



Technical Report No. 24

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THE EVOLVING ROLE
OF THE FEDERAL GOVERNMENT
IN THE MANAGEMENT OF LAKE MICHIGAN

By

WILLIAM L. JACKSON

School of Natural Resources
The University of Michigan

May 1972

Sea Grant Technical Report No. 24

MICHU-SG-72-209

The University of Michigan Sea Grant Program

The University of Michigan Sea Grant Program is a part of the National Sea Grant Program, which is maintained by the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce.

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ABSTRACT

Lake Michigan is one of the most valuable of the nation's water resources. As demands upon its various uses increase, the need for the coordinated and comprehensive management of its resource uses intensifies. Identified in this report are ten major human uses of Lake Michigan in need of more comprehensive public management, and the federal government's role in the comprehensive management of these resource uses is described. Basic federal activities in the areas of policy, planning, implementation and regulation, and review are described as they relate to the nation's water resources, in general, and to Lake Michigan, in particular. Trends in the development of the federal role in each of these areas are described.

PREFACE

This paper was developed while I was employed as a research assistant for the University of Michigan Sea Grant Program. This program, by fostering a broad range of research in a number of disciplines, aims to develop a systematic plan for comprehensive Great Lakes resource management. It is funded by the National Oceanic and Atmospheric Administration and the University of Michigan.

I would like to thank Dr. J. W. Bulkley in the School of Natural Resources at the University of Michigan for the personal guidance he gave in developing my graduate program, in supporting my employment in the Sea Grant Program, and in directing the development of this paper. I would also like to thank Dr. D. C. Chandler, director, Great Lakes Research Division for his time and help in serving on my thesis committee.

Great appreciation must also be expressed to Mr. David Robb of the Great Lakes Basin Commission, who offered many hours of his time in helping me develop my understanding of the concepts of water resource management, and who contributed significantly to the evolution of this paper.

RESEARCH FRAMEWORK

This report has been prepared by Mr. William Jackson for the Public Policy and Institutional Interaction Project of the Sea Grant Program at the University of Michigan. This research project is directed toward developing effective means and mechanisms for formulation and implementation of comprehensive resource policies for the Great Lakes. Mr. Jackson's investigation represents an initial examination of the role of the federal government in the development of water management for Lake Michigan. The research investigation began with an examination of the Lake Michigan Enforcement Conference as an institution of public policy formation. The limited scope of the Lake Michigan Enforcement Conference led to an examination of the role of the federal government in the specific field of water quality.

Mr. Jackson has provided a valuable baseline survey of comprehensive resource management for Lake Michigan. His report examines the variety of uses for which the lake resources may be utilized. The report identifies the need for comprehensive resource management in view of the legitimate but conflicting uses of the lake's resources. Next, the report provides guidance on the aspects of comprehensive resource management, which includes policy, planning, implementation, and regulation, and finally review. Mr. Jackson has made a systematic, thorough, and most capable investigation of his research topic. Accordingly, it is anticipated that this report, together with those

which will follow it, all will contribute to the goal of developing more effective resource management within the Great Lakes.

Jonathan W. Bulkley, Associate Professor
Project Director, Public Policy and
Institutional Interaction

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INTRODUCTION

Lake Michigan is one of the most beautiful bodies of fresh water in the world.¹ In its deep blue waters are stored the emotions, the thoughts, the fears, the love, the respect, and the joy of all who have experienced, first hand, this great physical wonder. Its mood, whether one of violent anger, strength, joy, peace, or sorrow, is easily communicated to a receptive mind. It makes one wonder--does the lake give moods to people, or do people give moods to the lake? The answer lies in its depths, and therein lies its beauty.

Lake Michigan is more than beauty, it is life in its highest form. Its water relates to and reacts with the land and the sky to provide a habitat for countless numbers of plants, mammals, fish, reptiles, birds, insects, and bacteria. Around its shores reside over 15 million people, each of whose life depends upon and relates to the massive environmental system that is the Lake Michigan resource.

People, unlike virtually every other living thing in the Lake Michigan basin, contribute nothing of positive importance to the grand ecological systems that are naturally Lake Michigan's. Instead, in the process of using the lake for their own needs, they deplete or upset the lake's natural existence, which, in turn, decreases its usefulness as a source for the fulfillment of human needs.

Evidence of human impact is everywhere. Cladophora, a stringy alga not naturally abundant in the lake, can now readily be found clinging to rocks in its southern waters. A beach in Hammond, Indiana,

must be closed to swimming. A lifeguard in Grand Haven, Michigan, must regularly rake dead alewives from the public beach. State parks in Michigan turn visitors away by the thousands every summer. DDT is found in the fatty tissue of the lake's coho salmon, while the lake trout are rarely found at all. The people, over 15 million of them,² have access to only 15% of "their" lake.

To state it more simply, Lake Michigan has been poorly used. It has not been purposely abused as much as it has been inexcusably and senselessly ignored. The lake has not been consciously managed for what it is--a physical and biological resource system offering a myriad of interdependent and conflicting uses. Instead, each of its uses has been developed primarily for single purpose economic gain. Much, in the positive sense, has come from this resource use development. This cannot be argued. What can be argued is that the past development and management of Lake Michigan, for human use, has resulted in many failures.

The most obvious failure is the pollution that threatens the lake's condition as we know it. Also, there has been discrimination in the distribution of its benefits and costs, a remarkable indifference to life forms other than our own, a failure to promote many of its non-economic social benefits, a failure to respect the future needs of the basin's inhabitants, and a failure to understand the interdependent nature of the various uses of the lake.

Management of Lake Michigan's various resource uses has been unsuccessful, as evidenced by the failures just mentioned. This management has failed primarily because it has not been comprehensive in its nature. Comprehensive management is management that considers

the lake as a complex ecological system offering many legitimate conflicting and interrelated resource uses. It is a management that develops these uses for the economic, social, and spiritual enrichment of human life, and respects the lives of other animal and plant species.

Recently, the need for the comprehensive management of all of our nation's water resources has been more widely recognized. There has been a response at all levels of government as well as in many private sectors. The rise of the federal government's role in the comprehensive management of the Lake Michigan resource will be described. The lake and its human uses will be discussed, and the arguments for the need for comprehensive management will be further developed. Also, the various components of a comprehensive management program will be outlined and the developing federal role in each of these areas will be discussed.

Because of the relative breadth of the subject matter, the following discussion must necessarily be somewhat of a general overview. Still, while reading, it must be remembered that the federal role is only one role in a management effort that, in the case of such an interstate body of water, includes federal, state, interstate, and local governments, private groups and interests, and even international participation. So, while the subject matter covered will, in one sense, be quite broad, it will, in another sense, be quite narrow.

It is hoped that by reading this discussion, a more thorough understanding can be obtained of the role of the federal government in the comprehensive management of Lake Michigan. While the federal role is only one part of the total management spectrum, it is the component

which determines the framework within which all other management activities take place. By understanding the past development of the federal role, and by examining the apparent direction of this role's future development, it is possible to obtain a more accurate perspective on the purpose, the role, and the futures of all other Lake Michigan resource management components.

LAKE MICHIGAN: A PHYSICAL DESCRIPTION

A. Size

With 1,100 cubic miles of water, Lake Michigan is the fourth largest body of fresh water in the world.³ Its surface area is 22,400 square miles and its deepest point is 930 feet. The lake drains 45,500 square miles of adjacent land. This drainage basin runs 350 miles north and south and 270 miles east and west. Sixty-four percent of this adjacent land is in Michigan; 31%, in Wisconsin; 5%, in Indiana; and 0.2%, in Illinois.

B. Geology

Lake Michigan, in its present form, has been in existence for about 10,000 years, and possibly even less. This is the length of time that has elapsed since the retreat of the last continental ice sheet, which, in combination with three previous ice sheets and subsequent weathering, formed the lake and its drainage basin. The lake itself is divided into two basins, a southern basin, with a maximum depth of 535 feet, and a northern basin, with a maximum depth of 930 feet. A comparatively shallow ridge runs from Grand Haven, Michigan, to Milwaukee, Wisconsin.

The surrounding land is characterized by numerous glacial lakes and moraines, but has fairly low relief. The northern portion of the basin is in contrast with the southern portion in several ways. The north is generally higher in elevation, more rugged, and more heavily

forested. The south is more rolling, with less prominent glacial features. Extensive sand dunes are located along most of the lake's eastern shore.

C. Hydrology

Lake Michigan is a part of the immense Great Lakes hydraulic system. Its lake levels and flows increase and decrease in response to the amount of water being supplied to the basin. Some basic hydrologic data are given in Figure 1. The fluctuating lake levels, while

Average Annual Precipitation - - - - -	31.08 in.
Average Annual Evaporation - - - - -	26.00 in.
Average Annual Natural Outflow - - - - -	117 bgd.
Highest Monthly Mean Elevation - - - - -	582 ft.
Lowest Monthly Mean Elevation - - - - -	575 ft.
Mean Elevation - - - - -	578.7 ft.

Figure 1--Basic Hydrologic Data for Lake Michigan⁴

important to the ecology of the lake's shallows and marsh areas, cause some problems. High water levels greatly increase shoreline erosion and low water levels necessitate a decrease in the tonnage that can be loaded by commercial ships at most of the lake's ports.

The lake's circulation is characterized by (1) deep, vertical mixing (turnovers) during the fall and late winter, when the water density is homogeneous, and (2) by surface circulation and limited vertical mixing in the spring and summer, when water temperature is stratified. The stratification of spring and summer water is in three layers. The bottom layer is heavy and cold ($\leq 39^{\circ}\text{F}$). The middle, thermocline area is characterized by rising temperatures with decreasing depth. The top layer is a light, warm, thin surface layer. The major

driving forces for the lake's circulation, in addition to temperature, are the wind and the Coriolis forces.

D. Climate

Lake Michigan is entirely within the northern temperate zone. Cold, snowy winters, and warm, humid summers are typical. The climate of the region is greatly influenced by the presence of the lake. Its waters moderate temperature fluctuations of the nearby land, and its evaporation, combined with a warming of westerly winter winds, results in heavy snows on the Michigan side of the lake.

LAKE USES IN NEED OF COMPREHENSIVE MANAGEMENT

Any management structure or institution designed to develop, maintain, and distribute the physical, biological, and social resources of Lake Michigan must be primarily concerned with these ten specific resource uses: drinking water, commercial shipping (including harbor maintenance), fisheries, industrial water supply, waste disposal, recreation, wildlife, scenery and aesthetics, shoreline, and thermal coolant.

A. Drinking Water

Over 1.5 billion gallons of Lake Michigan's water are treated daily (2,320 cfs) to be used as drinking water in fifty separate municipalities.⁵ Over two-thirds of this total is utilized by the city of Chicago. Grand Rapids, Michigan, is another major user. It is anticipated that the demand for Lake Michigan waters for municipal uses will triple by the year 2020.⁶ An increase in population, an increase in per capita water consumption, and an increase in the number of communities obtaining water from the lake will all contribute to this threefold increase in the use of Lake Michigan for municipal water supply.

Deteriorating water quality has resulted in rapidly increasing costs for treatment of lake water for drinking. Chicago, for example, has encountered nearly a 40% increase over ten years in the amount of money spent, per million gallons treated, for activated carbon,

chlorine, and coagulants.⁷ Notable increases in the intake water of coliforms, fecal streptococci, odor, ammonia nitrogen, phenols, and phosphates account, in part, for this cost increase.

The major federal agency concerned with municipal water supply is the Environmental Protection Agency (EPA). They inherited this responsibility, which was formerly that of the Federal Water Pollution Control Administration (FWPCA) in the Department of the Interior, in 1970.

B. Commercial Shipping

Lake Michigan, since the completion of the Saint Lawrence Seaway, is an important navigable waterway for national and international shipping. Annual commerce on Lake Michigan is approximately 70 million tons.⁸ Major commodities transported are iron ore, coal, gravel, and grain. Important ports are Calumet and Indiana harbors, Milwaukee, and Muskegon.

The economic importance of commercial shipping is virtually immeasurable. Its general importance was described by the COSREL Report.

Marine transportation is unmistakably the most efficient of the major positive uses of the coastal zone; it uses only one-half per cent of the national coastline, yet its annual gross economic activity may be equal to all other positive uses combined, it is possibly the most important single factor in the location and growth of 11 of our 13 largest cities, and it produces fewer use-conflicts than most other uses.

Despite its overwhelming economic importance, commercial shipping results in vessel pollution of harbor waters; disturbing of river, bay, and lake bottoms by dredging operations; single use access to the water; and occasional oil spills.

The role of the federal government in the business of commercial water transportation stems directly from the commerce, defense, and property powers it receives from the Constitution. It is empowered to regulate waters for purposes of interstate commerce, national defense, and navigation. Through the Army Corps of Engineers, piers, jetties, and wharves are constructed, and harbors are dredged and maintained. The U.S. Coast Guard in the National Oceanic and Atmospheric Administration (NOAA), aids in navigation, ice-breaking, and search and rescue missions.

C. Fishery

At one time a major industry on Lake Michigan, commercial fishing has deteriorated drastically since the early 1940s. The reason for this is that the lake's delicate ecological systems have been in radical states of disequilibrium because of the accidental introduction of exotic animal species. Oligotrophic lakes, such as Lake Michigan, have relatively simple predator-prey relationships. The introduction of the lamprey eel and the alewife resulted in the elimination of the lake's game fish (whitefish, trout) and the small herbivorous fish (chubs and perch), respectively. In addition, two important native fish, the lake sturgeon and the grayling, have been overfished to near extinction by commercial fishing. Whereas over 40,000 people were employed by the fishing industry in 1940, only a few hundred are so employed today. The lake's wounded fishery is now being managed primarily for sport fishing.

The federal role in Great Lakes' fisheries has not been a major one. The management responsibility of the lakes' fisheries is primarily that of the states. The major federal responsibilities in this area

are those of the Bureau of Sport Fisheries and Wildlife (BSFW). The BSFW is primarily research oriented. Among other things, it administers the Great Lakes' lamprey eel control program, and assists the states in programs to stock the lakes with sport fish such as coho salmon.

Important fish found in Lake Michigan are lake trout, smelt, whitefish, northern pike, yellow perch, coho salmon and chinuk salmon. Several native fish, whose existence is endangered, are lake sturgeon and the long jaw cisco.

D. Industrial Water Supply

The Great Lakes region is the largest industrial area in the United States. In 1960, over 40% of the nation's industrial output occurred in the Great Lakes region.¹⁰ The proximity of important manufacturing resources, the availability of cheap water transportation, and the abundance of fresh water to be used in industrial processes helps explain this industrial concentration.

The use of Lake Michigan water for such purposes as cooling, pickling, processing, and rinsing water approaches 4.25 billion gallons per day (6,574 cfs).¹¹ This volume is expected to triple by the year 2020. Indiana industries account for over three-fourths of this use. Primary industries in this area are steel, cement, chemicals, and petroleum products. Other important water-using industries (see Figure 2) are food products and paper production. Much of the water used by these industries is returned to the lake in a polluted state.

The federal government interjects its influence in a wide variety of ways into the nation's private industrial sector. Its role in areas directly concerning U.S. industry and water resource

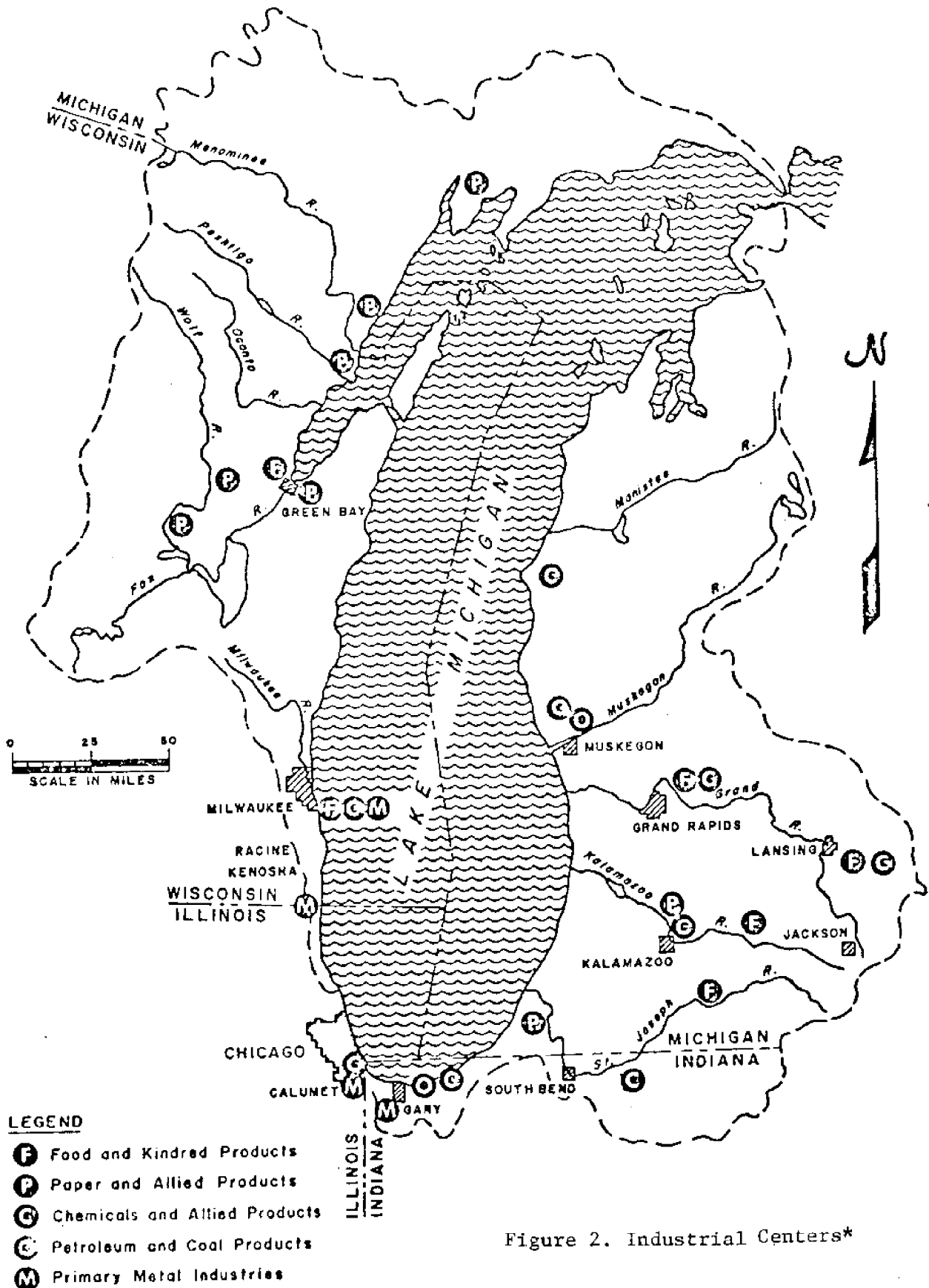


Figure 2. Industrial Centers*

* Taken from "Water Pollution Problems of Lake Michigan and Tributaries," Federal Water Pollution Control Administration, 1968, p. 6.

management is centered in the pollution abatement activities of the EPA. Efforts to attract industries, and responsibilities in locating them, have generally been those of lower-level governments.

E. Waste Disposal

Lake Michigan has always been a major receiver of numerous types of municipal, industrial, and agricultural wastes. Municipal wastes, when not adequately treated, are high in nutrients, especially phosphorus. Industrial wastes include oil, phenols, ammonia, cadmium, mercury, and cyanide in addition to such oxygen-consuming wastes as paper pulp and foodstuffs. Agricultural wastes include nutrient runoff and pesticides.

These wastes originate in all parts of the Lake Michigan basin and are transported by currents throughout the lake. While any body of water has a natural capacity to assimilate wastes, this capacity has been exceeded in parts of southern Lake Michigan, Green Bay, and Traverse Bay.

The results of excess pollution input into the lake are numerous. Premature aging, or eutrophication, may well be the most important problem resulting from water pollution. Oxygen depletion, radiation, toxic chemicals (including pesticides), oil slicks, and waste heat are also inputs that adversely affect the lake's water quality.

Again, federal responsibility for the abatement of water pollution is concentrated primarily in the Environmental Protection Agency.

F. Recreation

The Lake Michigan basin, especially Lake Michigan, itself, represents one of the major water-oriented recreation areas in the country. Swimming, fishing, boating, picnicking, and camping represent the area's major recreational activities. As population grows, and as the amount of leisure time for the average American increases, the demand for the lake's recreational resources will become even more intense.

Presently, only 4% of the lake's 1,661-mile shoreline has been developed into public recreation areas, and only 10% of the shoreline is public beach.¹² Most recreational facilities on the lake's southern half are used to capacity. Many, in the Calumet, Hammond, and Green Bay areas are closed because of pollution problems.

A study by the Bureau of Outdoor Recreation (BOR) shows that there are 80,000 summer homes, 200 private campgrounds, and 400 private group camps in the Lake Michigan basin.¹³ There are 625 federal, state, and local public recreation areas equal to 88,300 developed acres of recreation land in the basin. The BOR study estimates that to meet needs in 2010, 240,000 acres of intensively developed recreation land and 550,000 acres of extensively developed land will be needed.

Outdoor recreation is a sideline, or by-product, of the activities of several federal agencies, including the Army Corps of Engineers, but it is not their primary function. Federal agencies that are more directly involved in recreation are the National Park Service (Sleeping Bear and Indiana Dunes National Lakeshores), the Bureau of Sport Fisheries and Wildlife, and the Bureau of Outdoor Recreation (primarily a coordinating agency). Most recreation areas on Lake

Michigan are provided and managed by the states, counties, and municipalities.

G. Wildlife

Besides supporting a major fishery, Lake Michigan and its shoreline provide important habitats for numerous birds, mammals, reptiles, and migratory waterfowl. Nesting waterfowl common to Lake Michigan include the wood duck, the mallard, the blue-winged teal, and the ring-necked duck.

Lake Michigan's leeward (eastern) shore is a rare example of a "shifting dune" ecosystem. The progression from sterile sand to beach grass, to cottonwood, to pine, and eventually to a beech-maple climax occurs in only a few hundred yards. The variety of life systems in this habitat include animals as rare as the bald eagle, osprey, beaver, mink, otter, Kirkland's warbler, and greater sandhill crane to animals such as woodcocks, rabbits, black bears, squirrels, and deer.

Traditionally, federal laws dealing with wildlife have been primarily concerned with providing for research, forest land management, and increases in recreational opportunity offered by wildlife. Primary federal responsibility concerned with wildlife management is located in the Bureau of Sport Fisheries and Wildlife in the Department of the Interior.

H. Scenery and Aesthetics

Not only is it difficult to put a price on the scenic, aesthetic, and historic resources of the Lake Michigan basin, it is difficult to define what these resources are. Sunsets and wind could be included in this category. So, too, could the lake's moods, represented by

water color, wave action, visibility, sound, and temperature, and molded together by personal mood and experience. Sand dunes, beaches, forests, wildlife, city lights, fog horns, driftwood, beach grass, and sea gulls all represent resources of the highest scenic and aesthetic potential. Nobody in the federal government has been responsible for the management of this most precious Lake Michigan use.

I. Shoreline

The management, development, and use of shore areas has recently received attention as being a most important aspect of the management of a water body.¹⁴ Shore uses determine, to a major extent, water uses, pollution sources, public access, erosion, and the stability of shoreline ecology. Often, when a shore area is used for one purpose, it eliminates all potential for any alternative use.

The Lake Michigan shoreline is used for industry, recreation, cottages and homes, agriculture, primitive areas, metropolitan areas, harbors, electric power plants, airports, highways, sand mining, and marinas (see Figures 3 and 4). The use of the Lake Michigan shoreline has long been discriminatory in favor of the rich. At present, less than 15% of its shoreline is publicly owned. A major part of this public 15% is the Chicago waterfront.

Most major shoreline problems result from the absence of any comprehensive shore-use and development programs. Lake Michigan's shoreline has long been managed as private property on the open market. It has been subject only to local zoning, and development has long been oriented toward maximizing a locality's economic base. Local resources of importance or value to a wider segment of the public have not been managed as such. Only recently have the federal legislators

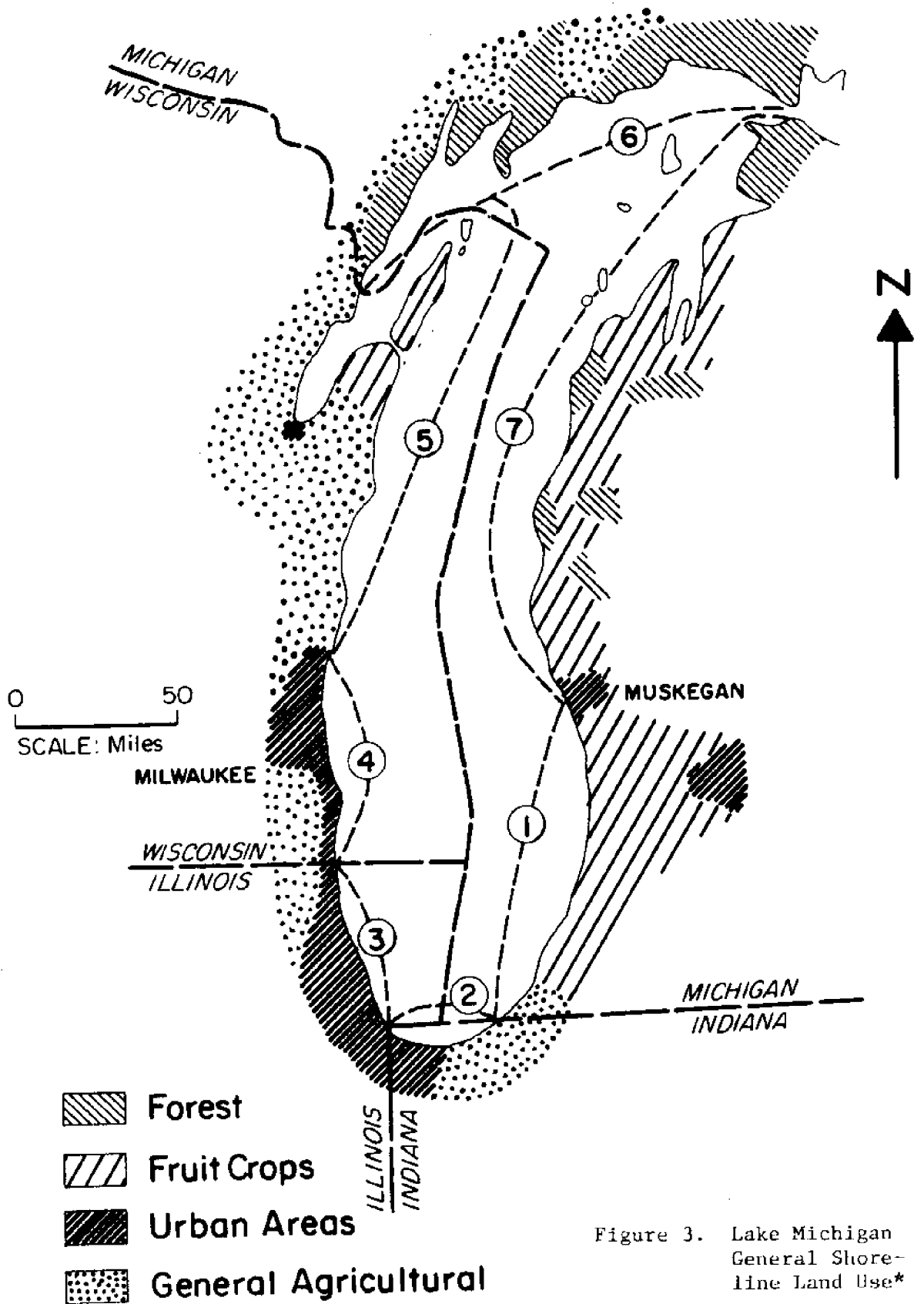
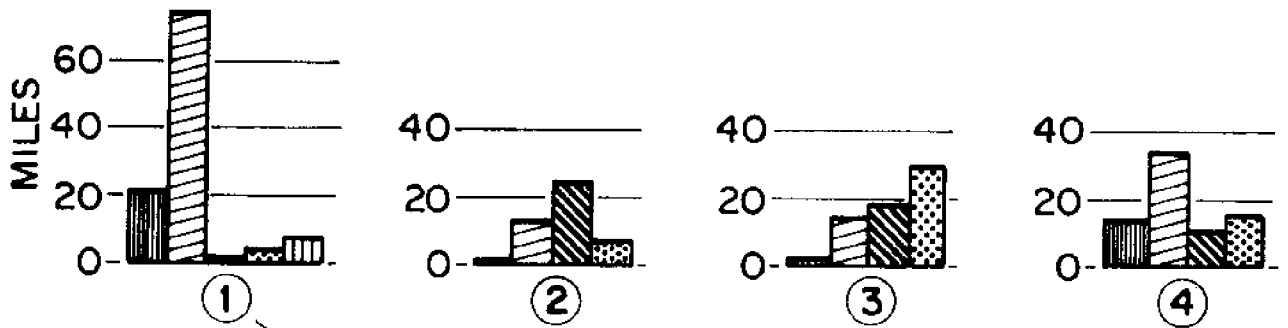
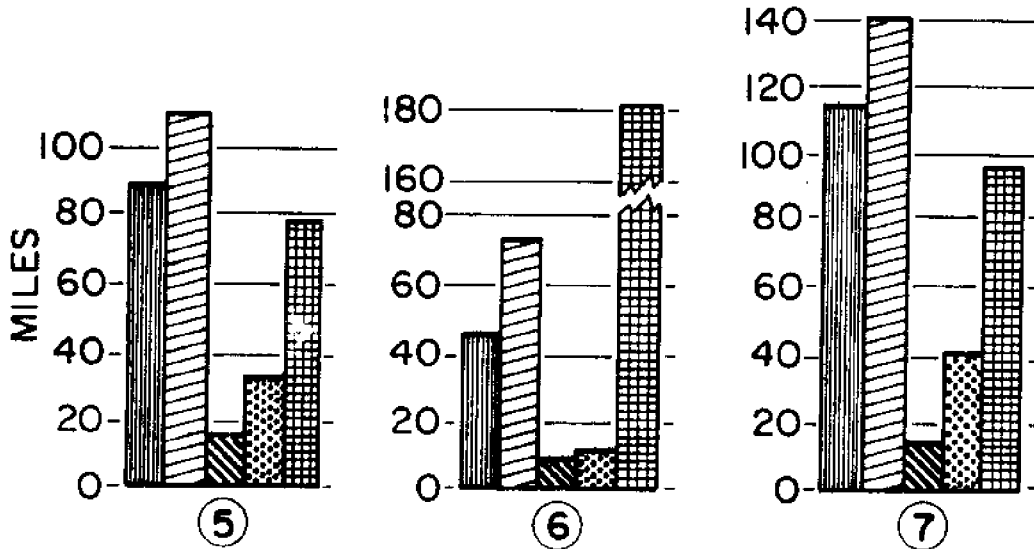







Figure 3. Lake Michigan General Shoreline Land Use*

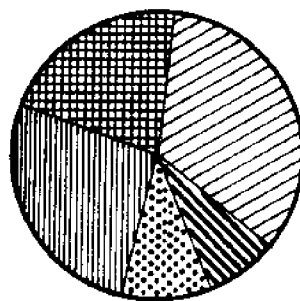
*Taken from the "Great Lakes Water Use Map," Canadian Department of Fisheries and Forestry, 1971.



Numbers refer to subsections on preceding map.



-  Forest
-  Agricultural
-  Recreational
-  Industrial
-  Residential



Percentage of Total Shoreline Land Use

Figure 4. Lake Michigan Shoreline Use in Miles*

* Taken from the "Great Lakes Water Use Map," Canadian Department of Fisheries and Forestry, 1971.

come to recognize this sorry fact.¹⁵ The present trend is to encourage the states to usurp some of the zoning and development authority of the local governments, so as to favor a more comprehensive, multiple-use concept in shoreline development.

J. Thermal Coolant

The Lake Michigan basin is an important area for the production of electric power. The area's large population and numerous industrial facilities require this power. Lake Michigan represents an "ideal" body of water to be used as condenser coolant for both fossil- and nuclear-fueled generating plants. For every kilowatt-hour of electric energy produced, from one to two times the equivalent amount of heat energy is dissipated by cooling water. The effects of this heat on the lake are not totally understood, but evidence indicates that too much heat could aid in the lake's eutrophication process, affect the reproduction and migration activities of fish, and break down some of the erosion protection offered by winter shoreline ice.¹⁶

In addition to problems of water heat, electrical power generation--especially nuclear-fission-type power generation--poses problems of radiation escape and land use. Present plans call for electric power production to increase more than ten times on Lake Michigan by the end of the century.¹⁷ Over 20 additional plants, approximately ten of which could be nuclear, will be needed in addition to the 29 power plants presently on the lakeshore (see Figure 5).

The four Lake Michigan states, under the encouragement of the Environmental Protection Agency, are presently setting a thermal discharge standard to apply to heat waste from power plants. In addition, the federal government is considering power plant siting legislation

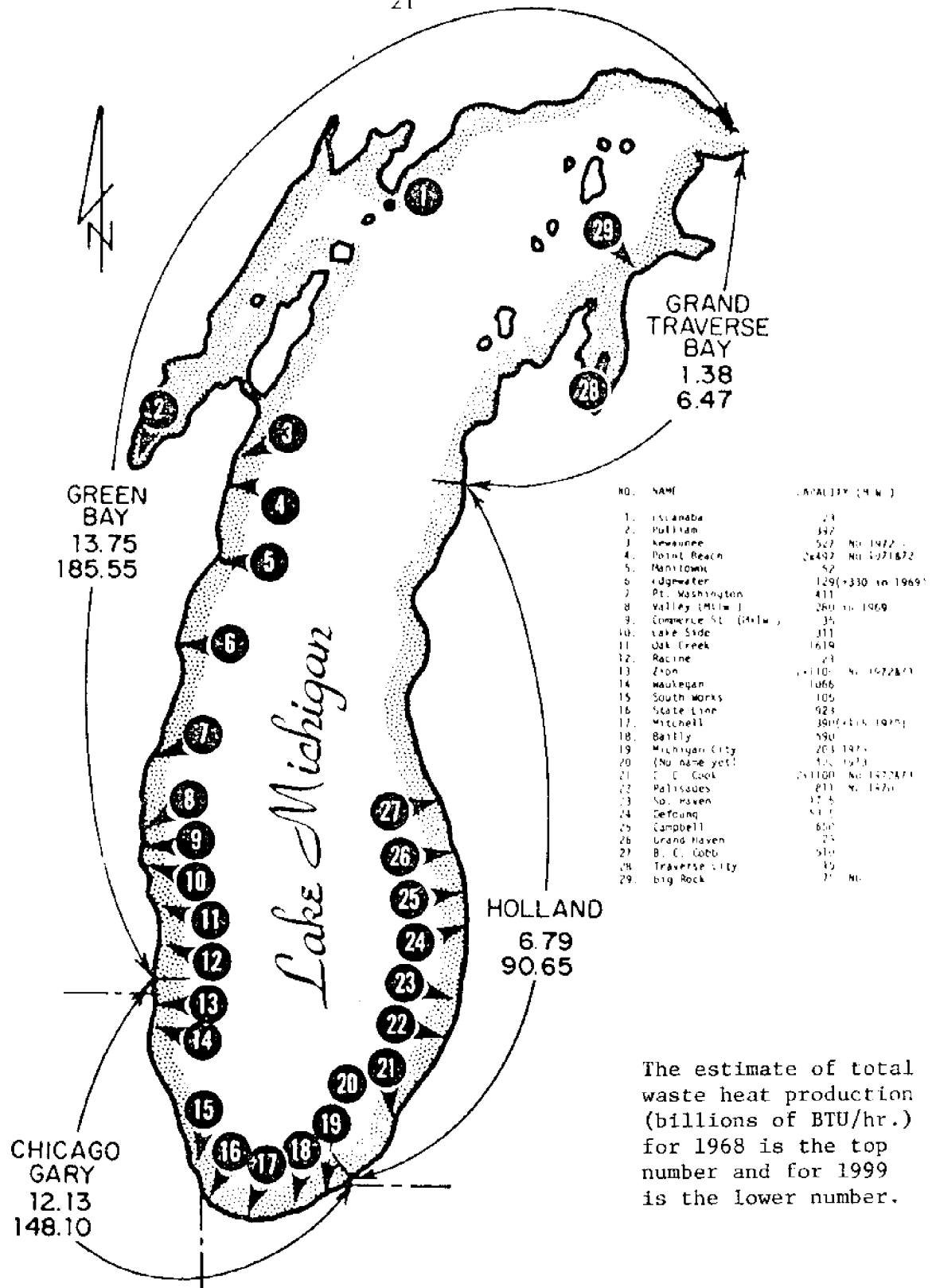


Figure 5. Existing Electric Production Facilities on Lake Michigan *

* Taken from The Physical and Ecological Effects of Waste Heat on Lake Michigan, U.S. Department of the Interior, 1970.

(S. 1684, H.R. 5277) to bring the process of power plant locating under close public scrutiny. At present, the Federal Power Commission (FPC) is the principal government agency concerned with making studies of electric power needs and cooling water needs, and it licenses all non-governmental hydroelectric power projects. The Atomic Energy Commission (AEC) is responsible for the licensing of all nuclear-powered generating installations.

THE NEED FOR COMPREHENSIVE MANAGEMENT

A. Multiple Use and the Private Market

Lake Michigan, while an abundant and precious physical, biological, and economic resource, should be respected as being finite in nature. There is a limit beyond which each of its ten resource uses cannot be developed. This limit can be purely physical or it can be relative in the sense that each resource use is a part of a continuum of conflicting resource uses. The more a particular use is developed, the less will be the opportunities for development on any other resource use. Eventually the social benefit to be gained by the further development of one resource use will be less than the opportunity lost for the development of another use.

While the demands on the resources of Lake Michigan are already intense, it is predicted that in 50 or 60 years

- the population of the basin will double,
- industry will expand six times,
- industrial demands for lake water will increase three times,
- municipal demands for lake water will increase three times,
- water recreation demands will increase three times,
- electric power production on the lakeshore could increase ten times.¹⁸

Before the demands for each of the lake's resource uses reached the intense levels that they have reached today, it was possible for the lake's relative physical abundance to serve as a buffer between

various uses. Each separate use could be developed freely for the positive benefits that it brought without regard for any limitations it might place on any other use. For practical purposes, the lake possessed infinite resource characteristics. However, while this condition has now changed, and as the lake's limitations have become visible, only small changes have been made in the way the resource is managed.

Probably the major reason for present-day problems resulting from man's development and use of Lake Michigan is his failure to recognize the lake as being an interrelated system of competing resource uses.¹⁹ His management of the lake has not been comprehensive, but rather, it has been fragmented and piecemeal. The lake's resource uses such as navigation, commercial fishing, electric power production, and waste assimilation have been treated as separate, independent uses of the lake. Separate federal agencies and separate federal legislation have been directed to each resource use area, almost always with the single purpose aim of helping promote the private development of that resource-use for its economic benefits. (A notable exception has been government involvement in water supply.) Each resource use has been managed as an economic, revenue-producing entity, not as a socially valuable component of a complex physical, ecological system.

When a physical and ecological resource is treated as offering several unrelated economic uses, its management generally becomes the responsibility of the private market system. If a resource use, such as waste assimilation, cannot be given a monetary value in the classic economic sense, it goes totally unmanaged. When such a resource use is limited in its capacity for exploitation, such as the lake's fisheries,

and when there is an economic investment in its development, the resource can be priced. It is then susceptible to management by the market system. In the most general sense, the resource uses of Lake Michigan have been either unmanaged or they have been managed by the private market system. Lyle Craine has proposed three important reasons why such an approach to resource management is unsatisfactory.²⁰

The first is the fact that many of the lake's resources have common property characteristics. This means that resources such as the water, fisheries, wildlife, and scenery are not the specific property or management responsibility of any group, or individual, or even state. They are owned by the public. They are, however, developed or exploited by private groups or individuals, each of whom has a narrow economic interest in the particular aspect of the public resource that he utilizes. There is, therefore, in terms of the free enterprise system, no motivation for comprehensive management of the resource. Even if there were, the physical size of many resources would make separate, private management virtually meaningless. When an economic input has such common property characteristics, public intervention, in addition to private market incentive, becomes necessary.

A second reason for the insufficiency of market system management, as described by Craine, is that many of the natural or developed resources of Lake Michigan are not divisible into readily marketable units to be priced and distributed according to traditional market practice. The lake's scenic and aesthetic qualities, and the quality of its water, cannot be valued and distributed to people willing to pay. Nor can they literally or morally be withheld from those unwilling or unable to pay. In simple terms, these are not outputs in

the usual production meaning of "output," and they cannot be classified as units of "supply." To attempt to do so can only result in a socially discriminating distribution of a natural and public resource. An example of a discriminating resource distribution is Lake Michigan's shoreline, where over 85% is owned and managed by well-to-do, private landowners and industries for use as industrial, commercial, or residential (cottage) sites.

A third reason, described by Craine, for the failure of resource management by the private market system is that there are various technical, ecological, and social externalities that are not accounted for by traditional economic theory. There are two classic examples of such externalities. The first is the pollution spillover from domestic sewage treatment plants, industries, land runoff, etc. The second is the discrimination in the distribution of benefits and costs of estuarine uses. Such discrimination occurs when artificial economic constraints, physical spillovers, or single-purpose resource use prohibits a member of the public from obtaining a benefit such as recreation or aesthetic viewing from a resource that is, by its nature, a public resource.

B. Public Management

The inability of the market system to effectively manage Lake Michigan as an interdependent resource which provides a multiplicity of competing resource uses, has left a void which necessitates comprehensive public management. To date, public management has not been adequate to meet the problems resulting from the resource use of Lake Michigan. However, it can be noted that public management is presently evolving in the development of its capacity to provide for comprehensive

management of Lake Michigan. This management should be more responsive to more broadly based public values and ecological needs than management practices of the past.

To date, public-sector involvement has been characterized by three fundamental shortcomings.²¹ First, there has been a fragmentation of responsibilities among different areas within government. Second, there has been a heavy dependency upon private enterprise and local government to develop goods and services from the Lake Michigan resource, consistent with a broader public interest. Third, there has been an inconsistency of the Lake Michigan problem area, or resource use area, to coincide with the arbitrary jurisdiction of governmental units.

Despite the fact that public management of Lake Michigan has been inadequate in the past, there is every indication that this situation is changing. The federal government has taken the initiative to lead the movement for better, more comprehensive management of our nation's water resources. The various aspects of comprehensive resource management will now be described. The recently evolving role of the federal government in each of these aspects will be discussed as it relates to the nation's water resources--of which Lake Michigan is a particular example.

C. Aspects of Comprehensive Resource Management

To adequately manage a resource such as Lake Michigan, the federal management system must be concerned with the following major areas: (1) policy, (2) planning, (3) implementation and regulation, (4) monitoring and review, and (5) knowledge. These areas need not only relate to each other (see Figure 6), but they should also relate

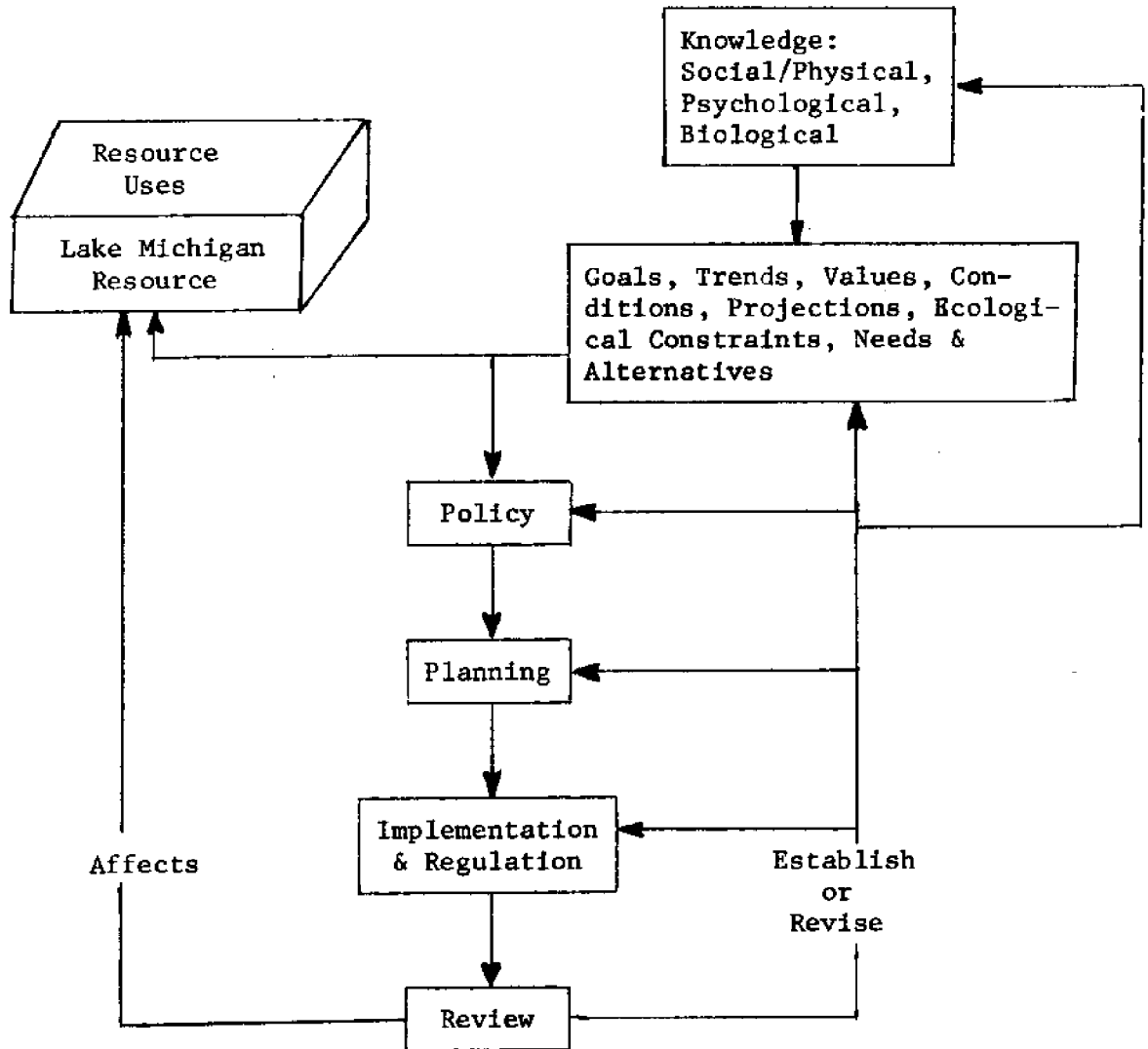


Figure 6. The state of the physical resource, in combination with the goals, values, needs, etc. of society must be related to each other to determine management policy. Planning delineates goals and policy and ways of achieving them. Plans must then be implemented, and the implementation should be enforced. The effectiveness of implementing a plan should then be determined--largely by its effectiveness in achieving stated policy. The entire system should be able to respond to this review.

to the basic problem at hand. This problem is to develop, maintain, and distribute the ten conflicting resource uses of Lake Michigan in a manner that is consistent with nature and with the values and goals of society.

ASPECTS OF COMPREHENSIVE RESOURCE
MANAGEMENT: POLICY

A. General

It has been a rapidly advancing scientific, technological, and industrial society that has contributed greatly to modern man's ecological crisis; it is this same technology that has provided many of the benefits of his way of life. It has relieved many from the necessity of devoting the entirety of their time to activities assuring a subsistence level of living. In addition, technology offers at least a potential for greater diversity in opportunity and in life style.

Modern man, whether voluntarily or not, has built himself into this scientific and technological culture. He cannot abandon it. He cannot reject it nor should he permit himself to be controlled by it. He can, however, direct this advancing science and technology to fit his cultural, social, material, and biological needs. He can develop his science and technology in accordance with what he wants and with what nature needs. He can develop sound ecological and social policy.

The policy-making process, as defined by Lasswell and Kaplan, refers to the "formulation, promulgation, and application of identifications, demands, and expectations."²² Stated more simply, policy making is the process of deciding upon what one wants from among a variety of attainable alternatives. It is the most basic management component, the one which gives fundamental directions and purpose to all other management activities, and the one component which is often the most inadequately developed.

Policy making involves a stating of fundamental goals and values. These goals should not be stated in abstract, conceptual terms, but rather in operational terms--terms which offer concrete directions to planners and implementors. Goals should be considered in the light of existing and projected social and physical conditions and trends. Policy making necessitates being able to determine not only what a heterogeneous society wants but what it needs and what it should want. As omniscience is a scarce commodity, policy making often relies on a series of educated guesses. None the less, if a resource is to be managed, it is necessary to determine for what, correctly or incorrectly, it is to be managed.

Lake Michigan is such a resource in need of a management policy. This policy should accept the entire lake resource as consisting of at least the ten previously mentioned resource uses--all interrelated, all limited, and all important. Such a policy should be concerned with managing the lake as a precious physical, ecological, resource which, if properly used, can be a means of attaining wise social goals.

Federal policy is formulated in many ways. Specialized agency policy is often formulated within the agencies. Individuals, such as the president, as well as consultants and advisory committees are also involved in federal policy making. To date, however, the most significant federal policy in the area of comprehensive water resource management has been expressed as legislation and has been the result of federal congressional activities.

There has long been limited federal legislation loosely regulating commercial fishing, shipping, water supply, and even recreation and wildlife. The first important legislation dealing with such a

resource in a comprehensive manner was enacted in response to one of the most blatant, adverse consequences of years of improper resource management--water pollution. Water pollution, in terms of multiple resource use, can be viewed as the over-use of the water resource as an assimilator of wastes.

This major federal water pollution legislation was first enacted in 1956. Since then, through numerous federal legislative actions, water pollution legislation has grown in strength as well as in its breadth of concern. It was not until the mid-1960s, however, that water pollution control formally was viewed as only a part of a total effort needed to comprehensively manage the many interrelated uses of our nation's water resources.

Following is a review of federal legislative policy as it relates to the comprehensive management of a water resource. Emphasis will be placed on federal water pollution control legislation and how it has developed since 1956. In addition, legislation dealing with more recently aroused areas of management concern, such as multiple-use planning, basin planning, shoreline planning, and general environmental policy will also be identified. While this legislation is directed to the nation's water resources in general, Lake Michigan is a specific example of a resource that is a direct concern of the legislation.

B. Water Pollution Control Legislation

The deteriorating quality of our nation's water has been a rapidly growing public concern since the mid-1950s. The federal Congress has responded to this rising public concern. The response has often been timid and insufficient, but it has also been persistent. There have been no fewer than seven major legislative responses in the

past 15 years to the problem of deteriorating water quality. Important trends and conspicuous areas of opposition have become apparent in the evolution of this federal response. After 15 years, evidence indicates that the federal program is still insufficient to meet the task at hand.²³ In this context, the problem of water pollution becomes as much one of integrating the nation's political, financial, and social resources to combat the problem as it is a purely physical/biological problem. In addition, water pollution control becomes only one aspect of the total problem of water resource management.

1. Early Legislation: The Federal Water Pollution Control Act of 1956

Nonspecific, comprehensive, federal water pollution control legislation only narrowly missed enactment in 1936, 1938, and 1940. Persistent efforts finally resulted in the enactment of the Federal Water Pollution Control Act of 1948. This law was designated only as an experiment and was limited in duration to five years. The Act was extended in 1953 for three more years. While the Act basically stated the policy of Congress to "recognize, preserve, and protect the primary responsibilities and rights of the states in preventing and controlling water pollution," the very fact of its enactment was a statement of federal recognition of water pollution as a nation-wide concern. However, it wasn't until July of 1956 that the first permanent, comprehensive, water pollution control legislation was passed by Congress.

The Federal Water Pollution Control Act of 1956 strengthened and expanded the 1948 Act in several respects. It specifically restated the congressional policy that the states had the primary

responsibility for controlling water pollution. It (1) authorized continued federal-state cooperation in the development of comprehensive programs for the control of water pollution; (2) authorized increased technical assistance to states and broadened research efforts by using research potential of nongovernmental institutions (including \$100,000 for research fellowships); (3) authorized grants (not loans as in the 1948 Act) to states and interstate agencies of up to \$3 million a year for five years for water pollution control activities; (4) authorized federal grants of \$50 million (up to an aggregate of \$500 million) for the construction of municipal treatment works, the amount for any one project not to exceed 30% cost; (5) authorized a cooperative program to control pollution from federal installations; and (6) modified and simplified procedures governing federal abatement actions against interstate pollution. The Act was to be administered by the Office of the Surgeon General and the Public Health Service, under the direction of the Department of Health, Education, and Welfare (HEW).

It is important to note that the major controversy surrounding the 1956 Act was concerned with the provision authorizing federal grants of \$50 million for the construction of municipal treatment works. This controversy was divided along party lines, with Republicans opposing the concept of federal construction grants. There was, at this time, little evidence of special interest politics, and little debate concerning federal versus states' rights and responsibilities. The reason was that while the bill was an important legislative milestone, it was basically very weak. It left the primary burden of responsibility with the states, and it made no reference to specific pollution problems (other than the problem of financing municipal treatment facilities).

Also, it failed to define what, specifically, was an allowable pollution level by avoiding the problem of standard-setting and the problem of defining water quality criteria. It had no particularly direct or strong provisions for enforcement, punishment, economic sacrifice, or prohibitive actions. It was, in essence, a "motherhood bill," that is, it included virtually nothing which could be opposed; it did not step on sensitive toes.

2. 1961 Amendments, Federal Water Pollution Control Act

Unlike the Eisenhower administration, the new Kennedy administration favored the construction grant concepts as debated in the 1956 Federal Water Pollution Control Act. 1961 became a ripe year for the strengthening and broadening of this Act, and amendments were enacted in this year. They strengthened the existing Act by (1) increasing the authorized federal financial assistance for municipal treatment plant construction from \$50 million to \$100 million per year, (2) providing for more intensified research toward more effective pollution control, (3) authorizing increased federal financial support to state and interstate agencies from \$3 million to \$5 million, (4) extending federal enforcement authority to navigable waters, be they inter- or intrastate, and (5) by designating the Department of Health, Education, and Welfare to administer the Act.

While these amendments, in part, continued and somewhat strengthened the past cooperative approach to water pollution control, they were more significant in the steps they took to increase the federal role in the abatement of water pollution. Most importantly, all navigable waters became the concern of federal government abatement

procedures (although enforcement provisions differed for inter- and intrastate waters).²⁴ The Department of Health, Education, and Welfare, instead of the Office of the Attorney General, became directly responsible for administering the Act and was given power to request the Office of the Attorney General to bring suit against a polluter in certain interstate pollution cases.

Debate over this legislation was highlighted by opponents who felt that the federal government was not adequately recognizing the rights and responsibilities of the states to participate in the costs of treatment plant construction. The opposition also felt that the states' rights were being limited by the Act's provision concerning intrastate navigable waters.²⁵ The question of states' versus federal rights and responsibilities that surfaced during discussion of this bill was to intensify in the years to follow, and to this day it has not been adequately resolved.

3. 1965 Water Quality Act

The Federal Water Pollution Control Act of 1956 was a first step and the amendments of 1961 were a significant second step, but the 1965 amendments to the Federal Water Pollution Control Act marked the most important federal legislative action to date in the area of water pollution abatement. These amendments, known as the Federal Water Quality Act of 1965 (S. 649), are important because they bring the federal government face to face with some of the difficult political, governmental, social, and economic realities of water pollution. Problems of federal versus state responsibility (especially in the areas of standard-setting and enforcement), special economic interests, and administrative inadequacies were debated. Time has again proven the

inadequacy of this particular phase of governmental response to the water pollution problem. The Act, however, was important and is worthy of discussion.

Briefly, the 1965 Act extended and broadened the 1961 version of the Federal Water Pollution Control Act. Consistent with the intent of the previous Act, it again recognized the primary responsibilities and rights of the states in controlling water pollution. It increased authorization for construction grants to \$150 million per year and included a provision for a 10% increase in the federal funding of all sewage plants that are a part of a comprehensive regional development plan.

The Act not only furthered the existing legislation but significantly expanded the federal program in two major areas. First, it provided for the creation of the Federal Water Pollution Control Administration within the Department of Health, Education, and Welfare, and charged it with administering all governmental activities concerned with water pollution. This was an important creation of federal administrative potential. It was indicative of the government's increased acceptance of its administrative role in the nation's water pollution problems.

Opposing creation of the Federal Water Pollution Control Administration were representatives of industry, state health departments, and state and interstate water pollution control agencies. These groups argued that there was no need for such an agency. They felt that it would only confuse already efficient working relationships with the Public Health Service (PHS). More importantly, they feared the loss of administrative authority to a higher level. Proponents, however, needed

only to look around to realize the necessity for increasing federal administrative capacity in accordance with its growing water pollution abatement responsibilities.²⁶ They also noted the lack of enthusiasm with which the PHS initiated interstate abatement procedures. Proponents felt, too, that the PHS was less willing to deal with aesthetic, ecological, and recreational aspects of water pollution than with public health aspects. Proponents' views prevailed and the FWPCA was created.

The second important area of expansion in the 1965 Act was in its provision for the establishment of water quality standards for interstate streams and lakes. These standards were to be provided and administered by the states, with the federal government acting only if the states failed to sufficiently carry out their responsibilities. State standards and implementation programs were to be written according to federal guidelines and were to be approved by the FWPCA. This provision for the creation of water quality standards was not particularly significant as a final product for it fell far short of providing an efficient program for the setting and enforcement of such standards. It was, however, an official acceptance of the water quality standards concept by the federal government. It was an admission that good faith alone would not solve the nation's water pollution problems, and it was indicative that the federal government was willing, at least to a degree, to be involved in the process of standards-setting.

The debate over this portion of the Federal Water Quality Act was intense. It brought into clear public view many of the more subtle subissues involved in the overall issue of water quality. It clearly identified many of the strong economic interests who viewed water pollution only in terms of the cost of abatement. It upset further many

state and local water agencies who had become sensitive to their gradual loss of authority and independence. And, finally, it made clear many functional shortcomings of the federal Congress in its ability to provide decisive water pollution legislation. This was becoming especially true in the House of Representatives, where special interests were more strongly represented, both on the floor and in committees (especially the House Public Works Committee), and legislative compromise became inevitable.²⁷ Opponents of the bill included many water polluting industries. Significantly present were pulp and paper, oil, and chemical companies, and their national lobbying associations. These interests feared the inevitable high costs of water pollution abatement should forceful legislation be passed. Also opposing the bill were state and interstate water pollution control agencies, professional engineering societies, and farm organizations.

Opponents of the water standards provision argued that standards could not be set uniformly because every polluter and every body of water was different. They felt that any standards-setting should be done by the states because of their closer relations with local waters. It can be assumed that many polluters felt that their own unique interests would carry more weight, and result in less restrictive standards at the state level, where their economic and political impact was more immediate. Most opponents felt that existing state programs were working and standards-setting would be unnecessary federal intervention in the area of state and private rights.

The normal cadre of environmental groups--the Sierra Club, National Wildlife Federation, Isaak Walton League, etc.--supported strong standards provisions for fairly obvious reasons. These groups

felt history indicated that the states could not be counted on to adequately establish standards and enforce them. Even if they did, it was argued that the result would be confusing because of inevitable differences in the standards which the various states would set.²⁸

The Federal Water Quality Act of 1965, as originally introduced and passed in the Senate, authorized the Department of HEW, after consultation with all affected parties, to set water quality standards for all interstate waters (this does not include all navigable waters). Enforcement provisions, which were to be held intact from the existing Federal Water Pollution Control Act, were to be used to make sure that water quality was not reduced below these standards.

The Act, as finally signed by the president (PL 84-660), severely handicapped the Department of HEW's authority to set and enforce water quality standards. The states, within one year of the law's enactment, were to file letters confirming their intent to set water quality standards and describing plans for implementation and enforcement of these standards. If the states failed to do this, and should the Department of HEW, after a year, find it necessary to become involved, it would have to do it through cumbersome procedural steps. These steps required the calling of a conference of concerned parties, waiting periods, hearings, and eventually full judicial review, before standards could finally be enacted.

4. Provisions for the Abatement of Pollution of Interstate Waters

There have been, since the initial, 1948 Federal Water Pollution Control Act, provisions enabling the federal government to take enforcement action in cases of interstate water pollution (when pollution

originating in one state affects the welfare of people in another state). The original Act provided the federal government with the authority to take court action against a polluter of an interstate body of water, provided that the governor of the state where the polluter was located requested such federal action. The 1956 Act provided for an informal "enforcement conference" of concerned states that would precede any court action. Either the state where the pollution originated or the state affected by the pollution was to request the enforcement conference/court action procedure. In 1961, this abatement procedure was strengthened to include all navigable waters. Also, the Department of HEW was able to request such proceedings in cases involving interstate waters, without the request of a governor, when the health or welfare of people in the affected state was endangered. The 1965 Federal Water Quality Act did not change the federal interstate enforcement procedure. It merely provided for the setting of standards so that the objectives of this procedure could be more clearly defined.

5. Interstate Enforcement Procedure

Under Section 10 of the 1965 Federal Water Quality Act, the Department of HEW is directed to call a conference whenever requested (1) by the governor of a state, (2) by a state water pollution control agency, or (3) by the governing body of a municipality with concurrence of the governor and the state's water pollution control agency.²⁹ These requests are to refer to water pollution that endangers the health or welfare of persons in a state other than the state in which the pollution source is located. The Department of HEW is also to call a conference when, on the basis of reports or studies it has received, it

has reason to believe that interstate pollution exists and is endangering the health or welfare of residents in a state other than the state of origin.

Representatives of state and interstate water agencies are required to attend these conferences. They may bring any other people they desire. In addition, any alleged polluters, or any groups or people affected by the pollution, are to be permitted to make a statement. After a presentation and discussion of evidence, it is the responsibility of the Department of HEW to prepare a statement that determines (1) whether interstate pollution is occurring, (2) the adequacy of the measures taken for abatement, and (3) the nature of the delays being encountered in the abatement of this pollution.

If the Department of HEW concludes that effective steps toward abatement are not being taken, it is to direct the state water pollution control agency to take remedial action. If after six months, adequate action is not taking place, the Department of HEW may call a public hearing concerning the issue in question. A specially appointed hearing board will send its findings and recommendations to the polluter along with a notice specifying a reasonable time--not less than six months--in which to abate his pollution. Should the polluter fail to comply, the Department of HEW could then request the Office of the Attorney General to bring suit against the polluter. The courts could then decide upon the necessary remedial action.

It should be noted that when a polluter in one state endangers the health and welfare of people in another state, there is at least a two-year period before the federal government can really do anything!

Even then, the judicial process can be slow, especially when the defendant has access to strong legal counsel.

In essence, when an enforcement conference is called, its success must depend largely upon cooperation and good faith. In general, there has been a high level of this cooperation and good faith in past enforcement procedures. While over 40 such conferences have been called, only four resulted in a hearing and only one in court action. This seeming air of cooperation, however, might well be evidence of timid government action. It is interesting to note that enforcement conferences have been held for such bodies of water as Lake Erie, the Detroit River, and southern Lake Michigan.

The conferences, in general, have been distinctive in that there have been very close work efforts between federal and state officials. Very few restrictions have been placed upon general conference presentations. Emphasized are technical presentations from federal and state agencies and from private concerns. Often special "technical sessions" are held to discuss a particular problem in depth. The quality of these technical reports has generally been high, and they have been published and circulated. However, while the conferences almost always result in conclusions and recommendations, the available enforcement machinery is cumbersome.

6. Clean Water Restoration Act of 1966

The Clean Water Restoration Act of 1966 can be viewed as an addition to the 1965 Federal Water Quality Act. It broke little new conceptual ground in terms of federal institutional involvement in water pollution abatement and it incited very little in the way of congressional debate or disagreement. What it did do was to increase the

federal monetary contribution in areas of treatment plant construction, industrial and advanced waste treatment research, and river basin planning programs. Enforcement powers, which were transferred from the Department of HEW to the Department of the Interior by an executive reorganization order, were slightly increased by permitting the secretary to require statements from alleged polluters, and it extended these proceedings to include international waters. In addition, the Oil Pollution Act of 1924 was transferred from the Department of the Army to the Interior Department, and penalties were increased for those who, by willful or negligent action, discharged oil into navigable waters.

Specifically, \$3,908,000,000 were authorized for federal water pollution control activities for the years 1967-71, an increase of \$3,663,000,000 over the amount authorized under the Federal Water Quality Act for the years 1967-69. Of this total, \$3,550,000,000 were to be used for the construction of sewage treatment plants. The law authorized the federal government to pay 30% of the financing, and 50% if the state set water quality standards for the affected interstate waterway. As can be noted, strong incentives were given to the states to set standards and provide funding assistance.

In debate over the proposed funding increases, many people agreed with Senator Lausche (D, Ohio) when he said that while the increase in funding was significant, it was "a drop in the bucket in relation to the ultimate needs."³⁰ Others felt that the proposed funding levels were inflationary. The debate, however, was not over the concept of such grants, but over the amount, and was not particularly heated.

7. Water Quality Improvement Act, 1970

The federal Congress struggled with major water pollution legislation for three years after the passage of the Federal Water Quality Act Amendments of 1966. But it wasn't until 1970 that the Water Quality Improvement Act was passed. This Act was aimed primarily at oil spills, and was helped to passage by a recent series of such oil spill tragedies. The bill made petroleum companies liable for up to \$14 million in clean-up costs for oil spilled as a result of their action. In addition, this bill made illegal the direct flushing of boat toilets, and it called for the development of criteria covering the levels of pesticides on public waters. The bill also required anyone engaged in a project requiring approval of a federal agency (i.e., nuclear power plant companies) to obtain a certificate from the state indicating that construction of the project would not break state water quality standards.

The Water Quality Improvement Act is significant in that it singles out specific types of pollution, such as boat toilets and ship bilge oil, and it attempts to legislate against these specific pollution sources. This is in contrast to past legislation that has, with the exception of municipal wastes, been of a relatively nonspecific nature.

8. The Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899, also known as the 1899 Refuse Act, forbids the discharge of industrial waste into navigable waters without a permit from the Army Corps of Engineers. A special section of this Act (33 U.S.C., Section 414) prohibits deposit of refuse, except from sewers and street runoff, into Lake Michigan waters from Cook County, Illinois, and Lake County, Indiana, except behind

breakwaters that will prevent the escape of the refuse into the open waters of the lake.

This Act was largely ignored for 70 years. On December 23, 1970, President Nixon, in a plan to reduce the pollution of U.S. waters, ordered the application of this Act. Basically, his plan called for all relevant industries (about 40,000) to apply for a permit from the Corps of Engineers to discharge any effluents into U.S. waters. This application would have to include full details of the nature of their effluents. All permits issued by the Corps would have to be approved by the EPA and the appropriate state water agency. It would be possible for companies to be denied a permit or to be issued a conditional one, with a clean-up timetable incorporated into it. There is to be a \$10,000 plus five years imprisonment penalty for false statements. This basic reenactment of the 1899 Refuse Act was seen as a move to help boost the enforcement powers of the newly created Environmental Protection Agency.

9. Federal Water Pollution Act Amendments of 1971

Federal efforts in the abatement of water pollution have not ebbed the rising tide of public dissatisfaction with the lack of success of these efforts. Congress, too, realizes that what is being done is not adequate. As a result, a new bill, the Federal Water Pollution Control Act Amendments of 1971 (also known as the "Muskie Bill"), has been submitted to the Congress. It has been passed by the Senate (S. 2770) and is, at this writing, in a House committee. The bill, if passed, will be the most significant enactment of federal water pollution legislation since the Federal Water Quality Act of 1965. It

calls for a major change in the mechanism of water pollution control enforcement, one moving from water quality standards to point source effluent limits.

In its present form, S. 2770 empowers the administrator of the EPA to require the "best" waste control technology to be used on all discharges into the nation's waters. This eliminates the need to search for a precise link between pollution and water quality. The bill also provides for minimum national standards that will require all municipalities to have secondary treatment facilities by 1974 and will prohibit all discharges into the nation's waters by 1985 except when treated by the best available technology. In addition, S. 2770 authorizes \$14 billion for construction grants over four years, with the federal participation in municipal treatment plant construction being set at 60%, a figure which could go to 70% if states also make grants.

This bill has the potential to contribute significantly to the abatement of water pollution from industrial and municipal sources. However, it will not be a water problem cure-all. Specific guidelines for setting treatment standards are not yet explicit, and enforcement may still be difficult without the cooperation and good faith of American industry. In addition, other water problems such as pesticides, farm runoff, urban storm runoff, and shoreline development will remain, and the lack of a basic environmental conscience in American industry and in the American consumer will remain.

This bill, if passed, will satisfy the legislative demands of many of the strongest pollution abatement proponents. It most certainly will change the area of future priorities away from water pollution

abatement to more progressive, multiple use management and development of our nation's water resources.

C. Other Legislation

1. General

Federal policy dealing with comprehensive water resource management, as expressed by legislation, has been largely concerned with the abatement of water pollution. The problems of related land uses, comprehensive long-range resource-use planning, and the regulation of various of a resource's uses so as to favor other uses were--with only some exceptions--not formally dealt with until the mid-1960s. Two important pieces of legislation, the Water Resources Planning Act of 1965 and the National Environmental Policy Act of 1969 are discussed below. Other legislation, both enacted and pending which relates to comprehensive water resource management other than water pollution control, are mentioned.

2. Water Resource Planning Act

With the nation's demand for water for industrial, municipal, recreational, and agricultural purposes doubling about every fifteen years, the federal Congress tried repeatedly in the early 1960s to provide for planning for its use. By 1965, the level of concern for the control of water pollution was high. The relationship between water quality and the wise control of competing water uses became clear. It was then that the president signed the Water Resource Planning Act (PL 89-80) into law.

This Act authorized the president to establish regional, federal-state river basin commissions to prepare and keep up-to-date

comprehensive water resource plans, and to establish priorities for the collection of basic data for planning and for construction projects. The Act authorized \$6 million as the federal government's share (to match states' shares) of the operating expense for river basin agencies. In addition, the Act authorized federal grants to the states of \$5 million a year for ten years for comprehensive water and related land resource planning.

Several important concepts underlay the passage of the Water Resource Planning Act of 1965.³¹ First was the belief that strong national leadership in water planning was essential to the adequate management of the nation's water resources. Second was the realization that many of a water resource's uses, not just direct water uses, were essentially competing uses that, if not managed properly, would result in something less than optimum public benefit from the water resource. Third was the belief that the hydrologic unit, not a political unit, was the proper geographic division for water resource management. Fourth was the belief that water resources planning should be "comprehensive," meaning that programs should embrace an entire basin as well as all possible resource uses.

The Water Resource Planning Act incorporated these concepts, thus making it an important contribution to comprehensive water resource management legislation--legislation that until this time had been emphasizing the abatement of existing water pollution inputs.

3. National Environmental Policy Act

While neither Lake Michigan nor any similar water resource has a stated policy for comprehensive management, the federal government very recently came to recognize that comprehensive management of America's

natural resources is particularly policy-deficient. An important response to this was the passage, in 1969, of the National Environmental Policy Act.

The stated purpose of this Act was to "declare a national policy which...[would] encourage productive and enjoyable harmony between man and his environment." This Act stated that it would be the continuing policy of the federal government to "use all practicable means and measures...to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." More specific policies stated by the Act are (1) to assure safe, healthful, productive, and aesthetically and culturally pleasing surroundings for all Americans; (2) to attain the widest range of beneficial use of the environment without degradation or undesirable and unintended consequences; (3) to preserve important historic, cultural, and natural aspects for national heritage; and (4) to enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

In addition to these general statements of policy, the Act requires the incorporation of environmental awareness into the activities of federal agencies. Under this Act, all federal agencies are to "utilize a systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment." Also required of each agency is an environmental impact statement for all activities that may affect the environment. These statements, in addition to stating the

environmental impact of a proposed agency action, should discuss alternatives, the relationship between short-term uses and long-term productivity and maintenance of man's environment, and any irreversible or irretrievable commitments of resources.

The National Environmental Policy Act established the Council on Environmental Quality (CEQ) to be the president's principal environmental body. The CEQ would be concerned with general environmental monitoring and review of federal programs, and would be responsible for making major environmental management recommendations to the president.

4. Miscellaneous Comprehensive Water Management Legislation

The federal government is only in the initial stages of providing the legislative backbone that will be needed if the nation's water resources are to be managed in a comprehensive manner. Water pollution control legislation (assuming passage of the 1971 Federal Water Pollution Control Act Amendments) is now fairly well advanced. Legislative efforts in other areas are scattered. Efforts can be expected to intensify, however. Three important areas are now perceived as needing attention: First, the importance of adjacent land use to the management of a water resource has been recognized. Second, there is the need for an approach to shoreline development that considers the interrelation of various uses to each other, to the adjacent water and shoreline resources, and to the existing uses of these resources. Third, there is the need to control the development of one type of resource use, such as electric power generation, so as not to limit another use.

The Water Resource Planning Act (PL 89-80), the Wilderness Preservation Act (88-577), and the Sea Grant Colleges Act (PL 89-688) have been partial responses to these needs. Pending legislation such as the Power Plant Siting Act (H.R. 5277, S. 1739) and the Environmental Class Actions Act (H.R. 49, S. 1032) are also partial responses. Probably the most important initial responses to these needs--still pending enactment--is legislation dealing with comprehensive land and coastal zone planning. These pending acts are discussed briefly below.

a. Coastal Zone Management Legislation

Coastal zone management legislation is still in the Senate hearing stage, but passage of some type of legislation seems likely. This legislation recognizes the ecological sensitivity and importance of coastal zone areas (including the Great Lakes). It also recognizes the increasing pressure on the areas for various types of developments. Developments such as cottages, port facilities, airports, highways, electric power generating plants, garbage dumps, marinas, recreation facilities, oil drilling, sand and gravel extraction, commercial buildings, etc. threaten to cause developmental havoc to our nation's coastlines.

Basically, this legislation is designed to offer grants to states as incentives to develop and implement comprehensive, multiple-use management plans for their coastal areas. The federal government, while placing primary responsibility with the states, would retain the authority to review plans and implementation procedures to be sure they would be effective and in the best interest of the public.

b. Land Use Policy and Planning

There have been several pieces of legislation proposed that deal with the general problem of land use planning. The Public Land Use Policy Act (H.R. 7211), the National Land Use Policy Act (H.R. 4322, S. 922), and the Land and Water Resources Planning Act (S. 632) are three pieces of such legislation. All three of these pieces of legislation are similar to the proposed coastal zone management legislation except that they include all land, not just coastal zones. In essence, this legislation would offer money as incentive to states to prepare comprehensive land management programs. These programs would be reviewable by the federal government, but it is doubtful that states would be penalized if they failed to prepare acceptable programs.

Clearly, the federal legislative response to comprehensive water management needs is broadening. It is entering an exciting new era in which emphasis will be placed on comprehensive planning; development; research; and optimal, multiple resource use. Like the water pollution legislation of the 1950s, 1960s, and early 1970s, it seems likely that the pending federal entry into areas that include land and shoreline zoning and development, and water use regulation will be insufficient at first. The needs are real, however, and these efforts can be expected to intensify.

As with water pollution legislation, resistance to this new legislative trend can be expected from certain economic interests. Probably more intense, however, will be opposition from local governments. It is almost inevitable that much of the exclusive local authority to plan and zone their own land will be usurped by the states at the request of the federal government. Such authority will become

more of a cooperative effort between the two levels of government. This usurping of authority is not without precedent in the field of water resource management, for this is most clearly what happened in the formulation of water pollution abatement programs.

It can be expected that legislation enacted in response to these broadening comprehensive management needs will parallel the development of water pollution control legislation. It will, most likely, be insufficient at first, but over time, it will surmount the necessary political and informational obstacles to become effective legislation. With the precedent already set, it can be hoped that such a response will occur in somewhat less than the 15 years necessary for effective water pollution legislation evolution.

ASPECTS OF COMPREHENSIVE RESOURCE
MANAGEMENT: PLANNING

A. General

Planning is the process by which a course of action is specified which, when carried into effect, can be expected to lead to the attainment of predetermined policy goals. In the development of plans, a planner plays an important political role. He must resolve conflicts among various objectives of different governmental units, groups, agencies, and individuals, while at the same time designing a plan consistent with the stated management policies for the resource in question. He needs to be able to consider the numerous trade-offs, benefits, and losses implicit in each multiple resource-use plan. The planner needs to be skilled in evaluating the compatibilities and the incompatibilities between different resource uses, between proposed resource use and existing resource use, between resource uses and the physical environment, and between resource uses and human needs. The various skills of multiple-use systems analysis, resource-use modeling, and suitability mapping must be at his disposal.

Whereas the federal government has played a dominant role in the formulation of water resources policy, it has played a small role in the planning process. Federal agencies have performed specialized "inter-agency" planning concerned with the special resource-use area within which they are involved, but this planning has seldom been comprehensive in its extent.

The most influential areas of planning activity have long been concerned with land and shoreline planning and zoning. These activities have, almost without exception, been the responsibility of municipal- and county-level governments. Only lately have the states interjected planning and resource-use guidelines or limitations, and the federal involvement has been even less intense. The problem with the past planning, zoning, and taxing practices of the local governments has been their tendency to favor land uses that will optimize the contribution of that land to the local economy. Open land, park land, agricultural land, and even low-density housing land has consistently been zoned or taxed to favor commercial and industrial development.

Not only have local interests, other than local economic interests, received little benefit from local planning and zoning practices but the interests of the public at large have been virtually ignored. Often a local resource use, or land use, offers value to a broader segment of the public than is in a certain locality. In addition, land, shore, and water use in one municipality may have effects on similar uses in another locality. There has been, historically, little effort to provide for these broader public interests, or to minimize such resource-use spillovers.

The federal government has slowly come to recognize this predicament and has begun to respond. Its basic strategy, as in pending legislation concerning coastal zone and land and water use planning, is to attempt to encourage the states to assume a more dominant role in the comprehensive planning for shore, land, and water resource use. By so doing, it is hoped that a broader range of public interests and resource uses can be served.

B. Regional Planning: The Great Lakes
Basin Commission

As discussed earlier, the Water Resource Planning Act of 1965 was the first formal response at the federal level to a recognized need for comprehensive, basin-wide, multiple-use water resource planning. Lake Michigan felt the positive effects of the passage of this Act in 1967 with the creation of the Great Lakes Basin Commission (GLBC).

The Great Lakes Basin Commission is a federal-state agency consisting of a federally appointed chairman and a hired professional staff. In addition, a commissioner and an alternate are designated by the governor of each state within the Great Lakes basin for representation on the GLBC. Eleven federal agencies also designate representatives to serve on the GLBC.³²

The principal duty of the GLBC is "the preparation of a long range, comprehensive and coordinated joint plan for development of water and related land resources in the Great Lakes basin."³³ It is the stated duty of the GLBC to work in cooperation with planners at all levels of government as well as with representatives of various private and public interests in the preparing and coordination of plans.

To accomplish the stated objectives, the GLBC has compiled a "Long Range Schedule of Priorities for Water and Related Land Resource Programs." Also, it is studying the feasibility of applying limnological systems analysis techniques to Great Lakes basin planning needs. Probably the major task of the GLBC is the formulation of a "framework study," a comprehensive and coordinated effort to compile the basic data needed for the formulation of long-range management plans. Information is being compiled in 27 basic areas included in the following basic categories: basic resource information, water use and management, land

use and management, economics/social/institutional, environmental quality, and program formulation and reports. Task forces have been created to begin to apply basic information gathered in the framework study to plans consistent with basic management needs.

In the process of working toward the completion of comprehensive, coordinated, long-range plans, basin commissions, including the GLBC, have become aware of several new concepts that, in a sense, replace some of those that resulted in the passage of the 1965 Water Planning Act.³⁴ The first of these concepts is that lower levels of government (i.e., state and local) should carry more of the responsibility for making long-range comprehensive plans. Second, the hydrologic unit is not necessarily the appropriate geographic area for water resources planning and management. Lake Michigan, for example, is represented by four planning subareas in the GLBC (see Appendix A). These areas can be determined in accord with the physical or resource use characteristics of the area. Third, there is a relative increase in importance of the influence of adjacent land use in contrast to simple water use on the impact of a water resource. Fourth, it is now realized that no single "best" plan exists for a given basin or management subarea. Any plan, in an attempt to serve many different interests, must be full of compromise if it is to be realistic.

Two very major obstacles face comprehensive planning agencies such as the GLBC. The first, as described, is the fact that local governments have virtually absolute responsibility over planning and zoning in their areas of jurisdiction. For comprehensive planning to be effective, some of this responsibility will have to be located at state, interstate, and federal government levels. Pending federal

coastal zone management legislation and land use planning legislation is a modest attempt to more evenly distribute the responsibility for land and shore use planning and zoning.³⁵ GLBC efforts to include local interests in comprehensive planning efforts have simply not been sufficient.

The second obstacle facing a comprehensive planning agency is the fact that nobody is required to abide by its plans. There is no implementation mechanism by which these plans can become reality. Without such a mechanism, any plan is meaningless. To date, there has been very little in the way of comprehensive plan formulation, much less implementation, in the Great Lakes basin at the federal, state, local, and interstate levels of government.

ASPECTS OF COMPREHENSIVE RESOURCE MANAGEMENT:
IMPLEMENTATION AND REGULATION

A. General

The goals and objectives of public management activities are set by the legislative process and made more specific by the planning process, but it is not until public policy is implemented that concept enters the world of action and accomplishment. Lynton Caldwell has described four modes of policy implementation pertinent to water resource management. They are persuasion, regulation, adjudication, and agency activity.³⁶

Persuasion is the least costly and requires the least in the way of administrative machinery of these four modes of policy implementation. When it works, which is seldom, it can be the most effective of the four modes--embedding itself in the very normative fabric of our society. Ideally, persuasion becomes a pattern of behavior internalized in the individual. "Keep America Beautiful" campaigns, population control campaigns, forest fire prevention campaigns, "Don't Do It in the Lake" campaigns, as well as tax incentives to industries installing pollution abatement equipment are all examples of attempts to accomplish a certain public goal by public persuasion. While persuasion seldom is effective by itself in implementing management policy, it is almost always a necessary component of any other mode of policy implementation.

Regulation is a more formal mode of action and requires a considerable amount of administrative machinery. It involves the creation of rules under which certain activities in a society may or

may not be carried out. Generally these are activities in which private interest or convenience conflicts with the general public interest. The pollution from industries, the scattering of debris from pleasure boats, and the local patterns of shoreline uses are all examples of situations in which individual interest finds itself in conflict with public interest.

In addition to the formulation of rules and laws, the regulatory process generally requires the creation of government regulatory agencies. These agencies are often similar to courts of law. They often have the right to issue or deny a license or a permit. They are allowed to adopt the "rules" under which the regulated function must operate, and they are involved in investigating alleged violations of these rules.

↖ The effectiveness of a regulatory agency depends upon four needs. First, there is the need for the physical capabilities of the agency, in terms of staff size and budget, to be compatible with the regulatory task assigned to them. Second is the need for the body of rules and laws under which the agency operates to be sufficient to meet the regulatory task at hand. Third, there is a need for the regulatory agency to remain invulnerable to symbiotic relationships with the regulated interests--relationships that can result in bribes, corruption, or immoral persuasion. Fourth, there is a need for a large degree of cooperation from the regulated interests. The absence of any of these four needs could result in a regulatory agency that is unable to carry out the task expected of it.

A third means of policy implementation described by Caldwell is adjudication. Often regulation must ultimately be enforced in the

courts. Other times, the courts serve as the only designated mode of policy enforcement and regulation. Still, at other times, the courts have been used by private citizens or groups to seek enforcement or regulation of activities that, for one reason or another, have been neglected by an agency officially designated to carry out this enforcement or regulation.

In the past, the courts have been receptive only to suits brought by individuals, groups, or agencies that attempt to regulate environmental issues by proving economic damage. Only recently, as in such classic cases as the Scenic Hudson Preservation case, the Across Florida Barge Canal case, and the Lake Michigan-Palisades Nuclear Power Plant case, have environmental damages been evaluated on their own merit. The trend seems to be one in which the courts will play a more receptive, more dynamic, and more effective role in the enforcement and regulation of policy designed for the comprehensive and environmentally sound management for all of our natural resources.

Agency activity is a fourth mode of public policy implementation in resource management. It has already been mentioned that, traditionally, the United States has preferred to manage its water resources by a system of free enterprise and private markets. Yet, there are a large number of agencies at the federal level that are directly involved in the management of aspects of our water resources. Most of the agencies, like the Army Corps of Engineers, the Federal Power Commission, the Environmental Protection Agency, and the National Park Service, perform regulatory functions in addition to their activities in the direct pursuance of their policies and programs.

As the federal government has assumed a larger role in the management of our nation's water resources, and as certain of its

policy/legislative activities have been expanded, the pressures upon the modes of policy implementation have increased. This pressure has been strongly felt by the nation's implementation and regulatory agencies. Not only has their capacity been inadequate to meet the rising policy demands of the federal legislation but their organization, which has been characterized by great fragmentation of related or complementary interests, has been seen as impeding the federal implementation capacity. It is not unusual to have separate agencies, each concerned with the management of one use component of the entire multiple use spectrum, connected by very cumbersome and indirect formal structural linkages. Often, the Office of the President is the only formal link between two such agencies.

The federal response to the problem generally has been to simply create new agencies as new problem areas become visible, or to give new responsibilities to old agencies. The old Federal Water Pollution Control Administration and the Water Resource Council are examples of new agencies created in this rather piecemeal manner. It wasn't until the Ash commission was created in 1969 to study the needs of executive reorganization that the major problem of agency structure, responsibility, and organization was formally addressed. Two recommendations of the Ash study relating to water resources have been carried out. These are the creation of the Environmental Protection Agency and the creation of the National Oceanic and Atmospheric Administration. One other recommendation, the creation of a Department of Natural Resources is still being considered in the Congress.

The results of this federal response to the administrative and organizational needs of federal agencies will now be discussed as they

relate to comprehensive management of water resources, in general, and to Lake Michigan, in particular. In addition, other federal agencies with direct management responsibilities on Lake Michigan will be mentioned.

B. Federal Agencies Concerned with Policy
Implementation in Lake Michigan

Agencies and groups at all levels of government--local, state, and federal--as well as numerous private businesses, groups, and interests have major responsibilities in carrying out federal water resource management policy. This section will be limited to major federal agencies whose activities influence the water resource management of Lake Michigan. The roles of these agencies will be briefly described, and the way in which they relate to each other in the overall federal organizational structure will be mentioned. Organizational charts of the federal government and of the departments discussed can be found in Appendix A.

1. The Environmental Protection Agency

A major result of the Ash committee studies, and a major component of President Nixon's executive reorganization, proposed and approved in 1970, was the establishment of an independent environmental protection agency. This agency is to consolidate major, but fragmented, federal programs concerned with pollution abatement into a single agency, independent of existing departments. Included in the transfer to the EPA were the Federal Water Quality Administration (formerly the Federal Water Pollution Control Administration) from the Interior Department, and the Bureau of Solid Waste Management, Water Hygiene, and Radiation Research from the Department of Health, Education and Welfare. Also

included in the transfer were functions concerning radiation protection standards from the Atomic Energy Commission, the authority to perform general ecological research, formerly held by the Council on Environmental Quality, and numerous pesticide research and registration functions of the Departments of Interior, Agriculture, and HEW.

In addition to the administration and coordination of these various responsibilities, the EPA was created to further work in the areas of pollution research, standards-setting, enforcement, and recognition of new environmental problems. It is hoped that the creation of the Environmental Protection Agency will not only increase the effectiveness of the federal government's major pollution control programs but that it will provide a focus for the evaluation of all federal pollution abatement activities. Also, it is hoped that it would help make clearer the responsibilities of industry, and of state and local governments.

While the EPA is an important initial response to the recognized need for a less fragmented, more all-encompassing federal pollution abatement program, its ultimate effectiveness will be dependent upon at least two major needs. First is the need for more effective water pollution control legislation. At present, the legislative and administrative backbone of the agency is simply not sufficient to meet the task assigned to it. This need has been partially recognized and is pending legislative enactment in the form of the 1971 Amendments to the Federal Water Pollution Control Act.

The second need is for the continuing advancement of other programs concerned with the comprehensive management of our natural resources in areas other than the abatement of pollution. By its own

admission, the EPA will be more concerned with policing the environment--with setting and enforcing standards--than with the designing or carrying out of a program for the long-range multiple use of our natural resources.³⁷ Current legislative activities dealing with coastal zone management and with land use planning seem to be an initial response to this need. The EPA's potential for success as an isolated pollution abatement bureaucracy seems limited. To be effective, it should be only one working function of a broad, comprehensive, and interrelated management program. Also, the EPA, as it presently stands, is an independent department. Its only formal organizational link with other federal agencies concerned with aspects of comprehensive resource management is through the Office of the President. If it is to be an effective component of a public resource management organization, it will need formal and direct organizational links with other pertinent management agencies.

EPA activities on Lake Michigan are performed primarily through its Region 5 Office in Chicago. Present agency policy is to emphasize decentralization of activities. As a result, the regional office reviews all local requests for treatment facility construction grants, and state program grants. In addition, the state water quality standards for Michigan, Indiana, Ohio, Illinois, Wisconsin, and Minnesota that were required under the 1965 Federal Water Quality Act were submitted to, and approved by, the Chicago office of the EPA (which at that time was a region office of the FWPCA).

In addition to these activities, the Region 5 Office is responsible for holding water pollution enforcement conference or hearing activities on Lake Michigan. It also cooperates in the water-

data monitoring activities on the lake, and it distributes money to support basic research and development activities in the Lake Michigan basin. Past research supported by the Chicago office of the EPA (and by the previous FWPCA) included studies into Lake Michigan biology (1968); lake currents (1967); municipal waste facilities (1963); nuclear installations, water pollution problems (1968); the effect of waste heat on Lake Michigan (1970); comprehensive water pollution control programs for the Calumet area, the Milwaukee area, and the Green Bay area; pollution from watercraft (1967), eutrophication, and research into waste treatment for phosphorus removal. All discharge permits for Lake Michigan area industries, required under the 1899 Rivers and Harbors Act, are reviewed by the Region 5 Office of the EPA.

2. The National Oceanic and Atmospheric Administration

Another important result of the Ash committee studies that was proposed by the president and approved by Congress in 1970 was the creation of the National Oceanic and Atmospheric Administration in the Department of Commerce. NOAA was created to bring together major federal programs dealing with the atmosphere and the seas (including the Great Lakes), and to create a center of strength within the civilian sector of the government for the management of these vital resources.

Included in the transfer to NOAA was the Environmental Science Services Administration (ESSA), which remains in the Department of Commerce. Included in the ESSA are the Weather Bureau, the Coast Guard, the Environmental Data Service, the National Environmental Satellite Center, and the ESSA research laboratories. Also transferred to NOAA were the Bureau of Commercial Fisheries and the Marine Minerals

Technology Program from the Interior Department, the Office of Sea Grant Programs from the National Science Foundation, the Lake Survey Office from the Army, and the National Data Buoy Program of the Department of Transportation.

The principal role of the NOAA in the Lake Michigan basin will be in providing basic services in the area of primary research and data collection to be used in the wise management of the lake resource. The Lake Survey Office, located in Detroit, is responsible for the publication of Lake Michigan navigation charts and the study of all matters affecting the Lake's hydrology and hydraulics. Sea Grant programs at the Universities of Michigan and Wisconsin are involved in basic research directed toward the long-range management of Lake Michigan and the Great Lakes. The Great Lake central region of the Bureau of Commercial Fisheries surveys the quantity and quality of the lake's commercial fish catch. The Coast Guard, through its 37 local stations on Lake Michigan, aids in navigation, performs search and rescue missions, and provides ice-breaking services.

3. Other Federal Agencies with Management Responsibilities on Lake Michigan

The EPA and the NOAA are important in that they are initial responses to the need for the reorganization and restructuring of federal agencies with roles in the comprehensive management of our nation's natural resources. There are many other federal agencies with responsibilities for the implementation and regulation of federal policies on Lake Michigan. These agencies are still organized and related to each other by a rather cumbersome structural system. Several of the more influential of these agencies will be briefly described here; their structural arrangements are charted in Appendix A.

a. The Department of the Interior

Four divisions of the Interior Department have important responsibilities related to the management of various of the Lake Michigan resource uses. They are the Bureau of Sport Fisheries and Wildlife, the National Park Service, the Geological Survey, and the Bureau of Outdoor Recreation.

The Bureau of Sport Fisheries and Wildlife, since the departure to the NOAA of the Bureau of Commercial Fisheries, performs the primary responsibilities of the United States Fish and Wildlife Service. Its objective is to perpetuate the use, understanding, and enjoyment by the people of the nation's sport fish and wildlife resources. This is done by the production and distribution of hatchery fish, the management of wildlife refuges, the regulation of migratory-bird hunting, the management of fish and wildlife habitats. All of these objectives are performed in cooperation with the states and private organizations.

In Lake Michigan, the BSFW has active programs concerned with the development and conservation of the lake's sport fishery resource. Besides operating three lake-trout hatcheries in Michigan, the BSFW through its North-Central Regional Office, is involved in fishery research, habitat improvement, the evaluation of pollution effects on fish, and the evaluation of stocking programs of steelhead and brown trout. In addition to its fishery activities, the BSFW does basic wildlife research and maintains several wildlife refuges. Refuges in the Lake Michigan basin include Shoe, Pismire, Wisconsin, Spider, and Gravel Islands in Lake Michigan and Sceney National Wildlife Refuge in Schoolcraft County, Michigan.

Many of the responsibilities of the Fish and Wildlife Coordination Act are carried out by the BSWF. These responsibilities include evaluating Army Corps and Soil Conservation Service construction projects as to how they might affect fish and wildlife resources. While most BSWF activities are coordinated through their North-Central Regional Office (Twin Cities, Minnesota), activities that involve two or more Interior Department bureaus are coordinated through the North-Central Regional Office of the Department of the Interior in Des Plaines, Illinois.

The National Park Service provides assistance to the states in the management, operation, and development of public park and recreational area facilities. They are responsible for acquiring and managing the national seashore system. Two such national seashores have been designated on Lake Michigan; they are the Sleeping Bear Lakeshore near Leland, Michigan, and the Indiana Dunes Lakeshore on the lake's south end. While local park offices are set up near each national lakeshore, National Park Service activities in the Lake Michigan basin are coordinated through the Midwest Regional Office in Omaha.

The Geologic Survey is responsible for classifying lands as to their value for leasable minerals or for reservoir or waterpower sites. It helps supervise the operations of private industry in mining and oil leases. Also, the Geologic Survey does basic hydrology studies, including the quantity, quality, distribution, movement, and availability of both surface water and groundwater.

The Bureau of Outdoor Recreation was created in 1962 and is responsible for promoting, coordinating, and developing outdoor recreation programs. The BOR carries out most of the responsibilities

of the Water Conservation Fund Act of 1965. Under this Act, the BOR gives grants to states for outdoor recreation planning, acquisition, and development activities. In addition, the BOR encourages the development of regional, comprehensive outdoor recreation plans. The "Lake Michigan Water-Oriented Outdoor Recreation Study" is a product of the BOR Lake Central Division. The purpose of this study was to make an inventory of existing recreation areas and facilities--both public and private--within the Lake Michigan basin and to establish the needs and goals for land for recreational development to the year 2010. In addition, this study identified potential recreation areas, determined the influence of water quality on water-oriented recreation, and recommended action programs for recreational development in the basin.

Other research by the Lake-Central Office of the BOR has produced the Great Lakes water levels study, the Great Lakes-Illinois River water quality study, the island study in Wisconsin and Michigan, the Grand River basin study, and the St. Joseph River basin study. The BOR is also responsible for studying rivers and trails for inclusion into the national wild and scenic rivers and trails systems. Also, under the National Environmental Policy Act of 1970, BOR is responsible for reviewing federal projects that have impact upon outdoor recreation.

b. The Department of Agriculture

The water resource planning and development activities of the Department of Agriculture are located primarily in the Forest Service, the Soil Conservation Service (SCS) and the Agricultural Research Service.

The U.S. Forest Service is responsible for the management of national forests under the provisions of the 1960 Multiple Use and

Sustained Yields Act. This Act gives the Forest Service the responsibility to consider a use balance among the nation's needs for lumber, recreation, natural beauty, watershed protection, and fire control. There are presently four national forests in the Lake Michigan basin: the Nicolet National Forest in Wisconsin and the Ottawa, Hiawatha, and Manistee National Forests in Michigan. Forest management in these areas is coordinated through the Forest Service's Eastern Region Office in Milwaukee.

The Soil Conservation Service performs its activities by offering technical and financial help to local soil conservation district offices. The SCS is active in conducting soil surveys, erosion studies, and in testing erosion control methods. In addition, SCS performs several functions under the Watershed and Flood Protection Act. SCS gives technical and financial help for flood prevention, fish and wildlife development, recreation, and agricultural and municipal water supply in small watersheds (up to 250,000 acres in size and unnavigable).

An important activity of the Agricultural Research Service is concerned with the use of chemical pesticides and fertilizers. However, responsibility for researching the effects of these chemicals on the environment is the responsibility of the Environmental Protection Agency.

c. The Department of Defense

Primary Defense Department activities relating to water resource management are centered in the Army Corps of Engineers in the Department of the Army. The Army Corps is one of the most active of all federal agencies on Lake Michigan and its tributaries. It is responsible for river and harbor dredging, flood control, land filling, pier and wharf construction, and shoreline erosion control. There are 27 federal

harbors in Lake Michigan that are maintained by the Corps. In addition, it assists the EPA in the evaluation of industrial refuse permit requests required under the recently implemented 1899 Rivers and Harbors Act. Recently, the Army Corps of Engineers has become involved in performing independent feasibility studies for several regional wastewater treatment alternatives for several American cities, including Chicago. These studies, however, are binding on no one, and serve only as an information input.

d. The Council on Environmental Quality

The Council on Environmental Quality is located in the Office of the President. It was established in 1970 under the National Environmental Policy Act in order to advise and assist the president with respect to environmental quality matters. It is the responsibility of the CEQ to review the state of the environment and the effectiveness of the government's efforts in managing it. The CEQ is to make formal recommendations to the president on environmental matters and is to publish an annual report describing the general state of the environment. In addition, the CEQ must review all environmental impact statements required under the National Environmental Policy Act.

e. The Water Resources Council

The Water Resources Council (WRC) is an independent agency consisting of the heads of six federal agencies (Agriculture, Army, HEW, Interior, Transportation, and the FPC) and a chairman appointed by the president. Its members' primary responsibility is to review the adequacy of administrative and statutory means available to federal agencies for the coordination of water and related land resource

policies. Also, the WRC is charged with reviewing the plans of federal-state river basin commissions (including the Great Lakes Basin Commission). They then transmit these plans, with recommendations, to the president. He reviews them and submits them to Congress.

f. The Atomic Energy Commission

The Atomic Energy Commission is an independent, appointed agency that was established to provide for the development, use, and control of atomic energy for the maximum contribution to the general welfare. The AEC performs research directed toward the peaceful use of atomic energy (e.g., nuclear power plants). In addition, it serves a regulatory function in that it licenses and regulates civilian use of nuclear materials and the construction and operation of nuclear reactors. This includes the regulation and licensing of nuclear power plants.

At present, there are three nuclear plants operating on Lake Michigan. These are the Palasades Plant near Benton Harbor, Michigan, the Big Rock Plant near Charlevoix, Michigan, and the Point Beach Plant in Wisconsin. In addition, there are four nuclear power plants under construction (Cook Plant, Zion Plant, Point Beach #2, and Kewaunee), and one plant whose construction application is pending (Bailey).

g. The Federal Power Commission

The Federal Power Commission is an independent agency designed to regulate the interstate aspects of the electric power and natural gas industries. It issues permits and licenses for nonfederal hydroelectric power projects and regulates the rates of wholesale interstate power transactions. The FPC also makes studies concerning the need for

electric power development, the value of the power, and the cooling water needs for steam-electric plants.

4. Lake Michigan Enforcement Conference

Although not a permanent body concerned with any management aspect of Lake Michigan, the Lake Michigan Enforcement Conference was a major federal administrative activity concerning the pollution of Lake Michigan and its tributary basin. The conference was called on January 31, 1968, by Secretary of the Interior Stewart Udall at the request of Governor Otto Kerner of Illinois. The conference was initiated under Section 10 of the 1965 Federal Water Quality Act, as described earlier.

By direction, the conference dealt with the pollution of Lake Michigan and its tributary basin on the broadest possible level. It brought in representatives from the federal government, state and local governments, industry, and the general citizenry. All types of pollution, including vessel, thermal, municipal, radiation, oil, pesticides and agricultural, and industrial pollution were discussed.

There have been three sessions of the conference: one in the winter of 1968, one in the winter of 1969, and the latest one in the winter of 1971. The first session constituted the body of the three-session conference. The second and third sessions were primarily concerned with reviewing progress made since the first session. Also, special reports from technical committees were presented and discussed.

The major conference conclusions and recommendations were those of the first session. Recommendations of the second and third sessions were concerned with pesticide regulation, physical monitoring, and thermal pollution, and were based upon information acquired from the technical committee reports. The conclusions and recommendations from

the first session are contained in Appendix B. While these recommendations have not been enforced, they, and the studies from which they came, carry a considerable amount of influence in the federal decision-making process. In addition, they have served as important guidelines to the states in the creation of their own water pollution control programs. The conclusions and recommendations to the second and third sessions are also summarized in Appendix B. Conclusions concerning water monitoring are discussed in the section titled "Review."

The Lake Michigan Enforcement Conference was very successful in bringing together a broad spectrum of interests and expertise, and it provided for a focal point for Lake Michigan pollution problems. It has, however, relied upon good faith to carry out its recommendations; so, as a true "enforcement" conference, it has not proved terribly successful.

Because of provisions in the pending Federal Water Pollution Control Act Amendments, calling for direct enforcement of standards in the courts, it is likely that the enforcement conference procedure will be abandoned, since the function of the Lake Michigan Enforcement Conference will have ended.

5. Department of Natural Resources--A Proposal

The recommendations of the Ash study offer important insights into the needs of federal agencies charged with the implementation of policy relating to the comprehensive management of our nation's water resources. These needs tend to result from the fact that most federal agencies were formally structured before the concept of comprehensive resource management and multiple resource use were fully developed.

Today, as the situation has changed, we find a need to update federal agency organization.

At present, Congress is considering an Ash committee recommendation to establish a Department of Natural Resources.³⁸ An examination of the rationale behind this recommendation and an examination of the recommendation itself provide for a good evaluation of present agency organization, and offer insight into possible future reorganizations.

In its own words, the Ash study evaluates present agency organization as follows:

Federal water resources development programs are located in three different departments: Agriculture, Interior, and the Army. A separate agency, the Water Resources Council, was established nearly five years ago to coordinate agency planning efforts and policy, but has made limited progress. Interagency rivalry, duplicative planning, and conflicting policies persist.

The nation's non-military public lands are administered by four agencies in two departments. Agriculture's National Forest lands and Interior's public domain lands, in particular, are often adjacent and sometimes closely intermingled. Even though these lands are administered under similar statutory objectives, procedures and policies are needlessly dissimilar. Their separate administration results in unnecessary efforts, and less effective land use programming for public uses.

Federal recreation areas are administered by five different agencies in three departments, with only limited coordination. Opportunities to develop facilities in relation to national needs are not taken advantage of as each agency plans its own development.

A variety of relatively small marine resource programs are located in several agencies of the government, inhibiting the development of a cohesive national marine resources program.

Energy programs consist of separate activities concentrating on particular sources and are scattered among several departments and agencies, with no single agency charged with developing a unified approach to energy resource utilization and conservation.

In short, natural resource programs with broad common purposes have not been grouped together, and a coordinated natural resource management policy has been virtually impossible to achieve.³⁹

In response to this general appraisal of present agency structure related to natural resource management, the Ash commission has recommended the formation of the Department of Natural Resources (DNR). Such a department would consist of five general components: land and recreation, water resources, energy and mineral resources, marine resources and technology, and geophysical science services. Briefly, these components would incorporate existing federal agencies as follows:

- Land and recreation would group together the National Park Service, Bureau of Sport Fisheries and Wildlife, Bureau of Outdoor Recreation, Bureau of Land Management, and the Conservation Division of the Geologic Survey--all of which are from the existing Interior Department. In addition, there would be the Forest Service from the Department of Agriculture, and the proposed Coastal Zone Management Program.
- Water resources would include the Corps of Engineers, the Soil Conservation Service, the Bureau of Reclamation, the Office of Water Resources Research, and the Water Resources Council.
- Energy and mineral resources would include, from the present Interior Department, the Bureau of Mines, the Geologic Survey, and the Office of Coal Research. In addition, it would include the civilian energy programs of the AEC, and the Rural Electrification Administration of the Department of Agriculture.
- Marine resources and technology would resemble, largely, the present National Oceanic and Atmospheric Administration.
- The geophysical science services would include the Environmental Science Services Administration from the Environmental Protection

Agency, and the U.S. Lake Survey and the data buoy development activity from the NOAA.

By creating the DNR with these five components, the Ash commission felt that (1) a center of responsibility for developing broad, unified natural resource policies for consideration by the president and the Congress would be established, (2) it would make possible a more rational balance in planning and managing resources in the light of conflicting demands, and (3) it would encourage the resolution of most disagreements on resource problems at a department level rather than at the White House level, or by having to resort to inconclusive inter-agency coordinating mechanisms.

It is interesting that the Ash committee, in its attempt to simplify structural linkages of agencies with responsibilities for natural resource management, has failed to include the EPA and the FPC in its plans for the DNR. Leaving these two agencies as isolated and independent agencies seems contradictory to the primary goals of the Ash commission in recommending the creation of the DNR.

ASPECTS OF COMPREHENSIVE RESOURCE
MANAGEMENT: REVIEW

A. General

Comprehensive water resource management has been described thus far as being a static, step-by-step process of policy making, planning, implementation, and regulation. In fact, water resource management is a dynamic and ever-changing activity. It must be so, for the human, physical, and biological objects of this management activity are, themselves, always changing. These objects and our perceptions of them will be referred to as the management "situation."

This management situation can be described as changing in several different ways. First, the actual physical resource being managed is constantly undergoing change. This change may be the result of a human activity or it may be natural in origin. It may manifest itself as a subtle change in the chemical, physical, or biological properties of the resource, or it may be a change in the human use potential of the resource that has resulted from prior management activities. In either case, the condition of the resource being managed is always changing. A management system should be able to efficiently cope with this changing condition.

A second way in which the management situation can be described as changing is in man's ability to understand the physical, chemical, and biological natures of the resource being managed. This ability may take the form of hard scientific knowledge concerning the properties or

characteristics of the physical resource being managed, or it may take the form of an increased understanding of the relationships between the various living and nonliving components of the resource. This ability to understand these relationships includes the ability to understand the relationships between human activities and the natural resource systems--both living and nonliving.

A third way in which the natural resource management situation is changing is in the increased susceptibility of the natural resource to physical use of alteration by human activity. This changing susceptibility may be the result of a changing intensity of resource use or it may be the result of an improved technology that can be applied to some aspect of resource use development. In either case, man's ability to use or to misuse a natural resource is continually increasing.

A management situation also changes as a result of the quantity and quality of knowledge available in the social sciences relative to the human object of resource management activities. This knowledge can take many forms. It may concern the identification of basic human needs or goals, or it may involve a monitoring of changing values, needs, and goals. These changes may result from the differing relative degree of fulfillment or lack of fulfillment of such values, needs, and goals by a country's social, economic, and political systems.

In essence, a management situation can change either as a result of a physical change in the resource to be managed or as a result of a change in man's ability to perceive the resource and to understand what it is that he wants or needs from that resource. A resource management system must be able to be responsive to these changes.

David Easton has written, "A system--to persist--must obtain adequate feedback about past performances and it must be able to take measures to regulate its future behavior. Regulation may call for simple adaptations to a changing setting in the light of fixed goals. But it may also include efforts to modify goals or transform them entirely. Simple adaptation may not be enough. To persist, it may be necessary for a system to have the capacity to transform its own internal structures and processes."⁴⁰

There are presently three mechanisms that are used by the federal water resource management system in order to make itself more responsive to the changing management situation: physical monitoring, agency program review, and the democratic political process. Each of these three will be discussed as they relate to the comprehensive management role of the federal government on Lake Michigan.

B. Physical Monitoring

The necessity for a more complete, more systematic, and more coordinated program designed to monitor the nation's water has been recognized by the federal government. Both the CEQ and the EPA are engaged in studies to determine the data requirements of a useful water resource monitoring program. Present efforts have been directed toward the systematic acquisition of water data.

Presently, more than a dozen federal agencies are engaged in the direct acquisition of water data. The Office of Management and Budget requires that these data-gathering activities be coordinated so as to avoid a duplication of effort. The Office of Water Data Coordination, formerly in the U.S. Geologic Survey and now in the NOAA, has been set up as the coordinator of this national water-data gathering

network. A sample of parameters measured by various NOAA monitoring stations can be found in Appendix C. The Office of Water Data Coordination is also developing what it calls its "accounting element." This element will provide information on the quantity and quality of water that flows out of 306 of the nation's major hydrologic basins.

In addition to this federal data-gathering effort, state and federal pollution control agencies are developing a joint surveillance network that will help identify:

- compliance and noncompliance with water quality standards,
- water quality baselines and trends,
- improvements in water quality produced by abatement measures being undertaken,
- emerging water quality problems, in sufficient time to effect adequate prevention measures.⁴¹

Specifically, the water monitoring needs of Lake Michigan were described in a 1969 technical report to the Lake Michigan Enforcement Conference.⁴² Three basic recommendations came from the report:

1. Each state should monitor a designated list of tributary streams near their points of discharge to Lake Michigan, collecting samples at least monthly, analyzing for a uniform list of 16 parameters where needed, and providing related flow data. Illinois will sample one tributary; Indiana, three; Michigan, 18; and Wisconsin, 12.
2. The FWPCA (now in the EPA) should monitor the open waters of Lake Michigan, sampling a selected list of 51 stations at three depths in spring, summer, and fall, and analyzing for a selected list of 22 parameters. Analysis for the same parameters should be performed monthly at the nine water plants listed in Recommendation 19 of the summary of the first session of the conference (see Figure 7).
3. The states should monitor all public beaches, beaches adjacent to tributaries with pollution discharges, and beaches adjacent to high-density population areas, collecting samples twice monthly from May 15 to September 15, and analyzing for total coliform and fecal coliform.

(The recommended parameters to be monitored are listed in Appendix D.)

While simple, systematic gathering of water data is important, it is only one need of a total monitoring program. There remains the need to more carefully monitor a resource's fish and wildlife populations and its adjacent land uses. Also, more coordination is needed in the monitoring of inputs into a water resource. Presently, the Army Corps of Engineers permit program requires information on industrial inputs, and the Geologic Survey and the Soil Conservation Service monitor land and agricultural runoffs. There is a need for more basic research to better determine the meaning of the quantities and trends of the basic parameters being measured by each of these groups. In addition, these parameters need to be more closely related to manageable human activities so that they can be of assistance in the formulation of wise management policy. It is important that monitoring data not only be systematically gathered but that the results and interpreted meaning feed directly back to the resource management system. In this way, the data can serve as a crucial link between the political/social management system and the physical/biological resource system.

C. Agency Program Review

Federal agencies, unlike the legislature or the president, are not directly subject to public review through the electoral process. There are, however, numerous activities which result in the review of agency goals, organizations, and effectiveness in accomplishing goals. This review may take place within an agency, it may be the responsibility of independent agencies such as the Office of Management and the Budget, the Council on Environmental Quality, or the Water Resources Council, or it might be the responsibility of an ad hoc presidential commission such as the Ash commission to study executive reorganization.

In addition, several legislative committees are involved in the review of agencies charged with policy implementation activities in the area of the committee's special interest. Several such committees are the Senate Interior Committee, the House Committee on Interior and Insular Affairs (especially the Subcommittee on Environment), the public works committees of both the Senate and the House (especially the Senate Public Works Subcommittee on Environmental Science and Technology), the House Select Committee on Small Business (the Subcommittee on Environmental Problems Affecting Small Business), the Government Operations Committee, and the Senate Commerce Committee (Subcommittee on Energy, Natural Resources and Environment). Also, both the House and the Senate passed joint resolutions to create the Joint Committee on the Environment to study the input of environmental and technological changes on the quality of the environment.

Private citizen groups, through lobbying activities, legal actions, and communications activities also play an active role in the review of federal agency activities. Such groups as the Sierra Club, the Wilderness Society, the Friends of the Earth, the Nader Center for Responsive Law, and Common Cause are extremely active nationally. Several local groups such as the Lake Michigan Federation, the Businessmen for the Public Interest, the Chicago Campaign Against Pollution, the Chicago Open Lands Project, and the League of Women Voters, are extremely active in matters concerning the use of the Lake Michigan resource.

D. The Democratic Political Process

It is not enough to fully understand a physical and biological system or to have coordinated and efficiently functioning agencies.

There still remains the necessity of coordinating the use and management of a physical resource with the needs, desires, and goals of the people. Traditionally, the democratic political process has been this country's supposed link between the people and the government. David Easton has described this process as a system of inputs and outputs.⁴³

Easton identifies inputs as demands from the political environment for the satisfaction of wants or needs by the political system. The political environment includes the social, biological, human, and physical environments. When these demands rise to a level that induces a stress in the system, the system responds with a feedback or "output." Easton describes outputs as being the decisions and actions of those in authority. The quality of this output can be measured by observing the resulting change in the levels of the demand input.

The problem with this description is that the political process does not operate in such a pure fashion. First, there is the problem that what a society needs or wants is often shaped by what it knows. For example, a society will not actually want or demand clean water if it isn't aware that its water is polluted and if it doesn't understand the implications of such a situation. In the same sense, a society won't demand a more equitable distribution of land use zoning authority among all levels of government if it doesn't realize that many of its problems of land use, uncontrolled urban sprawl, and lack of public access to public waters are, in part, a result of concentrated zoning authority at the local level.

Second, there is the problem that the needs of a society are not always expressed by the wants and needs of its individuals. This

often is the case when a want involves an individual convenience, or a need for personal identity or status. An example is the seemingly growing desire of people to move into a spacious single-dwelling suburban home without regard to the burdens it places upon the environment, social services, and the inner city. The success of the no-deposit, no-return bottle is another example of an individual convenience that serves no apparent social need.

A third reason for the inability of the political process to operate in a pure fashion is that, out of necessity, most governmental activities are the result of internal bureaucratic functions or "behind-the-scenes" decision making. It is virtually impossible for any sector of the public to be informed on even a small percentage of the daily activities of the federal government. This makes the federal government somewhat isolated from the true needs and desires of its people and it makes it more susceptible to special interests, pressures, or personal prejudices. It is especially sensitive to those whose economic position provides them with additional, effective means of influencing political decisions. Even with the national system of elections, news media, and internal agency and legislative review, it is still necessary to supplement the political, economic, and governmental process as a sole mechanism of sensing the social pulse of the nation.

Federally sponsored and independent studies into the biological, psychological, sociological, and material needs of a society are an important supplement to the simple expression of political or economic preference. Leisure needs, the quality of life, and the role, if any, of wilderness on the national psyche are all examples of human needs or human goals often not expressed in election results or economic

data. Such information, however, can serve as important input into the management decision process. It needs to be actively and systematically sought and utilized.

In summary, the review of management activities and the monitoring of the physical and human objects of such management activities is essential if resource management is to be effective, dynamic, and responsive to changes in the management situation. Physical monitoring, agency review, and a responsive political process are the mechanisms by which this review is accomplished. Some of the needs of physical monitoring and agency review are being actively pursued and progress is being made. The needs of the entire political process are far more complex, subtle and ingrained, and it is difficult to measure the effectiveness of any efforts taken to satisfy these needs.

SUMMARY AND CONCLUSIONS

Lake Michigan has been described as providing human populations with ten basic resource uses. While each of these resource uses provides a benefit to the society, the over development or unwise management of any one use can greatly reduce the potential for maximum social benefit from some other resource use, or it can reduce the overall use potential of the lake resource in general. Each resource use can be understood as being a part of a continuum of interrelated and conflicting resource uses. As the demand for further development of each use increases--as it presently is--the degree of conflict between the various uses intensifies. As this level of conflict between the various uses intensifies, it becomes all the more imperative that the Lake Michigan resource be managed in a coordinated and comprehensive manner.

To date, the management of the resource uses of Lake Michigan has been characterized by independent development of each use. There has been a heavy dependency upon private market management and the maximization of economic gain. What public management there has been has also been characterized by single-purpose resource use development. In addition, management responsibility has been highly fragmented and it has been restricted by formal political jurisdictions.

At present, this situation appears to be changing. The federal government, in the areas of comprehensive resource policy, planning, implementation and regulation, and review has been slowly evolving a framework which will be ever more able to provide for the management of

our nation's water resources--of which Lake Michigan is one--in a comprehensive manner. It is within this framework that the important management roles of private institutions and state and local governments will function.

The evolution of the federal role in comprehensive water resource management policy is best expressed by legislation. Past federal legislation dealing with comprehensive water resource management has emphasized the abatement of water pollution. Basically, there have been four significant steps in the development of federal water pollution legislation. First, there was the initial recognition that water pollution was a national problem, not simply a state or local problem (1948). Second, there was the growth of the federal financial commitment in an area that was "primarily the responsibility of the states" (1961, 1965, 1966). Third, there was the federal involvement in water pollution control enforcement through the setting of water quality standards and interstate enforcement mechanisms (1965, 1966). Fourth, there is the on-going change in the federal enforcement role away from water quality standards and toward an optimal technology concept (1971-?).

Recently, the legislative emphasis has begun to shift in favor of aspects of comprehensive water resource management other than the simple abatement of water pollution. Such areas as multiple-use coastal zone planning, land use planning and zoning, and river basin management are receiving more attention. This trend can be expected to continue and to intensify.

The federal government has played a small role in the comprehensive planning progress for Lake Michigan resource use. Planning and zoning has been an activity generally performed by local-level

governments. Current federal activities with the Great Lakes Basin Commission, and with coastal zone and land-use planning legislation are all designed to encourage and coordinate an increased state role in the comprehensive planning for the resource uses of Lake Michigan. Such activities at the federal level are just beginning and can be expected to intensify.

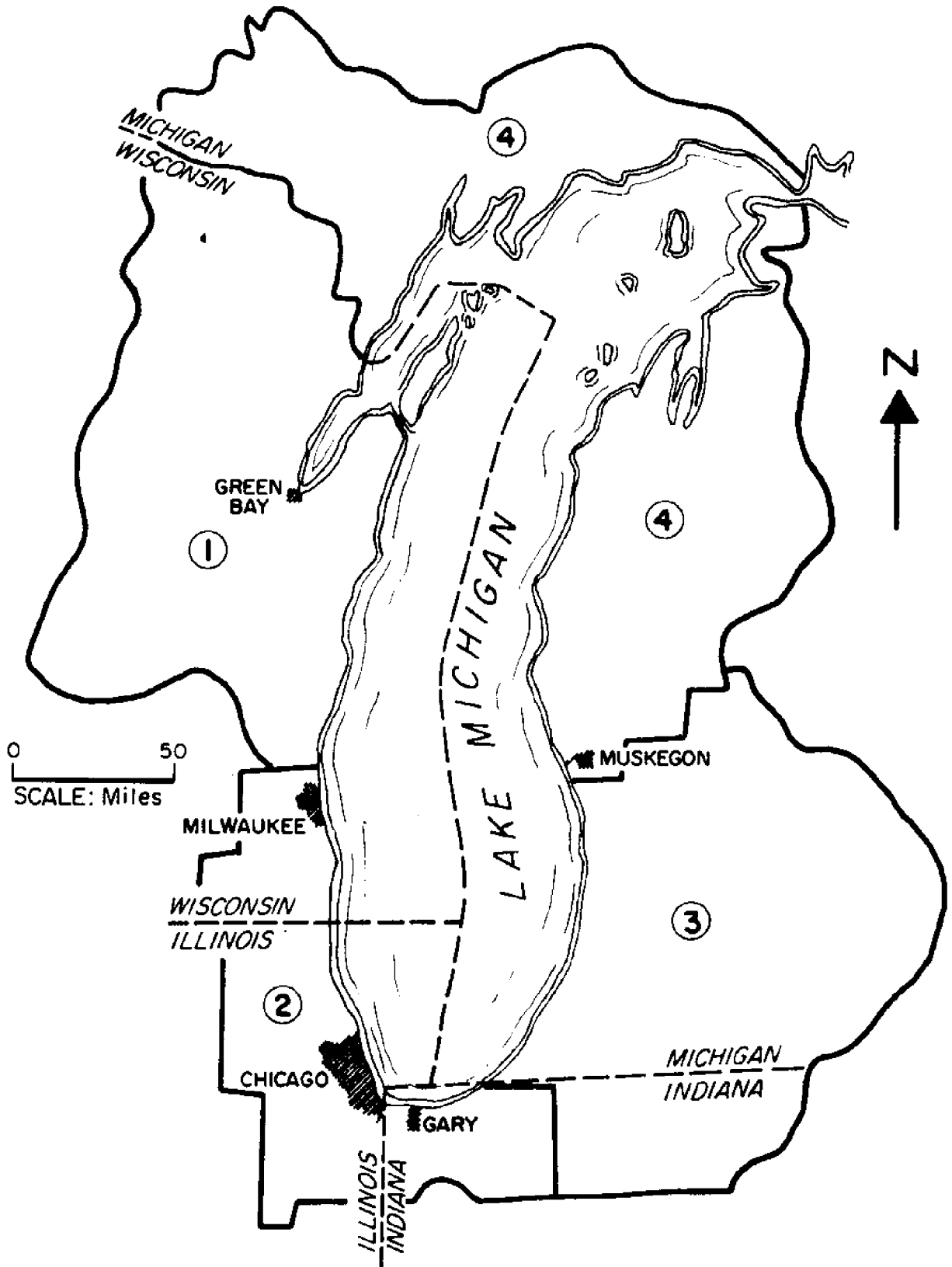
While federal water resource policy is implemented in many different manners, this report emphasized the policy implementation activities on Lake Michigan of federal agencies. These agencies have been characterized by single-purpose missions and organizational fragmentation. Recognition of this situation has, in part, resulted in the Ash commission studies on executive reorganization. One objective of this commission was to recommend ways to bring together agencies with related or complementary responsibilities. The Environmental Protection Agency and the National Oceanic and Atmospheric Administration are results of Ash commission recommendations. The creation of a Department of Natural Resources is a pending recommendation of this commission. It can be expected that the trend in the direction of such reorganization will proceed as the need for more comprehensive and coordinated resource management intensifies.

There are presently three mechanisms that are used by the federal water resource management system in order to make itself more responsive to the changing management situation: physical monitoring, agency program review, and the democratic political process. The needs for physical monitoring of Lake Michigan are being actively pursued, as is the need for federal agency review. While many shortcomings of the democratic political process can be identified, it is difficult to measure the success of efforts taken to correct these shortcomings.

As the level of demand upon the resource uses of Lake Michigan intensifies, the federal role in the comprehensive management of this precious natural resource seems to be evolving in a positive direction. There is a question, however, as to how expeditiously the federal management system--not to mention state, local, and private management systems--can overcome past traditions, practices, interests, and neglects and meet the growing need for the effective comprehensive management of the Lake Michigan resource. The more quickly this need can be met, the greater will be the opportunities for the wise management of Lake Michigan. The federal government is in the position to lead the evolution toward the fulfillment of this need.

APPENDICES

APPENDIX A



LAKE MICHIGAN: Planning Subareas Used by the Great Lakes Basin Commission

APPENDIX B

CONCLUSIONS AND RECOMMENDATIONS OF THE LAKE MICHIGAN ENFORCEMENT CONFERENCE

The Chairman of the Conference pointed out that:

1. Under the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.), pollution of interstate or navigable waters which endangers the health or welfare of any persons is subject to abatement under procedures described in section 10 of the Federal Act.
2. The first step of these procedures is the calling of a conference.
3. The purpose of the conference is to bring together representatives of the States and the U.S. Department of the Interior to review the existing situation and the progress which has been made, to lay a basis for future action by all parties concerned, and to give the States, localities, and industries an opportunity to take any remedial action which may be indicated under State and local law.

The conference was held on January 31, February 1-2, and February 5-7, 1968. The conference was recessed and reconvened in Executive Session on March 7-8, and March 12, 1968.

At the Executive Session the conferees agreed to the following conclusions and recommendations:

Conclusions - First Session, 1968:

1. Lake Michigan is a priceless natural heritage which the present generation holds in trust for posterity, with an obligation to pass it on in the best possible condition.
2. Water uses of Lake Michigan for municipal water supply, recreation, including swimming, boating, and other body contact sports, commercial fishery, propagation of fish and aquatic life, and esthetic enjoyment, are presently impaired by pollution. The sources of this pollution include wastes from municipalities, industries, Federal activities, combined sewer overflows, agricultural practices, watercraft, natural runoff, and related activities throughout the drainage basin.
3. Eutrophication is a threat now to the usefulness of Lake Michigan. Unless checked, the aging of Lake Michigan will be accelerated by continuing pollution and particularly by wastes containing

phosphates. Feasible methods exist for substantial removal of phosphates from sewage and industrial waste discharges. They need to be applied.

4. Evidence of severe bacterial pollution of tributaries has been found in the Fox River between Lake Winnebago and Green Bay, Wisconsin; in the Milwaukee River within Milwaukee County, Wisconsin; in and downstream from cities along the Grand River in Michigan and the St. Joseph River in Indiana and Michigan; and in the streams of the Calumet Area, Illinois and Indiana. Although the bacterial quality of Lake Michigan is generally good in deep water, the water is degraded at some points along the shoreline and in harbor areas.

5. Pollution has contributed to the growth of excessive inshore algal populations which have occurred in the vicinity of Manitowoc to Port Washington, Wisconsin; Chicago, Illinois; the eastern shore of Lake Michigan; and near Manistique, Michigan. Interference with water treatment plant operations because of algae has occurred at Green Bay, Sheboygan, and Milwaukee, Wisconsin; Waukegan, Evanston, and Chicago, Illinois; Gary and Michigan City, Indiana; Benton Harbor, Holland, Grand Rapids, and Muskegon, Michigan; and other cities. Phosphate concentrations now exceed critical algal growth values in many areas.

6. Excessive sludgeworm populations, indicating pollution of lakebed sediments, have been found at points one mile off the shore near Manitowoc, Sheboygan, Port Washington, Wisconsin, to Waukegan, Illinois, and Chicago, Illinois, to Muskegon, Michigan. Sludgeworms were not found in shallow waters subject to wave action.

7. The small quantity of oxygen normally dissolved in water is perhaps the most important single ingredient necessary for a healthy, balanced, aquatic life environment. The discharge of treated and untreated municipal and industrial wastes with high concentrations of biochemical oxygen demand have caused oxygen depletion in many of the Lake Michigan tributaries and in some harbors. At present the main body of Lake Michigan has not evidenced signs of oxygen deficiency.

8. In addition to one existing nuclear power plant, five nuclear power plants, three of which will have twin reactors, are proposed or under construction at Lake Michigan cities for completion between 1970 and 1973. The combined impact of siting many reactors on the shores of the lake must be considered so that this activity will not result in pollution from wastewater heat or from the discharge of excessive amounts of radionuclides.

9. Watercraft plying the waters of Lake Michigan and its tributaries are contributors of both untreated and inadequately treated wastes in local harbors and in the open lake, and intensify local pollution problems.

10. The danger of spills of pollutant chemicals, particularly oil, whether accidental or deliberate is so prevalent that it must be considered a significant source of pollution of the waters of Lake Michigan and treated as such. Oil discharges from industrial plants and

commercial ships, and careless loading and unloading of cargos, despoil beaches and other recreational areas, contribute to taste and odor problems and treatment problems at water treatment plants, coat the hulls of boats, and may be deleterious to fish and other aquatic life.

11. The maintenance of waterways for commercial and navigational use is a constantly necessary activity. The continued deposition of dredged material containing nutrients, oil, and solids of sewage and industrial waste origin in Lake Michigan poses a distinct threat to the quality of the lake.

12. Pesticides are found in Lake Michigan and its tributary streams resulting from the application of these materials. The ever-increasing use of these materials threatens water uses for recreation, fish and wildlife, and water supplies.

13. A persistent pollutant entering directly into Lake Michigan or dissolved into the water that feeds the lake, mixes with and may become an integral part of the lake water as a whole.

14. The massive die-off of alewives that occurred in 1967 created conditions that severely restricted recreational uses causing losses in millions of dollars to the tourist industry and certain municipalities. Although the dead fish were not the result of pollution, they caused pollution and are therefore a concern to water pollution control agencies.

15. Discharges of untreated and inadequately treated wastes originating in Wisconsin, Illinois, Indiana, and Michigan cause pollution of Lake Michigan which endangers the health or welfare of persons in States other than those in which such discharges originate. In large measure this pollution results from nutrients which fertilize the lake. This pollution is subject to abatement under the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.).

16. The Federal enforcement actions already in effect on the Menominee River area and the Calumet River area are supplemented but not superseded by this conference.

Recommendations - First Session, 1968:

1. Waste treatment is to be provided by all municipalities to achieve at least 80 percent reduction of total phosphorus and to produce an effluent that will not result in degradation of Lake Michigan's water quality. Such treatment will provide compliance with the water quality standards for Lake Michigan as approved by the Secretary of the Interior and the appropriate State water pollution control agency of Illinois, Indiana, Michigan or Wisconsin. This action is to be substantially accomplished by December 1972.

2. Industries not connected to municipal sewer systems are to provide treatment so as not to result in the degradation of Lake Michigan's water quality and to meet the water quality standards for

Lake Michigan as approved by the Secretary of the Interior and the appropriate State water pollution control agency of Illinois, Indiana, Michigan or Wisconsin. This action is to be substantially accomplished by December 1972.

3. Within six months each State water pollution control agency shall list the municipalities and industries discharging wastewater to the Lake Michigan Basin. The U.S. Department of the Interior will provide a comparable list of Federal installations. Each source so listed will indicate whether it discharges pollutants, including nutrients, having a deleterious effect on the Lake Michigan water quality. Detailed action plans for treatment of all waste having deleterious effect on the water quality of Lake Michigan are to be developed. Such plans shall identify the principal characteristics of the waste material now being discharged, the quantities, the proposed program for construction or modification of remedial facilities and a timetable for accomplishment, giving target dates in detail. This list shall be presented to the conferees for their review and consideration. Pollution sources shall be added to or removed from the list by formal action of the conferees.

4. Continuous disinfection is to be provided throughout the year for all municipal waste treatment plant effluents. This action is to be accomplished as soon as possible and not later than May 1969.

5. Unified collection systems serving contiguous urban areas are to be encouraged.

6. Adjustable overflow regulating devices are to be installed on existing combined sewer systems, and be so designed and operated as to utilize to the fullest extent possible the capacity of interceptor sewers for conveying combined flow to treatment facilities. The treatment facilities shall be modified where necessary to minimize bypassing. This action is to be taken as soon as possible and not later than December 1970.

7. Effective immediately, combined sewers are to be separated in coordination with all urban reconstruction projects, and prohibited in all new developments, except where other techniques can be applied to control such pollution. Pollution from combined sewers is to be controlled by July 1977.

8. Discharge of treatable industrial wastes (following needed preliminary treatment) to municipal sewer systems is to be encouraged.

9. Continuous disinfection is to be provided for industrial effluents containing pathogenic organisms, or organisms which indicate the presence of such pathogens, which may have a deleterious effect on persons coming into contact with Lake Michigan waters.

10. The States and the Department of the Interior will appoint members of a special committee on nuclear discharges and the thermal pollution aspects of power plants and reactors. The committee will meet with representatives of the Atomic Energy Commission and other

interested parties to develop guidelines for pollution control from nuclear power plants. The committee is to pay special attention to thermal discharges which affect the aquatic life environment of the lake. Representatives of the committee will be available to appear before any Federal or State agency considering approval of a permit for such power plants and reactors.

11. The prohibition of the dumping of polluted material into Lake Michigan is to be accomplished as soon as possible. The Corps of Engineers and the States are requested to report to the conferees within six months concerning their program, at which time the conferees will consider adopting a coordinated approach toward the disposal of dredged material together with a target date for getting the program into operation.

12. While the massive deaths of alewives in Lake Michigan are probably not caused by pollution this phenomenon certainly creates a pollution problem. The U.S. Department of the Interior, Fish and Wildlife Service, and the cooperating State agencies in the four States bordering Lake Michigan are to be commended on their efforts to achieve an ecological balance to stop the massive alewife die-off in Lake Michigan. It is recognized that this is a long-range program. In order to provide protection for the next several years, stringent interim measures must be provided. Such measures will include skimming of dead alewives before they reach the shores of Lake Michigan, disposal on properly located land sites and a local program to deal with alewives which get to shore despite the offshore skimming program. Recognition is given to the program being developed by the task force of the Great Lakes Basin Commission to meet this problem during this and the next few years. To assure the success of this program the conferees recommend that the States concerned and the Federal government support a program which would accomplish the above objective with funds and personnel.

13. The representatives of the conferees within 60 days meet and agree upon uniform rules and regulations for controlling wastes from watercraft. These rules and regulations will generally conform with the harbor pollution code adopted by the City of Chicago and the regulations adopted by the Michigan Water Resources Commission. The use of maceration chlorination is not approved at the present time. Since each of the four States operates under different statutes, conferees will recommend to their respective boards, legislatures, etc., approval of the proposed uniform rules and regulations. Commensurate requirements controlling the discharge of wastes from commercial vessels is to be the responsibility of the Federal government.

14. Each of the State water pollution control agencies accelerate programs to provide for the maximum use of area-wide sewage facilities to discourage the proliferation of small treatment plants in contiguous urbanized areas and foster the replacement of septic tanks with adequate collection and treatment.

15. Technical committee on pesticides will be established, to be chaired by a member of the Federal Water Pollution Control Administration, with representatives from each state. The committee shall evaluate

the pesticide problem and recommend to the conferees a program of monitoring and control. The first report will be submitted in six months to the conferees. The States shall seek legislation to license commercial applicators.

16. The U.S. Department of Agriculture be requested to submit to the conferees a report within six months on agricultural programs to prevent pollution from agricultural land use such as siltation and bank stabilization.

17. A committee be appointed to develop specific recommendations for a coordinated four State-Federal monitoring program in the Lake Michigan Basin and submit recommendations to the conferees at the next progress meeting.

18. State water pollution control agencies and U.S. Department of the Interior shall compile an inventory of all sites where potential exists for major spills of oil and other hazardous material, which may affect the water quality of Lake Michigan, and require that measures be taken where necessary to prevent the escape of this material to the waters. A report will be submitted to the conferees within six months.

19. The State water pollution control agencies shall arrange for a broad spectrum of water quality analyses, including planktonic algae counts, to be performed at least twice weekly at the following water filtration plants: Green Bay, Milwaukee, Evanston, Chicago (both plants), Gary, Michigan City, Benton Harbor, and Grand Rapids. Results will be reported annually to the conferees.

20. The Coast Guard will be requested to report at the next progress meeting on present and future plans for monitoring by aircraft and reporting of pollution on Lake Michigan.

21. The discharge of visible oil from any source in such a manner as to reach the waters of Lake Michigan shall be eliminated.

22. Present knowledge of water pollution control shall be employed immediately to abate water pollution in the Lake Michigan Basin, and research on pressing water pollution problems shall be vigorously pursued. Principal areas in which research is needed in the Lake Michigan Basin include: control of over-production of algae; more effective and less costly methods for removing dissolved chemicals, especially nutrients, from wastewaters; techniques for restoring eutrophic lakes; methods for ultimate disposal of residues removed from wastewaters; improved treatment and other measures for handling industrial wastes including recirculation; permanent solutions for combined sewer problems; effective treatment plants for ships; improvement and standardization of water quality tests; and improved techniques for water quality monitoring.

23. It is recommended by the State conferees that Federal legislation for the control of oil pollution on Lake Michigan be strengthened.

24. It is recommended by the State conferees that the full appropriation be made of the grant authorizations in the Federal Water Pollution Control Act.

25. Progress meetings be held at least every six months unless the conferees decide on another schedule for such meetings.

26. The conference will be reconvened at the call of the Chairman.

RECOMMENDATIONS: Technical Committee on Pesticides Monitoring and Control, Second Session, 1969

1. The concentration of DDT in the fish should not exceed 1.0 $\mu\text{g/g}$; DDT should not exceed 0.5 $\mu\text{g/g}$; dieldrin should not exceed 0.1 $\mu\text{g/g}$; and all other chlorinated hydrocarbon insecticides, singly or combined, should not exceed 0.1 $\mu\text{g/g}$. Limits apply to both muscle and whole body and are expressed on the basis of wet weight of tissue.

2. Each state should establish a regulatory authority to control and record type, quantity and place of insecticide use.

3. A Lake Michigan Interstate Pesticides Committee should be created by the conferees to attain uniformity among the states in pesticide use controls and establish uniform pesticide concentration limits in fish, water and other aspects of the Lake Michigan ecosystem.

4. The research needs listed in this committee's report should receive priority equal to that given to the monitoring program.

5. The monitoring program detailed in this committee's report, and modified as needed, should be implemented at the earliest possible date and continue as long as the insecticide hazard exists.

RECOMMENDATIONS: Technical Committee on Waste Heat Discharges, Third Session, 1971

I. Applicable to all waste heat discharges except municipal waste treatment plants and vessels.

1. At any time, and at a maximum distance of 1,000 feet from a fixed point adjacent to the discharge (agreed upon by the State and Federal regulatory agencies), the receiving water temperature shall not be more than 3°F above the existing natural temperature nor shall the maximum temperature exceed those listed below whichever is lower:

	<u>Surface 3 feet</u>
January	45 degrees
February	45
March	45
April	55
May	60
June	70

July	80
August	80
September	80
October	65
November	60
December	50

2. Water intake shall be designed and located to minimize entrainment and damage to desirable aquatic organisms. Requirements may vary depending upon local situations but, in general, intakes are to have minimum water velocity, shall not be influenced by warmer discharge waters, and shall not be in spawning or nursery areas of important fishes. Water velocity at screens and other exclusion devices shall also be at a minimum.

3. Discharge shall be such that geographic areas affected by thermal plumes do not overlap or intersect. Plumes shall not affect fish spawning and nursery areas nor touch the lake bottom.

4. Each discharger shall complete preliminary plans for appropriate facilities by December 31, 1971, final plans by June 30, 1972, and place such facilities in operation by December 31, 1973; however, in cases where natural draft towers are needed, this date shall be December 31, 1974.

5. All facilities discharging more than a daily average of 0.5 billion BTU/hour of waste heat shall continuously record intake and discharge temperature and flow and make those records available to regulatory agencies upon request.

II. Applicable to all new waste-heat discharges exceeding a daily average of 1/2 billion BTU/hour, except as noted in I, which have not begun operation as of March 1, 1971, and which plan to use Lake Michigan waters for cooling.

1. Cooling water discharges shall be limited to that amount essential for blowdown in the operation of a closed-cycle cooling facility.

2. Plants not in operation as of March 1, 1971, will be allowed to go into operation provided they are committed to a closed-cycle cooling system construction schedule approved by the State regulatory agency and EPA. In all cases, construction of closed-cycle systems and associated intake and discharge facilities shall be completed by December 31, 1974, for facilities utilizing natural draft towers and December 31, 1973, for all other types of closed-cycle systems.

III. The States agree to file with EPA within six months a plant-by-plant program identifying corrective actions for the modification of intake facilities, including power plants, municipal, and industrial users, to minimize the entrainment and damage to desirable aquatic organisms.

- IV. The conferees agree that there should not be a proliferation of new power plants on Lake Michigan, and that in addition to the above controls, limitations should be placed on large-volume heated-water discharges by requiring closed-cycle cooling systems, using cooling towers or alternative cooling systems on all new power plants.

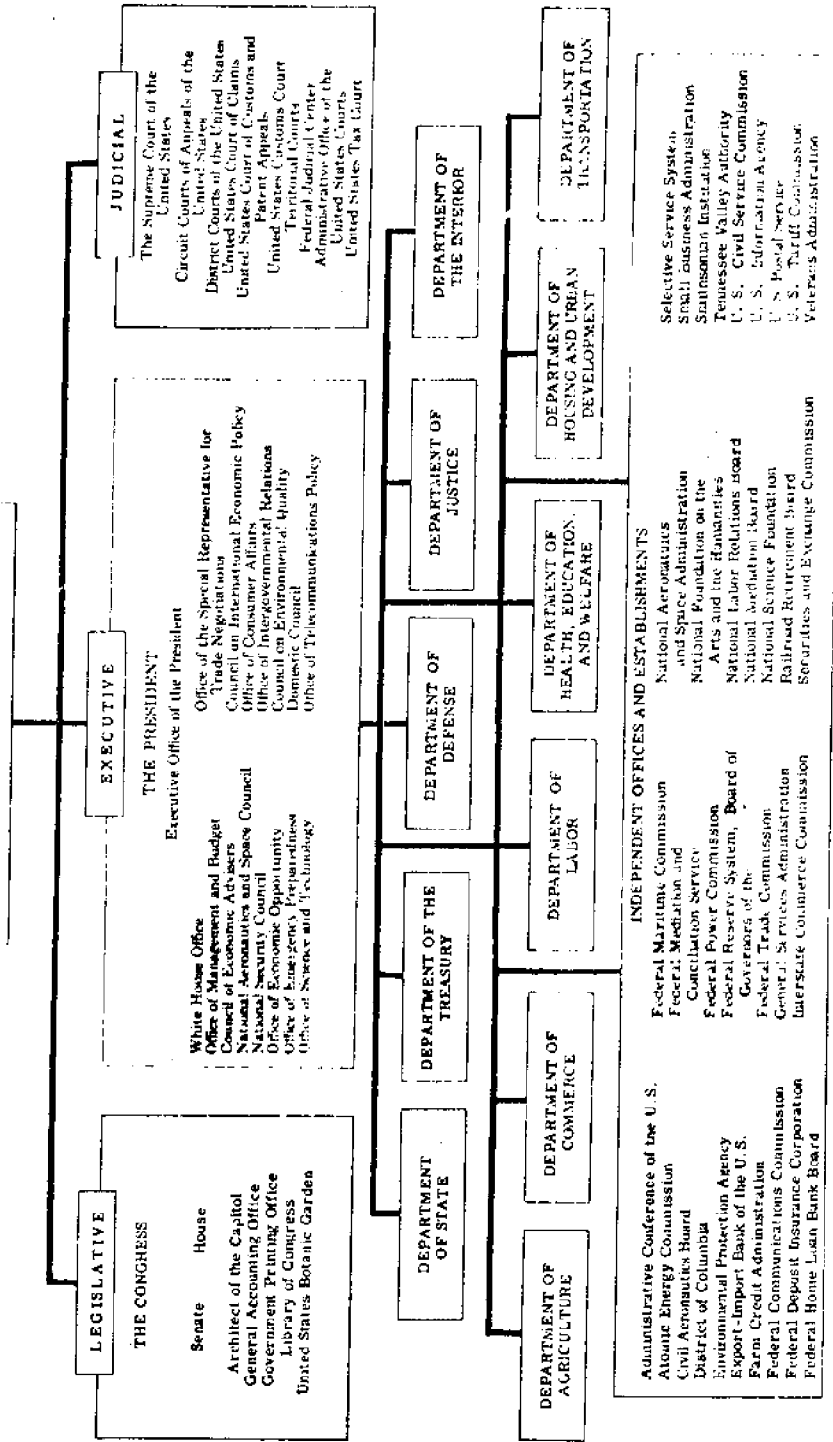
RECOMMENDATIONS: Concerning a Water Monitoring Program for Lake Michigan, Second Session, 1969, see text, page 82.

APPENDIX C
FEDERAL GOVERNMENT ORGANIZATION CHARTS*

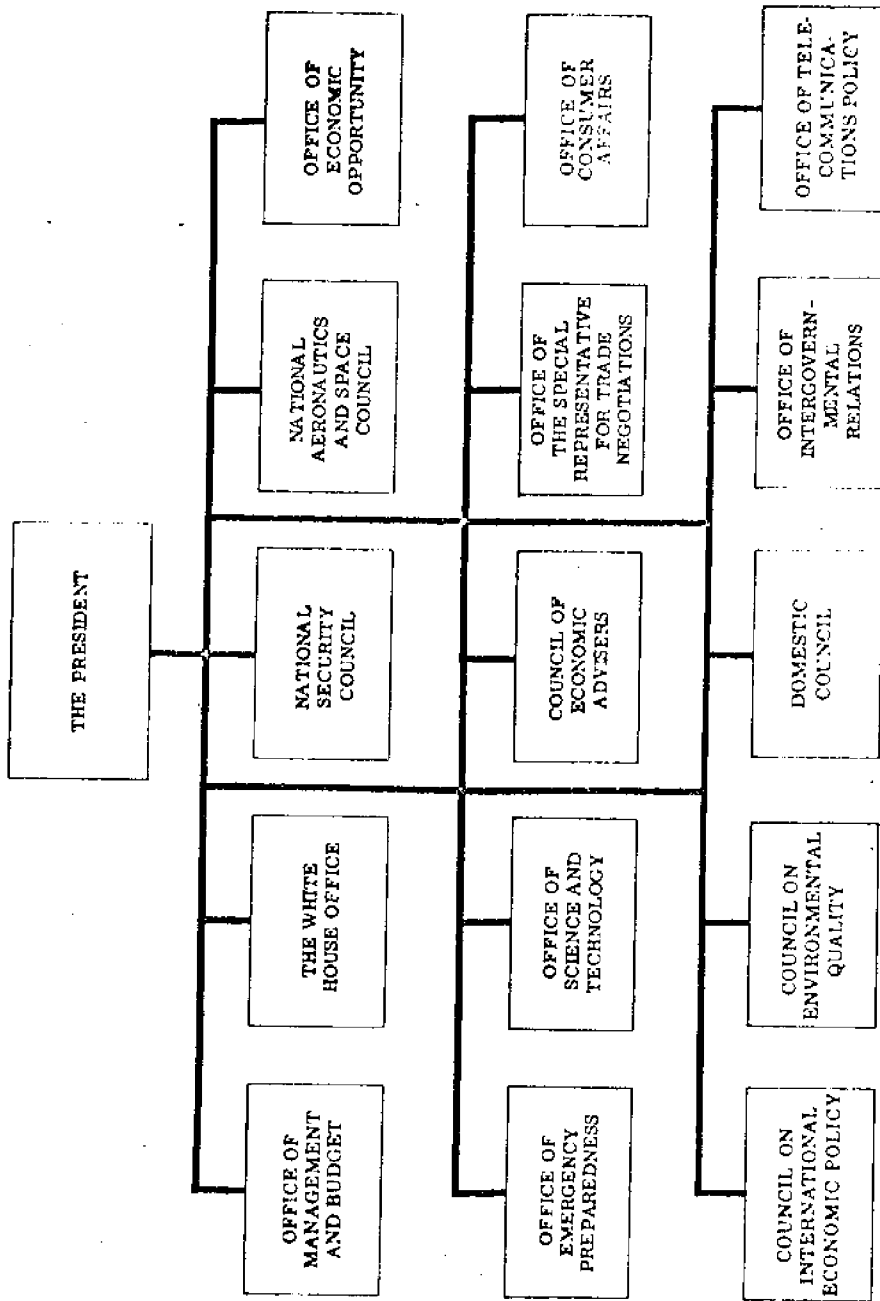
*Taken from the United States Government Organization Manual, Government Printing Office, Washington, D.C., August 1971.

THE GOVERNMENT OF THE UNITED STATES

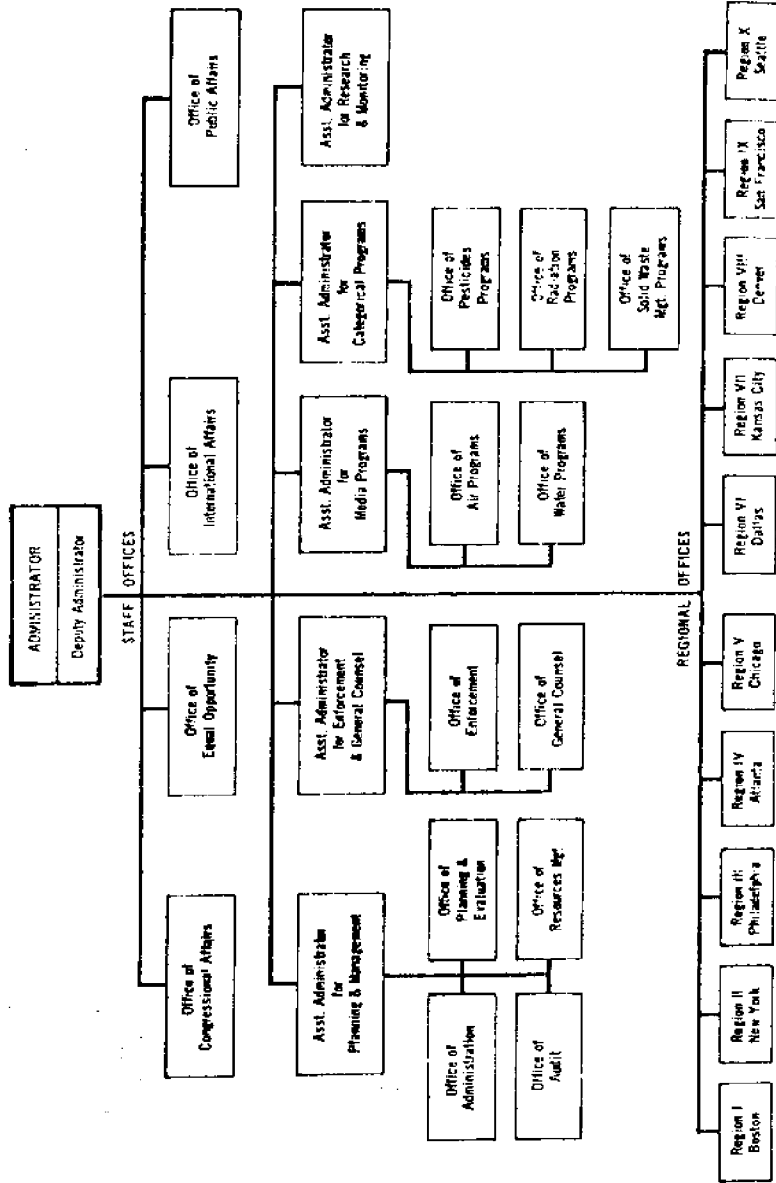
This chart seeks to show only the more important agencies of the Government. See text for other agencies.



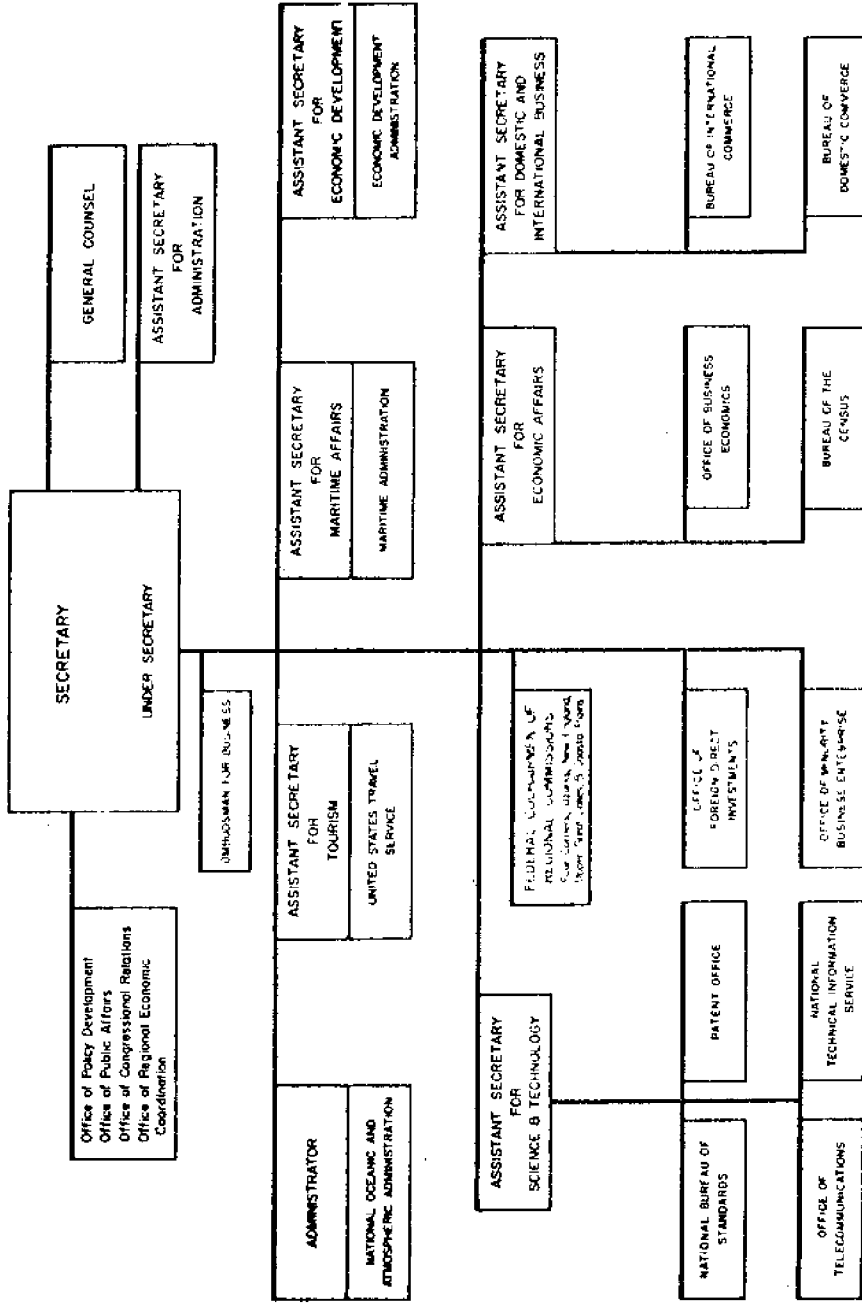
EXECUTIVE OFFICE OF THE PRESIDENT



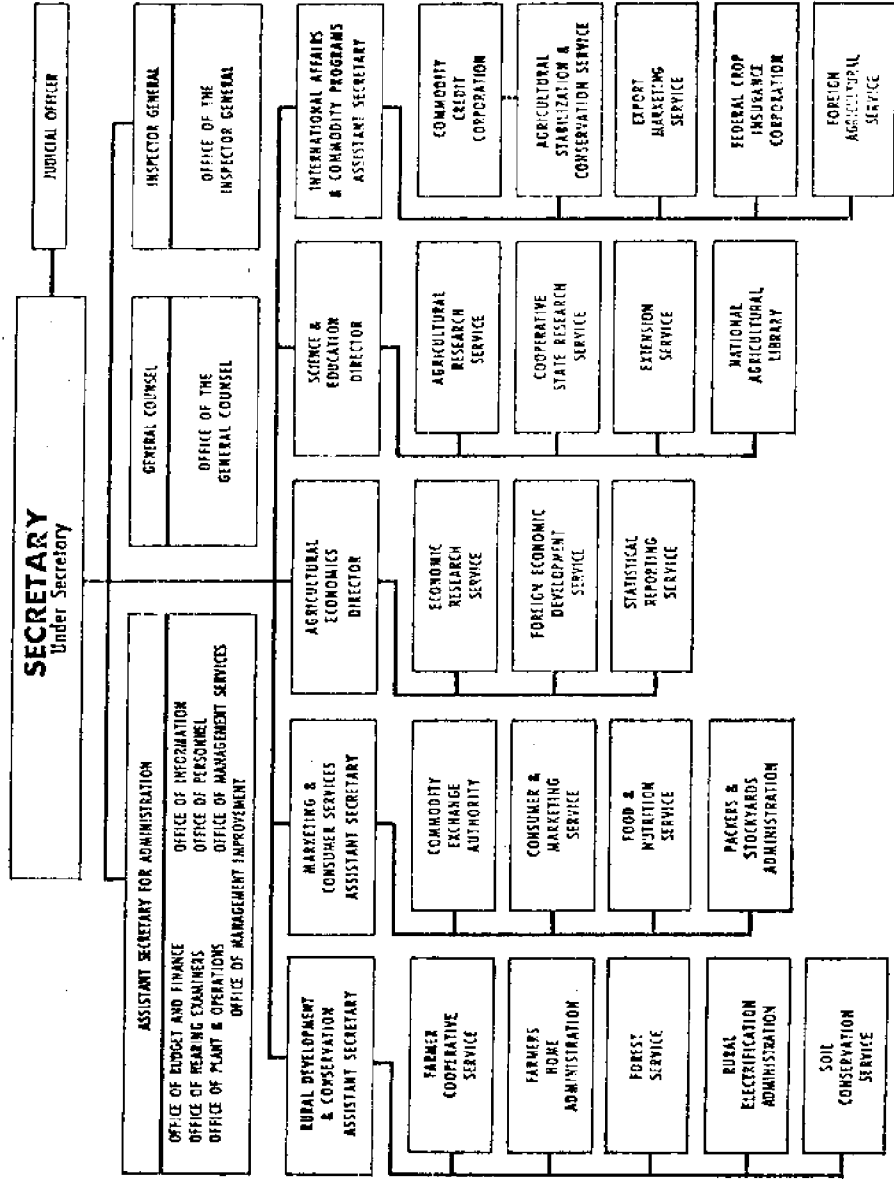
ENVIRONMENTAL PROTECTION AGENCY



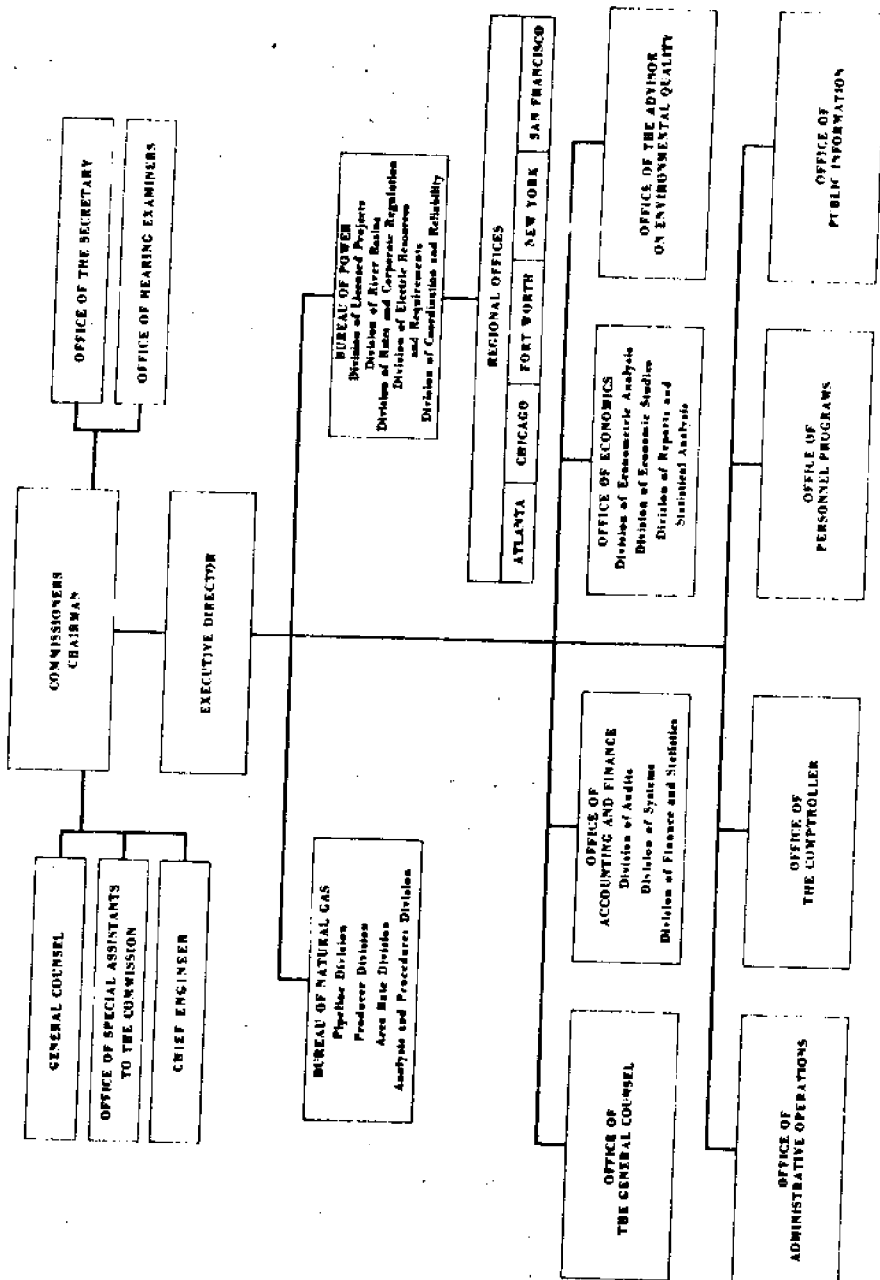
U.S. DEPARTMENT OF COMMERCE



DEPARTMENT OF AGRICULTURE



FEDERAL POWER COMMISSION



APPENDIX D

RECOMMENDED WATER PARAMETERS TO BE
MONITORED IN LAKE MICHIGAN

Lake Michigan Enforcement Conference,
Second Session, 1969

Tributary Parameters to Be Measured Regularly:

Alkalinity (total as CaCO₃), BOD, Chloride, Coliform (fecal), Coliform (total), Dissolved Oxygen, Hardness (as CaCO₃), Nitrates, Nitrogen, pH, Phosphorus, Dissolved Solids, Volatile Suspended Solids, Temperature.

Optional Parameters:

Calcium, Color, Conductivity, Fluorides, Magnesium, Potassium, Radiation (gross beta), Radiation (gross alpha), Sodium, Turbidity.

Tributary Parameters to Be Measured Periodically:

Cadmium, Chromium, Copper, Cyanide, Iron, Lead, Manganese, Nickel, Phenols, Sulfate, Zinc, Mercury.

Open-Water Parameters:

Ammonia, Calcium, Chloride, Color, Dissolved Oxygen, Magnesium, Nitrates, Nitrogen, pH, Phosphorus, Phytoplankton, Potassium, Radiation (gross alpha), Radiation (gross beta), Silica, Sodium, Dissolved Solids, Sulfate, Turbidity, Zooplankton, BOD.

NOTES

1. This writer's opinion.
2. This figure includes the population of the Lake Michigan drainage basin plus the population of greater Chicago.
3. Lake Baikal (5,300 cu. mi.), Lake Tanganyika, and Lake Superior (2,700 cu. mi.) are larger.
4. Taken from The Nation's Water Resources, Water Resources Council, Washington, D.C., 1968, p. 6-3-4.
5. "Water Pollution Problems of Lake Michigan and Tributaries," Federal Water Pollution Control Administration, Jan. 1968, p. 12.
6. Ibid., p. 13.
7. Conference Proceedings, Pollution of Lake Michigan and Its Tributary Basin, U.S. Department of the Interior, 1968, p. 1583.
8. "Water Pollution Problems of Lake Michigan and Tributaries," op. cit., p. 12.
9. Reprinted in the National Estuary Study, U.S. Department of the Interior, 1970, vol. 6, p. c-3.
10. Michael Terry Long, Great Lakes Institutions and Policies, unpublished paper, 1969.
11. "Water Pollution Problems of Lake Michigan and Tributaries," op. cit., p. 13.
12. Ibid., p. 16.
13. Conference Proceedings, Pollution of Lake Michigan and Its Tributary Basin, U.S. Department of the Interior, 1968, p. 1514.
14. U.S. Water Resources Council, Seminar Summary, "Water and Related Land Resources Management," Feb. 2-4, 1971, Cincinnati, Ohio.
15. As recognized in legislation for public land use planning and coastal zone management.
16. Physical and Ecological Effects of Waste Heat on Lake Michigan, U.S. Department of the Interior, Sept. 1970.
17. Ibid., p. 1-2.

18. Conference Proceedings, Pollution of Lake Michigan and Its Tributary Basin, U.S. Department of the Interior, 1968, p. 103.
19. Lyle E. Craine, "Institutions for Managing Lakes and Bays," submitted to Natural Resources Journal, April 15, 1971.
20. Ibid.
21. Ibid., pp. 10-11.
22. The Dictionary of the Social Sciences, J. Gould and W. Kalb (eds.), The Free Press of Glencoe, 1964, p. 509.
23. An example of such evidence is the on-going effort to amend the Federal Water Pollution Control Act.
24. The secretary of HEW could call for interstate enforcement proceedings, but intrastate enforcement proceedings could only be initiated by request of the state governor.
25. This position was stated in a House Public Works Committee minority report.
26. "Pollution of the Detroit River, and Michigan Waters of Lake Erie and Its Tributaries," Public Health Service, U.S. Department of HEW, April 1965.
27. The decade of the 1960s saw many cases not only in water pollution legislation but in environmental legislation, in general. Special interests were represented in the House of Representatives (especially in committees) so that much significant legislation was seriously stalled and/or compromised. Publicized examples are the Redwoods National Park, the Wilderness Act, the SST, and the National Environmental Policy Act.
28. House Hearings, Feb. 18, 19, and 23, 1965, as reported in the Congressional Quarterly Almanac, Congressional Quarterly Service, 1965, p. 749.
29. These responsibilities were transferred to the secretary of the interior in 1966, and to the secretary of the EPA in 1970.
30. Congressional Quarterly Almanac, Congressional Quarterly Service, vol. 12, 1966, p. 639.
31. U.S. Water Resources Council, Seminar Summary, "Water and Related Land Resources Management," Feb. 2-4, 1971, Cincinnati, Ohio, p. 49.
32. Departments of Agriculture, Army, Commerce, HEW, HUD, Interior, Justice, State, Transportation, and the FPC and EPA.
33. "Challenges for the Future," The Great Lakes Basin Commission, Ann Arbor, Michigan, 1971, p. 6.

34. U.S. Water Resources Council, Seminar Summary, "Water and Related Land Resources Management," Feb. 2-4, 1971, Cincinnati, Ohio, p. 53.
35. The states, too, have begun to act. The recent passage of the Michigan Shoreline Zoning Act is an example of such a state action.
36. Linton Caldwell, "The Politics of Ecology," from Environment, Resources, Pollution and Society, W. Murdoch (ed.), Sinauer Associates, Stamford, Conn., 1971.
37. "Policeman for Pollution," Time Magazine, Nov. 23, 1970, pp. 41-42.
38. Memorandum for the President, May 12, 1970, Subject: The Establishment of a Department of Natural Resources. From: President's Advisory Council on Executive Organization.
39. Ibid.
40. David Easton, A Framework for Political Analysis, Prentice Hall, Inc., Englewood Cliffs, N.J., 1965, p. 25.
41. William T. Sayers, "Water Quality Surveillance: The Federal-State Network," Environmental Science and Technology, vol. 5, no. 2, Feb. 1971, pp. 114-19.
42. Conference Proceedings, 2nd Session, Pollution of Lake Michigan and Its Tributary Basin, vol. 2, Federal Water Pollution Control Administration, 1969.
43. David Easton, op. cit.

BIBLIOGRAPHY

- Bauer and Gergen, The Study of Policy Formation, The Free Press, 1968, Chapters 1 and 4.
- Bradley, Earl H., Jr., The House of Representatives and Water Pollution Control Legislation 1959-1966, Master's Thesis, Case Western Reserve University, June 1970.
- Bradley, Earl H., Jr., Where the Land Meets the Water: A Review of Shoreline Management Programs in the United States, Master's Thesis, The University of Michigan, December 1971.
- Canadian Department of Fisheries and Forestry, Great Lakes Water Use Map, prepared by the Economic Geography Section and the Lakes Management Research Section, 1971.
- Congressional Quarterly Service, Congressional Quarterly Almanac, 1965, 1966, 1970, Washington, D.C.
- Cooly, R., and Wandesforde-Smith, G., Congress and the Environment, University of Washington Press, Seattle, Wash., 1970.
- Cooper, Charles F., "The Ecosystem Concept in Natural Resource Management," unpublished paper, 1969.
- Council on Environmental Quality, Environmental Quality, the Second Annual Report of the Council on Environmental Quality, August 1971, The Government Printing Office, Washington, D.C.
- Craine, Lyle E., "Development and Use of the Great Lakes: Policy and Institutional Needs," presented to Great Lakes Panel of the National Council on Marine Resources and Engineering Development, October 29 and 30, 1968.
- Craine, Lyle E., "Institutions for Managing Lakes and Bays," submitted to the Natural Resources Journal, April 15, 1971.
- Dreyfus, D. A., "A Definition of the Scope of Environmental Management," U.S. Senate Committee on Interior and Insular Affairs, 91st Congress, 2nd session, 1970.
- Easton, David, A Framework for Political Analysis, Prentice Hall, Inc., Englewood Cliffs, N.J., 1965.
- Easton, David (ed.), Varieties of Political Theory, Prentice Hall, Inc., Englewood Cliffs, N.J., 1966.

- Engineering Institute of Canada and the American Society of Civil Engineers, Proceedings of Great Lakes Water Resources Conference, Toronto, Canada, June 24-26, 1968.
- Fox, Irving K., "The Water Resources Planning Act: An Historical Perspective," printed in the Seminar Summary, U.S. Water Resources Commission Meeting, Cincinnati, Ohio, Feb. 2-4, 1971.
- Great Lakes Basin Commission, "Great Lakes Institutions," Ann Arbor, Mich., June 1969.
- Great Lakes Basin Commission, "Annual Report," fiscal year ending June 30, 1970, Ann Arbor, Mich.
- Great Lakes Basin Commission, "Challenge for the Future; An Interim Report on the Great Lakes Basin Framework Study," Ann Arbor, Mich., Aug. 1971.
- Great Lakes Basin Commission, "Law, Politics, and Institutional Arrangements," Great Lakes Basin Framework Study, Draft no. 1, unpublished.
- International Association for Great Lakes Research, Proceedings, Thirteenth Conference on Great Lakes Research, Part 1, Ann Arbor, Mich., 1970.
- Lake Michigan Federation, "Bulletin of the Lake Michigan Federation," nos. 5, 9, Chicago, Ill., 1971.
- Lasswell, H. D., and Kaplan, A., "Policy" from The Dictionary of the Social Sciences, J. Gould and W. Kalb (eds.), The Free Press of Glencoe, 1964.
- Murdoch, W. W., Environment, Resources, Pollution, and Society, Sinauer Associates, Stamford, Conn., 1971.
- National Academy of Sciences, "Alternatives in Water Management" Division of Earth Sciences, Washington, D.C., 1966.
- National Wildlife Federation, "Conservation Report," nos. 28, 29, 30, 32, 34, 36, Washington, D.C., 1971.
- Odum, Eugene P., Fundamentals of Ecology, 3rd ed., W. B. Saunders Co., Philadelphia, Pa., 1971.
- Office of Science and Technology, "Electric Power and the Environment," Energy and Policy Staff, Aug. 1971.
- Public Laws: 84-660, 84-753, 91-190. United States.
- Reed, Paul W., "The Federal Water Pollution Control Program in the United States," presented at the Annual Meeting of the American Concrete Pipe Association, Montreal, Canada, March 31, 1966.

- Sayers, William T., "Water Quality Surveillance: The Federal-State Network," Environmental Science and Technology, vol. 5, no. 2, Feb. 1971, pp. 114-19.
- State of Michigan Department of Natural Resources, Public Hearing, "Temperature Standards for the Protection of Fish and Aquatic Life," Lansing, Mich., June 24, 1971.
- Stein, Murray, "Enforcement of the Federal Water Pollution Control Program," 1966, reprinted in Conference Proceedings, Lake Michigan and its Tributary Basin, first session, Federal Water Pollution Control Administration, 1968.
- Stills, P. (ed.), International Encyclopedia of the Social Sciences, vol. 12, Macmillan Co., New York, 1968.
- Ten Broeck, Craig, The Influence of Human Activities upon the Estuarine Environment and Its Resources, Master's Thesis, University of Michigan, 1971.
- Time Magazine, "Policeman for Pollution," Nov. 23, 1970, pp. 41-42.
- U.S. Department of the Interior, Water-Oriented Outdoor Recreation Lake Michigan Basin, Bureau of Outdoor Recreation, Lake Central Region, June 1965.
- U.S. Department of the Interior, Conference Proceedings, Pollution of Lake Michigan and Its Tributary Basin, Session 1, 1968, vol. 1-7; Session 2, 1969, vol. 1-2; Session 3, 1971, vol. 1; Federal Water Pollution Control Administration.
- U.S. Department of the Interior, Water Pollution Problems of Lake Michigan and Tributaries, Federal Water Pollution Control Administration, 1968.
- U.S. Department of the Interior, The National Estuary Study, vol. 1-7, Fish and Wildlife Service, 1970.
- U.S. Department of the Interior, Physical and Ecological Effects of Waste Heat on Lake Michigan, Fish and Wildlife Service, Sept. 1970.
- U.S. Water Resources Council, Water and Related Land Resources Management, seminar summary, Cincinnati, Ohio, Feb. 2-4, 1971.
- U.S. Water Resources Council, The Nation's Water Resources, U.S. Government Printing Office, Washington, D.C., 1968.

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