THE NATION'S WATER RESOURCES 1975-2000

Volume 4: Great Lakes Region

Second National Water Assessment by the U.S. Water Resources Council

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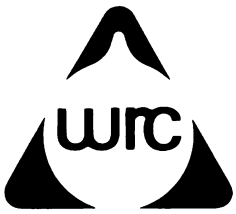

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Foreword

The Water Resources Planning Act of 1965 (Public Law 89-80) directs the U.S. Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. In 1968, the Water Resources Council reported the results of its initial assessment. The Second National Water Assessment, a decade later, provides a comprehensive nationally consistent data base for the water resources of the United States. The results of the Second National Water Assessment were obtained by extensive coordination and collaboration in three phases.

Phase I: Nationwide Analysis

The Council member agencies researched, analyzed, and prepared estimates of current and projected water requirements and problems and the implications of the estimates for the future.

Phase II: Specific Problem Analysis

Regional sponsors, one for each of the 21 water resources regions, surveyed and analyzed State and regional viewpoints about (1) current and future water problems, (2) conflicts that may arise in meeting State and regional objectives, and (3) problems and conflicts needing resolution.

Phase III: National Problem Analysis

The Council conducted this final phase in three steps: (1) An evaluation of phases I and II, (2) an analysis that identified and evaluated the Nation's most serious water resources problems, and (3) the preparation of a final report entitled "The Nation's Water Resources--1975-2000."

The final report of the Second National Water Assessment consists of four separate volumes as described below. These volumes can assist Federal, State, local, and other program managers, the Administration, and the Congress in establishing and implementing water resources policies and programs.

Volume 1, Summary, gives an overview of the Nation's water supply, water use, and critical water problems for "1975," 1985, and 2000 and summarizes significant concerns.

Volume 2, Water Quantity, Quality, and Related Land Considerations, consists of one publication with five parts:

Part I, "Introduction," outlines the origin of the Second National Water Assessment, states its purpose and scope, explains the numerous documents that are part of the assessment, and ident-

ifies the individuals and agencies that contributed to the assessment.

II, "Water-Management Problem Profiles," identifies ten general water problem issues and their implications and potential consequences.

Part III, "Water Uses," focuses on the national perspectives regarding existing ("1975") and projected (1985 and 2000) requirements for water to meet offstream, instream, and flow-management needs. State-regional and Federal perspectives are compared.

Part IV, "Water Supply and Water Quality Considerations," analyzes the adequacy of fresh-water supplies (ground and surface) to meet existing and future requirements. It contains a national water budget; quantifies surface- and ground-water supplies, reservoir storage, and transfers of water within and between subregions; describes regional requirements and compares them to supplies; evaluates water quality conditions; and discusses the legal and institutional aspects of water allocation.

Part V, "Synopses of the Water Resources Regions," covers existing conditions and future requirements for each of the 21 water resources regions. Within each regional synopsis is a discussion of functional and location-specific water-related problems; regional recommendations regarding planning, research, data, and institutional aspects of solving regional water-related problems; a problem-issue matrix; and a comparative-analysis table.

Volume 3, Analytical Data, describes the methods and procedures used to collect, analyze, and describe the data used in the assessment. National summary data are included with explanatory notes. Volume 3 is supplemented by five separately published appendixes that contain data for the regions and subregions:

Appendix I, Social, Economic, and Environmental Data, contains the socioeconomic baseline ("1975") and growth projections (1985 and 2000) on which the water-supply and water-use projections are based. This appendix presents two sets of data. One set, the National Future, represents the Federal viewpoint; the other set, the State-Regional Future, represents the regional sponsor and/or State viewpoint.

Appendix II, Annual Water Supply and Use Analysis, contains baseline water-supply data and baseline and projected water withdrawal and water-consumption data used for the assessment. Also included are a water adequacy analysis, a natural flow analysis, and a critical-month analysis.

Appendix III, Monthly Water Supply and Use Analysis, contains monthly details of the water-supply, water-withdawal, and water-

consumption data contained in Appendix II and includes an analysis of monthly water adequacy.

Appendix IV, Dry-Year Conditions Water Supply and Use Analysis, contains both annual and monthly baseline and projected water-withdrawal and water-consumption data for dry conditions. Also, a dry conditions water-adequacy analysis is included.

Appendix V, Streamflow Conditions, contains detailed background information on the derivation of the baseline streamflow information. A description of streamflow gages used, correction factors applied, periods of record, and extreme flows of record, are given for each subregion. Also included is the State-Regional Future estimate of average streamflow conditions.

Volume 4, Water Resources Regional Reports, consists of separately published reports for each of the 21 regions. Synopses of these reports are given in Volume 2, Part V.

For compiling and analyzing water resources data, the Nation has been divided into 21 major water resources regions and further subdivided into 106 subregions. Eighteen of the regions are within the conterminous United States; the other three are Alaska, Hawaii, and the Caribbean area.

The 21 water resources regions are hydrologic areas that have either the drainage area of a major river, such as the Missouri Region, or the combined drainage areas of a series of rivers, such as the South Atlantic-Gulf Region, which includes a number of southeastern States that have rivers draining directly into the Atlantic Ocean and the Gulf of Mexico.

The 106 subregions, which are smaller drainage areas, were used exclusively in the Second National Water Assessment as basic data-collection units. Subregion data point up problems that are primarily basinwide in nature. Data aggregated from the subregions portray both regional and national conditions, and also show the wide contrasts in both regional and national water sources and uses.

The Second National Water Assessment and its data base constitute a major step in the identification and definition of water resources problems by the many State, regional, and Federal institutions involved. However, much of the information in this assessment is general and broad in scope; thus, its application should be viewed in that context, particularly in the area of water quality. Further, the information reflects areas of deficiencies in availability and reliability of data. For these reasons, State, regional, and Federal planners should view the information as indicative, and not the only source to be considered. When policy decisions are to be made, the effects at State, regional, and local levels should be carefully considered.

In a national study it is difficult to reflect completely the regional variations within the national aggregation. For example, several regional

reviewers did not agree with the national projections made for their regions. These disagreements can be largely attributed either to different assumptions by the regional reviewers or to lack of representation of the national data at the regional level. Therefore, any regional or State resources-management planning effort should consider the State-regional reports developed during phase II and summarized in Volume 4 as well as the nationally consistent data base and the other information presented in this assessment.

Additional years of information and experience show that considerable change has occurred since the first assessment was prepared in 1968. The population has not grown at the rate anticipated, and the projections of future water requirements for this second assessment are considerably lower than those made for the first assessment. Also, greater awareness of environmental values, water quality, ground-water overdraft, limitations of available water supplies, and energy concerns are having a dramatic effect on water-resources management. Conservation, reuse, recycling, and weather modification are considerations toward making better use of, or expanding, available supplies.

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Illustrations

Physiography

Description

The Great Lakes Region encompasses the drainage basin of the U.S. portions of Lakes Superior, Michigan, Huron, Erie, and Ontario, and part of the St. Lawrence River on the United States side of the border with Canada (Figure 4-1). The region encompasses an area of approximately 134,173 square miles,[1] including land and water areas, and includes parts of the States of Illinois (3 percent of the region), Indiana (4 percent), Michigan (43 percent), Minnesota (8 percent), New York (17 percent), Ohio (9 percent), Pennsylvania (1 percent), and Wisconsin (15 percent). About 3,947 square miles of this area is water surface[2].

The land area of the entire Great Lakes Basin comprises approximately 4 percent of the land area in the 48 contiguous United States, but it supports 14 percent of the population and contributes a much larger percentage of the country's economic activities. Half the steel production capacity of the Nation and a large proportion of petroleum refining capacity and manufacturing facilities for chemical and food products are located in the region.

In the east-central part of the North American continent, the United States-Canadian boundary passes through four of the five Great Lakes, leaving only Lake Michigan entirely within the United States. The land of the Great Lakes Region is covered primarily by forests in the north and by agricultural and urban areas in the east and south. Lands in the central part of the region consist of an intermingling of grasslands, forestlands, agricultural, and urban areas, as indicated in Figure 4-2.

Geology

The present Great Lakes are largely the result of thousands of years of glacial advance and retreat that scoured and gouged the land, left thick deposits of glacial material, and ultimately formed the drainage systems of the five lakes as they exist today. The Great Lakes Basin lies principally within two major physiographic provinces--the Superior Upland and the Central Lowland areas. Small parts of the basin in New York and along the south side of Lake Erie lie in the St. Lawrence Valley. The Superior Upland consists of glaciated peneplain whose base is mostly crystalline rock. The Central Lowland is characterized by a generally flat lowland and lacustrine plain. The southeast border of the basin is formed by the southern New York and Mohawk sections of the Appalachian Plateaus Province. The area is a maturely dissected and glaciated plateau of varied relief and prominent escarpments.

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[1] This is the sum of the areas of counties used to approximate the hydrologic area of the region. Land-use and other socioeconomic data are related to this area. The drainage area within the hydrologic boundary is 113,760 square miles.

[2] This water area does not include any part of the Great Lakes.

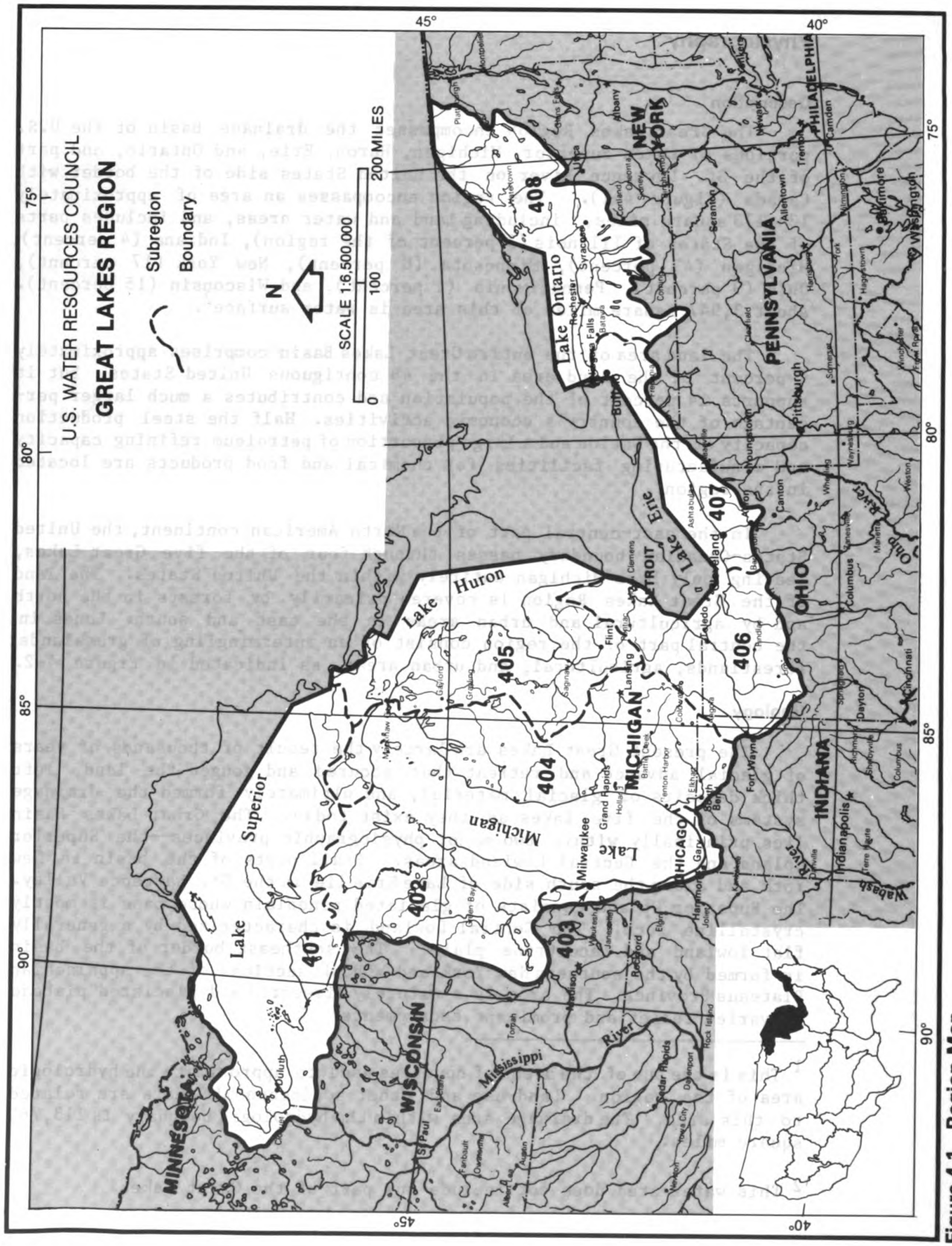


Figure 4-1. Region Map

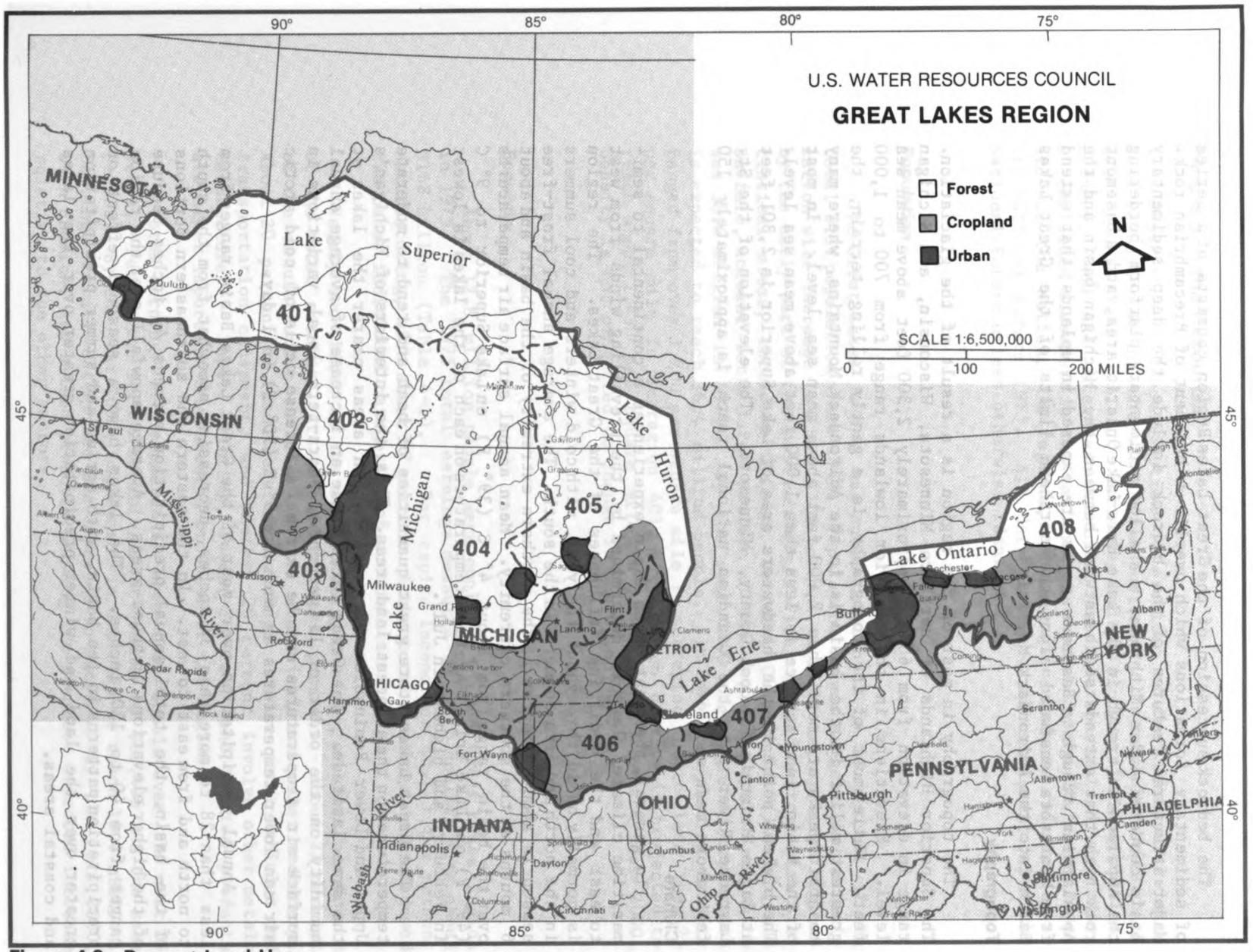
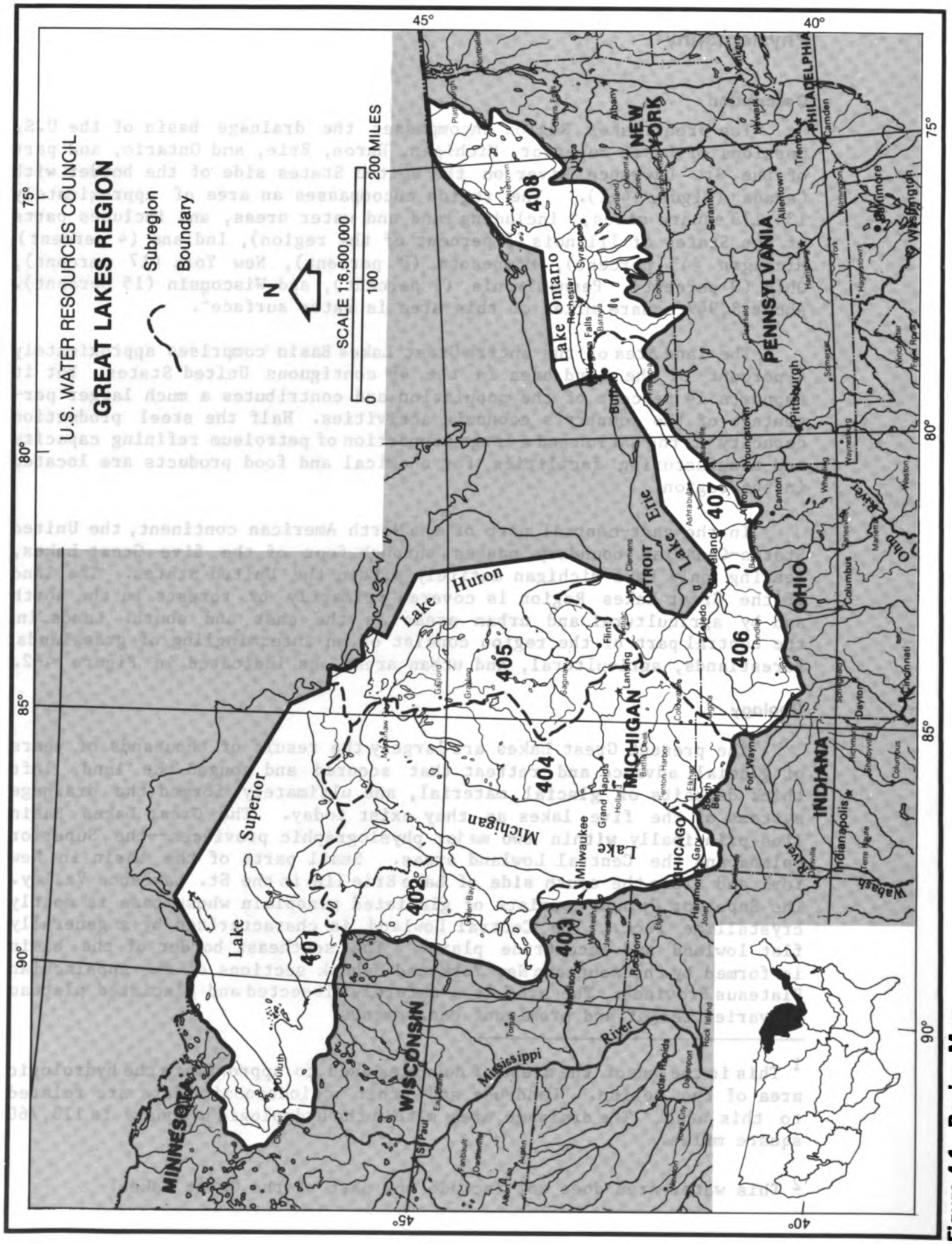


Figure 4-2. Present Land Use



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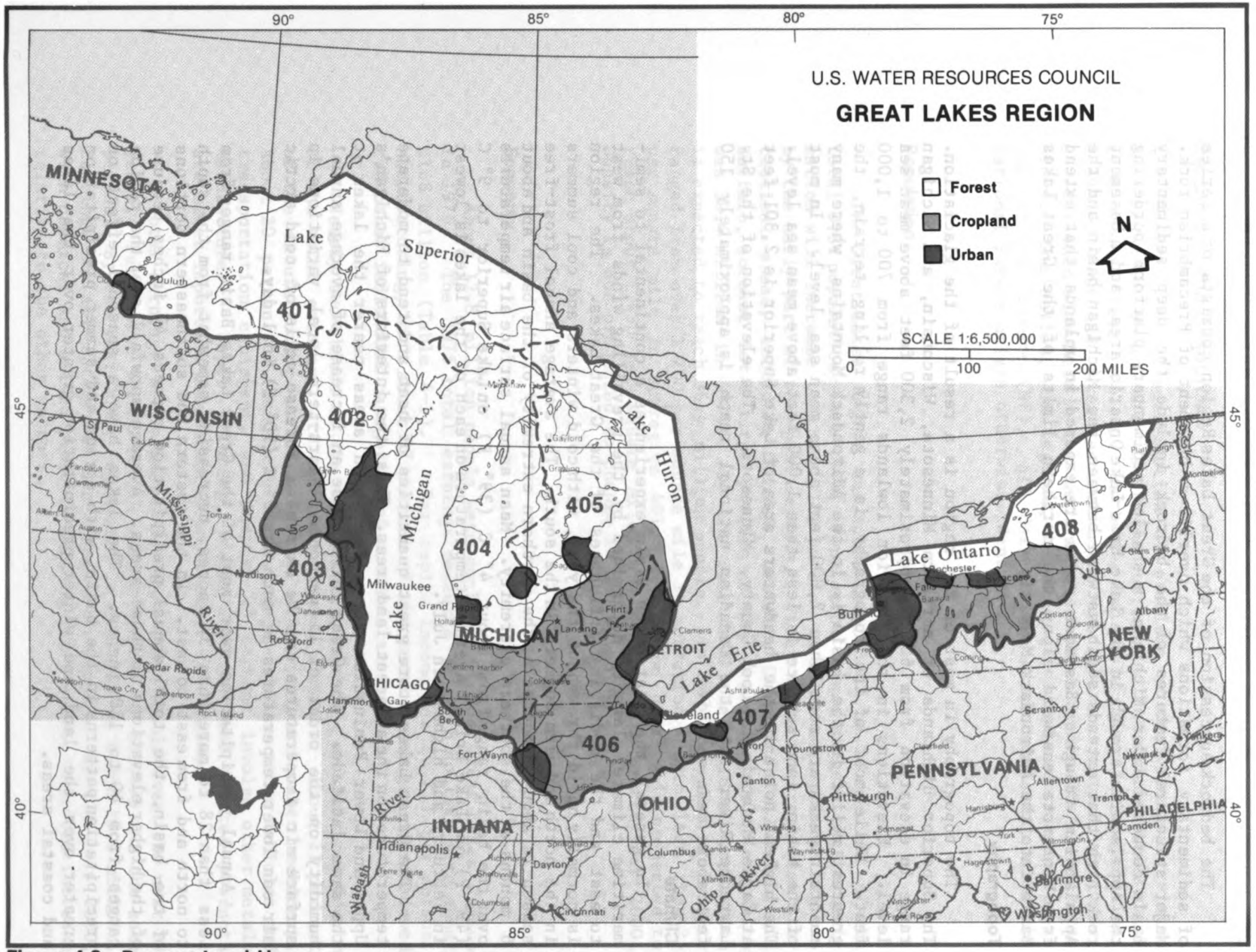


Figure 4-2. Present Land Use

The bedrock succession of the Great Lakes Region consists of a series of sedimentary formations which overlie a basement of Precambrian rock. Major structural features of the bedrock include the deep sedimentary basin centered under Michigan, a shallow sedimentary platform bordering the Appalachian trough in the Lake Erie-Lake Ontario area, and a basement rock high that extends southeastward between the Michigan basin and the Appalachian trough. Basement rocks are exposed in uplands that extend from Minnesota eastward along the northern limits of the Great Lakes Basin into the Adirondack Mountains.

Topography

The topography in most of the region is a result of the glaciation. The Superior Highlands of northern Minnesota, Wisconsin, and Michigan range in elevation from 600 to approximately 2,300 feet above mean sea level. Elevations in the interior lowlands range from 700 to 1,000 feet. While most of the topography is a gently rolling terrain, the greatest relief in the basin is in the Adirondack Mountains, where many mountain peaks are more than 2,000 feet above mean sea level. In most of the basin, land surface is less than 1,000 feet above mean sea level. The highest point in the headwaters area of Lake Superior is 2,301 feet at Eagle Mountain in Cook County, Minnesota. The elevation of the St. Lawrence River into the Canadian national reach is approximately 150 feet above mean sea level.

Climate

In general, the Great Lakes Basin experiences a continental to semi-maritime climate, largely determined by the prevailing winds from west to east and the modifying influences of the Great Lakes. The region is normally humid throughout the year, with cold winters and cool summers in the north and warm summers in the south. The average annual frost-free season is about 4 months at the northern extremity of the basin and about 6 months at the southern extremity. Mean annual surface air temperatures over the basin range from about 4° C (39° F) on Lake Superior to 9° C (49° F) on Lake Erie. Average temperature on each of the lakes is lowest in February and highest in July.

The Great Lakes store great quantities of heat and tend to moderate temperatures on the adjacent land areas. Thus, the interiors of Michigan's Upper and Lower Peninsulas are colder than areas nearer the lakes at the same latitude. The Great Lakes cause an increase of average annual humidity on the order of 15 percent. Short-term local variations in surface air temperatures can be extreme. Intense cells of cold arctic air can lower temperatures as much as 10° C (50° F) in 1 day.

Annual precipitation over most of the Great Lakes Basin ranges from less than 28 to more than 37 inches, decreasing somewhat from the south to north and from east to west. In the eastern and southeastern portions of the basin, the total annual precipitation exceeds 47 inches because of the higher elevations in those areas. Average snowfall over the region ranges from 40 to 120 inches. The lakes have a seasonal effect on precipitation patterns in the basin, with spring and summer precipitation greater over the land and winter precipitation greater over the lakes and coastal areas.

People and the Resources

Basic to any identification of problems of the water and related land resources is an analysis of the current and future activities which give rise to these problems. Estimates and projections of the population, economy, land and water-resource uses, and other parameters were made, as explained elsewhere in the national assessment report. These estimates are for the Nation, the regions, and subregions and are referred to as the National Future (NF). All data presented are consistent with the National Future unless otherwise identified.

Population

The Great Lakes Region has accounted for 14 to 15 percent of the total U.S. population since 1940. Population trends suggest that urbanization will increase to almost 100 percent in major metropolitan regions by the early part of the next century. Five standard metropolitan statistical areas, including Chicago, Detroit, Cleveland, Milwaukee, and Buffalo, account for a large portion of the regional population, which was 30.4 million in 1975. By the year 2000 the regional population is expected to reach 36.4 million people. In 1975, population density ranged from over 1,200 per square mile in subregion 403 to less than 25 per square mile in subregion 401. Population density is projected to reach about 1,450 per square mile in subregion 403 by the year 2000. Density is not projected to change in subregion 401.

Economy

About 12.8 million people were employed in the Great Lakes Region in 1975. The 1975 total earnings measured in 1975 dollars were about $168 billion (Table 4-1). Per capita income was $6,773 per person. Manufacturing, with about 37 percent of the total earnings, overshadowed the other individual categories of economic activity.

Nearly two-thirds of the manufacturing earnings, or about one-fourth of the total earnings, are related to metal products. About 22 percent of the manufacturing earnings involve electrical and other machinery. About 20 percent of manufacturing earnings involve motor vehicles and transportation equipment, and another 20 percent involve other metals manufacture. Paper, printing, foods, chemical, and related products are other important manufactured products of the region.

Total earnings are expected to more than double over the next 25 years. Per capita income should almost double to $13,495 in the same period. By the year 2000, employment is expected to reach 16.6 million. Earnings in all categories are expected to increase by the year 2000, with chemical and allied products showing the greatest expected increase relative to the other sectors.

Table 4-1.--Great Lakes Region earnings--1975, 1985, 2000
(million 1975 dollars)

Earnings sector	1975	1985	2000
Manufacturing	62,655	85,076	126,510
Agriculture	2,044	1,980	2,255
Mining	573	661	797
Other	102,553	150,923	257,423
Total	167,825	238,640	386,985

Natural Resources

No other area of the United States has the unique combination of agricultural and forestlands, minerals, and water resources that is found in the Great Lakes Region. Over one-third of the region is used for cropland and other agricultural purposes. Nearly half of the region is classified as forestland (Table 4-2). Most of the forest cover has been reestablished by natural regeneration and forest management. Minerals are the foundation of the heavy industry that has developed in the Great Lakes Region. Virtually all of the metallic minerals, including iron, zinc, lead, silver, and copper, are found in the northwest and extreme eastern parts of the basin. Mineral fuels including oil and gas, and nonmetallics including limestone, dolomite, sandstone, shales, salt, gypsum, and natural brines, are found in lower Michigan, Ohio, Illinois, Indiana, and New York. Sand, gravel, clay, marl, and peat are generally found throughout the region. Only a small amount of coal is in the area, but in adjacent regions there are many large coal-mining operations, the output of which affects the economy of the region. Agriculture is conducted throughout all land areas of the region.

Table 4-2.--Great Lakes Region surface area and 1975 land use

Surface area or land use type	1,000 acres	Percentage of total surface area
Surface area		
Total	85,871	100
Water[1]	2,526	2.9
Land	83,345	97.1
Land use		
Cropland	24,907	29.0
Pasture and range	3,358	3.9
Forest and woodland	39,152	45.6
Other agriculture	4,778	5.6
Urban	4,333	5.0
Other	6,817	8.0

[1]Water surface area excludes the Great Lakes.

Agriculture

Between 1975 and 2000, total cropland is expected to increase from 24.9 million acres to 25.4 million acres. Irrigated farmland is not now a significant portion of the agricultural farmland, nor is it projected to be in the future (Table 4-3). Feed and food crops predominate among the major agricultural land-use categories, followed by grazed forest and woodland, other crops, pasture, and rangeland.

Table 4-3.--Projected changes in cropland and irrigated farmland in the Great Lakes Region--1975, 1985, 2000
(1,000 acres)

Land category	1975	1985	2000
Total cropland----------	24,907	25,357	25,365
Cropland harvested---------	18,700	21,056	24,034
Irrigated farmland---------	164	243	334

Energy

The electric power expected to be generated annually by the year 2000 for the Great Lakes Region is about 843,000 gigawatt-hours (gWh) as compared to about 209,000 in 1975 (a gigawatt hour equals 1 billion watts per hour). Generation of electricity in the Great Lakes Region currently is primarily from steam plants using coal and gas as fuel. Hydroelectric plants also contribute significantly to the power supply (25,851 gWh in 1975); however, this is projected to decrease (to 20,684 gWh) by 2000. There are numerous small diesel plants, but these account for only a small fraction of the total energy supply. According to the NF, nuclear powerplants are projected to increase significantly between 1975 and 2000 and to become the predominant mode for electrical energy generation in the Great Lakes Region by 2000 (Table 4-4). Regional sources, however, do not forecast such a large dependence on nuclear power generation. Most of the fossil fuels that are consumed in the Great Lakes Region must be imported.

Table 4-4.--Great Lakes Region electric power generation--1975, 1985, 2000
(gigawatt-hours)

Fuel source	1975	1985	2000
Fossil----------	147,857	155,765	186,118
Nuclear----------	35,135	197,635	635,044
Conventional hydroelectric power--	25,851	20,684	20,684
Total generation ----------	208,843	374,084	841,846

Navigation

The Great Lakes' water surface is the world's largest surface body of fresh water. The five lakes and their connecting waterways and channels form a water highway 2,342 miles long, from the heart of the North American continent to the Atlantic Ocean. Of this, 1,270 miles are within the Great Lakes. The remainder is along the St. Lawrence River.

The major port areas of the Great Lakes are the Duluth-Superior Harbor and the ports of Chicago, Milwaukee, Detroit, Toledo, Cleveland, and Buffalo (Figure 4-3). Major waterborne commodities include iron ore, coal, steel, agricultural grains and cereals, as well as finished products. The United States portion of the Great Lakes Navigation System transported over 340 million tons of freight in 1970. This amount is projected to more than double by the year 2000. Five percent of the Nation's overseas general cargo exports are now being transported via the Great Lakes-St. Lawrence Seaway Navigation System. Constraints exist at the Welland Canal and Sault St. Marie. Therefore, improved facilities will be required to accommodate potential traffic, which is essential to the economic health of the region and the United States.

Environment

The varied and irregular topography of the basin offers a broad spectrum of diverse and significant features. Its thousands of natural lakes and streams and the five Great Lakes have served as a backdrop for important historical and cultural events and have provided outstanding recreational opportunities to the inhabitants of the region and adjacent areas. The northern portions of the Great Lakes, with their expansive forests, pristine lakes, and major scenic features, provide one of the Nation's outstanding environmental resources. In areas of the lower lakes, such as Presque Isle, the many small recreation harbors, inland lakes, and ponds offer a variety of outdoor experiences including boating, camping, hiking, fishing, and picnicking. In the eastern reaches of the basin, outstanding environmental amenities include the Adirondack park system in New York, the scenic shoreline areas along Lake Ontario, and excellent fishing and hiking areas throughout the many valleys, gorges, and rivers ranging from the eastern portions of Ohio to the upper portions of New York State (Figure 4-4).

Historic sites abound throughout the Great Lakes, varying from Indian settlements to space-age technological centers. The Great Lakes Region has excellent cultural and educational facilities that have gained world reknown. There are eight major national and State forests and numerous scenic rivers throughout the Great Lakes Region. An estimated 327 million instances of water-related recreation-activity occasions occurred in 1975. This demand is projected to be 366 million in 1985 and 434 million in 2000. In addition, demand for recreation boating and sport fishing is also expected to increase significantly in the future. At the current time, demand for recreation opportunities is outpacing the development of available facilities to meet this demand.

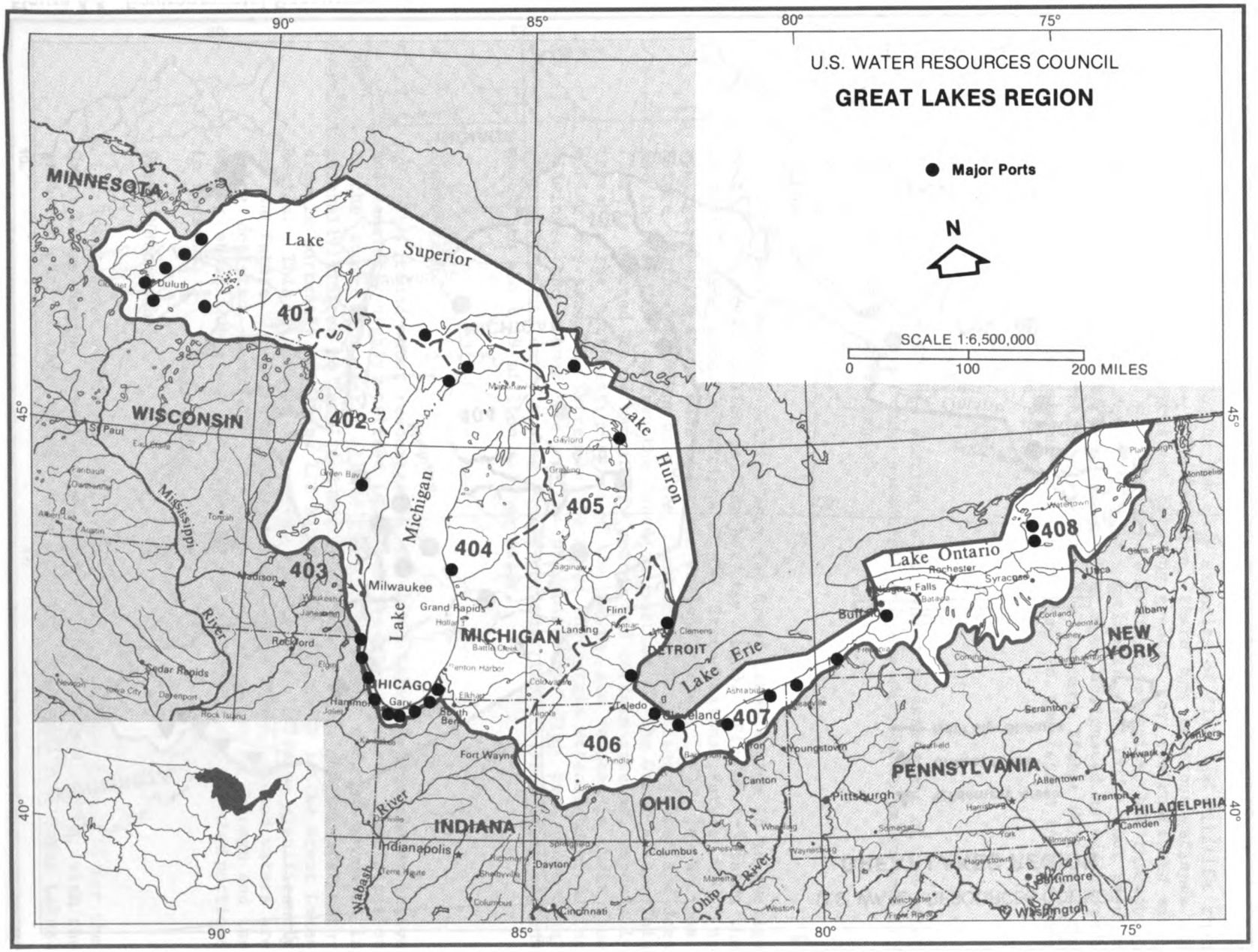


Figure 4-3. Navigation System

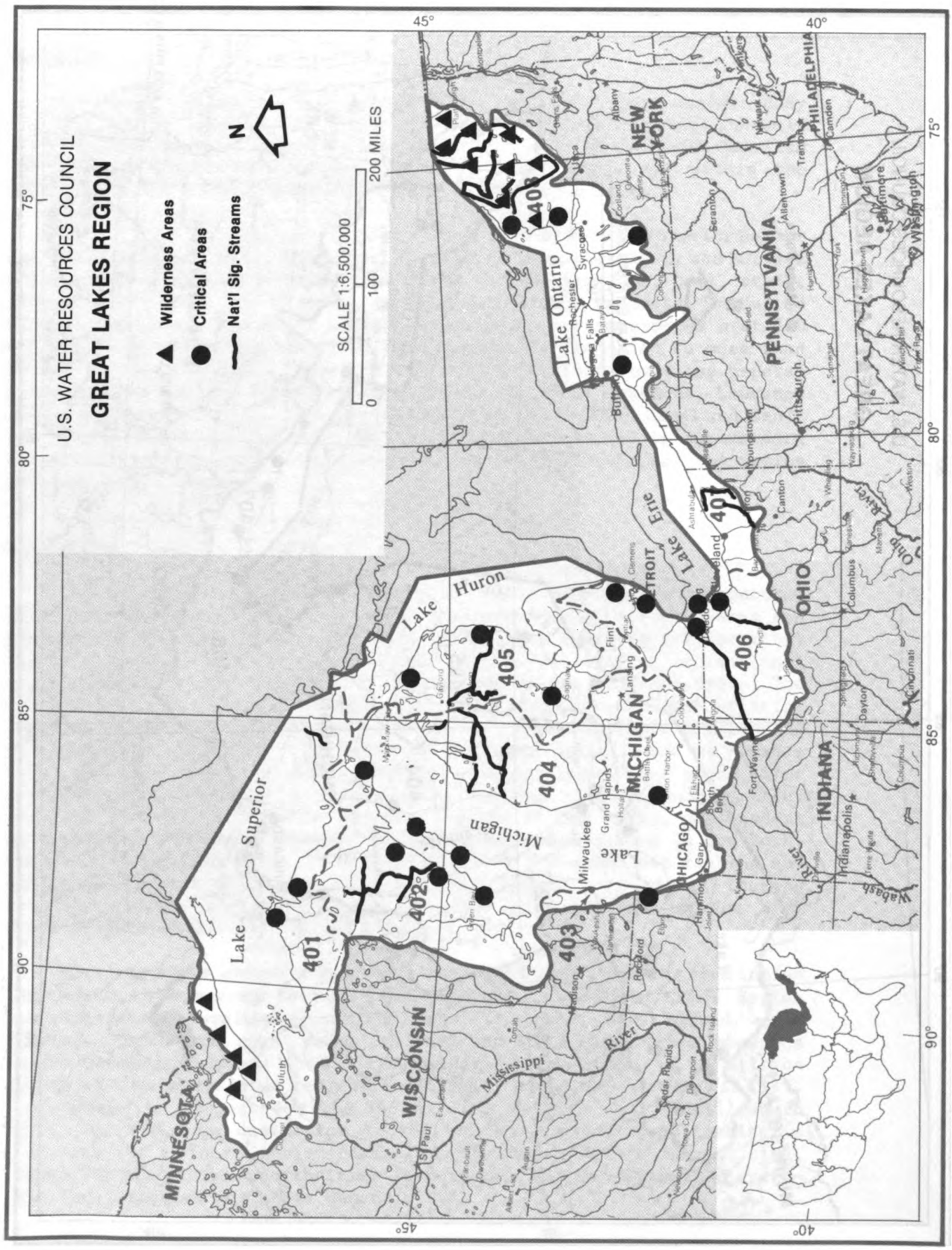


Figure 4-4. Environmental Resources

The Great Lakes Region has many examples of fish and wildlife that are unusual or unique. In addition, there are numerous wetlands and places that provide excellent breeding grounds for the continued maintenance of wildlife and waterfowl, not only in this region, but throughout many portions of the North American continent. In 1975, four species of wildlife indigenous to the region had been designated as endangered: the Kirtland Warbler, the Indiana Bat, the Eastern Timber Wolf, and the Eastern Cougar. Endangered species of fish in the region include Long Jaw Cisco and the Blue Pike.

Water

The purpose of this section is to present an assessment of the water situation and current and potential problems related to water and its use in the Great Lakes Region.

Surface Flows

The total surface outflow from the Great Lakes Region in an average year is almost 73 billion gallons per day (bgd). Figure 4-5 shows the estimates made under conditions of the State-Regional Future (SRF) as contrasted with those made under the National Future (NF). The National Future outflow includes only the flow from the United States and does not include the flow from the Canadian portion of the Great Lakes. This flow is reduced to 57 bgd in dry years, and certain streams, especially those in the northwest portion of the basin, are reduced in their flow during dry seasons. Extremely low flows in certain streams occur during midwinter and summer due to low precipitation. High peak flows occur generally in the early spring runoff periods. Imports from other regions amount to about 19 million gallons daily.

Ground Water

The ground-water resources in the Great Lakes Region are extensive and generally highly utilized in many of the urban regions. Precipitation is the source for nearly all of the ground water, and its movement is generally limited to localized aquifers (Figure 4-6). Ground water withdrawals currently amount to 1.2 billion gallons daily in the Great Lakes Region. This withdrawal rate is not projected to increase significantly in the future. In certain areas of the Great Lakes, ground waters are being depleted, especially in highly urbanized areas of Chicago and the nearby shoreline areas of Illinois and Wisconsin, and selected portions in Indiana.

Water Withdrawals

Total water withdrawn from streams and ground water in 1975 for the Great Lakes Region averaged about 43 billion gallons daily, with the greatest part of this being drawn directly from the five Great Lakes.

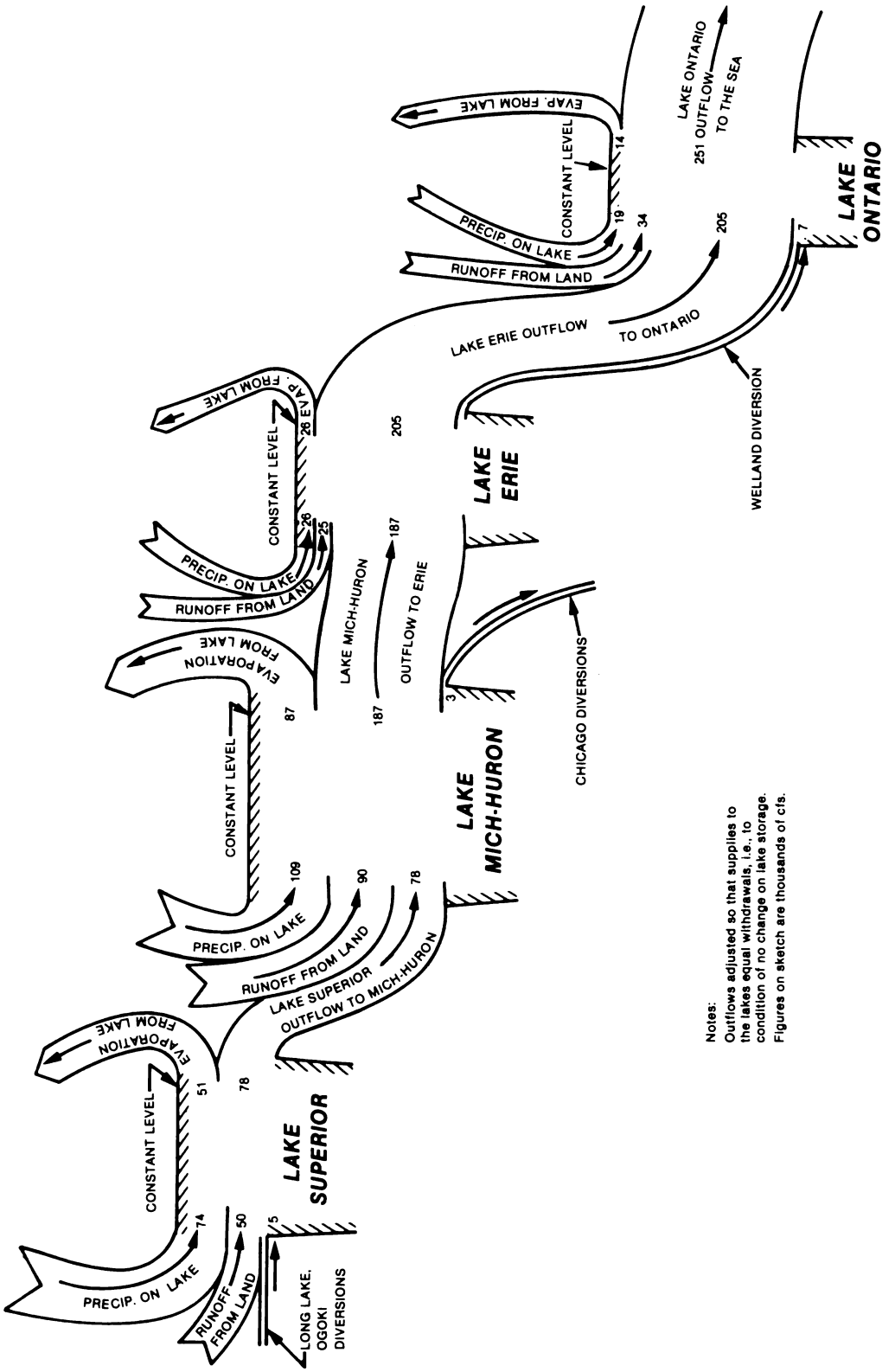


Figure 4-5. Streamflow

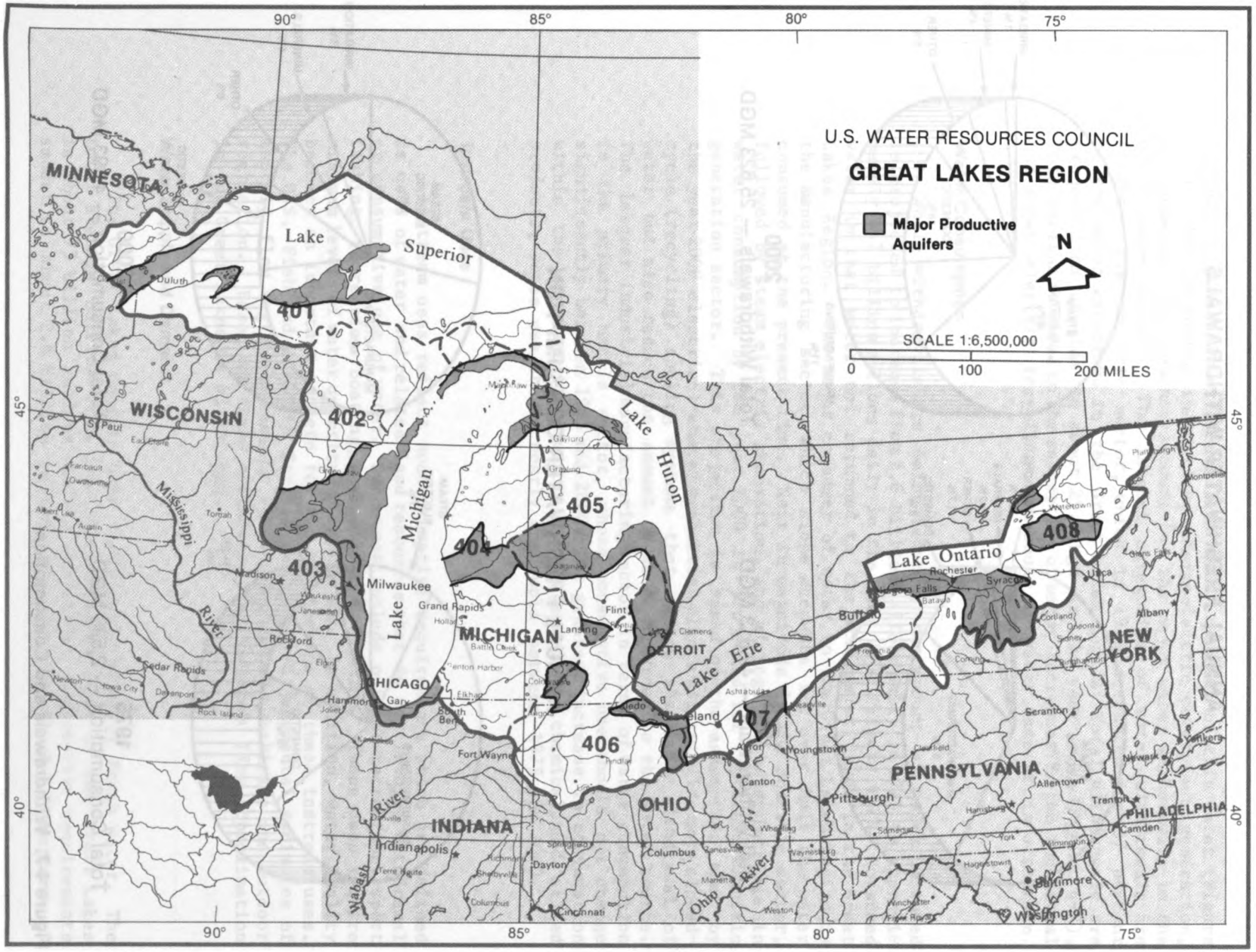
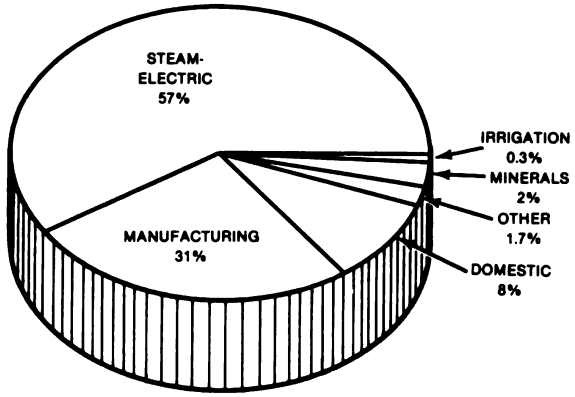
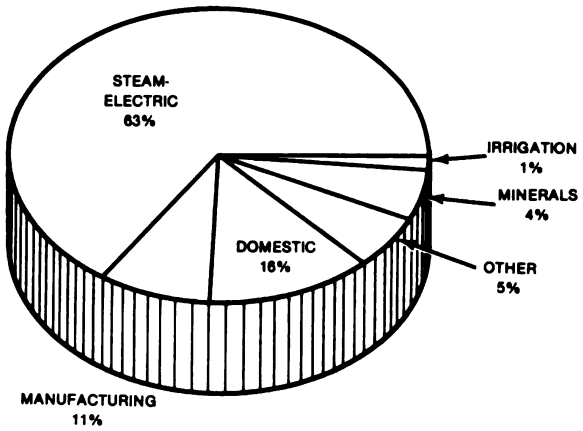


Figure 4-6. Major Aquifers

ANNUAL FRESHWATER WITHDRAWALS

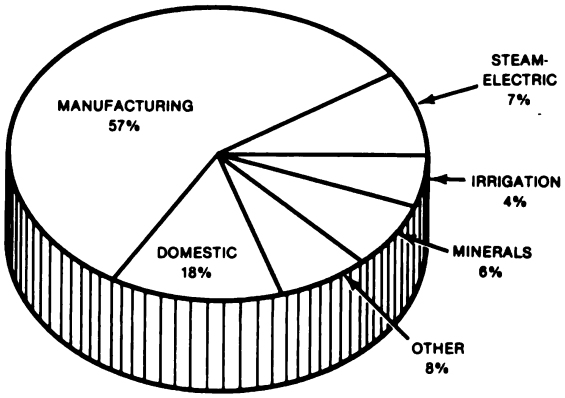


1975
Total Withdrawals — 42,813 MGD

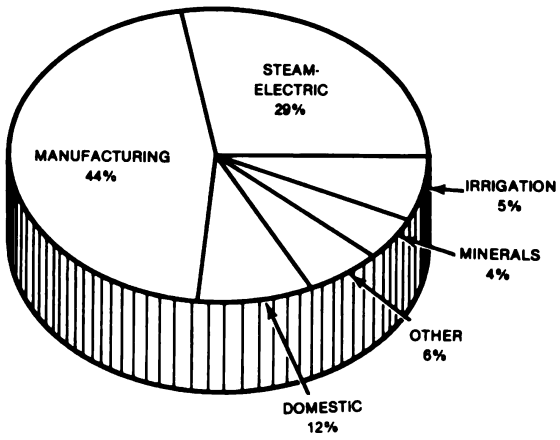


2000
Total Withdrawals — 25,623 MGD

ANNUAL FRESHWATER CONSUMPTION



1975
Total Consumption — 2,598 MGD



2000
Total Consumption — 4,693 MGD

Figure 4-7. Withdrawals and Consumption

Irrigation presently withdraws less than 1 percent of this water (Figure 4-7). Manufacturing industries, thermoelectric powerplant generation, and domestic requirements account for the major water withdrawals in the Great Lakes Region. The largest categories of water withdrawals are in the steam electric sector, which in 1975 accounted for 57 percent of the water withdrawn in the Great Lakes Region. Total withdrawals are projected to decline to about 25.6 bgd in the year 2000 (Figure 4-7). This decline is based on the assumption of major increases in the industrial and steam electric recycling and reuse of water once it is withdrawn.

Water Consumption

While withdrawals are being reduced, the amount of water consumed is projected to increase from 2.6 billion gallons daily in 1975 to approximately 4.7 billion gallons daily in the year 2000 (Figure 4-7). Consumed water is that water not returned to the streams or lakes in the Great Lakes Region. The major consumer of water in the Great Lakes Region is the manufacturing sector, which alone accounts for over half the water consumed at the present time. Next in magnitude is the domestic sector, followed by steam electric generation, and mining. The major increase in water consumption by the year 2000 is projected for the steam electric generation sector. This projection is based on the assumption that by the year 2000 electrical-energy generating plants will utilize more closed-cycle (recycling) cooling systems that reduce the daily withdrawal of water but also reduce the amount of water returned to the water source. The largest industrial manufacturing sector in terms of water consumption is the primary metals sector, whose consumptive use should not change significantly between 1975 and 2000. The greatest increase in consumption within the manufacturing sector is projected for chemical and allied products, whose use should nearly quadruple between 1975 and 2000.

Instream Uses

Instream uses reflect nonconsumptive requirements which are defined as uses of water and related land resources that do not involve withdrawal or consumptive use of water. Such uses include outdoor recreation, sport fishing, recreation boating, and wildlife habitat. These uses require minimum levels of water quantity or streamflow. In addition, water quality becomes an important concern for the maintenance of these instream uses. The U.S. Fish and Wildlife Service has prepared judgmental estimates of monthly flow regimes necessary to support aquatic habitats and outdoor recreation. Based on these estimates, the instream flow approximation in the Great Lakes is 63,951 mgd.

Water Supply and Demand

The Great Lakes contain over 5,413 cubic miles of fresh water. The total average outflow from the United States side of the Great Lakes is about 73 billion gallons daily. Currently, consumptive requirements amount to about 2.6 billion gallons per day, or about 3.5 percent of

the total flow into the Great Lakes. Because future withdrawals are projected to decrease significantly due to reuse, water resource supplies in the Great Lakes Region appear to be adequate to meet future water demands by the year 2000.

Nonetheless, certain inland portions of the Great Lakes drainage basin have experienced significant water shortages in streams and aquifers, particularly in northern portions of Michigan and localities throughout Wisconsin and Minnesota. These localized problems can be severe to the inhabitants of those areas. Competition for use of available water supplies is great in areas where the basin's waters are used for both drinking water and waste discharges. Although the region overall is blessed with an abundance of water, conservation programs and conjunctive use strategies will be required to insure proper management of the water resources of the basin.

Comparative Analysis

Table 4-5 presents the National Future (NF) estimates of streamflows and water needs in the Great Lakes Region.

The Great Lakes Basin Commission adopted the position that the nationally generated, National Future data describing socioeconomic changes, volumetric data for withdrawal and consumptive use, and water supply information would be acceptable as the State-Regional Future data for the Great Lakes Region. For those categories where NF data were not available, information was taken from the Great Lakes Basin Framework Study. The use of the National Future data does not imply full review and acceptance; rather it reflects the lack of State information on a subregion basis.

Table 4-5.--Socioeconomic and volumetric data summary: the Great Lakes Region

Category	1975		1985		2000	
	NF	SRF[a]	NF	SRF[a]	NF	SRF[a]
SOCIOECONOMIC DATA (1000)						
Total population	30,391	30,391	32,855	32,855	36,351	36,351
Total employment	12,796	12,796	14,446	14,446	16,583	16,583
VOLUMETRIC DATA (mgd)						
-Base conditions-						
Total streamflow	75,281	NE	75,281	NE	75,281	NE
Streamflow at outflow point(s)	72,710	72,710	71,981	NE	70,588	NE
Fresh-water withdrawals	42,813	42,813	32,666	32,666	25,623	25,623
Agriculture	230	230	296	296	369	369
Steam electric	24,362	24,362	22,689	22,689	16,061	16,061
Manufacturing	13,220	13,220	4,106	4,106	2,821	2,821
Domestic	3,267	3,267	3,614	3,614	4,077	4,077
Commercial	1,010	1,010	1,091	1,091	1,206	1,206
Minerals	696	696	831	831	1,044	1,044
Public lands	6	6	13	13	17	17
Fish hatcheries	22	22	26	26	28	28
Other	0	0	0	0	0	0
Fresh-water consumption	2,598	2,598	3,300	3,300	4,693	4,693
Agriculture	199	199	254	254	319	319
Steam electric	175	175	497	497	1,384	1,384
Manufacturing	1,474	1,474	1,719	1,719	2,059	2,059
Domestic	476	476	519	519	563	563
Commercial	113	113	123	123	140	140
Minerals	155	155	175	175	211	211
Public lands	6	6	13	13	17	17
Fish hatcheries	0	0	0	0	0	0
Other	0	0	0	0	0	0
Ground-water withdrawals	1,215	1,215	NE	NE	NE	NE
Evaporation	0	0	0	0	0	0
Instream approximation						
Fish and wildlife	63,951	63,951	63,951	63,951	63,951	63,951

NE - Not estimated.

[a] The Great Lakes Basin Commission accepted the National Future as the State-Regional Future for use in the national assessment because of the lack of State data on a subregion basis.

Problems

The major water resources problems and issues in the Great Lakes Basin are water pollution, erosion and sedimentation, flooding, and other water quality concerns.

Pollution

The most critical regional problem is that of water-quality degradation of the near-shore zone of the Great Lakes (especially near urbanized areas) and of rivers and intensely developed inland lakes. Major causes of poor water quality are: (1) municipal and industrial point source pollution; (2) extensive agricultural operations resulting in nonpoint source pollution; (3) construction and large earth-moving activities and other sources of urban runoff; and (4) recreation, boating, and navigation activities on and near inland lakes.

The most serious types of Great Lakes related pollution are: (1) toxic substances which are carried through the food chain and accumulated in fish; and (2) nutrient enrichment (especially from phosphorus loadings), which results in accelerated eutrophication and unpleasant visual, odor, and taste aspects.

Toxic substances polluting the waters in the region include heavy metals (mercury, chromium, copper, zinc, lead, and cadmium), arsenic, pesticides, petroleum products, phenols, chloroform, cyanide compounds, PCB's, and other industrial chemicals. Although concentrations in the water itself are not critical, many of these substances--particularly lead, mercury, cadmium, PCB's, and certain pesticides--accumulate and persist in the Great Lakes food chain. The result is the potential for dangerous concentrations of toxic substances in humans whose diet includes contaminated fish.

Indicators of deteriorating quality of the Great Lakes include significant increases in total dissolved solids (calcium, sodium, sulfate, and chlorides), low dissolved oxygen levels in some instances, reduction in quality and diversity of fish species, and overabundances of aquatic plant nuisances in localized areas. The most serious problems have occurred in Lakes Erie and Ontario, although problems have also occurred in localized areas of the other Great Lakes as well--the near-shore waters of southern Lake Michigan, Green Bay, Saginaw Bay, and the Duluth-Superior harbor area.

Thermal pollution, or heat given off by power generation and industrial cooling, is a problem in certain localized areas. Heated discharges do benefit warm water fish species but may help to stimulate growth of algae in seasons where normal growth may be limited. As the number of power generating facilities and industrial facilities increases in the future, thermal pollution will probably become a more significant water-quality issue requiring attention. Trends towards closed-cycle cooling could reduce thermal pollution of the water to a major extent.

The implementation of Federal and State laws and programs addressed to improvements in water quality should resolve many of these water quality problems. Improvements have been accepted as part of the future projections made for this study. Failure to achieve these improvements could allow water quality problems of major consequence to continue and further intensify in the Great Lakes Region.

Erosion and Sedimentation

Three types of erosion problems exist throughout much of the Great Lakes Region: shoreline, stream-bank, and land-surface (sheet, rill, and gully) erosion.

According to the United States Army Corps of Engineers, about 1,200 miles of the total 3,470 miles of U.S. Great Lakes shoreline are undergoing significant erosion. Over 200 miles of shoreline are critically eroding, resulting in severe property damage. Great Lakes shoreline erosion is most often caused by wave action which is aggravated during high lake levels. Steep shoreline slopes and sometimes easily erodible soils, such as the clay bluffs along parts of the Lake Superior shoreline in northwestern Wisconsin, compound the problem.

The U.S. Great Lakes shoreline erosion is estimated to annually contribute about 400 million metric tons of mostly sedimentary material to the near-shore waters, or about nine times the sediment from land-surface erosion (based on preliminary Pollution from Land-Use Activities Reference Group estimates of sediment contributed by United States tributaries as a result of sheet and gully erosion). In an average year, U.S. Great Lakes shoreline erosion contributes approximately 9,000 metric tons of total phosphorus, or roughly the same as that contributed from land-surface erosion to the Great Lakes. However, the relative proportion of available phosphorus from shoreline erosion may be less than that available from land-surface erosion. Property damages to the total U.S. Great Lakes shoreline were estimated by the U.S. Army Corps of Engineers for the 1951-52 period of high lake levels to be $61 million (or $168 million in 1973 dollars). The Corps has been conducting another shoreland damage survey of high lake levels since 1972. Based on pilot studies in 11 of 83 counties, a very rough estimate of $430 million (1976 dollars) in damages has been determined. The referenced study will probably be completed in 1979. Updated damage figures are expected to be included upon completion of the study. Stream-bank erosion has resulted from both natural processes and human activity. The severity depends on the stream-bank slope, type of soil, and intensity of activity on or near the stream bank. Average annual damages from stream-bank erosion in the U.S. Great Lakes Basin were estimated at $1.7 million in 1970.

Sheet, rill, and gully erosion rates on the land areas of the basin, critical in localized areas, have been compounded by construction and other large earth-moving activities and runoff from agricultural lands. Sediment entering the Great Lakes from rivers and streams is associated with nutrients and other pollutants, further complicating water quality problems.

Flooding

Flooding is a problem throughout the Great Lakes Region, affecting both urban and agricultural interests. The Great Lakes Region has experienced an annual average dollar damage of $79 million in flood loss for urban areas and about $20 million in agricultural damages (1970 conditions at 1975 prices). If past practices regarding flood-plain regulations and structural measures continue, damages are expected to increase for both urban and agricultural areas. By the year 2000, urban annual average flood damages are projected to increase to $111 million (1975 dollars), and agricultural flood damages are projected to increase to $24 million (1975 dollars). Flooding problems are caused primarily by two major factors: storm surges on the lakes themselves, especially during periods of high lake levels, and extreme storm events on the inland areas that increase stream runoff flows. Flood damages, however, in terms of the economic loss are historically related to the increased development of flood-prone areas. Unless flood-proofing measures or locational changes of facilities are undertaken, the average annual damages due to flooding will continue to increase.

Water Quantity

The results of the volumetric analysis for the Great Lakes Region indicate a generally adequate supply of fresh surface water to support aquatic habitats and human activities over the next 25 years. However, in certain locations, especially in portions of Illinois, ground-water resources are becoming severely limited. In addition, drought conditions along portions of Michigan's northern peninsula and in areas of Minnesota and Wisconsin have produced severe strains on localized water resources, both ground-water and surface-water supplies. Drought conditions, where severe, affect aquatic habitats and economic activities such as agriculture and industry.

Low Lake Levels

Although the Great Lakes have in recent years experienced relatively high lake levels, fluctuations in lake levels are yearly and multiple-year phenomena.

During low lake levels, problems can be expected with maintaining adequate power production in areas where hydroelectric power is an important source of energy, such as in the Buffalo and Massena areas. During periods of lower lake levels, navigation channels may have inadequate flows, disrupting navigation, especially commercial navigation, or causing ships to move at lesser drafts. Fluctuating water levels in some Great Lakes channels and harbors may not provide adequate overhead clearance for freighters and barges.

Declines in lake levels may also disrupt near-shore aquatic systems, producing serious environmental degradation to wetlands and marshes.

Water Surface

The Great Lakes Region is blessed with vast expanses of water surfaces, both in the five Great Lakes and in the many inland small lakes and rivers. Yet there is an increasing problem of public access to these water areas: access to the lakes and to inland waters has been limited by shoreline developments. The significant expansion in public demand for water-oriented outdoor recreation activities has placed greater strain on existing facilities. Many areas of the lakes experience overcrowded conditions, hazardous congestion of boaters, swimmers, and fishermen. In particular areas, expansion in safety and maintenance programs are vitally needed to ensure that, if this increased demand for outdoor recreation is to be met, it can be done in a safe and satisfactory manner.

River Basin Management

The Great Lakes Region contains over 30 million inhabitants representing a diversity of lifestyles, interests, and viewpoints. Governmental jurisdictions, from local units to international organizations, number in the tens of thousands. To solve the Great Lakes resource problems in a comprehensive and coordinated fashion requires recognition of and sensitivity to this diversity. Many public and private groups concerned with water resources in this region have taken significant steps toward involving the various public interests in planning, management, and policy-formulation programs. The involvement of these diverse groups in the development of programs for the wise use and conservation of Great Lakes resources is an extremely important goal.

The development of communication between local communities and agencies at the State, regional, national, and international levels is of utmost importance to the successful management of Great Lakes resources. Local knowledge and understanding of Great Lakes problems and potentials can be a valuable contribution to wider-scale resource management efforts. To be carried out successfully, such efforts must be fully understood by local participating communities.

A most critical management problem is the coordination of all levels of public agencies as they relate to local communities. While formidable problems and obstacles must be overcome before such coordination can be accomplished, extensive collaboration among the region's many individuals and diverse interests will be needed if the Great Lakes are to be managed effectively and wisely for future generations. Effective management depends upon relevant comprehensive planning on a timely basis.

Individual Problem Areas

The Great Lakes Basin Commission identified 28 specific areas with urgent problems concerning water and related land resources of the Great Lakes Region. For each of these areas, the problems were described and evaluated. These problem areas are the following:

1. Superior Slope Complex
2. St. Louis River Basin/Duluth Superior Area
3. Apostle Islands, Bad River, Montreal River Complex
4. Michigan's Upper Peninsula--Lake Superior and Lake Huron Drainage
5. Fox-Wolf River Basin
6. Northwest Shore of Lake Michigan
7. Sheboygan-Green Bay Complex
8. Southeast Wisconsin Complex
9. Chicago-Indiana Complex
10. St. Joseph River Basin
11. Kalamazoo-Black-Macatawa-Paw Paw River Basins
12. Grand River Basin
13. Northern Lower Peninsula
14. Saginaw River Basin
15. Saginaw Bay-Thumb Complex
16. Detroit Metropolitan Area
17. Huron-Raisin Complex
18. Maumee River Basin
19. Ohio Lake Plains
20. Cleveland-Akron Metro Area (Rocky-Cuyahoga-Chagrin River Basins)
21. Grand-Ashtabula-Conneaut River Basins
22. Erie-Chautauqua Complex
23. Erie-Niagra Region
24. Lake Erie Basin
25. Genesee River Basin
26. Greater Finger Lakes-Oswego River Basin
27. Lake Ontario Lake Plains
28. Black River-St. Lawrence Complex

The map (Figure 4-8a) shows the location of each of these areas. A tabulation of the types of problems found in each area is presented in Figure 4-8b. A summary describing each area, its problems, and their effects follows.

Problem Area 1: Superior Slope Complex

Description

The Superior Slope Complex Problem Area is on the north shore of Lake Superior and lies entirely within the State of Minnesota, stretching from Duluth to the Canadian border. Streams that drain the area are small and fast-flowing. The predominantly forested area has many outstanding natural features. Portions of St. Louis, Lake, and Cook Counties are within this problem area.

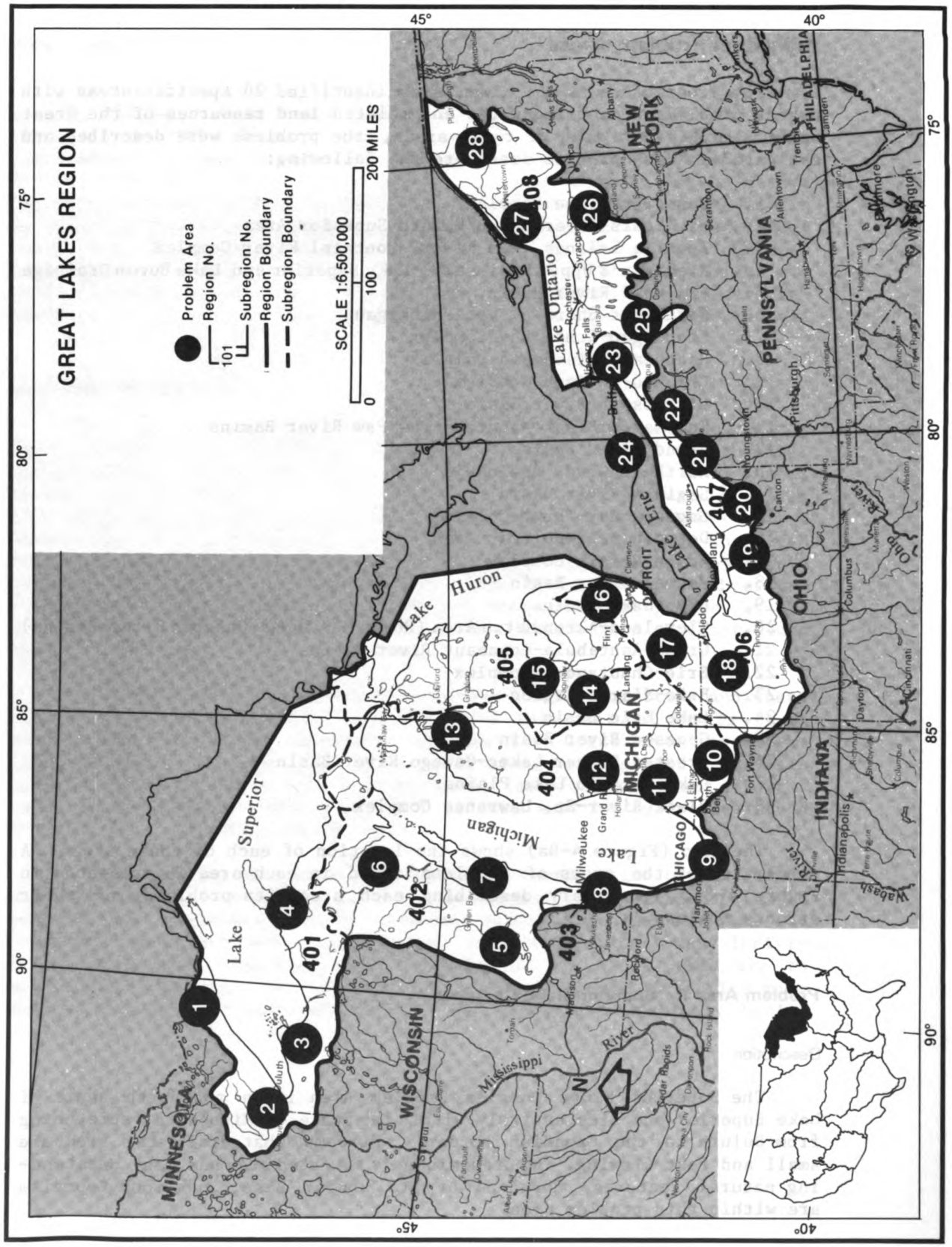


Figure 4-8a. Problem Map

GREAT LAKES REGION (4)

PROBLEM MATRIX

Problem area		Problem issues O Identified by Federal Agency Representatives X Identified by State Regional Representatives													
		Water quantity				Water quality				Related lands					
No. on map	Name	Fresh surface	Ground	Marine and estuarine	Surface depth	Fresh surface	Ground	Marine and estuarine	Surface depth	Flooding	Drainage	Erosion and sedimentation	Dredge and fill	Water related use conflicts	Other
Subregion 401	Lake Superior					O						O			O
Area 1	Superior Slope Complex			X				X				X	X	X	X
2	St. Louis River Basin/Duluth Superior Area	X		X		X		X		X	X	X	X	X	
3	Apostle Islands, Bad River, Montreal River Complex			X		X		X		X		X	X	X	
4	Mich.'s Upper Pen.-Lake Superior & Lake Huron Drain.	X	X	X		X	X	X		X	X	X	X	X	X
Subregion 402	NW Lake Michigan					O							O		O
Area 5	Fox-Wolf River Basin	X	X	X		X	X			X		X	X	X	
6	Northwest Shore of Lake Michigan		X	X		X	X	X		X	X	X	X	X	
7	Sheboygan-Green Bay Complex			X		X	X	X		X	X	X	X	X	
Subregion 403	SW Lake Michigan		O			O	O			O		O	O		O
Area 8	Southeast Wisconsin Complex		X	X		X	X	X		X	X	X	X	X	
9	Chicago-Indiana Complex	X	X			X	X	X		X	X	X	X	X	X
Subregion 404	Eastern Lake Michigan					O						O			O
Area 10	St. Joseph River Basin	X		X		X		X		X	X	X	X	X	X
11	Kalamazoo-Black-Macatawa-Paw River Basins		X			X	X	X		X	X	X	X	X	
12	Grand River Basin	X		X		X	X	X		X	X	X	X	X	
13	Northern Lower Peninsula		X	X		X	X					X	O	X	X
Subregion 405	Lake Huron					O						O			O
Area 14	Saginaw River Basin					X	X			X	X	X	X	X	X
15	Saginaw Bay-Thumb Complex		X	X			X	X	X	X	X	X	X	X	X
Subregion 406	St. Clair-Western Lake Erie					O				O		O	O		O
Area 16	Detroit Metropolitan Area	X		X		X		X		X	X	X	X	X	X
17	Huron-Raisin Complex	X	X	X		X	X	X		X	X	X	X	X	X
18	Maumee River Basin	X		X		X	X	X		X	X	X	X	X	
19	Ohio Lake Plains	X	X	X		X	X	X		X	X	X	X	X	
Subregion 407	Eastern Lake Erie					O					O	O			O
Area 20	Cleveland-Akron Metro Area		X	X		X		X		X	X	X	X	X	
21	Grand-Ashtabula-Conneaut River Basins	X		X		X		X		X	X	X	X	X	
22	Erie-Chautauqua Complex		X	X		X	X	X		X	X	X	X	X	X
23	Erie-Niagra Region	X		X		X		X		X		X	X	X	
24	Lake Erie Basin			X		X	X	X				X	X	X	X
Subregion 408	Lake Ontario					O						O			O
Area 25	Genesee River Basin					X		X		X		X	X	X	X
26	Great Finger Lakes-Oswego River Basin	X		X		X				X	X	X	X	X	X
27	Lake Ontario Lake Plains	X				X		X				X	X	X	X
28	Black River-St. Lawrence Complex	X		X		X		X		X	X	X	X	X	X

***Figure* 4-8b. Problem Matrix**

Problems

Water Issues

Periodic high water levels adversely influence shoreline erosion and property damage. Taconite tailings emitted from the Reserve Mining Company into Lake Superior pose potential problems in terms of adversely affecting spawning beds and increasing both lake turbidity and the asbestiform-fiber count in public drinking water supplies in nearby community water systems. Commercial fishing pressures, sea lamprey parasitism on lake trout, and competition of herring with smelt have contributed to a decline in the fishery industry in northern Lake Superior.

Related Land Issues

The growth of permanent and seasonal housing along Lake Superior and the inland lakes, symptomatic of the area's population increases, threatens the area's environmental and social amenities. Inadequate soils or lack of soil has rendered onsite soil-absorption-waste-disposal systems virtually useless. Existing and future mining operations can have significant impacts on the land resource base, water resources, and regional economy. There is an inadequate number of harbors of refuge for safe recreational boating.

Institutional and Financial Issues

The regulation of Great Lakes water levels involves complex institutional jurisdictions. Apparent amelioration of damages in the lower lakes at the expense of the Lake Superior shoreline is a critical issue.

Adverse Effects

The effects from Great Lakes system regulation (as opposed to regulation of Lake Superior without regard to downstream interests) include adverse economic and environmental impacts on the Lake Superior region. Asbestiform fibers in public drinking water will have long-term effects on the area population's health. Taconite tailings increase the turbidity of Lake Superior waters and may be harmful to the aquatic life in the lake. Shoreline erosion causes property damage and contributes sediment to the area of Lake Superior near the shore. Unregulated development in rural areas can result in water quality impairment (bacteria and nutrients), shoreline land use conflicts, a reduction in recreational opportunities, and the destruction of natural amenities. A declining lake trout fishery will reduce fishing opportunity. The lack of harbors of refuge will continue to threaten recreation boater safety during severe weather conditions. The introduction and spread of nonindigenous aquatic species will reduce the quality of aquatic species mix. Left unresolved, the problems detract from the region's recreation and commercial fishing attractiveness and may negatively affect the economy of the region.

Problem Area 2: St. Louis River Basin/Duluth-Superior Area

Description

The problem area encompasses the St. Louis River Basin on the western end of Lake Superior. The St. Louis River has its headwaters in Seven Beaver Lake in St. Louis County, approximately 163 miles above Duluth. The metropolitan areas of Duluth and Cloquet, Minnesota, and Superior, Wisconsin, are included in the problem area together with the adjoining urban and rural areas located at the western terminus of Lake Superior. The St. Louis River, St. Louis Bay, and Lake Superior itself are the predominant water features. The Duluth-Cloquet-Superior area is divided into two quite different types of terrain. The upland area is not highly developed and is composed to a large extent of timber, brushland, or open grassland. The lakeshore area is highly developed, while the upstream, or western, portion of the St. Louis River and Bay is not.

Problems

Water Issues

Poor water quality exists in the St. Louis River from Cloquet to Lake Superior, affected by severely low dissolved oxygen levels resulting from industrial pollutants, organic wastes from paper and pulp mills, urban runoff, and discharges from shipping vessels and municipal wastewater treatment plants. Reserve Mining's disposal of taconite tailings in Lake Superior has influenced asbestiform fiber levels in the lake. Fisheries for lake trout, white fish, and lake herring have declined because of commercial fishing pressures and sea lamprey parasitism on lake trout. There is a need for further navigation improvements and disposal of dredged materials.

Related Land Issues

Flooding, both urban and rural, has damaged land and structures. Fluctuating lake levels have added to flooding problems. The red clay area of northwest Wisconsin contributes large quantities of sediment. Residential and second home development has encroached upon critical environmental areas such as wetlands, marshes, flood plains, and headwaters of various creeks. There is a lack of harbors of refuge.

Institutional and Financial Issues

Conflicts occur between Federal and State standards and policies regulating dredging and related disposal activities.

Adverse Effects

Low flows and low dissolved oxygen are harmful to fish and other aquatic species in the St. Louis River and Bay and reduce recreation opportunity. Organic wastes exert a demand on the dissolved oxygen supply of the lower St. Louis River, St. Louis Bay, and Superior Bay. The consequences are: the reduction of the aquatic environment suitable for supporting fisheries; limitations on water contact sports; and adverse effects on environmental and aesthetic amenities of the area, which in turn may decrease the economic value of nearby land resources. A major concern is the possibility of carcinogenic effects of asbestiform fibers on humans. If pollution of local water resources continues, it may be necessary to modify additional water supply systems, and this would increase the costs of these services.

The long-term impacts of chemical constituents in the Lake Superior water, including possible problem levels of DDT, PCB's, and mercury in commercial fish, may adversely affect human health and commercial fish. Inundation of low-lying properties and shore erosion during high lake levels have caused property damage and consequent economic loss. Estimated average annual urban flood damages (in 1975 dollars) for the St. Louis River Basin for 1980 are $138 thousand (Framework Study). Flooding has caused damages to crops and rural structures. Estimated average annual rural flood damages (in 1975 dollars) for the entire St. Louis River Basin for 1980 are $72 thousand (Framework Study).

Sediment loads to Lake Superior degrade water quality and cause problems for municipal water supply systems, thereby increasing treatment and handling costs. Dredging and open-lake disposal of sediments can cause temporary disruption of the aquatic environment by increasing turbidity and covering some benthic organisms. Polluted sediments are contained in diked disposal areas. Suspension of dredging activities would result in obvious adverse economic consequences. Limited access to the lake does not allow the recreation potential of Lake Superior boating and fishing to be realized, thus causing overcrowding at existing sites and a dislocation of demand to other areas with consequent loss of realizable economic and environmental returns. Winter conditions and inadequate depths limit the navigation season and have an economic impact on the region by causing reliance on land transport modes, stockpiling of raw materials, and an inefficient use of the existing vessel fleet and related facilities, all of which affect the regional and local economy, including employment and production levels.

Problem Area 3: Apostle Islands, Bad River, and Montreal River Complex

Description

This portion of Lake Superior's south shore drainage is characterized by numerous lakes, wetlands, and streams, a secondary forest growth, and a dispersed population dependent on the pulp-logging industry, the tourist trade, and various other activities. Ashland is a major lake port and

population center. A nearly level lake plain and its red clay soils are significant geologic features of this glaciated area. A portion of the Montreal River Complex (131 square miles) is within the State of Michigan.

Problems

Water Issues

Some 29 large lakes, totaling 6,794 acres, in these four counties suffer from one or more of the following problems: weeds, algae, or fish winterkill. Five of these lakes, totaling 639 acres, are classed as eutrophic. The water quality problems of Lake Superior result from a combination of sources, including municipal and industrial discharges, faulty septic systems, shipping wastes, erosion of highly unstable red clay soils, and polluted dredged materials. There is a shortage of suitable and attainable ground-water sources, particularly in urban areas.

Related Land Issues

High lake levels, wave action, and man's activities have contributed to erosion of highly unstable red clay soils. Private development often conflicts with the natural environment and disrupts sensitive ecological systems. The number of small boat and refuge harbors cannot satisfy recreational boating demand. In the area consisting of Ashland, Bayfield, Douglas, and Iron Counties, 385,358 acres, or 13 percent of the total land area, needs conservation treatment, and 2.5 percent of the land, or 73,801 acres, is critically eroded. The losses exceed 20 tons per acre. Eleven floodprone communities in these four counties have no floodplain ordinances, and four of these are not enrolled in the flood insurance program.

Institutional and Financial Issues

Development of the Apostle Island National Lakeshore may cause esthetic deterioration of nearby shoreline communities resulting from intensified recreational developments. Also, Federal and State agencies need to coordinate the management of Indian reservations to eliminate conflicts related to Indian rights in the light of Federal programs and policies affecting the region.

Adverse Effects

Through erosion, water quality degradation has occurred as a result of increased turbidity, especially in the red clay regions. Shoreline erosion and loss of structures have caused economic losses to resident shoreline owners and reduced recreational activities. Pollutants may disrupt the balance of the oligotrophic Lake Superior ecosystem. Nuisance

algae growth and excessive aquatic plants are symptomatic of periodic eutrophic conditions in Chequamegon Bay. Suspended sediment increases certain chemical constituents. Absorbed nutrients and chemical oxygen demand adversely affect fish and aquatic life. Localized instances of high turbidity occur in Lake Superior, resulting in a reduction in the visual and aesthetic beauty and a degradation of water quality. Eutrophic conditions limit swimming opportunities.

Annual economic damages to urban residential and commercial development in the flood plain in 1975 dollars for 1980 are estimated as follows: Bayfield--$152,000, Bay River Basin (Mellen and Odanah, Wisconsin)--$161,000; Montreal River Basin (Hurley, Wisconsin, and Ironwood, Michigan)--$55,000 (Framework Study). Improperly functioning septic systems contribute to water conditions conducive to nuisance weed and algae growth.

The bulding of new homes along streams and around lakes limits public boat access, curtails possibilities for water-based hunting, and limits wild areas for camping and picnicking. Declining water quality due to septic systems makes water-based recreation undesirable. A tourist influx to the Apostle Islands National Lakeshore (projected as high as 400,000 to 500,000 people annually) will stimulate portions of the regional economy, but associated costs will also be incurred. An additional harbor of refuge is required to provide safer recreational boating between the Duluth-Superior area and the Apostle Islands.

Problem Area 4: Michigan's Upper Peninsula — Lakes Superior and Huron Drainage

Description

This problem area is located in the northwest portion of the Great Lakes Basin and borders the southern shore of Lake Superior and the northwest corner of Lake Huron. The sparse population, forested landscape, numerous lakes and streams, and the Lake Superior shoreline make this area popular for many recreational activities.

Economic problems are among the most critical. Trades and services, particularly in the recreation field, play a key role in the economic structure. Mineral production, associated industries, and forestry products also are important to the economy. Iron ore and copper deposits, primarily found in the western portion of the region in the Gogebic and Marquette iron ranges, are no longer the valuable natural resources they once were because of high processing costs. Other resources, such as forests and streams, are gaining value. Fishing opportunities and heavy winter snowfall are attracting tourists and skiers. Generally, the population is decreasing, except in a few of the larger urban areas, such as Marquette. Over the past decade, this area has experienced high unemployment and low incomes. There has been a significant emigration of workers, particularly young adults unable to find employment.

Problems

Water Issues

Surface- and ground-water quality problems, including turbidity and discoloration of surface waters, occur throughout the Upper Peninsula. These problems originate from municipal, industrial, and shipping discharges (which include leachates from solid waste disposal sites, chlorinated and other organic materials, other sewer waste, and dredged materials) as well as from natural processes. There is a shortage of suitable and attainable ground-water sources, particularly in urban areas. Translake petroleum shipment, winter navigation season extension programs, maintenance dredging, and existing lock size have raised questions as to their effects upon water quality and shoreline erosion. Ground water in this area may be taxed by the large water supply needed for open pit mining of low grade iron ore, power generating facilities, and increasing urbanization.

Related Land Issues

Energy-related generating facilities have raised concern with their thermal, chemical, and solid waste discharges. Both urban and rural flooding problems will continue as a result of encroachment on the flood plain, periodic high lake levels, and ice jams downstream from a hydroelectric plant on the St. Mary's River. Streambank and shoreline erosion is a problem throughout the Upper Peninsula. Population growth and economic development will have significant impact upon the esthetic and environmental character of the area. There is a need for preservation and protection of wetlands.

Institutional and Financial Issues

Compensation of shore property owners and power interests for damages due to implementation of lake regulation measures may be an issue. Conflicts exist between Federal and State standards and policies regulating dredging and related disposal activities.

Adverse Effects

Inundation of low-lying lands and shore erosion during high lake levels cause property damage. Residential and commercial flooding causes economic hardship and disrupts normal activities. The average annual urban damages for 1980, expressed in 1975 dollars, are estimated as follows: Presque Isle River--$75,000; Ontanagon River--$204,000; Keweenaw Peninsula Complex--$101,000; Sturgeon River--$113,000; Fall River (mouth to L'anse)--$46,000; and Grand Marais Complex--$81,000 (Framework Study). An additional economic loss is expected to occur to United States shore property owners on Lake Superior through implementation of Lake Regulation Plan SO-901. Long-term impacts of chemical constituents on human health, including

possible problem levels of DDT, PCB's, and mercury in lake trout, should be considered. Suspended solids and asbestos from Reserve Mining are related problems. These problems also limit recreational opportunities and fish and wildlife habitats.

If ice jams occur downstream from the hydroelectric facility on the St. Mary's River, flooding of the plant may occur. Flooding of discharge structures may reduce power potential through reduction of the differential head upstream and downstream. Erosion along some shoreline stretches causes property damage and localized conditions of turbidity of nearshore waters. Dredging and open lake disposal of sediments temporarily disrupt the aquatic environment by increasing turbidity and covering some benthic organisms. Polluted sediments are contained in diked disposal areas.

A large number of poorly supervised solid waste disposal sites could increase the economic cost of treating public and private water supply systems and reduce recreational benefits in the region. Frequently adverse weather conditions threaten recreational boaters. Limited access to the shoreline prevents realization of recreational potential of Lake Superior boating and fishing.

Problem Area 5: Fox-Wolf River basin

Description

The Fox-Wolf River Basin drains a large area of east-central Wisconsin. All or portions of 18 counties make up this area. Land uses range from forests in the headwaters to productive farmland dotted with rural communities in the central and lower reaches of the basin. Most of the population is concentrated along the lower Fox River and the Green Bay-Lake Winnebago area. Appleton-Oshkosh and the city of Green Bay are the two SMSA's in the basin and constitute an economically important urban-industrial complex surrounding the lower Fox River and Green Bay. The northern areas of the basin are rugged and extremely varied. To the south, rolling terrain and eventually broad, flat plains are characteristic. The southern basin is dominated by broad, marshy areas along the river which are periodically flooded.

Problems

Water Issues

Some 47 lakes, totaling 198,372 acres, have one or several of the following problems: weeds, algae, fish winterkill, or pollution. Thirty-one of these lakes, totaling 180,232 acres (including the 137,708-acre Lake Winnebago), are classified as eutrophic or very eutrophic. The problem is especially acute in Waupaca and Winnebago Counties. Poor water quality in the lower Fox River is primarily caused by discharges from paper mills

and municipalities. These activities contribute nutrients and toxic chemicals (PCB's and metals).

Related Land Issues

Brown, Calumet, Fond du Lac, Forest, Green Lake, Langlade, Marquette, Menominee (now the Menominee Indian Reservation), Outagamie, Shawano, Waupaca, Waushara, and Winnebago Counties has 1,388,130 acres (27.3 percent of the 13-county land area) needing conservation treatment and 98,029 acres (1.9 percent of the 13-county land area) experiencing critical soil losses (in excess of 20 tons per acre). In the above counties, 51 floodprone communities do not have flood-plain ordinances; 11 of these are not enrolled in the flood insurance program either; and 10 do not have flood-plain maps. Forest, Marquette, and Menominee Counties do not have ordinances, maps, or flood insurance. Waushara and Calumet Counties have neither insurance nor maps. Langlade County has no ordinance and no maps.

Institutional and Financial Issues

Current institutional arrangements and policies for controlling flood-plain development, reducing erosion and sedimentation through improved land treatment, reducing point and nonpoint sources of pollution, and acquiring and protecting the area's recreational and environmental resources are often ineffective because of inadequate funding, incentives, coordination, enforcement, and/or public awareness of existing Federal, State, and local programs. Additional funds and State staff are needed to properly evaluate environmental impacts. The legal implications of Indian reservations should be studied with regard to the above issues.

Adverse Effects

Low flows from Lake Winnebago accentuate water problems, thereby limiting recreational and aesthetic opportunities. Nutrients, BOD, and toxic chemicals interfere with water supply and other uses of the lower Fox River and Green Bay. The lower Fox River from Appleton to Green Bay is currently water quality limited. The City of Green Bay previously used ground water, but excessive pumpage has caused drastic declines in well levels, and the city has had to switch to Lake Michigan as a water source. The poor quality of water in Green Bay results in beach closings and fishing restrictions. Pollutants alter stream and lake ecosystems, oxygen depletion, and turbidity, with the consequent loss of economic opportunities in commercial fishing, recreation, and adjacent land values.

Continued development on the flood plain results in increased damages ($2.8 million in 1970, in 1975 dollars). Average annual damages in 1975 dollars are estimated to increase in the Fox River basin to $2.3 million (urban) and $1.2 million (rural) by 1980 (Framework Study). The crowding of inland lake surfaces and shores has destroyed natural and esthetic

attributes and has increased nutrient input to lakes and streams, thereby reducing their environmental values and uses.

Problem Area 6: Northwest Shore of Lake Michigan

Description

This problem area is made up of northeastern Wisconsin, which drains into Green Bay and Lake Michigan, and that part of Michigan's Upper Peninsula which drains into Lake Michigan. Major rivers in the area include the Menominee, Peshtigo, Oconto, Escanaba, Indian, and Manistique. The Michigan portion of this area is roughly 80 percent forested. The remainder of the area is 60 to 79 percent forested. Aspen-birch and spruce-fir forest types predominate. Urban areas are minimal with major cities including Menominee and Escanaba, Michigan, and Marinette, Wisconsin. Generally, as one moves north and west from Lake Michigan, the topography of this region changes from a flat to a more rolling terrain. Except for local areas, surface-water quality is good and the supply adequate. Iron is mined in Marquette, Iron, and Dickinson Counties in Michigan. Sand and gravel mining operations occur throughout this area. Valuable marshlands are extensive in Green Bay and Big and Little Bays de Noc.

Problems

Water Issues

Twelve large lakes, totaling 5,491 acres, in the Wisconsin area, have one or several of the following problems: weeds, algae, winterkill, pollution. Seven of these lakes (2,539 acres) are classified as eutrophic or very eutrophic. Water quality degradation has occurred along rivers and streams in this area. The degrading elements include iron precipitate, toxic chemical contamination, combined waste discharges, and leachates from solid waste disposal sites. Acid mine drainage is also a potentially serious problem affecting certain streams. Ground-water quality also is a problem in certain areas.

Related Land Issues

Urban and rural flooding problems exist because of flood-plain development, high water levels, and obstruction of stream dischrage by sediment buildup. The quality of wildlife habitat has been degraded by agricultural practices, rural homesite development, and wetlands drainage. In the Wisconsin area, consisting of Florence, Marinette, and Oconto Counties, 181,564 acres, or 9.9 percent of the land, needs conservation treatment; 4 percent, or 7,090 acres, is experiencing critical soil losses (losses in excess of 20 tons per acre). Seven flood-prone communities and all three counties in the Wisconsin area lack flood-plain ordinances. Only Florence County has flood maps.

Institutional and Financial Issues

Current institutional arrangements and policies for controlling floodplain development, reducing erosion and sedimentation through improved land treatment, reducing point and nonpoint sources of pollution, and acquiring and protecting the area's recreational and environmental resources are often ineffective because of inadequate funding incentives, coordination, enforcement, and/or public awareness of existing Federal, State, and local programs.

Adverse Effects

Ground-water supply may be limited, especially where there is a large water demand for open pit mining and power generating facilities. Erosion results in water quality degradation, and flooding damages shoreline properties (61.9 out of 76 miles between the cities of Marinette and Green Bay are subject to shoreline flooding). Water quality changes have modified bay and stream environments, consequently affecting aquatic life. Water quality is poor in Green Bay, including waters southeast from the navigation channel and southeast from the north line of Brown County (12.2 miles) from the mouth of the Fox River. Poor water quality has resulted in fish kills and total lack of fish in some areas. Other degraded zones appear at the mouth of the Oconto, Peshtigo, and Menominee Rivers. High concentrations of ammonia, phosphate, and phenol and low dissolved oxygen concentrations (zero in some places, surface and bottom, in August) are the main water quality problems. Tolerant benthic organisms (more than 5,000 sludgeworms per square meter in one sample area) and plankton algae flourish where coliform levels are high. Only upper Green Bay (north of Peshtigo River and Sturgeon Bay) is relatively clean. Poor ground water, unsuitable for domestic use, forces communities to seek other sources of water supply (Lake Winnebago area, Marinette and Menominee Counties).

Closed beaches in the city of Green Bay result in unsatisfied outdoor recreation demand. Pollution of the lower bay, (Secchi disc readings of 1 through 3), odors, and dead fish discourage swimming even when beaches are not closed because of high coliform counts. Dead fish along shores and eutrophic bay odors discourage use of the lower portion for camping and picknicking.

Problem Area 7: Sheboygan-Green Bay Complex

Description

The Sheboygan-Green Bay Complex is located in northeastern Wisconsin. The drainage area includes that portion of the State draining to Lake Michigan from the city of Sheboygan north to the end of the Door peninsula and that portion draining to Green Bay from northeast of the city up to the end of the peninsula. Major streams in this area are

the Sheboygan River, the Manitowoc River, the East and West Twin Rivers, the Kewaunee River, and the Ahnapee River. Between these rivers, many small streams flow to Lake Michigan and Green Bay. Included in this area are the eastern shores of Green Bay, the Counties of Door, Kewaunee, and Manitowoc, and parts of Brown, Calumet, Fond du Lac, and Sheboygan Counties. The topography of the basin is extremely varied. The southern part is rolling, with the land gently sloping upwards inland from Lake Michigan. Proceeding north to the east side of the Door Peninsula, the beaches give way to small bluffs. North of Sturgeon Bay, cliffs are very near the shore and provide impressive views of Green Bay and the shoreline below.

Problems

Water Issues

Inadequate municipal waste treatment and nonpoint source pollution have caused localized water quality problems. Shallow soils over a limestone formation have allowed ground-water contamination in Door County. Ground-water pollution has also occurred in Door County from septic tank infiltration, food processing, and pesticide applications. Extreme water hardness throughout the area and localized high iron content are problems. In these four counties, eight large lakes, totaling 1,789 acres, have one or more of the following problems: weeds, algae, or fish winterkill. In Sheboygan County, four-fifths of the large lakes (1,297 acres) are eutrophic. In the Door, Kewaunee, Manitowoc, and Sheboygan Counties, 461,568 acres, or 37.7 percent of the land, need conservation treatment. About 1.3 percent, or 16,136 acres, are undergoing critical soil loss (in excess of 20 tons per acre). Thirteen flood-prone communities in these four counties do not have floodplain ordinances. Five of these are not enrolled in the flood insurance program. Two communities, plus Kewaunee County, do not have maps of flood-prone areas. Gully, bank, and sheet erosion and sedimentation are prevalent throughout the area. Contributing to these processes are red clay erosion in certain areas, construction activities on steeply sloped lands, and wave action.

Institutional and Financial Issues

Current institutional arrangements and policies for controlling floodplain development, reducing erosion and sedimentation through improved land treatment, reducing point and nonpoint sources of pollution, and acquiring and protecting the area's recreational and environmental resources are often ineffective due to inadequate funding, incentives, coordination, enforcement, and/or public awareness of existing Federal, State, and local programs.

Adverse Effects

High lake levels contribute to urban flooding and erosion. Estimated average annual urban flood damages in 1975 dollars for 1980 are

as follows: Manitowoc -- $314,000; Sheboygan -- $446,000 (Framework Study). In addition, increases in nearshore turbidity and sedimentation adversely affect the benthic organisms in the nearshore zone and thus reduce the quality of fishing in the area.

Biological water quality is poor enough in at least 16 lakes and two rivers, primarily in Sheboygan and Manitowoc Counties, to have required chemical treatment to kill algae and aquatic weeds. Repeated treatment was required in most cases. The following lakes of over 50 acres have been treated: Crooked, Crystal, Elkhart, Long, Wilkie, English, and Cedar Lakes. The Mullet and Sheboygan Rivers were also treated. This problem has the greatest effect on recreational and environmental values and is mainly caused by agricultural runoff and nutrients from sewerage facilities and perhaps also by nitrogen concentrations in ground water. Nitrogen concentrations in ground water is a particularly important public health problem since this can cause methahemoglobanemia (blue babies). Inadequately treated sewage and other pollutants impair use of various stream segments for recreation, habitat, and esthetic purposes. Fish kills have occurred. Alterations of aquatic ecosystems affect commercial and recreational uses of the waters in the area, including Lake Michigan.

The algae population increases costs of municipally-supplied water for 90,000 Green Bay and 46,000 Sheboygan users (1960 population). Pesticides in drinking water supplies and nitrate concentrations in Lake Michigan Basin wells in Wisconsin may cause long range public health costs and require consideration of water supply alternatives as ground water becomes contaminated. Bacteria and virus problems in the water supply create public health problems that are critical during the summer tourist season. Nitrate concentrations of 10 percent of the wells analyzed in the Lake Michigan Basin in Wisconsin suggest degradation of water quality in particular wells.

Red clay erosion is a problem in streams of the Sheboygan and Manitowoc River Basin. Roadside erosion occurs in the following magnitudes: Manitowoc County--192 acres; Kewaunee--74 acres; Door--57 acres; and Sheboygan--53 acres. In Kewaunee County new construction activities are taking place primarily on very sloping to steep land and causing large amounts of erosion.

Problem Area 8: Southeast Wisconsin Complex

Description

This problem area consists of the land drained by the Milwaukee River and its tributaries, including the Menomonee and the Kinnickinnic Rivers which join the Milwaukee near its mouth at Lake Michigan; the Root River Watershed; several minor watersheds (Pike River, Oak Creek, and Sauk Creek); and the Lake Michigan shoreline from Ozaukee to Kenosha County. The Milwaukee, Racine, and Kenosha areas are becoming increasingly

urban, while the headwaters region of the Milwaukee River Basin is predominantly agricultural, with high potential for recreational development. The problem area contains all or part of the following counties: Milwaukee, Racine, Kenosha, Waukesha, Ozaukee, Washington, Sheboygan, Fond du Lac, and Dodge.

Problems

Water Issues

A decline of water levels has occurred in the deep aquifer in the highly urbanized Milwaukee area. The movement of naturally occurring saline waters into the pumpage area is a problem in northeast Milwaukee County. Organic waste loads and nutrients from municipal and industrial discharges and land runoff as well as combined sewer and sanitary sewer overflows and rural and urban runoff cause water quality problems in the area's lakes and streams, as well as in the areas near the shore of Lake Michigan. Persistent organics (DDT and PCB's) in discharges are of great concern. Eleven large lakes, totaling 3,647 acres, have one or more of these problems: weeds, algae, or fish winterkill. Seven of the lakes, totaling 1,894 acres, are classified as eutrophic or very eutrophic.

Related Land Issues

Urban growth through the area is using up agricultural land and causing intensive shoreland development of inland lakes. Inadequate navigable depths are of concern. The analytical area consists of Kenosha, Milwaukee, Ozaukee, Racine, and Washington Counties. In this area 358,380 acres, or 37 percent of the land area, need conservation treatment, and 49,825 acres, or 5 percent of the total area, are undergoing critical soil loss (in excess of 20 tons per acre). Twenty-two flood-prone communities do not have flood-plain ordinances; five of these are not in the flood insurance program, and two do not have maps of flood-prone areas. Soil erosion from both rural areas and urban construction has resulted in stream and lake sedimentation. Natural shoreline erosion conflicts with residential shore use.

Institutional and Financial Issues

Current institutional arrangements and policies for controlling flood-plain development, reducing point and nonpoint sources of pollution, and protecting the area's recreational and environmental resources are often ineffective due to inadequate funding, incentives, coordination, enforcement, and/or public awareness of existing Federal, State, and local programs.

Adverse Effects

With the decline in the water table, there has been a shift to

Lake Michigan for water supply with the result that costs for municipal and industrial water supplies have increased. Segments in this area with limited water quality include Honey Creek; Indian Creek; Kinnickinnic River; Lincoln Creek; Menomonee and Milwaukee Rivers; South, Menomonee, and Burnham Canals in Milwaukee County; Underwood Creek in Milwaukee and Waukesha County; Pike Creek in Kenosha County and Pike River in Racine County. Reclamation of contaminated shallow aquifers for water supply has been difficult and increased the costs of water treatment.

Average annual flood damages (estimated at $325,000 in 1975 dollars in 1970 for the Milwaukee River Basin) increase with uncontrolled use of flood plains. There are 39,000 flood-prone acres in the Milwaukee River Basin. Wetland drainage reduces open space habitat and natural areas, affecting water quality, altering drainage, destroying spawning areas, and reducing water depths. Shoreland and wetland developments result in the loss of potential recreational and natural areas. This can cause economic and environmental costs at a later date. Soil loss and erosion pollute surface waters in urban and rural areas, thereby degrading their use as aquatic habitats and recreational spots. There is loss of substantial Lake Michigan bluff frontage at high value residences, with potentially severe property damage. Critical erosion occurs between Port Washington and Milwaukee Harbors (18 miles). High bluffs are subject to rapid erosion between the mouth of Oak Creek and Wind Point (10 miles), between the south city limits of Racine and the north city limits of Kenosha (5.5 miles); and from the south city limits of Kenosha to the state line (4.5 miles). Agricultural land loss and decreased production are the direct effects of urbanization. Between 1963 and 1970, Milwaukee, Waukesha, and Ozaukee Counties had increases of 7.32, 4.30, and 3.40 percent in urban lands, respectively. Crowding of water surfaces and existing facilities causes unmet recreation demands to be diverted to other areas.

Problem Area 9: Chicago-Indiana Complex

Description

This is the most highly urbanized area in the entire Great Lakes Basin. The concentration of people and industries lies on the hydrologic divide between Lake Michigan and the Illinois River, which is part of the Upper Mississippi River Basin. The problem area covers portions of northeast Illionois, northwest Indiana, and the corner of southwest Michigan. This megalopolis generates tremendous requirements for water and related land resources.

The city of Chicago with the State of Illinois chose to protect its water supply in Lake Michigan by diverting about 810 square miles of the natural Lake Michigan drainage area to the Illinois River. The Metropolitan Sanitary District of Greater Chicago constructed and maintains the diversion system, except for the O'Brien Lock on the Calumet River, which was built and is maintained by the Corps of Engineers. The U.S. Supreme Court set a limit to water diversion from the Lake Michigan

watershed by the State of Illinois. Under present conditions, the total withdrawal, including pumpage for municipal and industrial water supply and diversion for navigation and waste assimilation purposes, is limited to an average 3,200 cubic feet per second (cfs), or 2,068 million gallons per day (mgd). The Water Resources Development Act of 1976 authorized a study of increased diversion to 10,000 cfs for a 5-year period. The problem descriptions for the Chicago metropolitan area have been developed by both the Great Lakes Basin Commission (GLBC) and the Upper Mississippi River Basin Commission (UMRBC). UMRBC's coverage includes the Fox River Basin and other portions of McHenry and Kane Counties, The GLBC coverage of the Chicago area for this assessment activity is Lake, Cook, DuPage, and Will Counties, Illinois, and Lake, Porter, and LaPorte Counties, Indiana.

Problems

Water Issues

Water quality problems are severe in many of the inland waterways. Industrial wastes produce floating debris, oil, discoloration, and suspended solids. Inadequately treated discharges of organic wastes from municipal and industrial sources create problems, particularly during periods of low stream flow. Population growth has overloaded existing municipal treatment facilities. There are limited areas and facilities around inland waters for recreational boating. The ground-water usage in the Chicago area exceeds the recharge capability of the ground-water aquifer.

Related Land Issues

There is a shortage of well-drained soils with urban development potential. Wet soils unsuitable for development have been urbanized. Industrial and residential expansion conflicts with natural areas, such as the Indiana Dunes National Lakeshore. There is both a critical flooding problem and a lack of outdoor recreational opportunities in the Little Calumet River Valley. However, the Little Calumet River Project, now authorized for advanced engineering and design, is structured to resolve both problems.

Institutional and Financial Issues

A regionwide system of ground-water management is needed to avoid haphazard withdrawals and waste.

Adverse Effects

Ground-water usage in the Chicago area exceeds the recharge capability of the ground-water aquifer. Lowered water tables require more pumping, relocation, or the establishment of new pumping centers, increased pumping lifts, and increased investment to maintain water sup-

plies. There are institutional limitations on Lake Michigan as a water supply for Chicago and the surrounding metropolitan area.

Suspended iron causes coloration of water; oil and other organic pollutants cause shifts to pollution-tolerant aquatic species; ammonia-nitrogen can be toxic to fish; low dissolved oxygen and organic wastes make the Calumet River esthetically unpleasant and unsuitable for desirable aquatic species. Eutrophication of near-shore waters results in algae growths which clog water intake screens and foul bathing beaches in the Calumet area.

Commercial, industrial, and residential encroachment onto the flood-plain has resulted in damages which have disrupted public services, caused production slowdowns, and increased the flood threat to flood-plain residents. Shoreline erosion has caused damages including destruction of bulkheads and seawalls, the undermining of roads and other paved areas, and damage to power line poles, railroad facilities, park facilities, industrial plants, and residential areas. Dredging and openlake disposal of sediments can temporarily disrupt the aquatic environment by increasing turbidity and covering some benthic organisms. Polluted sediments are contained in diked disposal areas. Because of poor water quality and overcrowding of existing facilities, recreation opportunities are severely limited. Demands for sport fishing are unmet; health hazards have limited the amount of suitable swimming areas; and increased maintenance costs of operating pleasure boats have occurred. Urban development is encroaching onto natural areas and potential recreation sites. Funding is inadequate to acquire such areas.

Problem Area 10: St. Joseph River Basin

Description

The St. Joseph River Basin occupies a total of 4,285 square miles--2,600 square miles in Michigan and 1,685 square miles in Indiana. The St. Joseph River, which rises in Baw Beese Lake in northern Hillsdale County, and its major tributary, the Elkhart River, flow west, emptying into Lake Michigan at Benton Harbor. Land is used predominantly for agriculture, with noteworthy production of fruit near Lake Michigan. The basin is rich in natural water areas and prime wetlands. Major cities are Benton Harbor/St. Joseph, South Bend, and Elkhart.

Problems

Water Issues

Fluctuations in water levels along certain reaches of the St. Joseph River conflict with weekend recreation use. Pollution of the St. Joseph River system is caused by siltation, by municipal, industrial, storm water and combined sewer discharges, and by fertilizers and pesticide runoff from agricultural land.

Related Land Issues

Encroachment on the flood plain has aggravated urban flooding problems. Pressures for land use changes on prime agricultural land and wetlands are the most prominent land use conflicts. Fishing sites are generally overcrowded.

Institutional and Financial Issues

Public funding is inadequate for constructing municipal waste-water treatment plants, acquiring natural areas, and protecting privately-owned wetlands (Water Bank Program).

Adverse Effects

Impoundments without fish ladders on the St. Joseph River impede expansion of the anadromous fishery. The lower few miles of the St. Joseph River experience low levels of dissolved oxygen and elevated levels of coliforms, nutrients, suspended solids, and residues. Three reaches of small tributaries have high coliform and low dissolved oxygen levels. Three main stem reaches display dissolved oxygen depletion and excessive nutrients-algae problems. Water quality is limited from Hillsdale to Jonesville. Degraded water quality impairs fishery resources, limits recreation opportunities, causes undesirable changes in vegetation and animal species, and is responsible for excessive eutrophication in localized areas. High bacterial levels limit use of surface waters for swimming and other recreation activities and produce health hazards.

Urban development in the flood plain has resulted in significant property damages. Estimated average annual flood damages in 1975 dollars for 1980 are: Benton Harbor--$60,000; Niles--$49,000; South Bend--$210,000; Mishawaka--$244,000; Elkhart--$258,000 (Framework Study). Flooding in rural areas has caused damage to crops and agricultural properties. Also, because of poor drainage, wet soils limit the use of land for agricultural production. Drainage of wetlands destroys wildlife habitat and other ecologic functions of wetlands. Shoreline erosion has caused damage to property and structures. Sheet erosion from construction sites and agricultural lands degrades water quality and reduces the capability of the land to produce crops, thus degrading the land resource base.

Problem Area 11: Kalamazoo-Black-Macatawa-Paw Paw River Basins

Description

The Kalamazoo-Black-Macatawa-Paw Paw Rivers Basin is located in the southwestern corner of Michigan and contains about 3,050 square miles, or 1,954,000 acres, involving all or portions of 11 counties. All of the rivers in the basin flow into Lake Michigan along almost 50 miles of shoreline. The Kalamazoo River, with a drainage area of 2,060 square

miles, is the largest river in the basin. Agricultural enterprises vary from general farming in the eastern and central areas to grape, apple, and blueberry growing along Lake Michigan. Manufactured products include food, paper, wood specialties, drugs, and wine. About 600,000 people live within the basin. Kalamazoo and Battle Creek are major urban centers.

Problems

Water Issues

The biological and chemical quality of surface water has been degraded by industrial and municipal discharges, malfunctioning septic systems, and fertilizer and pesticide runoff from agricultural lands. Serious ground-water quality and supply problems in Ottawa County result from high mineral content in the aquifers and the improper use of septic systems.

Related Land Issues

Urban development in the flood plain results in flood damages and destruction of the environmental and storage values of the flood plain. Sheet and streambank erosion from croplands and runoff from urban construction sites contribute sediment to the area's watercourses. Pressures for land use changes are exerted on prime agricultural and recreation lands.

Institutional and Financial Issues

The lack of adequate land-use planning results in the continued pressure to develop agricultural lands and environmental areas, strip developments, and other problems.

Adverse Effects

Degradation of water quality may lead to low dissolved oxygen in streams, destruction of aquatic life, and eutrophication of inland lakes. Inland lake eutrophication causes esthetically unpleasant conditions and reduces recreational value. Poor water quality has limited swimming and boating opportunities, has disrupted aquatic habitats and species, and has degraded esthetic qualities of water bodies due to eutrophication and algae growths.

Urban development in the flood plain has resulted in significant property damages. Flooding in rural areas has caused damage to crops and agricultural properties. Flood damage also destroys the environmental value of flood plains. Also, because of poor drainage, wet soils limit the use use of land for agricultural production. Estimated average annual urban flood damages in 1975 dollars for 1980 are the following: Allegan--$61,000; Otsego--$26,000; Plainwell--$17,000; Kalamazoo--$1,301,000; Battle Creek--$29,000; Paw Paw Lake--$60,000 (Framework Study).

Problem Area 12: Grand River Basin

Description

The problem area encompasses the Grand River Basin on the southeastern shore of Lake Michigan. The Grand River lies wholly within the southwestern portion of the State of Michigan, draining 5,572 square miles before reaching Lake Michigan. The stream rises in south-central Michigan near Jackson, flows north to Lansing, then west through Grand Rapids, and on to Lake Michigan at Grand Haven. During that 260-mile course, the Grand River receives waters from its major tributary streams: the Portage, Red Cedar, Looking Glass, Maple, Flat, Thornapple, and Rogue Rivers and numerous smaller streams. Part or all of 16 counties are included in the drainage basin.

Problems

Water Issues

Limited water resources and overuse of those resources have created overcrowded conditions for sport fishing, boating, and other water-oriented recreation. Poor water quality, including high levels of coliforms and low dissolved oxygen, occurs throughout the Grand River Basin because of inadequate waste treatment. Ground-water supply and quality are poor in Ottawa and Muskegon Counties because of the mineral content of the aquifers and the improper use of septic systems.

Related Land Issues

Both rural and urbanized flood-plain areas are damaged by flood waters. Erosion of the Lake Michigan shore at Grand Haven and streambank erosion on privately-owned rural land are major problems. The filling of wetlands destroys natural areas and affects water quality and quantity. Expanding urban areas are creating conflicts with agricultural, recreational, and natural uses of the land.

Institutional and Financial Issues

The lack of adequate land-use planning and zoning results in continued pressure to develop agricultural lands and environmental areas, strip developments, flood-plain damages, and other problems.

Adverse Effects

Because of the inadequate treatment of municipal and industrial wastes, degradation of water quality continues. Poor water quality has resulted in losses of desirable fish species and habitat, limited recreation opportunities, and eutrophication. Segments with poor water quality include

Red Cedar River from East Lansing to its confluence with the Grand River; Grand River from Jackson to the Jackson-Ingham County line; Grand River from Lansing to Grand Ledge; and Sycamore Creek from Mason to the confluence with the Red Cedar River. Sedimentation and pollutants from agricultural lands also contribute to water quality degradation.

Flooding damages occur along flood plains in urban and rural areas. Drainage problems on agricultural land limit production. Estimated average annual urban flood damages in 1975 dollars for 1980 are as follows: Grandville--$354,000; Grand Rapids--$1,081,000; Kent County (Comstock Park to Belmont)--$126,000; Ionia--$146,000; Eaton Rapids--$44,000; Lansing--$147,000; and East Lansing--$881,000 (Framework Study).

Dredging and open lake disposal of sediments can temporarily disrupt the aquatic environment by increasing turbidity and covering some benthic organisms. Polluted sediments are contained in diked disposal areas. Sites are needed to dispose of polluted dredged material. Unplanned filling and dredging may eliminate the role of wetlands as habitat in a drainage system's hydrology. Natural and scenic areas of significant esthetic value would be lost.

Problem Area 13: Northern Lower Peninsula

Description

Located entirely within the State of Michigan, this problem area encompasses a portion of the Lower Peninsula noted for its numerous lakes, trout streams, and forests. The recreation industry, a major stimulus to the regional economy, is dependent on tourists from Chicago, Detroit, and other urban areas to the south. The Grand Traverse Bay area is noted for its fruit and vegetable production and outstanding recreation opportunities. The problem area consists of all land drained by Lake Michigan and Lake Huron tributaries from the Muskegon River north to the Straits of Mackinac and south to the Au Sable River.

Problems

Water Issues

Local water quality problems are caused by municipal discharges, septic systems, and agricultural runoff. Potable water supplies are diminished by wetland loss and by ground-water contamination by abandoned oil wells and improper use of septic systems. These water supplies also have been limited by natural mineral contents.

Related Land Issues

Rural and minor urban flooding is a problem at scattered locations throughout this problem area. Urban expansion and resort development

threatens wildlife habitat, prime agricultural land, and natural areas. Exploration and drilling activities for oil and gas are being undertaken. The use of all-terrain vehicles damages Lake Michigan sand dunes and protective vegetive cover.

Institutional and Financial Issues

Land-use information, policy, and controls are needed to insure that land-use decisions are based on capabilities of the land base to support particular uses. Federal and State funding are needed to acquire natural and scenic areas, wetlands, and other open space.

Adverse Effects

Increasing water quality degradation limits the use of local water sources for recreation and habitat, causing in particular a loss of high quality fishery habitat. Sediment deposits smother spawning beds and harm stream fisheries. Bacteria and aquatic weeds limit use of stream segments for recreation and habitat. Municipal and rural wastes impair use of water for recreation and habitat. The changes in aquatic habitat affect viability of sport fisheries. Chemical accumulations in fish endanger human health if fish are consumed in certain amounts.

Flooding will continue to cause economic damage to rural and urban areas. Sheet and gully erosion and associated soil losses impact streams and lakes. Increased erosion along shoreline and streambanks and uncontrolled growth and development create economic and environmental problems. Damming of streams may cause sedimentation and nutrient enrichment. The associated changes in stream regimen influence the species composition. Offshore drilling may be technically possible in Lake Huron but may pose potential threats to shorelands.

Problem Area 14: Saginaw River Basin

Description

The Saginaw River Basin drains an area of approximately 5,240 square miles in the central and eastern portion of the Lower Peninsula. The system consists of the Saginaw River, which directly drains 246 miles, and the tributary drainage basins of the Cass, Flint, Shiawassee, and Tittabawassee Rivers. The Saginaw River flows through northeastern Saginaw County in a north-northeasterly direction and through the south third of Bay County before emptying into Lake Huron at Saginaw Bay.

Problems

Water Issues

Water quality is degraded by municipal and agricultural wastes, sewer overflows, and industrial discharges (from the chemical and petroleum

industries, in particular). Winter conditions disrupt shipping in Saginaw Harbor.

Related Land Issues

Flooding of urban areas is aggravated by encroachment on flood-plains. Expanding urban areas cause the loss and degradation of valuable wetlands, open space areas, and prime agricultural land. Urban construction contributes sediments which pollute watercourses and necessitate more frequent maintenance dredging of harbors and navigation channels. Erosion and sedimentation lower environmental quality of watercourses and destroy fish habitat. Land-use conflicts and changes will continue, with associated environmental, economic, and social impacts. Urban expansion utilizes land resources that have potential for other uses.

Institutional and Financial Issues

There is a lack of adequate land-use planning. Better flood-plain zoning at the local level is needed to avoid future flood damages. Inadequate funding at the Federal and State levels does not permit acquisition of natural and scenic areas, wetlands, and other open space areas.

Adverse Effects

Poor soil drainage reduces potential crop production. Heavy runoff may carry nutrients, pesticides, and sediment to watercourses. Municipal wastes (inadequate treatment and combined sewer overflows) restrict use of watercourses. Water quality effects include: Saginaw River--Mirex (Kepone) and other chemicals, chlorides, nutrients, low dissolved oxygen, high bacteria, suspended solids, nutrients; Flint River--heavy organic waste loads, low dissolved oxygen, high nutrient and bacteria levels; Shiawassee River--excessive nutrients, high bacteria, low dissolved oxygen; Tittabawassee River--high bacteria, high nutrients, low dissolved oxygen, high chlorides, high suspended and dissolved solids, pH, taste, odor. Water quality problems lower the environmental quality of watercourses (taste, odor, sediments) and change the diversity of fish species present. Segments with poor water quality include: the Flint River from Flint to the Genessee-Saginaw County line; the Shiawassee River from Owosso to 10 miles downstream; and the Tittabawassee River from Midland to the Midland-Bay County line. Water quality problems cause undesirable conditions for recreation uses. Swimming is restricted by high bacteria counts, boating is limited by poor esthetics, and fishing is poor because of low dissolved oxygen and high sediment loads. Saline-water intrusion may cause a loss of ground-water resources for use as public water supply.

Floods damage commercial and residential property. The 1980 estimates of major urban flood damages in 1975 dollars are: Saginaw River (Shiawassee Flats)--$104,000; Tittabawassee River (Midland)--$351,000; Shiawassee River (Owosso-Corunna)--$89,000; Flint River (Flint)--$104,000; and Cass

River (Vassar)--$187,000 (Framework Study). Estimated average annual rural damages in 1975 dollars for Saginaw River (Shiawassee Flats) is $1,164,000 for mainstem and major tributaries (COE-Detroit). Encroachment on flood plains increases flood damages to commercial and residential property. Flooding and poor drainage result in agricultural production loss.

Problem Area 15: Saginaw Bay-Thumb Complex

Description

Saginaw Bay and many of its smaller tributary drainage areas are the main features of this problem area. Also included is the small area of Michigan's "Thumb" region which drains into Lake Huron and the Saginaw River Basin.

Saginaw Bay is an inland extension of the western shore of Lake Huron covering 1,143 square miles. The outer limit of the bay is defined by a line between Point Aux Barques and Au Sable Point, a distance of 26 miles. The Saginaw Bay area is noted for its extensive and extremely valuable marshlands. The major tributaries other than the Saginaw River are the Au Gres, Rifle, Pine, Kawkawlin, Pigeon, and Pinnebog Rivers.

Problems

Water Issues

Localized reaches of Lake Huron tributary streams have water quality problems including high bacteria, excessive nutrients, and low dissolved oxygen. Poor water quality in Saginaw Bay is caused by inputs from tributary streams. Highly mineralized ground water reduces potable water supplies.

Related Land Issues

Flooding of residential and natural areas around Saginaw Bay is caused by high lake levels and storm driven waves. Uncontrolled urban and residential growth limits land use options and creates additional costs to localities. Private developments preempt many of the high quality areas with potential for recreation development. Land-use conflicts and changes will continue, with associated environmental, economic, and social impacts. Alterations of wetlands impair their ability to regulate water quality and quantity and provide fish and wildlife habitat, shoreland buffers, etc.

Institutional and Financial Issues

Federal and State funding is inadequate for acquisition of natural and scenic areas, wetlands, and other open space.

Adverse Effects

Localized bacteriological problems in the Tawas and Au Gres Rivers result from partially treated sewage effluent. Slight dissolved oxygen depressions and high nutrient and coliform concentrations are found in a portion of the Rifle River. High nutrient levels and coliform counts in two reaches of the Pine River are due to rural drainage and septic tank discharges and one industrial discharge. High coliform counts and nutrient levels and dissolved oxygen depression are found in one reach of the Sebewaing River. Bacteriological and other problems exist in minor tributaries, including Shibeon Creek, the Pigeon River, and the Pinnebog River.

Highly mineralized ground water limits potable water supply. Deteriorated water quality in Saginaw Bay and tributary streams restricts usage for water supply and recreation needs and creates public health hazards. Poor waste quality also causes filter clogging, taste and odor problems, and corrosion at water treatment plants. In warm weather, nutrients from industrial, municipal, agricultural, and other sources have produced extensive algae blooms in the bay and accumulations of plant debris along the shoreline. Total phosphorus concentrations are over four times greater than those of Lake Huron.

The coastal regions of the inner bay exhibit particularly high phosphorus concentrations. The benthic organisms of the inner bay have changed toward those species tolerant of pollution (e.g., oligochaete), with the disappearance of those requiring clean water (e.g., mayfly).

Continued development of land for residential purposes will cause additional flood damages along the lower Kawkawlin River and other developing areas. Flooding causes soil loss from cultivated fields and damages drainage channels and structures as well as other farm facilities. Estimated average annual rural damages in 1975 dollars for 1980 are as follows: Au Gres River Basin--$227,000; Kawkawlin Complex--$34,000; and Thumb Complex--$202,000 (Framework Study). Siting of powerplants has impacts on the nearshore environment of Lake Huron. Problems can include thermal pollution, pollutants in blowdown water, and entrainment of organisms. Of concern are possibilities of disruption of the food chain, impacts on fish populations, alteration of species diversity-abundance relationships, and the reduction of the stability of ecosystems in the littoral zone.

Problem Area 16: Detroit Metropolitan Area

Description

The Detroit metropolitan area consists of a mixture of highly urbanized, suburban, and outlying agricultural areas in southeastern Michigan. Major drainage basins are the Black River, Belle River, Pine River, Clinton River, and Rouge River. The St. Clair River, Lake St. Clair, and the Detroit River form the link between Lakes Huron and Erie. The predominant

topographic feature of the problem area is the broad, flat lake plains along the eastern half. All or portions of Wayne, Macomb, St. Clair, Sanilac, Oakland, Lapeer, and Washtenaw Counties are included in this area.

Problems

Water Issues

Poor water quality results from nonpoint source discharges, industrial discharges, some raw sewage overflow from combined sewers, and primary and secondary treatment plant effluent in streams with inadequate assimilative capacity. Water surface and facilities for water based recreation are insufficient.

Related Land Issues

The drainage of wet soils is needed in some areas for agricultural or urban use. Erosion and sedimentation problems degrade water quality and impair uses. The filling of shore marshes threatens fish and wildlife habitat, destroys natural areas and open space, and may alter the quality and quantity of water entering the Great Lakes system.

Institutional and Financial Issues

Issues facing the ports at Detroit and other Great Lakes cities include competition with other coastal ports, governmental policies and programs regarding Great Lakes shipping, discriminatory inland freight rates for service to Great Lakes ports, winter navigation difficulties, and possibilities of navigation improvements. Canada and the United States disagree about who has the appropriate management-authority over the St. Clair River Delta Islands.

Adverse Effects

Degraded water quality from point and nonpoint (nutrients, pesticides, sediment) sources of pollution poses health problems, limits municipal and recreational uses, and destroys aquatic habitat. Areas of particular concern include: Clinton River from Pontiac to the mouth, including the Red Run Basin (low dissolved oxygen and high BOD, solids, and nutrient levels); River Rouge (bacteria, dissolved solids, nutrients, low dissolved oxygen); portions of Black and Belle River Basins (dissolved oxygen, bacteria, dissolved solids); and Ecorse River Basin (combined sewer discharges).

Degradation of Lake St. Clair and the Detroit River from municipal and industrial sources (high BOD and bacteria counts, toxic wastes, and low dissolved oxygen) limits fishery value, wildlife habitat, recreation uses, and poses health problems. Areas of particular concern are the

Lake St. Clair shore from Clinton River to Windmill Point (combined sewer overflows and pollution from Clinton River) and the Detroit River (bacteria, phenol, dissolved oxygen, oil).

Urban flood damages and the associated economic losses increase as a result of flood-plain development, high lake levels, and ice jams. Expanded winter navigation, however, may reduce ice jams. Flood-plain development precludes recreational use of the area. Estimated urban average annual damages in 1975 dollars for 1980 include: Black River Basin--$230,000; Clinton River Basin--$41.5 million; Rouge Complex--$3.3 million; and along Lake St. Clair--$5,100,000 (Framework Study). Rural flooding affects crop production adversely and damages agricultural structures. Estimated average annual rural flood damages in 1980 include: Black River Basin--$120,000; St. Clair Complex--$356,000; and Clinton River Basin--$175,000 (Framework Study).

Problem Area 17: Huron-Raisin Complex

Description

This problem area consists of the land drained by the Huron and Raisin Rivers and several lesser streams in extreme southeastern Michigan and a very small portion of northwest Ohio (23 square miles). Located at the fringe of the Detroit and Toledo metropolitan areas, this predominantly agricultural region is becoming increasingly urban. The rolling terrain and inland lakes of the area's western portion make it desirable for meeting the recreation demands of the region. All or portions of Monroe, Lenawee, Wayne, Washtenaw, Oakland, Livingston, Ingham, and Jackson Counties in Michigan and Fulton County, Ohio, are included.

Problems

Water Issues

Poor water quality results from industrial discharges, nutrient contributions, agricultural wastes, some raw sewage overflow from combined sewers, urban runoff, septic systems, and primary and secondary treatment plant effluent in stream reaches with inadequate assimilative capacity. Use of ground-water supplies is limited by high mineralization, leachate pollution, and low yield wells.

Related Land Issues

Flood-plain development aggravates flooding in urban areas and limits recreational use of the flood plain. Erosion and sedimentation degrade water quality, create additional treatment expenses, and impair uses of surface waters and adjacent lands.

Institutional and Financial Issues

Inadequate land-use planning results in continued uncontrolled development pressure on valuable areas. Various government levels have disagreed on the issue of mandatory local participation in regional systems. There is no adequate agreement or support for a water quality planning and management agency to bridge the Ohio-Michigan boundary watersheds of the Maumee and Huron-Raisin Rivers. The situation may be improved with the implementation of the ongoing 208 study of the Toledo Metropolitan Area, which includes Bedford and Erie Townships in Monroe County, Michigan. The study is being conducted by the Toledo Metropolitan Area Council of Governments.

Adverse Effects

Degraded surface-water quality, which results from municipal and industrial discharges and agricultural pollution sources (nutrients, pesticides, sediments), limits agricultural, municipal (taste), and recreation uses; impairs commercial and sports fishery resources; impairs esthetics; and creates health hazards. Areas of particular concern include: Huron River from Dexter through Ford Lake (low dissolved oxygen, high bacteria, and nutrient loads); Saline River from Saline to 10 miles downstream; South Branch of the River Raisin from Adrian to the confluence with main branch; and Lake Erie shoreline from Estral Beach to Maumee Bay (bacteria, algae, turbidity). Also Lakes Gallagher, Brighton, and Whitmore and the Belleville and Ford impoundments all have algae problems. Western Lake Erie experiences excessive algae and weed growth, low dissolved oxygen, and turbidity. Poor quality of ground water as a result of leachates and high mineral content impairs agricultrual and domestic uses.

Flooding and ice damage increases monetary losses to urban developments on flood plains and the Lake Erie shore. Urban encroachment on flood plains precludes recreational use. Estimated 1980 average annual urban flood damages (in 1975 dollars) include: Ypsilanti--$254,000; Flat Rock--$195,000; and Rockwood--$141,000 (Framework Study).

Loss of property and agricultural production results from flooding and poor drainage, while inadequate drainage limits urban use of land and contributes to flooding. Estimated 1980 average annual rural flood damages in 1975 dollars include: Huron River Basin--$408,000; Swan Creek Complex--$89,000; and Rasin River--$21,000 (Framework Study).

Shoreline and streambank erosion in urban and rural areas causes soil loss and creates water quality problems by contributing polluted sediment and increasing turbidity. The Detroit District Corps of Engineers, in conjunction with the State of Michigan, is constructing a confined disposal facility. This "banana-shaped" facility is designed also to mitigate the erosion problem of the area. Point Mouillee River delta erosion result from upstream impoundments that trap sediment and thereby reduce the regeneration of the delta. Urban development consumes valuable agricultural, cultural, recreational, and habitat areas, creates

use conflicts along shorelines, inflates land values, and impairs water quality by reducing cover and increasing erosion. Erie Game Area causeway construction may harm wildlife and aquatic vegetation.

Problem Area 18: Maumee River Basin

Description

The Maumee River stretches 134 miles from Ft. Wayne, Indiana, to Maumee Bay. The St. Joseph River, originating in Michigan, and the St. Mary's River, with headwaters in Ohio, meet in Ft. Wayne to form the Maumee. The Tiffin River flows south from Michigan to join the Maumee at Defiance, Ohio. The Auglaize River, which flows north to enter the Maumee at Defiance, and its major tributaries--the Blanchard, Little Auglaize, and Ottawa Rivers--drain much of the southern portion of the Maumee watershed. Maumee Bay, in Lake Erie, is fed by this extensive system of rivers and tributaries that drain 6,919 miles of rich agricultural land.

Problems

Water Issues

Pollution of Maumee River, Bay, and Basin streams, is caused by agricultural wastes, municipal organic waste discharges, combined sewer overflows, industrial discharges, mining activities, and local instances of septic tank contributions.

Related Land Issues

Flood damages occur in both urban and agricultural areas. Severe shoreland erosion along Maumee Bay and excessive river bank erosion create problems of sedimentation and property damages. Urban and rural residential and industrial development and transportation networks have caused land-use conflicts. Soil in this area drains poorly. Overloaded tile drains in agricultural land will intensify as a problem. Consideration also should be given to long-term effects on water quality caused by lake waste disposal.

Institutional and Financial Issues

Data on the Maumee Bay environment is inadequate for use in decision-making. There is a need to identify nonpoint source pollutants, their effect on the environment, and measures to reduce their quantity.

Adverse Effects

Fluctuating flow conditions restrict local water supply and growth

of certain urban areas, particularly Fort Wayne, Indiana. Surface water degradation as a result of municipal wastes, industrial discharges (oil, toxic chemicals, organic waste, phenol, suspended and dissolved solids), and urban and rural runoff (containing nutrients, pesticides, and sediments) creates public health, food processing, and water supply problems with loss of aquatic habitat, species diversity, esthetic values, and recreation potential. Particular areas of conern include tributary streams and segments of the Maumee River (excessive ammonia-nitrogen), Auglaize River, Ottawa River, Blanchard River, and portions of Maumee Bay. Problems include high bacteria counts, low dissolved oxygen, excessive algae, and turbidity. Undesirable ground-water supplies result from taste and odor problems caused by hydrogen sulfide; these problems limit municipalities' ability to use these sources, thus causing increased costs for utilizing alternative water supplies, usually at a more distant source.

Flood-plain development, rapid runoff, and inadequate channel capacity increase urban flood damage losses. Estimated average annual urban damages in 1980 (expressed in 1975 dollars) include: along the Maumee River: Grand Rapids--$34,000, Defiance--$38,000, Fort Wayne--$3.1 million; along the St. Joseph: Cedarville and Leo--$32,000; along the St. Mary's: Decatur--$38,000, Auglaize County--$142,000; along the Blanchard: Findlay--$1.96 million; along the Tiffin: Brunersburg and Evansport--$48,000; and along Maumee Bay--$290,000 for 1990 (Maumee River Basin Level B Study). Agricultural lands are subject to increased flood damages and impairment of drainage systems. Poor surface drainage limits use of land for agricultural or urban purposes. Property damage and sediment contribution to Maumee Bay result from high lake levels and eroded agricultural lands upstream. Urban and rural sedimentation causes water quality degradation and aquatic habitat loss and increases in flooding damages. Estimated average urban and rural annual damage for 1980 in 1975 dollars is $4.47 million (Maumee River Basin Level B Study). Soil loss and sediment contribution to streams result from excessive river bank erosion.

Required maintenance dredging of Toledo Harbor and shipping channel may impact upon water quality and create disposal problems with associated costs and subsequent impacts upon the hydrology and aquatic habitat of the area. The required dredging is 250,000 cubic yards per year from Maumee River and 1 million cubic yards per year from Maumee Bay. Erosion and filling of wetlands destroy wildlife and fishery habitat, degrade water quality, increase flooding, and cause the loss of open space, natural areas, and buffer zones from waves. Residential, industrial, and transportation development eliminates valuable agricultural, recreational, habitat, and natural areas, and increases runoff and land prices.

Problem Area 19: Ohio Lake Plains

Description

The Lake Plains problem area occupies the flat, fertile plains of Lake Erie's southwestern shore. Major rivers between the Toledo and

Cleveland areas include the Toussaint, Portage, Sandusky, Huron, Vermilion, and Black. Northern Ohio counties which fall entirely or partially within this problem area are Lorain, Erie, Huron, Ottawa, Sandusky, Seneca, Crawford, Wyandot, and Wood.

Problems

Water Issues

The low critical flow conditions of many streams cause poor water quality and high bacterial concentrations. Poorly treated wastewaters, storm sewer discharges, and agricultural runoff degrade water quality, creating potential health hazards, loss of recreation economy, and restricted use of inland and Great Lakes waters. Poor ground-water quality is caused by the leaching of high mineral concentrations from bedrock.

Related Land Issues

Flooding inflicts economic loss on urban and agricultural areas. Soil in the Lake Plains area drains poorly. Stream channelization is an issue. Shoreline and streambank erosion cause property damage and water quality problems. Conflicts exist over the development versus the preservation of shoreline areas. Lack of public access restricts hunting and fishing opportunities. Additional consideration should be given to the long-term water quality effects of lake disposal activities. Impacts of power sites on wildlife and the shallow Sandusky Bay should be assessed.

Adverse Effects

Extremely low critical flow conditions in some streams restrict surfacewater use. Poor water quality from inadequate runoff (nutrients) restricts surface-water use for domestic uses and recreation (body contact and esthetics) with its related economic benefits and limits sport and commercial fishing. Areas of concern include: Bowling Green (low dissolved oxygen, high nutrients); Oak Harbor (low dissolved oxygen, high nutrients); Upper Sandusky (low dissolved oxygen, high nutrients); Carey (low dissolved oxygen, high nutrients); Tiffin (low dissolved oxygen, high nutrients); Fremont (low dissolved oxygen, high nutrients); Willard (low dissolved oxygen, high nutrients); Norwalk (low dissolved oxygen, high nutrients); Elyria (low dissolved oxygen, high nutrients, heavy metals); Portage (food processing bacteria); Sandusky (bacteria); Black Rivers (food processing bacteria); and Pipe Creek (bacteria).

Pollution from private and municipal sewage disposal wells contaminates ground-water supply, limiting its use for domestic purposes and increasing costs of using alternative water supplies. An area of particular concern is in Bellevue, Ohio. Ineffective wastewater treatment and excessive urban, industrial, and agricultural runoff degrade the quality of Lake Erie's nearshore zone, creating potential health hazards and con-

sequently limiting the potential for domestic uses, recreation (body contact and esthetics), and commercial and sport fishing.

Flooding causes residential and commercial economic losses as well as crop production losses. Estimated urban damages for 1980 in 1975 dollars include: Toussain-Portage--$23,000; Sandusky--$1,304,000; Huron-Bermilion--$586,000; and Black (Lorain and Elyria)--$97,000. Estimated rural damages for 1980 in 1975 dollars include: Toussaint-Portage River--$1,421,000; Sandusky River--$1.65 million; and Huron-Vermilion River--$268,000.

Erosion causes property damage and loss of valuable shoreline along Lake Erie. Intensive agricultural activities result in erosion of agricultural land and subsequent deposit of sediments and polluted runoff in streams and in nearshore zones which affects water quality and fish habitat. Competition between development, agriculture, recreation, and preservation interests limits potential uses along shoreline. Future recreation demands will not be met.

Problem Area 20: Cleveland-Akron Metro Area (Rocky-Cuyahoga-Chagrin River Basins)

Description

The problem area consists of three river systems--the Cuyahoga, the Rocky, and the Chagrin. In addition, there are several small streams that drain directly into Lake Erie. The Rocky River Basin is the westernmost of the three rivers and drains an area of 294 square miles in Medina, Summit, Lorain, and Cuyahoga Counties. The Chagrin River Basin is located in the northeast part of the problem area and drains an area of 267 square miles in Cuyahoga, Geauga, Lake, and Portage Counties. The Cuyahoga River Basin drains an area of 813 square miles. Beginning east of Chardon only 16 miles from Lake Erie, the river flows south to Lake Rockwell. Below Lake Rockwell, the river flows south to Akron where it begins a northerly course through the greater Cleveland area to Lake Erie.

Problems

Water Issues

Water quality of both Lake Erie and inland waters is degraded by municipal and industrial wastes, combined sewers, and rural and urban runoff. Several communities have exceeded the capacity of the ground water to meet their domestic use needs. Increased navigation depths and harbor improvements are of concern.

Related Land Issues

Urban and rural flood damages occur. Many of the area's soils have drainage limitations, making it difficult to utilize them for cropland and urban development. Lake Erie shore erosion is critical.

Institutional and Financial Issues

Ground-water supply management is insufficient and uncoordinated. A shoreline management policy is urgently needed along Lake Erie's southern shore. The financing of municipal treatment facilities and water supply development projects is an obstacle in meeting future needs. A proposed jet port along the Lake Erie shore would have significant environmental impacts.

Adverse Effects

Inefficient ground-water management causes municipal supply problems. Degradation of the quality of inland waters by municipal wastes, combined sewer overflows, industrial discharges (chemical and steel), and rural runoff restricts domestic and recreation uses, destroys fish and wildlife habitat, causes loss of more desirable species, and increases costs for additional treatment. Critical areas of concern include: Cuyahoga River navigation channel and downstream of Akron (high concentrations of dissolved solids, high COD, BOD, phenols, nutrients, heavy metals, high temperature, low dissolved oxygen, bacteria and oil problems); Rocky River has high dissolved solids (Lakewood), bacteria (East and West branches), low dissolved oxygen (mouth), and high phosphates (lower reaches); Chagrin River has turbidity, low dissolved oxygen, discoloration (Chagrin Falls), and bacteria (low reaches). Poor water quality creates unsafe conditions for body contact and unpleasant esthetics. Water quality problems in the near-shore zone of Lake Erie limit uses of lakes and beaches. A particular area of concern is the Cleveland area, where chemical and steel industries discharge toxic substances, phenols, and heavy metals. Beaches have been closed due to poor water quality at Rocky River Beach, Edgewater Beach, and White City Beach.

Flooding causes residential and commercial damage as well as crop loss from valuable farmland. Estimated average annual urban damages in 1975 dollars to residential and commercial property in 1980 include: Rocky River--$110,000; Cuyahoga River--$1 million; and Chagrin River--$403,000 (Framework Study). Estimated rural damages, primarily vegetable and sod farming, in 1975 dollars for 1980 include: Rocky River-- $92,000; Cuyahoga--$63,000; and Chagrin River--$25,000 (Framework Study). Soil drainage conditions limit use of land for agricultural and urban development. Excessive drainage activities destroy valuable wetland functions.

Required maintenance dredging may produce water quality and disposal problems. Average annual amounts include: Cleveland, 1.22 million cubic yards and Rocky River, 15,000 cubic yards. Rapid urban development precludes other uses of land (i.e., agriculture and recreation) which may be more valuable. Water-related recreation is restricted by insufficient supply of facilities and poor water quality. Overcrowding of recreational areas exists, and escalating land prices make acquisition of land for public use difficult.

Problem Area 21: Grand-Ashtabula-Conneaut River Basins

Description

The Grand and Ashtabula River Basins are defined as including minor Lake Erie tributaries between the Chagrin River Basin and the Ohio-Pennsylvania State line. This area includes most of Lake and Ashtabula Counties and the northeast corner of Trumbull County in Ohio. Conneaut Creek, included within this problem area, involves part of Erie County, Pennsylvania.

Problems

Water Issues

Municipal and industrial effluents and inadequate septic systems cause water quality problems in Lake Erie and inland waters.

Related Land Issues

Economic losses are caused by residential and agricultural flooding. Shoreline erosion damages residential and other property and contributes to the sediment pollution of Lake Erie. Dredging to maintain harbor depths creates disposal problems and may impact temporarily upon water quality, although the extent and significance of such impact is unknown. Competition and conflict over lakeshore uses cause unmet recreational demands and depletion of open space and natural areas.

Institutional and Financial Issues

There is an urgent need for a shoreline management policy along Lake Erie's southern shore.

Adverse Effects

Water quality degradation by municipal and industrial (chemical) effluents limits public water supply and recreation uses of inland surface waters and the nearshore zone of Lake Erie. Problems include low dissolved oxygen, high pH, high dissolved solids, high sediments, phenols, phosphates, high bacteria, and algae blooms. These conditions are common to both the Grant and Ashtabula Rivers. Similar conditions are found in the nearshore zone of Lake Erie along Lake and Ashtabula Counties. Urban and rural flooding damages residential property and crops, causing economic loss. Estimated average annual damages in 1975 dollars to urban areas for 1980 include: Grand River Basin--$264,000; and Ashtabula-Conneaut Complex--$37,000 (Framework Study). Estimated average annual damages in 1975 dollars to rural areas for 1980 include: Grand River Basin--$307,000;

and Ashtabula-Conneaut Complex--$106,000 (Framework Study). Shore erosion damages residential and other property, reduces habitats, and increases sediment pollution of Lake Erie. Maintenance dredging may impact upon water quality and habitats, although the extent and significance is unknown. Annual dredging amounts include: Ashtabula--220,000 cubic yards; Conneaut--100,000 cubic yards; and Fairport--400,000 cubic yards. Urban, agricultural, and recreational conflicts over lakeshore use result in unmet recreation demands, depletion of open space and natural areas, and additional degradation of water quality from nutrients, pesticides, and sediments.

Problem Area 22: Erie-Chautauqua Complex

Description

This problem area occupies 653 square miles and consists of the portions of Erie County, Pennsylvania, and Chautauqua County, New York, that are in the Lake Erie drainage basin. For Erie County this includes the area north of a line dividing the county diagonally from northeast to southwest. For Chautauqua County it includes a strip approximately 5 miles wide that follows the shoreline of Lake Erie, including the urban areas of Dunkirk, Fredonia, and Westfield.

Problems

Water Issues

Combined sewer overflows, poor septic tank systems, and urban and agricultural runoff cause water quality problems. Fluctuating water levels in Lake Erie have adverse impacts on recreational boating, swimming, shoreline erosion, and fish and wildlife areas. Saline intrusion and pollutants cause ground-water supply loss.

Related Land Issues

Flooding occurs in localized instances. Large agricultural areas have inadequate drainage. Shoreline and streambank erosion and sedimentation are problems thoroughout the entire basin, particularly regarding Presque Isle. Dredging has associated disposal and environmental effects. Public access to the Lake Erie coastal waters for fishing and boating is limited. Urban development encroaches on prime and unique farmland. Preservation of Presque Isle is of major concern.

Institutional and Financial Issues

Lack of adequate land-use planning and enforceable controls creates problems associated with haphazard development. Agricultural water management and careful planning and regulations for potential natural gas

exploration are needed. Acquisition of natural and scenic areas, wetlands, and other open space is not possible without adequate funding.

Adverse Effects

Degradation of water courses by municipal, industrial, and agricultural sources renders surface waters, including the nearshore zone of Lake Erie, unsuitable for water contact recreation, sport fishing, and other uses. Areas of particular concern are Erie Harbor and Presque Isle Bay. Eutrophication of nearshore, bay, and harbor areas and high total coliform levels have occurred. Ground-water supply is limited by intrusion of saline waters and pollution by improper septic system use. Areas of particular concern are Erie City, Craneville, and McKean where ground water has high iron, manganese, and hardness content.

Unique and valuable vineyards will be lost if urban encroachment continues. Increasing suburban development and inadequate zoning create a need for large capital outlays for sewer systems. Land use conflicts have resulted in the problems of lack of proper solid waste disposal sites, power plant siting, and loss of recreational opportunities. The high vulnerability of the Presque Isle Peninsula to excessive erosion from severe Lake Erie storms portends calamitous losses of recreational and economic opportunities.

Problem Area 23: Erie-Niagara Region

Description

The Erie-Niagara Basin has an area of approximately 1,950 square miles. The basin consists of the watersheds of all streams draining into Lake Erie and the Niagara River between Tonawanda Creek in the north and the Cattaraugus Creek in the south. The basin contains all of Erie County, New York (except Grand Island) and substantial portions of Niagara, Genesee, Wyoming, and Cattaraugus Counties. Small portions of Allegany, Chautauqua, and Orleans Counties are situated along the basin periphery.

Problems

Water Issues

Fluctuating Great Lakes levels and flows have varying impacts on commercial navigation and recreational boating, hydroelectric power production, shoreline erosion and flooding, and fish and wildlife habitat. The overflow of untreated municipal wastes, land runoff, and industrial discharges degrade water quality and present health hazards in Lake Erie and inland and connecting waters.

Related Land Issues

Urban and rural flooding create economic losses. Ice jamming and high lake levels cause erosion and damages. Dredging may cause adverse environmental impacts, although the extent of the biological impacts and their significance is unknown. Urban-industrial encroachment and the use of land for various types of transportation cause problems of access to the shoreline and recreation areas and conflicts with other potential uses. Increased diversion of Lake Erie water may be necessary to augment flows in the New York State Barge Canal.

Institutional and Financial Issues

There is a lack of enforceable control regulations and funding for nonpoint source pollution abatement. There is inadequate funding to permit the acquisition of natural and scenic areas, wetlands, and other forms of open space.

Adverse Effects

Fluctuating lake levels hinder power plant operation, impede commercial navigation and recreational boating, damage fish and wildlife habitat, and increase economic losses and property damage as a result of erosion.

The water quality of Lake Erie and connecting waters is degraded by suspended solids, phenols, and oil. Pollution by municipal wastes has caused discoloration, sewage foam, and unpleasant odors. Industrial wastewaters containing oil and phenols as major pollutants degrade water quality by odor and color, taint fish flavor, strain gorge walls, inhibit recreation uses, and create health hazards. Degraded water quality lessens the scenic beauty of watercourses from odors created, discoloration, and foam.

Flooding damages urban and rural flood-plain development. Estimated average annual urban losses for 1980 in 1975 dollars are the following: Cattaraugus Creek--$193,000; Tonawanda-Buffalo Complex--$115,000; and Scajaquada Creek--$455,000 (Framework Study). Erosion of Lake Erie is causing property damage to developed areas. Dredging is required to maintain depths for commercial vessels. The average annual dredging volumes for Black Rock Channel-Tonawanda Harbor is 100,000 cubic yards (100 percent polluted); and for Buffalo Harbor the volume is 600,000 cubic yards (100 percent polluted). Dredging and open-lake disposal of sediments can temporarily disrupt the aquatic environment by increasing turbidity and covering some benthic organisms. Polluted sediments are contained in diked disposal areas.

Urban-industrial encroachment on land conflicts with other uses, including recreation, wetlands, natural and historic areas. The result is loss of valuable wetland functions, historical heritage lands, and

natural areas for open space enjoyment. Recreation uses are limited by degraded water quality which restricts body contact and taints fish flavor. Insufficient recreational facilities cause unsatisfied demands. Both limitations result in a loss to the tourist economy of the area.

Problem Area 24: Lake Erie

Description

A number of uses of Lake Erie must be considered with respect to the lake itself rather than with respect to any drainage basin. While some of the activities originate on the shore of Lake Erie, the use of the lake for these activities may not recognize the international boundary, nor the boundaries of the four States which abut the lake. Activities which utilize the lake as a whole are discussed in this problem area. The physical geography of the Lake Erie Basin, out of which has developed and on which has been superimposed a very high degree of economic development, has created some situations that are not unique to Lake Erie but are more aggravated than in the other Great Lakes. Lake Erie is the smallest of the Great Lakes in volume, with less assimilative capacity for pollutants. It has the second largest concentation of population along its shores, resulting in large inputs of polluting materials. Lake Erie is the most polluted of the lakes. Lake Erie has been a symbol of lake pollution and high eutrophication; however, the International Joint Commission has recently indicated that Lake Erie waters have improved in quality over the last few years.

Problems

Water Issues

Fluctuating lake levels have varying impacts on commercial navigation, hydroelectric power production, shoreline erosion and flooding, and wildlife habitat. Degraded water quality from municipal and shipping sources restricts uses for public water supply, recreation, and fishing.

Related Land Issues

Erosion and agricultural practices cause sedimentation and turbidity. Land-use activities negatively affects wetlands, estuaries, and ultimately, the quality of Lake Erie.

Adverse Effects

Lake Erie water levels have direct impact on hydroelectric power production in the Niagara River. Low lake levels reduce the amount of cargo that ships can carry. High lake levels accelerate shoreline and flood wildlife habitat, decreasing their productivity.

The most significant effects of discharges on the near-shore water quality of Lake Erie are higher concentrations of dissolved solids, turbidity, nutrients, bacteria, and algae. The eutrophic conditions of Lake Erie have caused excessive algal growths which interfere with water uses, including water supplies, aquatic life, esthetics, industrial uses, recreation, and shoreline property. The biota has undergone drastic changes and consists primarily of pollution-tolerant taxa. The fish population includes many species that were not of importance just a few years ago. Critical areas in Lake Erie include most of the western and central basins, including the areas adjacent to Detroit, Toledo, Cleveland, and Buffalo. Many harbors cannot support desirable life of any sort. Low summer oxygen levels in the bottom waters (hypolimnion) of the central basin have been concurrent with increasing algal growths, which indicate an accelerated eutrophication or aging of the lake. Since 1959, the area of observed anoxic layer in later summer has increased substantially, having been observed as large as 6,600 km^2 in 1970 and 11,600 km^2 in 1973.

The species composition has changed from one composed of economically desirable species to one dominated by less desirable species. Although the total commercial catch has remained constant, the value of the catch has decreased, and the large commercial fishery is not profitable. Depletion of oxygen in the hypolimnion may displace fish that require cool summer temperatures and may kill benthic organisms. Sedimentation may reduce reproductive success among fish species that spawn on the bottom.

Algae and other nuisance aquatic plants create problems when they accumulate and decompose at bathing beaches. Beaches become less desirable, and the tourist economy declines. Filamentous algae are a problem at the eastern end of Lake Erie. Unpleasant conditions limit boating opportunities and transfer demand in other areas. Attached algae foul docks, boat propellers, buoys, etc., thereby increasing maintenance costs.

Sediment accumulation can cover spawning areas and valuable fish food organisms. Sedimentation of spawning areas negatively affects commercial fishing success and decreases available fish stock for sport fishing.

Problem Area 25: Genesee River Basin

Description

The Genesee River Basin covers 2,749 square miles, almost entirely in western New York with a small portion (96 square miles) in northwestern Pennsylvania. It is roughly elliptical in shape, with a north-south major axis of approximately 100 miles and a maximum width of about 40 miles. The river rises in the Allegheny highlands in Potter County, Pennsylvania, at an elevation of about 2,500 feet and flows approximately 157 river miles in a generally northward direction to its mouth at Rochester Harbor on Lake Ontario.

Problems

Water Issues

Irregular water withdrawals from East Koy and Black Creeks reduce crop production when irrigation water is not available.

Related Land Issues

Structural flood-plain development obstructs flood flows, resulting in damages and economic loss. Rural flooding damages crops and delays production activities. Excessive sheet and bank erosion causes sedimentation problems, additions of phosphorus, and cropland loss. Sedimentation from erosion damages water quality and fish habitat.

Adverse Effects

Poor water quality resulting from inadequate treatment of municipal and industrial wastes, combined sewer overflows, and urban and agricultural runoff has limited potential recreational and fishing uses of water and has created health hazards. High bacterial counts near Rochester have resulted in closing public beaches. Structural flood-plain development is a major cause of urban flood damages, which are estimated to average $382,000 in 1980 in 1975 dollars. The estimated averages for Rochester are $92,000; Wellsville, $63,000; Black Creek, $38,000; Red Creek, $129,000. Flood damages to agricultural areas and losses due to delayed production activities because of wet soils are estimated to reach $523,000 in 1980. Excessive erosion and sedimentation result in increasing economic losses, including the loss of valuable farmland and property, and adverse effects on water quality, including poor esthetics and loss of fish habitat. Dredging may cause resuspension of toxic materials, smothering benthic organisms, and temporarily increasing turbidity. It also creates the problem of polluted dredged material disposal. A particular area of concern in Rochester Harbor, where an average of 360,000 cubic yards of bottom material are removed annually. Urban-industrial or agricultural encroachment causes many problems for recreation areas, such as overcrowding, limited access to water resources and hunting areas, and loss of wildlife habitat.

Problem Area 26: Greater Finger Lakes-Oswego River Basin

Description

The Greater Finger Lakes-Oswego River Basin Problem Area contains a system of lakes, canals, and other natural waterways that form a major system of drainage to Lake Ontario for a large area of central New York. The area covers 5,122 square miles. The Oswego River forms north of the city of Syracuse at the juncture of the Oneida and Seneca Rivers and enters Lake Ontario at the city of Oswego. The Oneida River drains

the eastern third of the basin, which includes Oneida Lake and its 1,300 square mile watershed. The Seneca River drains the western two-thirds of the basin, which includes the Finger Lakes.

Problems

Water Issues

There is no coordinated management program for the optimum regulation of lake levels and flows in the Finger Lakes-Oswego River system.

Related Land Issues

Urban flood-plain development results in property damage and economic loss due to flooding. Rural flooding causes valuable cropland loss and decreases crop production. Bank erosion causes property damage to urbanized areas.

Institutional and Financial Issues

Inadequate funding at the Federal and State levels does not permit the acquisition of natural and scenic areas, wetlands, and other open space and recreation areas.

Adverse Effects

Proposed use of various water bodies for cooling water sources and heat sinks for thermal electric generating stations has raised concerns over the effects on water quality. Poor water quality is caused by inadequate municipal and industrial waste treatment, land runoff, and chemical discharges. The results include limited swimming and fishing opportunities, polluted public water supplies (i.e., Oneida Lake), loss of waterfowl and fishery habitat, and eutrophication.

Uncontrolled flood-plain development results in continued economic losses, the average annual loss being $1,176,000 in 1980, in 1975 dollars. Also, flooding of agricultural land results in loss of valuable cropland and crop production. Erosion and sedimentation from urban and agricultural areas, including streambank and sheet erosion, contribute to stream sedimentation loads, degrade water quality, created property damage to urban areas, and affect agricultural production.

Dredging, which creates the problem of dredged material disposal, may cause resuspension of toxic materials and cause smothering of benthic organisms and temporary increases in turbidity. Disposal practices may result in the loss of fish and wildlife habitat. Recreational, urban, and agricultrual land uses often conflict with natural land values; the land uses sometimes cause environmental problems and increase the costs of providing public services.

Water resources available for recreational use remain inaccessible for public use in many areas, while other areas are overcrowded. Also, flooding damages and poor water quality reduce opportunities for recreation, fish, and wildlife (i.e., Lake Onondaga has high chlorides restricting fish quality). Loss of wetlands decreases habitat, open space, and natural areas and destroys their capacity to regulate water quantity and quality.

Problem Area 27: Lake Ontario Lake Plains

Description

The Lake Ontario Lake Plains are composed of a number of river basins located along the southern shore of Lake Ontario. The Lake Plains area, which consists of three parts, occupies 2,862 square miles of land. The first part is the western portion and includes parts of Niagara, Genessee, Monroe, and Orleans Counties. The second part is the middle portion and includes parts of Monroe (eastern portion), Wayne, Ontario, Cayuga, and Oswego (western portion) Counties. Part three is the easternmost and includes Oswego County (eastern portion) and parts of Jefferson and Lewis Counties.

Problems

Water Issues

In Nigara County, extreme low flows in streams tributary to Lake Ontario (except for those augmented with Barge Canal waters) limit the capacity of these streams to assimilate wastes. Inadequate sewage and industrial waste treatment degrade water quality in many of the rivers and creeks.

Related Land Issues

Erosion causes sediment problems which inhibit the use of water and damage property. Rapid housing development along the Lake Ontario shoreline restricts other uses and creates conflicts.

Institutional and Financial Issues

Inadequate funding at the Federal and State levels does not permit the acquisition of natural and scenic areas, wetlands, and other forms of open space.

Adverse Effects

Inadequate treatment of municipal and industrial (food processing) wastes has caused significant water quality deterioration. Poor water

quality has caused algae blooms, health hazards, poor esthetics, and the closing of beaches, thus limiting fishing and recreation opportunities. Areas of concern are: Oak Orchard Creek (low dissolved oxygen, high nutrients); West Branch of Sandy Creek (high bacteria, high BOD, low dissolved oxygen); Niagara and Monroe County beaches (high bacteria and massive algae growths). Sheet, bank, and shoreline erosion and sedimentation (Sodus Bay area) have caused property damage, degraded water quality, limited fishing and recreation opportunities, and have created the need to dredge the New York State Barge Canal. Shoreline development often results in loss of public access, wetlands, and natural and scenic areas. Economic pressures are causing farmers to sell valuable agricultural land for suburban developments.

Problem Area 28: Black River-St. Lawrence Complex

Description

The Black River drains an area of 1,961 square miles in north-central New York State and is a major tributary of Lake Ontario. This basin occupies parts of five counties: the majority of Lewis, a narrow belt across Jefferson, the northern end of Oneida, and large parts of the northern sections of Herkimer and Hamilton. To the north and east of the Black River Basin lies the St. Lawrence Basin, which has an area of 5,821 square miles and includes all New York State streams draining into the St. Lawrence River. These include the Oswegatchie, Grass, Raquette, St. Regis, Salmon, and Chateaugay Rivers. The basin extends from Cape Vincent and the Thousand Islands in Jefferson County on the southwest into Clinton County on the northeast. It includes all of St. Lawrence County, most of Franklin County, and parts of Clinton, Essex, Hamilton, Herkimer, Lewis, and Jefferson Counties.

Problems

Water Issues

Inadequate treatment of both municipal and industrial wastes in urban and rural areas degrades water quality. Minor, but troublesome oil spills have occurred, and the potential remains for a major spill in the St. Lawrence River.

Related Land Issues

Flood-plain development significantly increases flood damages. Rural flood-plain damages affect pasture for dairy activities and cropland. Year-round, large-scale commercial navigation of the St. Lawrence Seaway poses a number of environmental concerns. Large-scale steam electric generating plants (nuclear or fossil fuel) along the St. Lawrence River may raise concerns about thermal and esthetic pollution, radiation hazard, and access to the river.

Institutional and Financial Issues

Inadequate land-use planning results in continued developmental pressure on agricultural lands and environmental areas, strip developments, and other problems. Inadequate funding at the Federal and State levels does not permit acquisition of natural and scenic areas, wetlands, and other open space.

Adverse Effects

Extreme low flows on inland streams cause water quality problems and impair esthetics, boating, and fish and wildlife habitat. Inadequate municipal and industrial (paper mills) treatment, septic tanks, and other sources contribute to water quality degradation, causing standards for dissolved oxygen, bacteria, and nutrients to be exceeded in localized areas. Uses for water supply, recreation (body contact), and fish and wildlife habitat are limited. Urban flooding has damaged private properties, while rural flooding has resulted in crop damages and losses of valuable agricultural lands and soils. Sedimentation has caused a loss of valuable agricultural lands and fish and wildlife habitat, turbidity, and smothering of benthic organisms and spawning areas. Land-use conflicts have resulted in loss of wetlands and natural and scenic areas. Use conflicts also have rendered various water recreation resources inaccessible or overcrowded.

Summary

The Great Lakes Region is about 4 percent of the land area in the 48 contiguous United States, but supports 14 percent of the Nation's population. Half of the steel-producing capability of the Nation, a large portion of its petroleum-refining capacity, and extensive manufacturing facilities for chemical and food products are located in the Great Lakes Basin. The Great Lakes Region supplies a wide range of resources which play a vital role in sustaining the Nation's economy. The five Great Lakes provide an important and vital navigation route for transporting iron ore, agricultural products, and finished industrial products throughout the major metropolitan regions of the Great Lakes. The lakes also support an enormous demand for recreation surface-water uses, including recreational boating, fishing, swimming, hiking, and camping. The lakes also provide valuable and necessary supplies of fresh water to the region's people and industries.

Most of the water withdrawn from the Great Lakes hydrologic system comes directly from the lakes. The largest amount goes to cool steam electric generating plants. While the overall water supply in the region is abundant, there are short-term problems with ground-water depletion in localized areas and severe droughts in inland portions of Michigan, Minnesota, and Wisconsin.

The major water resource issues in the region include water quality problems, erosion and sedimentation, flooding and land-use conflicts, and localized water supply and instream flow problems.

Water quality problems abound, especially in and near highly urbanized areas. Water quality concerns include toxic materials, eutrophication, and visual problems that limit the use of water not only for economic purposes but also for recreation and wildlife habitat. Flooding and erosion have resulted in significant economic damages and have caused concern about flood-plain and coastal land use in the Great Lakes. Erosion and sedimentation have caused reductions in the potential for agricultural production, impaired water quality, and reduced the esthetic and environmental attributes of streams and rivers throughout the basin.

Conflicts are increasing between those who desire greater access to the environmental amenities of the Great Lakes and those who desire to live in relative harmony with the areas without the disruption that greater access may cause them. The diversity of Great Lakes Basin residents and resources has raised concerns over how to identify true public interests. There is a need for involvement of the diverse public interests in all phases of public and even private programs that relate to the region's water resources. Significant efforts have been made to involve local communities in the many public programs in the water-resources field; however, further efforts need to be made in this regard.

Conclusions and Recommendations

The goal of the national assessment, especially in the regional analysis, is to recommend activities, including planning, management, and research, necessary to resolve the problems which have been identified. This section summarizes some of the major recommendations developed in the conduct of the regional assessment as it pertains to the Great Lakes.

Federal Role

The strong emphasis on structural solutions to water problems should be reevaluated where feasible solutions may be available through nonstructural programs. Also, greater consideration of the importance of good operation and maintenance of facilities is needed to assure that none of the investments made are wasted.

Further steps need to be taken to eliminate duplication of efforts in the Federal programs. Coordination is needed in arranging the variety of existing water resource programs into an understandable and streamlined approach to water resource problems.

Continuity in the Federal grant program for municipal waste-water treatment plants is essential to assure needed cooperation among communities. In addition, funding of 208 areawide waste-water management planning activities should be continued and increased in order to update plans and manage water quality at the local and State levels rather than at the Federal level.

Planning

Utilizing criteria from the Water Resources Council's proposed guidelines for regional or river basin (Level B) planning, the following activities have been recommended:

Great Lakes Environmental Planning Study. This study looks at the entire Great Lakes as a complete water resource system and analyzes the effects of human and natural activity on the Great Lakes water supply and water quality. Work is currently underway on this special study.

Great Lakes Regional Water and Energy Study. This study addresses the ultimte fate of various bioactive pollutants once they have entered the lake systems, and it focuses on the biological uptake of pollutants and the long-term availability or reactive life of their various constituents.

Regional Interrelationships. A study is suggested to look at the specific interactions between the Great Lakes Basin and the rest of the world with respect to outside influences that affect the water resources of the region and how these interrelationships affect Great Lakes planning and study activities.

Data and Research

The following research and data needs have been identified:

Tracing Bioactive Pollutants from Courses to the Lakes. This study examines the various transport mechanisnms of pollutants from human and natural systems as well as chemical, physical, and biological changes which occur during their transport from land to water. Research would focus on nutrients, heavy metals, and refractory organics.

Fate of Bioactive Pollutants Within the Lakes. This study adresses the ultimate fate of various bioactive pollutants once they have entered the lake systems, and focuses on the biological uptake of pollutants and the long-term availability or reactive life of their various constituents.

Effects of Suspended Pollutants on Biota and Food Chain of the Great Lakes. Research should address the effects pollutants have on biological organisms, particularly fish and plants which are common to the Great Lakes, and especially on organisms that are used for human consumption.

Land Use and Resource Surveys. Complete soils, water resources, geological surveys, and land-use information are needed on hydrologic, county, and State bases. This is particularly important in areas such as wetlands where improved mapping and inventory data are essential.

Inventory of Elements Hazardous to the Public and Environment. Continuation and expansion of basic data and applied research studies concerning hazardous substances are important. Such efforts include a broadened scope for periodic chemical examination of public water supplies, studies addressed to determining effects of hazardous materials on plant and animal life, and environmental surveillance of particularly hazardous materials such as radioactive elements in the environment.

Pollution Sources and Management. Low-cost waste-water treatment and on-site disposal systems in problem soils need to be studied from both a research and a developmental viewpoint. Also, increased emphasis on research and professional training in solid and liquid waste management is desirable. This also includes continued studies to determine efficient means of waste-water sludge disposal.

Ground-water Quality/Quantity Issues. The present ground-water quality monitoring system needs to be expanded. In addition, digital mode studies of aquifers and an accelerated series of county ground-water studies are needed.

Surface-water Quality/Quantity Issues. Long-range continued support for lake quality researching and demonstration studies are needed. Expansion in the data gathering network is also recommended to collect more information on hydrologic and limnologic characteristics of small streams, rivers, and lakes. Generalized hydrological and limnological models need to be developed to assist understanding and management of water quality/quantity concerns.

Institutional Arrangements

Flood-plain Management. A strategy for authorization of a comprehensive flood-plain management program (nonstructural and structural) is needed with a view towards Federal funding and assistance to States and/or other non-Federal entities. This strategy would address the many separate Federal and non-Federal programs, for which there currently is no process for overall planning and implementation.

Mineral Resources. A mineral resources policy should be adopted to consider the uniqueness of mineral deposits for their proper identification, preservation, and development. Furthermore, a mine reclamation bill similar to that passed for metallic minerals, needs to be developed for nonmetallic minerals.

Recreational and Natural Areas. Federal studies should be conducted on an interagency basis to determine potential future recreational land development sites. In addition, increased public, official, and citizen awareness should be enhanced concerning natural areas and features of scientific and educational interest.

Agriculture and Forestry. Provisions should be made for planting appropriate vegetation stock on urban and suburban projects. Tax law revisions or relief programs are needed for private owners to encourage preservation and protection of natural and potential agricultural and silvicultural areas. General cooperative programs need to be developed providing technical assistance, cost-sharing, and incentives to assist agricultural and silvicultural operators in preserving their lands and meeting environmental quality control guidelines.

Water Quality. Legislation is needed to provide environmental fees needed to administer water pollution control programs. Efficient monitoring and enforcement of water-quality laws require expanded use of areal thermosensing to detect discharges into streams, along with continued work on developing mixing zone criteria.

Land Resources. USGS topographical mapping needs to be accelerated, as does the development of a wetland classification system that protects specific wetlands in accordance with national, State, and local goals and priorities.

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