toledo Refinery 2935 Front Street Toledo	43697	M	M
OHD000608695 348-0367	Gulf Oil Toledo Terminal 2774 Front Street Toledo	43605	—	—
Not Assigned 348-1032	Harrison Junkyard Address Unreported	99999		
OHD981097157 348-0385	Heist Cleaning Service 3804 Cedar Point Road Oregon	43616	L	M
OHD000605295 348-0441	King Road Lucas County San. 3535 King Road Toledo	43617	M	M
OHD005050349 348-0463	Libbey-Owens-Ford Co., Plants 4 & 8 1769 E. Broadway Toledo	43605	—	—
OHD981529092 348-0482	Manhattan Dump 2020 Manhattan Blvd. Toledo	43612	L	L
OHD980615801 348-0502	Maston Septic Service 7202 Providence Whitehouse	43571	O	L
OHD980704381 348-0503	Matlack Trucking Co. 1728 Drouillard Road Toledo	44309	L	L
OHD005045992 348-0568	NL Industries 5400 N. Detroit Avenue Toledo	43612	L	L
OHD005051180 348-0569	NL Industries, Inc. Bearings Div. 715 Spencer Street Toledo	43609	L	L
OHD000720268 348-0576	North American Car Corp. 4545 Hoffman Road Toledo	43611	O	L
OHD980679427 348-0588	Oberly Ray DSPL 3812 Twining Street Toledo	43608	O	L
OHD980615934 348-0589	Oberly Robert Waste Removal 3903 Stickney Toledo	43608	L	L

TABLE 51 continued

OHD #	Name and Address		FIT	Ohio EPA
OHD980991798 348-0616	Owens Illinois Hilfinger 1800 N. Westwood Avenue Toledo	43606	M	M
OHD005034459 348-0621	Owens-Illinois Libbey Plant 27 940 Ash Street Toledo	43611	L	L
OHD005562020 348-0622	Owens-Illinois Tech. Center 1700 N. Westwood Avenue Toledo	43607	L	L
OHD980901276 348-0633	Phillips Petroleum Property Front St. & Millard Ave. Toledo	43605	L	L
OHD018354894 348-0730	Sheller-Globe Corp. Cy Auto Stamping Div. Lint & Dura Avenue Toledo	43612	L	M
OHD005057542 348-0767	Standard Oil Co. (Ohio) Lallendorf & Cedar Point Road Oregon	43616	O	L
OHD005046511 348-0781	Sun Oil Co. Of Pennsylvania 1819 Woodville Road Oregon	43616	L	L
OHD980679419 348-0787	Swan Creek Landfill Glendale Avenue Toledo	43614	L	L
OHD000605956 348-0812	Toledo City of Stickney Ave. Dspl. Site 3900 Stickney Avenue Toledo	43612	M	H
OHD980611685 348-0813	Toledo Edison Co. Coke Oven Gas Line Front & Cherry Streets Toledo	43652	L	L
OHD980509905 348-0814	Toledo Ldfl. City of Aka Dura San Ldfl. Dura Ave. Toledo	43612	L	M
OHD980611677 348-0815	Toledo Powdered Metal Cross Street Toledo	43623	L	L
OHD980510499 348-0816	Toledo Sewage Disposal Plant Bay View Park Toledo	43611	L	L
OHD980611305 348-0818	Treasure Island Landfill Counter & Kalamazoo & York Sts. Toledo	43611	M	M
OHD980510523 348-0829	Tyler Street Dump Tyler St. Toledo	43612	Y	M

TABLE 51 continued

OHD #	Name and Address	FIT	Ohio EPA
OHD005055777 348-0839	Union Oil Co., Toledo Refinery 1840 Otter Creek Road Oregon 43616	L	L
OHD980510580 348-0918	W/S Ave. Toledo Mun San Landfill South Ave & Maumee River Toledo 43615	L	M
OHD981525710 348-0895	Webstrand Corp. 525 Hamilton Street Toledo 43602	L	L
OHD000606368 348-0901	Westover Corp. San Landfill 820-920 Otter Creek Road Oregon 43616	M	M
OHD005044128 387-0033	American Cyanamid Co. 12600 Eckel Road Perrysburg 43551	O	O
OHD980610935 387-0071	Asman's Landfill Rt. 795 & Fostoria Road Millbury 43447	M	M
OHD041350323 387-0167	Chrysler Corp. Toledo Machining Plant 8000 Chrysler Drive Perrysburg 43551	L	L
OHD087050019 387-0190	Coastal Tank Lines 6622 SR-795 Walbridge 43465	L	L
OHD068111327 387-0294	Evergreen Landfill 6525 Wales Road Northwood 43619	L	M
OHD981529084 387-0454	Lake Township Dump Hanley Road & Cummings Road Walbridge 43465	L	L
OHD005050406 387-0462	Libbey-Owens-Ford Co. Plant 6 140 Dixie Hwy. Rossford 43460	L	L

ATMOSPHERIC DEPOSITION

According to the Summary of the Report of the Great Lakes Water Quality Board to the International Joint Commission dated November 1987, atmospheric transport and deposition into the Great Lakes basin, either directly onto the water surface or indirectly into the drainage basin with subsequent transport, has been clearly demonstrated. Going on, this summary report states that even though the magnitude of the input (relative to other sources and pathways) has not been fully defined, the available evidence indicates that atmospheric deposition is a major pathway for contamination of the Great Lakes ecosystem.

Continuing, the summary report states that releases of lead to the atmosphere, primarily from automotive exhausts, have decreased as the use of leaded gasoline in the United States and Canada has decreased, and that atmospheric transport and deposition of certain pesticides (e.g. DDT) into the Great Lakes continues today, even though their use has been banned or severely restricted in both the United States and Canada. These chemicals are still manufactured and used in great quantities in other locations in the world. Short of a worldwide ban on the manufacture, transport and use of these contaminants, appreciable contamination of the Great Lakes ecosystem will continue indefinitely.

The authority to regulate emissions into the atmosphere are based on clean air requirements, but legislative provision to control emissions of persistent toxic substances into the atmosphere need to be incorporated. The Ohio Alliance for the Environment in its March 1987 *Newsletter* reports that since 1987 improvements have been made in reducing the amount of discharge from direct sources of toxic contaminants, but much more research and action is still needed to restore the lakes to a healthy level; and that little is known about the specific effects and possible controls for toxic chemicals into the air.

The Ohio Alliance for the Environment's report goes on to say, that seven million chemical compounds now exist, 30,000 of which are in substantial commercial use; that approximately 1,000 new chemicals are developed each year; that over 1,000 chemicals are suspected carcinogens. It is important to note that some of these chemicals occur naturally, which means that manufactured chemicals are not the only source of toxic substances.

Air emissions of such substances are a concern because the atmosphere serves as a pathway into the environment as a whole. Large lakes such as the Great Lakes, tend to act as a "sink" for pollution from all sources. It has been shown that with the upper Great Lakes, the input of toxic chemicals such as PCBs and lead comes from atmospheric deposition.

The current US EPA and Ohio EPA ambient air quality standards are displayed in Table 52 on the following page. The Toledo Environmental Services Division functions as the air pollution enforcement arm of the Ohio EPA in the Toledo area. This Division was interviewed in order to secure information regarding attainment/non-attainment status regarding the pollutants listed in this table, with such status reported as follows:

TABLE 52
US EPA & OHIO EPA AMBIENT AIR QUALITY STANDARDS*

POLLUTANT	DURATION	RESTRICTION	MAXIMUM ALLOWABLE CONCENTRATION** PRIMARY	SECONDARY
Particulate Matter - PM10	Annual geometric mean	Not to be exceeded	50 mg/m^3	50 mg/m^3
	24 - hour concentration	Not to be exceeded more than once per year	150 mg/m^3	150 mg/m^3
Sulfur Dioxide	Annual arithmetic mean	Not to be exceeded	80 $\mu m/m^3$ (0.03 ppm)	
	24-hour arithmetic mean concentration	Not to be exceeded more than once per year	365 $\mu m/m^3$ (0.14 ppm)	
	3-hour arithmetic mean concentration	Not to be exceeded more than once per year		1300 $\mu m/m^3$ (0.5 ppm)
Carbon Monoxide	8-hour arithmetic mean concentration	Not to be exceeded more than once per year	10 mg/m^3 (9.0 ppm)	
	1-hour mean concentration	Not to be exceeded more than once per year	40 mg/m^3 (35.0 ppm)	
Ozone	1-hour mean concentration	Not to be exceeded on more than one day per year, average over three years	0.12 ppm (244 $\mu m/m^3$	
Nitrogen Dioxide	Annual arithmetic mean	Not to be exceeded	.53 ppm (100 $\mu m/m^3$	
Lead	3-month arithmetic mean concentration	Not to be exceeded	1.5 $\mu m/m^3$	

NOTES:

Primary standards are established for the protection of public health
Second standards are established for the protection of public welfare
$\mu m/m^3$ = micrograms per cubic meter
ppm = parts per million
mg/m^3 = milligrams per cubic meter

* US EPA & Ohio EPA Air Quality Standards are Identical
** 40CFR 50.4 - 50.12

LEAD: Attainment

Lead is a toxic metal released into the atmosphere primarily through the exhaust of automobiles using leaded fuels. Lead accumulates in the human body and can interfere with the blood-forming process, and the normal nervous and renal system functions. Young children are most susceptible to the ill effects of lead. The level of this pollutant has dropped substantially since the early 1970s. Because of enforcement activities related to fuel switching and the further reduction of lead levels in leaded gasoline, the data from recent years shows that the air quality in the area of concern related to lead is approximately 10 times cleaner than the national standard.

NITROGEN DIOXIDE: Attainment

Nitrogen dioxide is a brown gas, formed during high temperature combustion, which reacts with hydrocarbons in the presence of sunlight to produce photo-chemical oxidants or smog. It is also a pollutant in its own right, and can affect lung tissue, reduce resistance to disease, contribute to bronchitis and pneumonia, and aggravate chronic lung disorders. It is also a contributor to acid rain. The level of this pollutant has dropped with no violation ever having been recorded in the area of concern. In fact, routine monitoring of this pollutant was ended in July 1981, but reestablished in 1984 through a scaled-down sampling system in order to keep abreast of any new trend.

OZONE: non-attainment

Ozone is a colorless, pungent, toxic gas, formed by a series of chemical reactions where hydrocarbons, nitrogen oxides from automobiles and other sources, are exposed to sunlight. Ozone is the principal constituent of smog, and is a severe irritant, impairing lung function and aggravating existing respiratory disorders. The level of this pollutant has dropped with only one violation of the standard in 1983, and no violations for succeeding years. Significant reduction in hydrocarbon emissions have taken place in recent years with redesignation expected by US EPA to attainment status.

CARBON MONOXIDE: attainment

Carbon monoxide is a colorless, odorless, tasteless, toxic gas produced by incomplete combustion of fossil fuels. The automobile engine is the main source of this pollutant. It is quickly absorbed by the blood, and reduces the oxygen available to the tissues, impairing visual perception and alertness. Continued exposure to elevated carbon monoxide levels can threaten life. Persons with cardiovascular diseases are especially vulnerable to this type of pollution. The level of this pollutant dropped measurable in 1976 and 1983. Two violations were measured in 1984, but none in the intervening years.

SULFUR DIOXIDE: non-attainment for area east of Route 23 and west of eastern boundary for City of Oregon attainment for remainder area.

Sulfur dioxide is a heavy, pungent, colorless gas formed primarily by the combustion of sulfur-bearing fuels such as coal. It reacts readily with other atmospheric compounds and pollutants to form sulfates, a group of compounds that aggravate respiratory ailments such as bronchitis, emphysema, asthma and heart disease. Sulfates, combined with moisture in the atmosphere, produce acid rain. The area of concern is classified as non-attainment for sulfur dioxide, but there have been no violations, either primary or secondary, of the US EPA Standards since 1979.

PARTICULATE MATTER: attainment for primary sources, but non-attainment secondary sources for areas of East Toledo and Oregon, with attainment for secondary sources in the remainder area.

Particulate matter relates to particles in the air (such as soot, ash, etc.), including non-toxic materials (dust and dirt), as well as toxic substances (lead, asbestos and sulfates). Natural and man-made sources can contribute to adversely affect human respiratory systems to various degrees, depending on particle size and composition. Data show no violation of either primary or secondary standards for 1983, 1984 or 1985 with the Toledo Environmental Service Division petitioning for redesignation to total primary and secondary attainment for the entire area. However, there is a small area, mainly in East Toledo, where the monitoring station is located, that indicated a secondary violation for 1986.

Acid Rain

The Great Lakes National Program Office, US EPA, has operated the Great Lakes Atmospheric Deposition (GLAD) network since early 1981. A precipitation sampling station as a part of GLAD had been located by Toledo Environmental Services Division in Oregon, Ohio at Bay Shore and Stadium Roads, from 1981 through 1985. Due to budget constraints this local sampling station was thereafter eliminated, with the nearest stations being Put-in-Bay, Ohio on South Bass Island, and Mount Clemons, Michigan.

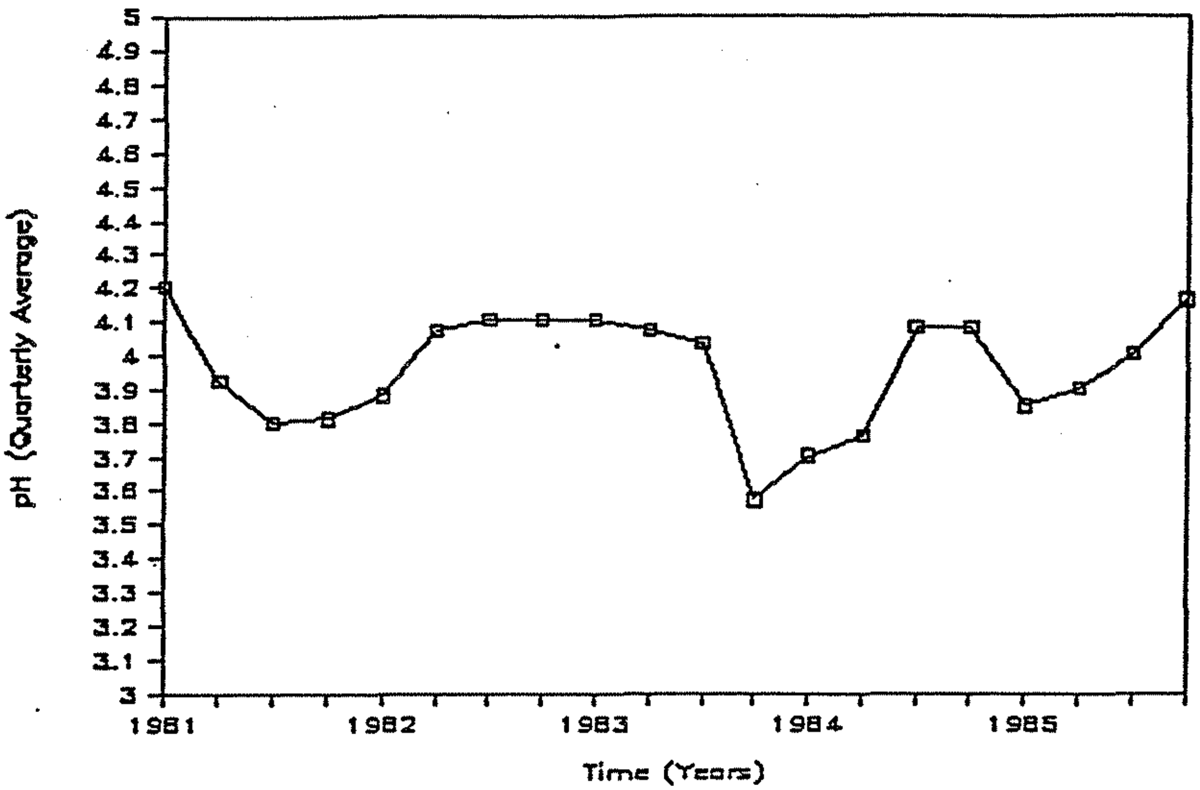
During the period when local precipitation sampling station was in operation, the process consisted of collecting weekly samples and checking for pH and conductivity before sending the sample to the GLAD laboratory for further analysis. The pH of unpolluted rain is about 5.6. Because the pH scale is logarithmic, rain with a pH of 4.6 is ten times as acidic as "normal" rain, while rain with a pH of 3.6 would be 100 times as acidic. Figure 54 graphically displays the quarterly pH averages for the period covering 1981 through 1985 as developed by the Toledo Environmental Services Division. The quarterly averages indicate that rainfall in the Toledo area is often 50 to 100 times more acidic than normal rainfall. The GLAD laboratory analysis for chemical pollutants was available for only one year, therefore, weighted calculations were not conducted.

The area of concern is most fortunate in that the acidic rainfall is buffered by our natural occurring limestone bedrock and local soils which mitigate the ecological effects of acid rain. However, even though most of the ecological effects to the local area are mitigated, there is substantial damage being caused locally by acid rain. Buildings and statues are being corroded, cars rust more quickly and their paints are damaged, and synthetic materials ranging from clothes and nylons to windshield wipers become more rapidly unusable. In addition, heavy metals are leached more readily from structures and soils, so the acid rain may be contributing to the presence of toxic substances in the water. Reduced productivity of farm crops, particularly soybeans, and forest resources has also been linked to acid rain. The buildings, statues, cars, trees and agricultural products all are impacted by the precipitation before it can be neutralized by the soil and bedrock of the area.

Wildlife resources locally may also be experiencing degradation due to the acidity. Many animal resources rely in early spring on temporary ponds and marshes for their breeding areas and important food resources. Most affected are the amphibians and waterfowl that move into these ponds and wetlands even before the snow has melted. Since the ground is still frozen, its ability to neutralize the acidity may be greatly limited. The most acidic precipitation of the year often falls as snow in fall and winter. The spring snow melt may be sending a rush of still acidic water to the ponds and marshes at a critical time. For instance, most salamander species move into the breeding ponds for a brief period, beginning before the ice melts off of the pond. Salamander mortality has been directly linked to the acidity of their breeding ponds.

The decline of black duck populations is also now believed to be linked at least in part to the acidity of their feeding ponds when they arrive in early spring. Other migratory waterfowl are also finding reduced abundance of aquatic insects because the spring flush of acidic waters reduces populations at a time when food needs are high in order to fuel migration and prepare for the breeding season.

FIGURE 54
PRECIPITATION pH vs. TIME



SOURCE: 1985 ANNUAL REPORT, ENVIRONMENTAL SERVICES AGENCY, CITY OF TOLEDO, p. 20

Despite the acidity of rain water in the RAP Area, water in streams is generally alkaline, as shown by Table 53. The pH averages 7.7 to 7.8 for all streams, with the exception of Otter Creek, which is notably more alkaline than any other stream in the area.

TABLE 53
pH VALUES IN RAP AREA STREAMS
TESD DATA, 1981-1986[18]

Stream Sampled	pH <0.6	6.0-.9	7.0-.9	8.0-.9	9.0-.9	>10.0	Avg	# Samples
All streams	1	79	809	486	28	1	7.8	1404
Swan Cr.	0	9	153	54	0	0	7.7	216
Ottawa River	0	27	255	134	4	1	7.7	421
Maumee River	0	23	196	165	3	0	7.8	387
Heilman Dt.	0	1	34	15	0	0	7.7	50
Silver Cr.	0	3	32	19	0	0	7.7	54
Shantee Cr.	0	2	33	19	0	0	7.8	54
Grassy Cr.	0	6	30	20	0	0	7.7	56
Delaware Cr.	1	5	33	16	0	0	7.6	55
Hill Dt.	0	3	36	16	0	0	7.7	55
Otter Cr.	0	0	7	28	21	0	8.7	56

TESD Air Sampling

TESD has eleven air sampling network sites. These are described in Table 54 by station number, location, and type of testing performed. The table also includes map numbers which correlate with Figure 55, a map that displays the location of air sampling sites.

TABLE 54
TESD AIR SAMPLING NETWORK SITES

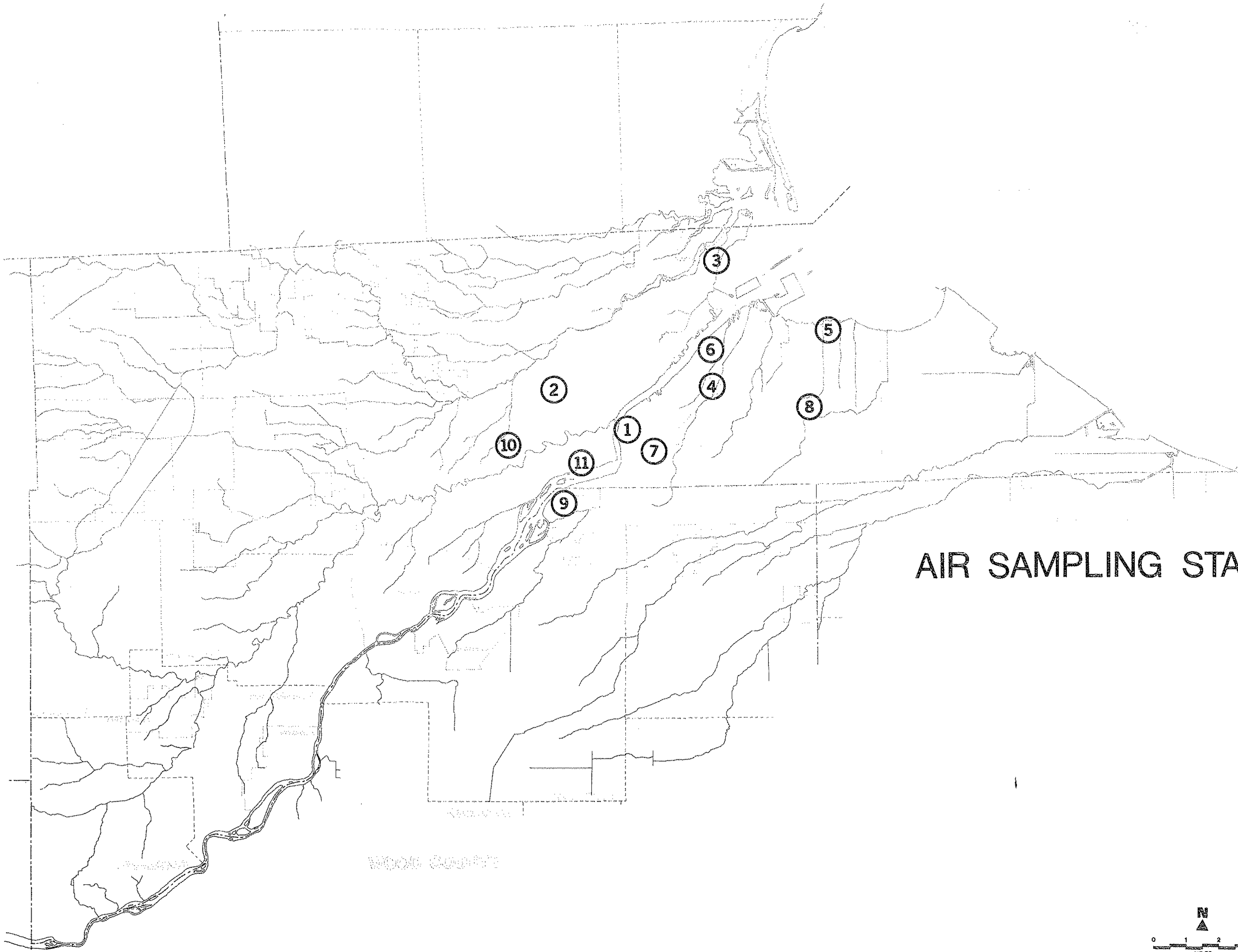
Map #	TESD STATION	LOCATION	TESTS PERFORMED
6	1	East Side Sewage Pumping Station Lee and Front St.	T.S.P.
7	2	East Side Central School 825 Navarre Ave. at Berry St.	T.S.P
8	3	Oregon Municipal Building 5330 Seaman	T.S.P.
9	4	Rossford Municipal Building 133 Osborn Street	T.S.P.
10	5	60 N. Westwood at Hill (soon moving to U.T. Comm. Tech. and converted to P.M. 10)	T.S.P
11	6	1503 Broadway at South	T.S.P.
2	7	2927 Monroe (at Bancroft & Detroit) (heavy traffic intersection)	CO
3	8	2930 - 131st. Street	O_3
4	9	Water Filtration Plant 600 Collins Park	SO_2
5	10	Acid Rain Monitoring Site	Acid Rain
1	11	Toledo Environmental Services Bldg.	T.S.P., SO_2,

T.S.P.	Total Suspended Particulates
CO	Carbon Monoxide
SO_2	Sulfur Dioxide
O_3	Ozone
NO_2	Nitrogen Dioxide
Acid Rain	
PM-10	Particulate Matter - 10 microns (a more refined T.S.P. Test; other T.S.P Sites may be converted at a later date)

Source: Rick Uscilowski - Chief Chemist, Toledo Environmental Services Div. (TESD)

FIGURE 55: TESD AIR SAMPLING NETWORK

AIR SAMPLING STATIONS



LOWER MAUMEE RIVER REMEDIAL ACTION PLAN - AREA OF CONCERN

tmacog

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GLOSSARY

305b	A biennial report from the state to US EPA which describes the quality of the water of the state. Specifically, whether it meets the "fishable and swimmable" criteria mandated by the Clean Water Act. The term "305b" refers to the section of the Act requiring this report.
$\mu g/l$	Micrograms/liter (parts per billion)
Ag	Silver
As	Arsenic
BOD, BOD_5	*Biochemical Oxygen Demand*. This is a water quality parameter which serves as an indirect measure of the amount of organic matter (food) available for bacteria in a water sample. It measures the amount of oxygen, in pounds, needed to support the growth of bacteria in a water sample over a specified period of time; usually 5 days.
Ba	Barium, a "heavy metal"
Be	Beryllium, a "heavy metal"
BWQR	Biological Water Quality Report: a detailed water quality survey of a stream reach conducted by OEPA. BWQRs were formerly known as CWQRs (Comprehensive WQR).
Bypass	A point in a sanitary sewer system where untreated sewage can overflow directly to a stream instead of continuing to the treatment plant.
C	Carbon
CDF	*Confined Disposal Facility*. Diked areas in Maumee Bay which are used to hold and dewater sediments dredged off the bottom of the shipping channel.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act* of 1980, more commonly known as *"Superfund,"* which provides authority for Federal cleanup of abandoned toxic waste sides and response to releases of hazardous substances into the environment.
CLEAR	*Center for Lake Erie Area Research*, a Lake Erie water quality monitoring program, sponsored by Ohio State University.
CN	Cyanide
COD	*Chemical Oxygen Demand*. An indirect measurement of the amount of carbon (food) in a water sample. This test is somewhat similar to the BOD test, in that it measures the pounds of oxygen needed to use up (oxidize) the carbon in a water sample. The COD uses chemicals to determine the amount of oxygen needed, while the BOD test is a biological test.
CSO	Combined sewer overflow
$CaCO_3$	Calcium carbonate: "scale." Used as a standard in measuring water hardness.
Cd	Cadmium, a "heavy metal"
Cl,Cl^-	Chlorine, chloride. Chlorine is a poisonous gas commonly used to kill germs in treated sewage or drinking water. Chloride is an electrolyte, a "salt" (sodium chloride), and is not a disinfectant
CoE	US Army Corps of Engineers
Combined sewage	Sanitary sewage and stormwater combined. Ideally, sanitary sewage and stormwater are carried in separate pipelines. In many inner-city areas, however, there is only one sewer system, and it carries combined sewage.
Cond.	Conductivity: a specific laboratory test for determining the conductivity of a water sample. It indicates the quantity of dissolved electrolytes in a sample.
Cr	Chromium, a "heavy metal"
Cu	Copper
DO	Dissolved oxygen. Amount of oxygen dissolved in a water sample (in mg/l or ppm). DO is necessary for the survival of fish and other

	aquatic life
EPA	Environmental Protection Agency. US EPA is the Federal agency, and Ohio EPA is Ohio's statewide equivalent.
Eutrophication	A natural aging process generally describing the fertility (mainly aquatic plant productivity) of lakes. This process is speeded up if a lake receives an excess amount of nutrient pollutants, especially phosphorus.
F	Fluoride
Fe	Iron
Fecal Coliform	Bacteria which when found in large numbers in a water sample, indicate the presence of untreated sewage.
HUD	Housing and Urban Development. A Federal Agency which provides funding to assist cities and villages with housing and infrastructure problems
Hg	Mercury, a "heavy metal"
I/I	Infiltration and Inflow: excess storm and/or ground water entering a sanitary sewer system
ICI	Invertebrate Community Index: a numerical measure of water quality as reflected by a stream's ability to support aquatic life
IJC	International Joint Commission
K	Potassium
kg	Kilogram(s): 1000 grams. A kilogram is slightly more than two pounds.
LEWMS	Lake Erie Wastewater Management Study
LM	Lake mile. How many miles downstream (and out into Lake Erie) a given point is from the mouth of the Maumee
Leachate	Liquid that leaks out of a landfill or dump; usually ground or surface water highly contaminated with wastes from the dump or landfill.
MBAS	Methylene Blue Active Substance: a measure for the presence of surfactants in water or wastewater. Surfactants ("surface- active agents") are large organic molecules that cause water to foam or produce suds when agitated.
MG	Million gallons
mg	Milligram(s): a thousandth of a gram. There are 454 grams to a pound.
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter (= ppm)
mgd	Million gallons per day
ml	Milliliter(s): a thousandth of a liter. A liter is slightly less than a quart.
MOE	(Ontario) Ministry of the Environment. Equivalent of EPA.
MP	Mile point. How many miles upstream (above) the mouth of a stream a given point is. See RM.
Methane	Natural gas. Formed by the decomposition of organic matter in the absence of oxygen.
Mn	Manganese
N	Nitrogen: one of the chemical elements which in certain forms is a nutrient necessary for life.
NH_3	Ammonia: a form of nitrogen, which is a pollutant.
NO_2	Nitrite(s): a form of nitrogen, which is a pollutant.
NO_3	Nitrate(s): a form of nitrogen, which is a pollutant.
ng/g	Nanograms/gram. "Nano" is a prefix which means *"one billionth"*, or 10^{-9}. ng/g=ppb.
NPDES	National Pollutant Discharge Elimination System. Refers to a permit which is required in order to discharge wastewater to a stream. This permit dictates how clean the water must be before it can be discharged.
Na	Sodium
Ni	Nickel, a "heavy metal"

O/G	Oil and grease. In water quality monitoring, refers to a specific chemical test for amount of oils in a sample.
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
P	Phosphorus. Considered the critical nutrient in the pollution of the Great Lakes. By limiting amount of phosphorus discharged to Lake Erie, the lake's eutrophication can be controlled.
PAH	*P*olynuclear *A*romatic *H*ydrocarbons
Pb	Lead, a "heavy metal"
PCB	Polychlorinated Biphenyls. Organic chemicals which, during the 50 years they were manufactured and used, an estimated 400 million pounds entered the environment, according to US EPA Hazardous Waste laboratory. Their use ranged from dielectric oils to carbonless paper production. A colorless liquid, it was used as an insulating fluid in electrical equipment: e.g., transformers, capacitors, because of its stability and heat resistance. PCBs are a suspect carcinogen. A significant health impact has been linked to incomplete combustion of PCBs. The oxidation of PCBs form dioxins and furans, the most toxic of all man-made substances. They have been found in measurable concentrations in waterways and sediments throughout the world, and are widely-spread contaminants of fish and wildlife resources. PCB contamination began in an era when industrial wastes were disposed of by flushing them directly into waterways, local sewage treatment plants, or landfills.
PEMSO	*P*lanning and *E*ngineering *D*ata *M*anagement *S*ystem for *O*hio (PEMSO) system, which Ohio EPA uses for classifying stream segments, modeling pollution sources, and their effects on water quality. Related watershed classification systems: TMACOG uses smaller watersheds, which are generally a subset of the PEMSO watersheds. The third system is *L*and *R*esources *I*nformation *S*ystem (LRIS), developed for the 208 program, and further defined for the Lake Erie Wastewater Management Study (LEWMS).[3] LRIS watersheds are usually, but not always, the same as TMACOG's.
pH	A measure of acidity or alkalinity, on a scale of 1 to 14. Neutral is 7.0; lower values are acidic, and higher values are alkaline (basic).
POTW	Publicly-Operated Treatment Works. A wastewater treatment facility operated by a city, village, or county that treats primary domestic sewage. Usually refers to a municipal sewage treatment plant.
ppb	Parts per billion (= $\mu g/l$)
ppm	Parts per million (= mg/l)
RCRA	*Resource Conservation and Recovery Act* of 1976. Deals with the transport, storage, treatment, or disposal of hazardous wastes and their associated facilities.
RM	River mile: how many miles upstream (above) the mouth of a stream
Regulator	A device used to control the bypass of untreated combined sewage to a stream. The purpose of the regulator is to allow the system to bypass combined sewage when the system is overloaded from stormwater; but to prevent bypasses during dry weather
S.D.	Sewer District
SO_4	Sulfate(s)
SS	Suspended solids: in water quality sampling, the weight of solids (in mg) suspended in a milliliter (ml) of water.
Se	Selenium
Superfund	See CERCLA
TDS	Total dissolved solids
TESD	Toledo Environmental Services Division: a division of the City of Toledo which is responsible for performing air and water quality monitoring in Toledo. Formerly TESA (*Agency*).

TKN	Total Kjeldahl Nitrogen: a specific chemical test used to determine how much of certain forms of nitrogen are in a water sample. It includes organic and ammonia nitrogen, but excludes nitrites and nitrates.
TMACOG	Toledo Metropolitan Area Council of Governments: regional planning agency for Lucas, Wood, Ottawa, Sandusky and Erie Counties in Northwest Ohio, and Erie, Bedford, and Whiteford Townships in Monroe County, Michigan
tpy	Tons per year
Turb.	Turbidity: a measure of whether or not water is clear. When used in terms of water quality monitoring, it refers to a specific test used to quantity *how* turbid a water sample is.
USGS	United States Geological Survey. Federal agency involved in detailed mapping of the U.S., and surface and groundwater monitoring.
WQ	Water quality
WTP	Water Treatment Plant. Usually refers to a municipal plant for producing city drinking water.
WWH	Warmwater Habitat: a stream classification used by Ohio EPA to set the water quality standards for a stream. Warmwater standards are not as stringent as Coldwater.
WWTP	Wastewater Treatment Plant. Usually refers to a municipal treatment facility, and often used interchangeably with "Sewage Treatment Plant"
Zn	Zinc, a "heavy metal"