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Preserving the Great Lakes

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PRESERVING THE GREAT LAKES

by

Guy J. Kelnhofer, Jr.

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The study describes the Great Lakes and how they are being used. The effects of the past and present development practices on the Great Lakes environment are related. The principal Great Lakes planning and management agencies are identified and their roles are described briefly. An evaluation is made of the ability of the Great Lakes agencies, using their authorized programs, to restore and preserve the environment of that basin. The study concludes with recommendations designed to improve the institutional arrangements and managerial ability of those public agencies that are concerned with the environmental quality of the Great Lakes.

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STATEMENT

This report was prepared under a contract entered into by the National Water Commission to provide background for the Commission's deliberations on the subject of national water policy. It has not been approved by the Commission and the Commission does not guarantee the accuracy or the completeness of the data contained in the report. The report is released at this time through the National Technical Information Service to stimulate public discussion of water resource policy issues. Your comments and suggestions will be appreciated.

National Water Commission
Room 405
800 North Quincy Street
Arlington, Virginia 22203

PRESERVING THE GREAT LAKES

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PRESERVING THE GREAT LAKES

Introduction

The purpose of this monograph is to review the present environmental conditions of the Great Lakes and to assess the factors contributing to present conditions. The monograph then seeks to assess the implications of these conditions and to determine the success of programs designed to deal with problems in the Lakes. Finally, the monograph presents illustrative institutional arrangements which could contribute to preservation of the Lakes.

Physical Characteristics

The Great Lakes constitute the largest reservoir of fresh water in the world[1/] and contain 40 percent of the surface water in the United States. The water area of the Lakes is about 95,000 square miles and the volume of water in the Lakes is 5,460 cubic miles, or 18 billion acre-feet.

The combined shoreline of the Great Lakes is roughly equal in length to the combined shoreline of the U.S. Atlantic and Pacific coasts.[2/] About 59 percent of the Great Lakes Basin, 176,000 square miles, is in the United States and 41 percent in Canada.

The Great Lakes Basin contains about four percent of the total land area of the United States and around 14 percent of the population.

1/ Goodsell, Leonard J., "The Great Lakes--Water Levels, Flooding and Erosion," A statement before the Committee on Public Works, House of Representatives, November 26, 1969, The Commission, Ann Arbor, Michigan, mimeographed, p. 1.

2/ MacLaren, J.W., "New Requirements in Water Resources Planning on the Great Lakes." Great Lakes Water Resources Conference, Engineering Institute of Canada and American Society of Civil Engineers, Toronto, Canada, 1968, pp. 366-367.

All of Michigan and parts of Minnesota, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York lie within the Great Lakes Basin.

Lake Superior has 31,800 square miles of water surface, making it the largest of the Lakes. It contains slightly more water than the other four Lakes combined; 53.8 percent of the total supply. The second largest in volume, Lake Michigan, has 21.4 percent of the total water volume and 22,400 square miles of water surface. Lake Huron, the second largest of the Lakes in area,[1/] has 15.6 percent of the total volume of the Great Lakes' water and a surface of 23,000 square miles.

Erie, the shallowest of the Great Lakes, holds only 2.0 percent of the total supply and has a surface of 9,900 square miles. Lake Ontario is the smallest of the Lakes, with a surface of only 7,600 square miles and holds 7.2 percent of the total volume.

Multipurpose Use of the Great Lakes

Water Supply: One of the important uses of the Lakes is as a water supply source for industries and municipalities. In 1966, for instance, it was estimated that 28 million people were supplied by water pumped out of the Great Lakes. In the preceding decade, 1956 to 1966, the population of the region had increased only 75 percent but water consumption had increased by 600 percent for the same

1/ Great Lakes Basin Commission, "Water Quality and Pollution-Lake Huron," Appendix No. 7, The Framework Study, The Commission, Ann Arbor, Michigan, V. 3, p. 49, July 1971 (first draft).

period. Some 240 municipalities of various sizes draw on the Lakes for their domestic raw-water supplies. In addition, many industries, some with their own intakes, depend upon the Lakes to supply their water requirements. Industrial pumpage is estimated at three times the municipal withdrawal and the combined total averages about 16,000 million gallons per day.[1/]

Fishing: The Lakes are an important source of both sport and commercial fishing. Lake Superior, because of its low nutrient supplies, has been less productive than the smaller Lake Erie. Overall production from all the Lakes has maintained a fairly constant volume of about 100,000 tons annually;[2/] about half of that amount representing the Lake Erie harvest. Species changes have reduced significantly the amount of high-grade fish in the annual catch. These changes have been caused by the combined effects of quality degradation, poor management of native stocks, and the introduction of parasites and competitors from the ocean environment. In response to these marine invaders, fish biologists have introduced several varieties of salmon and trout which have begun to reproduce successfully and are making the Great Lakes an important attraction for the sport angler.

1/ Great Lakes Basin Commission and Great Lakes Panel of the Committee on Multiple Use of the Coastal Zone, National Council on Marine Resources and Engineering & Development. Great Lakes Institutions, The Commission, Ann Arbor, Michigan, 1969, p. 1. In 1970, the Great Lakes Basin Commission's work group on water supply reported withdrawals of 14,700 mgd for the Great Lakes Region, with 90% of the withdrawals from the Lake Michigan and Lake Erie Basins.

2/ MacNish, C.F. and Lawhead, H.F., Ibid., p. 38.

Navigation: The Great Lakes are used extensively as a water highway that connects producers to American and Canadian markets and raw materials within the Basin and gives the Midwest direct access to overseas markets and materials. With the opening of the St. Lawrence Seaway in 1959, a water route for ships was opened from the Atlantic Ocean to Lake Superior, a distance of 2,300 miles. Ships with a 27-foot draft navigate the Lakes; ships with a length of 1,000 feet and a beam of 105 feet can now travel the Upper Lakes. In 1971, 53 million tons of cargo passed through the St. Lawrence Seaway and 93 million tons passed through the locks at Sault Ste. Marie. Grain producers in the northern Plains, iron miners in Minnesota, Wisconsin, and Michigan, and steelmakers in Illinois and Indiana are among the more important users of these navigation resources.[1/] About 50 percent of the Nation's steel is produced in the Great Lakes Basin.

Recreation: The beaches and open waters of the Great Lakes and the offshore islands have been important recreation resources for the residents of the region and for tourists. Many state and local parks, beaches, and private marinas along the shores of the Lakes provide recreation for millions of local residents and tourists. Federal recreation areas include Perry's Victory National Monument in Ohio, Grand Portage National Monument in Minnesota, Isle Royale National Park in Lake Superior, Indiana Dunes National Park on Lake

1/ MacNish, C.F. and Lawhead, H.F., ibid., p. 13.

Michigan, Pictured Rocks National Lakeshore in Michigan, Wisconsin's Apostle Islands in Lake Superior, and Michigan's Sleeping Bear Dunes National Park.

Power Production: The waters of the Great Lakes descend to the Atlantic Ocean through a drop in elevation of about 600 feet. About 80 percent of that fall has been harnessed to produce hydroelectric power. The huge reservoir of water in the Great Lakes assures a steady flow which generates about 8,000,000 KW of electricity for the Basin. The bulk of this power is generated at Niagara Falls and on the St. Lawrence River. Because of the large supply of cold water stored in the Lakes, it is looked to as an ideal location for the siting of thermal power plants which need large amounts of water for cooling purposes. About 20,000,000 KW of fossil-fueled power is produced on the Lakes. Controversies in recent years about the effects of thermal discharges on biologic activity in the Lakes have made the electricity producers cautious about promoting new plant sites on the shores of the Great Lakes. To meet the objections of those who oppose thermal discharges and to meet the state and Federal restrictions on temperature changes in receiving waters, many of the new plants sited on the shores are being equipped with cooling towers in place of the earlier flow-through arrangements for cooling their condensers. The high cost of this alternative is likely to stimulate the power producers to continue to explore ways to utilize the vast, unused cooling potential of the Lake waters in ways that will not be damaging to the Lake ecology.

Waste Disposal: For the past fifty years or more, a major use of the Great Lakes has been as a waste receptacle. Thousands of homes, towns, cities, institutions, and industries have used and continue to use the Lakes as a place to dispose of their liquid wastes. It has been used, until recently, as an economical place to dispose of solid wastes, as well, particularly the dredging spoil from harbor maintenance work and the garbage and other refuse from ships. In Minnesota, Reserve Mining operates a taconite processing plant which dumps 67,000 tons of tailings into Lake Superior every day. Many large industries and municipalities do not discharge directly into the Lakes but into tributaries and connecting channels which carry the effluents into the Lakes. Some efforts are being made to change the types and quantities of pollutants that may be discharged into the Lakes but no serious programs at the Basin level have been proposed yet which would deny the use of the Lakes as the repository of treated sewage effluents.

Mining: A considerable amount of mining goes on in the Great Lakes Basin but little mining has been done in the Lakes themselves. Oil and gas deposits in Lake Erie are a potential source of mining activity and gas is already being produced in Lake Erie from deposits in Canadian waters. Nodules of manganese have been found in the northern portion of Lake Michigan and there is evidence of nickle and silver deposits in Lake Superior between Isle Royale and the Minnesota shore. There is little doubt that conservationists

who are very concerned about maintaining the exceptional quality of the water in Lake Superior would be strong in their opposition to the mining of any mineral deposits in the bed of that Lake. The presence of the deposits in the face of dwindling supplies and rising prices for the minerals is, however, a spur to ore producers to attempt to develop recovery techniques which will be acceptable to the conservation interests.

Other Uses: Other important uses are made of the Great Lakes. There is a potential use of the Lakes as a setting for aquacultural enterprises. The Lakes are used, in addition, as a laboratory for various kinds of experiments, research, and investigations designed to expand our knowledge of the natural world and the aquatic environment.

Environmental Values of the Great Lakes

The environmental values of the Lakes can be better appreciated if we assume that everyone would continue to discard and spill anything they pleased in the Great Lakes or on their shores. One of the first values that would be threatened would be our freedom to drink the water from the Lakes. It would become very expensive to treat the water to make it fit to consume, and it would also be necessary to maintain a highly sophisticated surveillance system to monitor the quality of the water coming into the intakes.[1/] One of the environ-

1/ Dutton, C.S., "Capabilities and Limitations in Engineering Technology," Great Lakes Water Resources Conference, op. cit., p. 438.

mental values of the Lakes which we take for granted, then, is the abundant supply of safe, clean, fresh water.

A second environmental value that might be endangered by a laissez faire policy on the use of the Lakes is the climatic contribution. The Lakes have a moderating effect on temperature extremes. If the Lakes were used indiscriminately as heat sinks to cool industrial equipment and machinery and to dispose of heated wastes, a time might come when the Lakes would be warmer than they are now, at least in their shallower areas.[1/] It is impossible to predict the nature and scope of the climatic changes that might occur in the immediate vicinity of the Lakes. Gradually, as warming occurred, the existing weather regime of the Lakes would be altered and that alteration could evidence itself in changes in the length of seasons, severity of winters, precipitation amounts and distribution (areally and seasonally), amount and distribution of fog, wind velocities and directions, and seasonal temperature variations.

Another environmental-related value that would be adversely affected by unbridled pollution of the Lakes is recreation. Boating, swimming, walking on the beaches, picnicking on the shoreline, fishing, and hunting on the lake shore would all diminish to a small fraction of the present levels of such activities. Beaches strewn with refuse, water contaminated and unsightly, and harbors grown up and choked with aquatic nuisance growths would repel rather than attract

1/ MacLaren, J.W., Ibid., p. 369.

those in search of recreation. Property having ready physical or visual access to the Lakes would lose its value because of its association with water that was offensive to see and unpleasant to smell.

The more desirable species of fish and wildlife would all but disappear eventually in the face of unrestricted pollution of the Great Lakes. The continued addition of large quantities of toxic substances would, in time, destroy nearly all Lake-associated life forms in time and convert the Lakes into seemingly dead seas. Oil-filmed water and oily beaches would be uninhabitable for water fowl and for fur-bearing animals that live in shore environments.

A fifth environmental value that would be noted in its absence is the amenity which the Lakes add to the environs of lakeside communities, the Great Lakes region, and the Nation as a whole. The Lakes add quality and interest to the lives of those who live in their proximity and provide satisfaction to more distant residents who enjoy it through occasional visits. Visual and physical access to the Lakes is endangered by private and public developers who seek to close off the beach for exclusive uses and who would build structures that obstruct the view of the Lakes for those who do not live on the shoreline. The amenity value is endangered also by those who propose to build offshore installations in the Lakes to provide airfields, drilling platforms, pumping stations, and similar permanent reminders and extensions of our urban presence.

Problems of the Great Lakes

Pollution: The major problem of the Great Lakes is the increasing pollution of Lake waters,[1/] including biological imbalance, buildup of dissolved solids, bacterial contamination, suspended solids, chemical contamination, and oxygen depletion.[2/] Wastes polluting the Lakes are being generated by municipalities, industries, agricultural operations, dredging, and land developments. Bacterial and viral contamination of coastal waters threatens the health of bathers and leads to the closing of beaches that are convenient to large urban populations. Beaches in Green Bay, Milwaukee, the Chicago North Shore, and Hammond-Whiting on Lake Michigan have been closed for as long as 30 years.[3/] Fisheries are affected by pollution which changes the environmental conditions needed to support the food chain and sustain the life of sport species of fish. Through pollution, species changes occur which produce an abundance of those species of pollution-tolerant fish having little sport value and low unit value in commercial markets. In addition to species changes, pollution may affect fisheries by tainting the flesh of fish, giving them an undesirable flavor; and by concentrating toxic substances in their tissues to the point where they may not be safe for human consumption.[4/]

1/ Spangler, M.B., The Role of Marine Sciences in the Multiple Uses of the Coastal Zone of Lake Erie and Lake Superior, pp. 139-140.
2/ Spangler, M.B., op. cit., p. A-44.
3/ Environmental Protection Agency, "Accelerated Great Lakes Program," The Agency, Washington, D.C., 1972, unpublished.
4/ Spangler, M.B., op. cit., pp. 139-140.

Water fowl and other forms of aquatic life are threatened by pollution in several ways. Birds, such as gulls, which eat contaminated fish may concentrate mercury or DDT in their bodies, leading to their death from poisoning or to species reduction by interference with their reproduction capabilities.[1/] Pollution of lake waters may induce changes in the water's temperature, turbidity, oxygen supply, and light penetration, making the lake inhospitable for many of the life forms which have occupied the waters and bottom sediments. Oil discharges may attach to the feathers of birds inhabiting lake waters, causing them to lose buoyancy and insulation; leading to their death by drowning, disease, or exposure.

Lake Erie is the most severely affected of the five Lakes. A recent report by the Environmental Protection Agency gave this pessimistic appraisal of the Lake's condition:

> ...a mat of algae two feet thick and a few hundred miles in extent floats in the middle of the Lake in mid-summer, oxygen levels in areas of the Lake bottom are reduced to zero, displacement of indigenous fish populations by scavenger and trash fish is widespread. Discharge of untreated sewage from combined sewers has compelled the closing of most beaches on the Lake. The area of Lake bottom where regeneration takes place --the zone of zero oxygen--is spreading, bringing the threat that eutrophication will soon become self-sustaining....[2/]

Pollution is a serious problem in the western end of Lake Erie; in the St. Clair and Detroit Rivers which connect Lake Huron to Lake

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1/ Spangler, M.B., op. cit., p. A-44.
2/ Environmental Protection Agency, op. cit., p. 10.

Erie; in Saginaw Bay on Lake Huron; in the Niagara River which connects Lake Erie to Lake Ontario; in the western end of Lake Ontario; in Green Bay and in the lower end of Lake Michigan. Lake Superior and, to a greater extent, Lake Huron are also being polluted but are not yet showing signs of being extensively damaged. Many tributaries discharge polluted waters into the Lakes, such as the Cloquet, Fox, Cuyahoga, Maumee, Detroit, Ashtabula, Black, and the Genesee River.

Eutrophication: The trophic condition of lakes is a measure of their biologic activity. Lake Superior is an example of an oligotrophic lake, low in nutrients and supporting little plant growth. There the concern is to preserve the Lake against the introduction of nutrients in quantities that would stimulate biologic activity and adversely affect its pristine quality. Lake Erie is a lake which is undergoing eutrophication, becoming rich in vegetation-supporting nutrients. The shallow western end of Lake Erie is already in an advanced eutrophic condition.

Eutrophication is a natural aging process that takes place in all lakes. Under the stimulation of large quantities of nutrients introduced into the water by waste discharges from municipalities and industries, a process which normally occurs over tens of thousands of years under natural conditions is being speeded up and compressed into a few decades. Because the individual Lakes are not uniform in their depth or in the behavior of their currents, and the waste discharges are not evenly distributed over the Lake surface, they

do not age evenly. In the same Lake, portions of it may be eutrophic, mesotrophic, or oligotrophic, depending upon such factors as depth, currents, proximity to pollution sources, the rate at which pollutants are being discharged, and the types of pollutants received. The central and eastern parts of Lake Erie are still mesotrophic, having a moderate amount of nutrients, plant growth, and biologic activity. But there is a growing concern that the entire Lake will soon become eutrophic unless the amount of pollution entering the Lake can be curtailed drastically.

Lake Level Control: The control, or smoothing out, of fluctuations in the level of the Lakes is becoming a matter of increasing importance. The interests affected by water level fluctuations fall into four categories: shoreline installations; shipping; power production; and wildlife. Shoreline interests include industries, municipalities, and residents who own shoreline property and who operate facilities located on the lakeshores. High water levels cause flooding and erosion which damage or destroy docks, residences, roads, and utilities near the shore and erode or inundate beach areas.[1/] Low water levels conversely, make docks and marinas inaccessible to water craft. At the same time, however, beaches may be improved and extended by low water conditions. Water intakes and sewer outfalls may

1/ "The erosional process may be greatly accelerated during periods of high lake levels. The bluff line at the same localities receded as much as 10 feet during the 12-month, high water period from the spring of 1951 to the spring of 1952." MacNish, C.F. and Lawhead, H.F., "History of the Development of Use of the Great Lakes and Present Problems," Great Lakes Water Resources Conference, op. cit., p. 7.

be exposed and rendered inoperative or impaired in performance by low water levels. Shippers generally favor high levels which enable them to load their ships to the maximum; calculating that each extra inch of draft adds 125 tons of cargo capacity to their ships. Power producers also favor high levels which permit them to operate hydro-electric facilities at maximum output. Wildlife can be harmed by fluctuations in water levels; with high waters drowning out nesting and spawning areas and low waters allowing marsh and shallow-water areas to dry up or lose their values for feeding and reproduction. Low water levels are associated also with a lowered dilution capacity of the Lakes and connecting channels; causing a more rapid buildup of pollutants.

It should not be construed, however, that the Lakes fluctuate greatly or frequently. Because of their tremendous storage capacity and restricted outlets they are highly stable; "...the (extreme) ranges in mean monthly lake levels ...(are) 4.0 feet for Lake Superior; 6.5 feet for Lake Michigan and Huron; 5.4 feet for Lake Erie; and 6.6 feet for Lake Ontario."[1/] Still, in recent years there have been three cycles of flows and levels which caused serious concern: low water in the thirties, high water in the early fifties,

1/ Patterson, Thos. M. and Lawhead, H.F., "History and Present Status of Regulation and Regulation Studies of Water Levels and Flows on the Great Lakes," Great Lakes Water Resources Conference, op. cit., p. 214. Smith, R.H. and Conner, R.D., "Potential Benefits of Great Lakes Level and Flow Regulation," Great Lakes Water Resources Conference, p. 232. The authors note that the extreme stability of the Lakes has led many user groups to depend upon that stability to a marked degree.

and low water which bottomed out in 1964. That latter experience set the stage for the ongoing study of level control by the International Joint Commission.

Diversion: While diversion of water from the Lakes is not immediately a problem of any consequence, it is expected to become one in the future. The Supreme Court ruled in 1968 upholding the right of Chicago to continue diverting 3,200 cfs of water from Lake Michigan, an action which had been contested by a number of Lake states. Chicago diverts its sewage effluent out of the watershed of Lake Michigan to protect its own water supply intakes from contamination. Chicago expects a continued growth in population and economic activity which will require an expansion in its water supplies. There is anticipation that Chicago will return to the Court at a later date to request that it be allowed to divert an additional amount of water from Lake Michigan to meet its needs.

Diversions from the Lakes are also being contemplated by others. To protect the waters of Lake Erie and Lake Michigan from further pollution by municipal and industrial waste discharges, a diversion of these wastes is being suggested. Makeup water to replace the diverted wastewater would have to be acquired. The problem would be to find water for that purpose which is of a quality that would be suitable for diversion into the Great Lakes. An additional complicating factor is the need to balance the inflow and outflow diversions in a way which will not lead to the damage of interests which are sensitive to fluctuations in levels.

Other proposals have been made which would divert water into the Lakes from Canada for the purpose of raising Lake levels permanently to enhance navigation, hydroelectric production, and water quality. Some of these suggestions may fail to consider the delicate inflow-outflow balance which the system enjoys under natural conditions. Any additions made to that system must be calculated for their effect throughout the system on all interests and throughout the complete weather cycle.[1/]

Fisheries: With the opening of the Welland Canal between Lake Erie and Lake Ontario, the sea lamprey and the alewife overcame the barrier of Niagara Falls and gained entrance to the Great Lakes. Both species flourished in the Lakes and the lamprey, a predator, inflicted severe damage on the larger native species, particularly on the whitefish and the lake trout. In addition to the adverse effects of these marine invaders on the native species, the alewife died off periodically in such vast numbers that their disposal became an urgent and very costly chore for lakeside communities. Beaches piled high with rows of decaying fish also had a depressing effect upon the tourist business of lakeshore resorts and restaurants.

Attempts have been made for many years to combat the menace of the lamprey, particularly in recent years, through the development and use of species-specific chemical controls. New predator species

1/ Patterson, Thos. M. and Lawhead, H.F., "History and Present Status of Regulation and Regulation Studies of Water Levels and Flows on the Great Lakes," Great Lakes Water Resource Conference, op. cit., pp. 204, 218.

of fish have been introduced to reduce the alewife population to more manageable size. Both of these efforts have had a large measure of success and the growth of new sport fish species in the Lakes has had a stimulating effect upon the tourist business of some lakeshore communities. Management programs aimed at restoring the fishing industry on the Lakes to former levels of production, however, are seriously threatened, experts say, by the progressive deterioration of water quality in the Great Lakes.[1/]

Knowledge Deficiencies: Too little is known about the way the Lakes function. Thus, it is risky to prescribe pollution abatement measures which may cost billions to implement when it cannot be said with confidence that proposed measures are going to be entirely effective in the Lake environment. There is the apprehension, also, that some of the cures prescribed could have unforeseen side effects, with consequences even more damaging than the initial problem.

Information about the meteorology of the Lakes is also deficient. Better data is needed about the way the Lakes are affected by and have an effect upon weather in the area. Better meteorological data would provide a much improved capacity to make management decisions which would reduce the dangers of storms, flooding and fog, and the damages of drought. These data would also add significantly to our ability to manage our fish and wildlife resources and to plan our water quality control programs in the Great Lakes system.

1/ Smith, Stanford H., "The Laurentian Great Lakes: Prospects for the Next Century," Contribution 000, Great Lakes Fishery Laboratory, Ann Arbor, Michigan, no date, p. 16.

Planning Coordination: It would be very difficult to calculate how many different entities, public and private, are involved in development or management activities that impinge in some way upon the Great Lakes. Nor would it be practical to attempt to coordinate the activities of all of them in an effort to achieve a more harmonious meshing of intents and purposes. It is, however, both practical and desirable to seek a much better interchange of information and coordination of activities among the state, regional, Federal, provincial, and Dominion agencies exercising the most important planning and development responsibilities in the Great Lakes. There appears to be a widespread dissatisfaction with the proliferation of publicly-authorized Great Lakes organizations. People in the Great Lakes area indicate that they are becoming confused and uncertain about the number of agencies, what their various roles are, how they relate to one another, and whether such a variety of groups is either necessary or effective in dealing with the problems of the Great Lakes. Officials, who are members or participants in the Great Lakes agencies, are concerned also because they suspect that their time and money is not being used as efficiently as it should. It is not unusual for a state or Federal official to be simultaneously a member of two or three of these bodies, all of them acquiring and studying data about similar Lake problems. Lack of effective coordination among Great Lakes agencies sometimes leads to the adoption of standards and programs, in such areas as fisheries

and air and water quality control, which are not compatible among jurisdictions which share responsibility for the management of a common resource.[1/]

Management Control: A growing problem in the Great Lakes is that no one is in charge. There is emerging a recognition that the Lakes form a system and are interdependent. There is increasing understanding that none of the communities or states acting independently can arrest or reverse the degradation of the Lakes. Concerned citizens and interest groups cannot contribute effectively in the decision processes that now govern the development of the Great Lakes. Because the Lakes are interdependent and many of the problems that affect the Lakes are also interdependent, it is difficult to come to grips with them in isolation. Neither the Great Lakes Basin Commission nor the Great Lakes (Compact) Commission is authorized to intervene; they can only study, make plans, and exhort others to act.

Considering that Canada has jurisdiction over 41 percent of the Great Lakes Basin, it is obvious that the United States and the several Great Lakes states are unable to work effectively to relieve pollution and other lakewide problems without the active and intimate cooperation and assistance of Dominion and provincial authorities. The need for a basinwide institutional arrangement to overview the development of the Great Lakes is both a national and an international problem.

1/ Smith, Stanford H., Ibid., p. 13.

The Alternative Futures of the Great Lakes

Many of those who are concerned about the increasing degradation of the water quality of the Great Lakes fear that it may continue to decline until all the Lakes are in an advanced stage of eutrophy. The future they visualize, of vast stretches of weed-filled, oil-slicked waters exuding noxious smelling gases, may not be an impossible one. Evidence of its possibility, if not probability, exists in the conditions of some tributaries and in some of the shallow-water areas of Lake Erie, Lake Ontario, and Lake Michigan. The fact that these eutrophic symptoms have developed and intensified over a relatively short span of time, lends some credence to the fear of those who believe that these trouble spots could portend the future of the Lakes for persons already born. Included in their vision of the future is a highly-urbanized shoreline of refuse-littered beaches, lined with industries, indented with many busy harbors filled with ships from many lands. Shallow areas near the shore are developed into man-made islands providing space for factories, airfields, and power plants and the horizon is broken by drilling platforms for oil and gas recovery.

An alternative future is one envisioned by those who fear that the zeal of the conservationists will lead to a serious reduction in our competitive industrial position. They see the Lakes of the future as vast stretches of pure sparkling water, teeming with fish and covered with great flocks of ducks and geese. The shores are

lined with long stretches of beach, empty except for an occasional deer or otter and littered only with a scattering of driftwood. The forests that run almost unbroken along the shoreline are quiet and undisturbed, except for the sound of an axe or the smoke from a hidden farmstead. Factories, wharves, and cities still stand along the shores but they lie silent and deserted; rusting and broken reminders of an industrial civilization that once thrived in the Great Lakes Basin.

There are many others, probably a majority, who anticipate a future which is not a product of capitulation to those who would pursue development at all costs or to those who would turn back the clock to a pre-industrial way of life. The future they visualize is one in which man has learned to live in harmony with nature. The Great Lakes are not abandoned to the creatures of the wild but, instead, support a stabilized population and a contained and orderly urban and technologically advanced industrial development. The ships and boats that ply the waters in great numbers are clean, modern vessels, quiet and smoke-free with self-contained systems for processing their wastes, making no discharges into the Lakes. The shores of the Lakes are developed into beaches that are clean and well equipped for the enjoyment of urban residents in adjoining cities. Research institutions are operating in the Basin providing managers with data and insights which enable them to program their operation with accurate understandings of the biological and

meteorological conditions prevailing. An international board of managers is functioning to study and respond to changing conditions of the Lakes, the needs and aspirations of industries and residents, and the economic and conservation policies of national and international agencies.

Which of the alternative futures will actually emerge is a product of the decisions that will be made and the decisions that will be postponed in the next few decades. Choices among these futures may never be made deliberately but may occur incrementally in reaction to numerous small threats and opportunities which must be met now without sufficient knowledge about the way the Lakes function and their tolerance for some of the stresses to which they are being subjected by user groups.

Means for Minimizing the Loss of Environmental Values

Phosphorous: There are a number of measures which can be taken to minimize the loss of environmental values in the Great Lakes. One of the more promising means, according to many advocates, is to reduce the input of phosphorous into the Lakes. Unlike nitrogen, the prospects of controlling phosphorous inputs are quite good because most of it comes from detergents in municipal wastewater. Control of a significant proportion of the input can be achieved, it is suggested, by reducing the quantities of phosphorous used in cleaning compounds and by upgrading sewage treatment processes to remove much of the phosphorous from the sewage effluent.

Storm Water Discharges: In many communities, particularly the older ones, storm and sanitary sewers are combined. When the capacity of treatment plants in these communities is reached, the excess is bypassed without treatment into the receiving water body. Dumping is done with increasing frequency as the communities expand in size and the old plants become barely able to cope with the dry-weather flow. There are a number of alternative ways to alleviate this problem. Nearly all of them cost large amounts of money and take many years of planning and building to accomplish. One of the more promising approaches for the future is to regulate building design and land developments to reduce the quantity of runoff that is discharged from private property into public drainageways; making the management of storm water more a private responsibility of the individual property owner and relieving the public of the need to dispose of the large volume of runoff water that is passed on now by private landowners.

Sewage Disposal: One of the more important means of minimizing environmental damages to the Lakes is to upgrade sewage treatment practices of industries and municipalities and public and private institutions, both American and Canadian. Ways could be found to make it unprofitable for industries to discharge wastewater to the Lakes, even treated wastes. It could become possible also for municipal treatment plants to upgrade their sewage effluents to a quality which is comparable to that of the receiving waters or to find other places to dispose of their wastewaters. While the Lakes do have dilution capabilities, there is growing doubt that we know

enough about the actions of the Lakes, how they respond to the constituents left in the treated effluents, and the tolerance of people and other life forms using the Lakes to the cumulative impact of subtoxic amounts of these constituents ingested over a period of many years.[1/]

Marine Waste Discharges: A prohibition against overboard discharges of sewage from vessels plying the Lakes has been adopted by many Lake states and Ontario; and ship owners and owners of pleasure boats will gradually make the investments required to come into compliance. Shore installations are being built and manned to receive and treat the wastes accumulated in marine holding tanks. The regulation of ships afloat to control the discharge of their galley wastes, deck sweepings, and ballast water will be more difficult to accomplish. Other marine controls are needed to reduce the risks of accidental spillages during loading and unloading operations, from collisions and groundings, and from inadequately secured storage above decks. Well organized and equipped crews, trained for such work, must be prepared to move quickly to contain and clean up accidental spills which can be damaging to Lake and shore resources.

Filling: The Lake environment could be less subject to damage by taking steps to govern and regulate the filling of shore marshes and the making of changes in the contour of the shoreline. The marsh areas are often valuable as nesting and breeding grounds for

1/ Dutton, C.S., op. cit., p. 443.

game birds, song birds, scavenger birds, fur-bearers, snakes, and frogs; some are utilized as fish spawning grounds. Their preservation should be secured in the interests of maintaining a fish and wildlife population that is varied and well balanced. The tendency to change the shoreline configuration by building jetties or filling in low water areas near shore to extend one's frontage is one which should be kept in check as much as possible.

Erosion Controls: Annual erosion rates in the Basin average about two tons per acre; varying from a low of about 0.1 tons per acre in the northern forest areas to as much as 8.0 tons per acre in intensively cultivated areas in the southern part.[1/] The sediment collects in the harbor entrances where it must be removed periodically by dredging operations. These dredging works stir up pollutants and muddy the waters to the detriment of the biologic environment in the area. More importantly, the sediment carries with it residues of persistent pesticides, from upstream agricultural areas, which are ingested by bottom-dwelling worms and crustaceons. Passed up the food chain, these residues concentrate in fish and birds to affect their lives adversely and to endanger the health of people who may consume them. Land treatment measures in rural areas, backed by desilting basins and systems for floculating solids, would be effective in reducing the amount of sediment reaching the Lakes

1/ Great Lakes Basin Commission, "Erosion and Sedimentation," op. cit., p. 2.

from fields during the growing season and after harvesting. Urban areas also produce sediments. Average annual erosion rates are estimated to range from 85 tons per acre in the Buffalo, New York, area to about 200 tons per acre in the South Bend-Elkhart, Indiana, area.[1/] Regulation of construction practices by road builders and developers of subdivisions is needed to reduce the amount of sediment being washed into the Lakes and tributaries from urban building sites.

Training: Another step that could be taken to guard the environmental values of the Lakes is to train and license the operators of the sewage treatment plants that discharge effluents into the Lakes and tributaries. Despite the high capital cost and the performance potential of the treatment plants, they cannot produce properly if they are operated in a careless and unproductive manner by unskilled personnel. This is an area where state and Federal funds, technical aid, and regulatory pressures are needed to make it feasible for local governments and small industries to achieve and maintain reasonable standards in their treatment plant operations.

Research: Many of the measures that might be taken to minimize the loss of economic and environmental values in the Great Lakes are not being taken because of ignorance about their effectiveness or the extent of the benefit they might produce. What is needed to develop a broad range of integrated and useful activities to protect

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1/ Ibid., p. 3.

these values is a well-funded research program designed to show what array and schedule of actions would work best to achieve balanced economic and environmental goals in this region. There is a need for more information about how the Great Lakes system functions and about the characteristics and performance of each of the individual Lakes in that system. Research is needed also to develop a better understanding of the tolerance levels of various environmental components in the Lakes to the stresses that are imposed by man's activities on the shores, in the depths, and on the surface. Such a research effort can have promise only if it is funded in such a way that sustained and uninterrupted attention can be directed to these problems over an extended period of years by a multidisciplinary group of scholars working simultaneously in a number of related institutions.

Management: It is through improved management that a wide range of public and private resources can be mobilized and directed to focus on significant problems with maximum effectiveness. In the absence of a good management apparatus to organize and guide the work, there is the likelihood that areas worthy of special attention will be neglected while others of only minor significance will receive an undue share of the total budget. Management failures will show up in other ways; in programs that are in conflict with one another; that continue to absorb funds long after they have outlived their purpose; that pile up information of low utility at high cost;

and that duplicate work because of communication gaps. An effective management apparatus is needed not only to permit more efficient use of funds but to accept responsibility for achieving results and for keeping the public informed about the progress being made, the problems encountered, and the kinds of support that are required to carry out the management assignment. The absence of a well-defined and structured management organization for the Great Lakes leaves the public with no authoritative and informed source for information about the nature and scope of the effort being made to remedy the problems, about the adequacy of that effort, and about the additional effort that must be made to accomplish the task.

Education of Publics: The ultimate means for minimizing the loss of environmental values in the Great Lakes is education. The public has the power to dedicate the funds and apply the persuasion of the ballot to mount a very serious program of environmental conservation and improvement. If water research and management professionals believe that public health and welfare may be in serious jeopardy because of the magnitude of the environmental degradation occurring, then there is probably a considerable gap between their view of the problem and the view held by the general public. To win the public to their point of view (assuming it is a more accurate appraisal than that made by the public), requires an energetic informational campaign. This campaign must be designed to make available to the public the kinds of information possessed by the

professionals which convince them that the threat is a serious one deserving a greater measure of private and public dedication. There is also a long-range element to this educational need, which is to condition school children, who will be the future managers of the Great Lakes, to appreciate and understand the environmental values that need to be conserved and to acquire attitudes that will lead them to avoid those currently common practices which are wasteful and damaging to those values.

Present Policies and Programs for Protecting the Environmental Values of the Great Lakes

It would be inaccurate and misleading to imply that little is being done to identify and solve the problems affecting the environment of the Great Lakes. A great deal is being done which involves the dedicated effort and expert attention of large numbers of public officials, business leaders, labor organizations, civic groups, academic institutions, and private citizens.

An attempt to identify and describe all of these activities and all the policies and programs being developed and implemented by various organizations to deal with some aspect of the environment of the Great Lakes would be an extremely laborious task and one having little practical utility. Attention is directed, instead, to what seem to be the more influential organizations and programs which affect the environmental values of the Great Lakes.

Not treated individually are the separate states that own the United States' portion of the bottom of the Lakes and connecting channels.[1/] The states bordering the Lakes are responsible for the development and enforcement of water quality standards and they provide financial and technical assistance to their municipalities to assist them in building and operating their wastewater collection and treatment facilities. However, with the exception of Michigan, which is ringed by the Great Lakes, the states do not demonstrate a strong orientation toward nor preoccupation with the Lakes upon which they front. The eight states have the following percentages of the basin area in their jurisdiction: Pennsylvania, 1 percent; Illinois, 3 percent; Indiana, 4 percent; Minnesota, 8 percent; Ohio, 9 percent; Wisconsin, 15 percent; New York, 17 percent; and Michigan, 43 percent.[2/] This is not to say that the Lake states are indifferent to the Lakes and their problems but to point out that the Lakes do not command very much attention or priority in the array of management concerns which crowd the agenda of most state governments in the Basin. Considering that Minnesota, for instance, is but one of the six sovereign governments exercising jurisdiction in Lake Superior and that Ohio is but one of the seven involved in Lake Erie,

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1/ Congress confirmed the states title to lands lying beneath navigable waters in 1953 with the passage of the Submerged Lands Act.

2/ Great Lakes Basin Commission, "Land Use and Management," Appendix 13, Framework Study, The Commission, Ann Arbor, Michigan, August 1970 (first draft).

it is easy to see why the individual states would not demonstrate a more intense and continuing interest in the management problems of the Lakes.

What follows is a brief description of the existing policies and programs presently available to assist in the task of developing and managing the water resources of the Great Lakes.

Enforcement Conferences: The Federal Water Pollution Control Act (P.L. 84-660), Section 10, authorizes the calling of an enforcement conference to abate interstate pollution at the request of a governor of a state or on the initiative of the Secretary of the Interior. Conferences have been held on Lake Erie, Lake Michigan, and Lake Superior. States, localities, and other private and public agencies contributing to pollution are identified and given schedules in which they are to bring their activities into compliance with the water quality standards.

Great Lakes Environmental Conference: In 1970, the governors of the Lakes states, representatives of the U.S. Government, and representatives of the Dominion Government and the Provinces of Ontario, Manitoba, and Quebec initiated work to draft a new Great Lakes Water Quality Agreement between the United States and Canada. The proposed agreement, just signed, would strengthen the International Joint Commission and set up under its auspices a Great Lakes Water Quality Control Board.

The International Joint Commission: In 1909, Canada and the United States entered into the Boundary Waters Treaty. The

International Joint Commission was established to carry out the purposes of the treaty. The Commission is organized to make a ruling on any proposal, called an "application," which may be brought before it concerning any use, diversion, or obstruction of the flow of boundary waters by one nation which may have an effect upon the other nation. The Commission's ruling on applications is final. It is also authorized to investigate and make recommendations on any problems referred to it by either one of the Federal Governments. Some 27 international control or advisory boards have been created by the Commission over the years.

The Great Lakes Fishery Commission: A fisheries convention between Canada and the United States was ratified in 1955. From it came the Great Lakes Fishery Commission to coordinate research; to undertake activities to reduce the degradations of the sea lamprey; and to improve the fishery resources of the Great Lakes.[1/]

Upper Great Lakes Regional Commission: The governors of Michigan, Wisconsin, and Minnesota requested the Secretary of Commerce to designate a 119-county area in the Upper Great Lakes as an economic development region under the terms of Title IV of the Public Works and Economic Development Act of 1965. Following this designation in 1965, the three states organized the Upper Great Lakes

1/ Smith, Stanford H., op. cit., p. 14: Some measure of the need for more effective coordination by this Commission can be seen in this statement: "Whatever the reasons or contributing factors, the lack of a concerted and compatible approach to take timely conservation or corrective measures may have been the single most dominating factor that has contributed to the deterioration of the fisheries of the Great Lakes."

Regional Development Commission which was established in 1967 to promote the economic development of the region.

Great Lakes Task Force: At the suggestion of the conference of Great Lakes senators, a Great Lakes Task Force was organized to coordinate the interests and views of the port and shipping interests of the Great Lakes. The Task Force has two major purposes: to promote the orderly development of the Great Lakes region and to foster a quality environment there.

Conferences of Great Lakes Senators and Congressmen: The senators of the Great Lakes states are called into conference periodically to coordinate the action of the states on various legislative matters which have special significance for the region. The congressmen of the Lake states participate in a similar conference arrangement for the same purpose.

St. Lawrence Seaway Development Corporation: Congress established the Seaway Corporation to construct, operate, and maintain the United States' portion of the works that were constructed on the St. Lawrence River to provide deep-draft ships with ocean access to Great Lakes' ports. In addition to its operating responsibilities, the Corporation is engaged in activities to promote and improve the development of Great Lakes' ports, increase the use of the Seaway, and implement the export and merchant marine programs of the Federal Government.

Great Lakes Commission: The eight states bordering on the Great Lakes are parties to a compact by which they agree to work jointly to promote their common interests in the Lakes. The Great Lakes Commission, formed by the compact, had its origins in 1955 when the first five states ratified the compact terms. The other states followed in a few years and Congress gave its consent to the compact in 1968 when the President signed S.660 into law as P.L. 90-419. The Commission has drafted and is promoting the adoption of a new Federal-state compact to establish a management authority to replace the existing compact Commission. This is one of the principal Great Lakes agencies.

Great Lakes Basin Commission: The governors of the Great Lakes states petitioned the Water Resources Council for the formation of a river basin commission for the Great Lakes as authorized under Title II of the Water Resources Planning Act of 1965 (P.L. 89-80). The Great Lakes Basin Commission was established and organized in 1967. It is engaged in the preparation of a coordinated joint plan for the development of the waters of the Great Lakes. Federal and state agencies are members of the planning body which operates on the basis of consensus. It is the largest and best financed of the Great Lakes agencies.

Great Lakes Study Group: This is an informal organization of Canadian and United States agencies and institutions doing studies and gathering data on the Great Lakes' water resources. It was

formed in 1962 to exchange information and coordinate studies about Lake Erie, but later was expanded to include investigations into all the Great Lakes.

International Field Year on the Great Lakes: Canada and the United States are undertaking a joint program of hydrologic research on one of the Great Lakes as part of their contribution to the worldwide International Hydrologic Decade. The IFYGL runs from 1968 to 1974 and includes a period of intensive field investigations beginning on April 1, 1972, and concluding a year later. The U.S. work will be under the direction of the National Oceanic and Atmospheric Administration. The Lake chosen for detailed study is Lake Ontario.

Federal Agency Programs

The U.S. Army Corps of Engineers, in cooperation with the Environmental Protection Agency, has conducted pilot waste treatment studies at three areas in the Great Lakes Basin: Chicago-Southend of Lake Michigan; Detroit-Southeastern Michigan; and Cleveland-Akron Metropolitan and Three Rivers watershed. The initial studies have been completed and are being followed by further analyses of survey-scope stage. Alternatives to the conventional disposal of waste into water bodies are being investigated in these studies.

The Bureau of Outdoor Recreation, Department of the Interior, is conducting studies of urban recreation needs in 14 selected urban complexes. Two of these studies will be conducted in Urban Recreation Areas located on the shores of the Great Lakes; one on Lake Michigan and one on Lake Erie.

A study of the shorelines of the United States, authorized by the 1968 Rivers and Harbors Act (P.L. 90-483), has just been concluded. A special study of Great Lakes' shoreline use was done under Section 106 of that authorization by the Corps of Engineers. The Great Lakes study was closely coordinated with a similar investigation being made by the Great Lakes Basin Commission's Work Group 12, Shoreline Use and Erosion.

Recreation funds for planning and land acquisition are provided by a number of Federal programs as authorized under such legislation as: the Land and Water Conservation Fund Act of 1965, Title IX of the Housing and Urban Development Act of 1965, the Watershed Protection and Flood Prevention Act of 1954, the Water Quality Act of 1965, the Dingell-Johnson Program, the Pittman-Robertson Program, the National Wild and Scenic Rivers Act of 1968, and the National Trails System Act of 1968.

Appraisal of Present Policies and Programs

There is no doubt that the policies and programs we employ are having beneficial effects. Data are being gathered, more attention is being focused on the problems of the Lakes, new management organizations are being studied, and many new treatment plants are being built to upgrade the quality of the wastes being dumped into the Lakes. The question is not whether the policies and programs are doing that for which they were designed, but whether we have designed the kinds of policies and programs that we must have to do the kind of job that needs to be done.

Will the present policies and programs be able to stop the pollution, clean up the waters to something approaching their earlier condition, provide the data and knowledge that will enable us to understand how the Lakes function and how to manage them? Will they give us a decisionmaking framework that is comprehensive in its grasp of the problems; representative of the international, national, provincial, state, metropolitan, and private interests having legitimate viewpoints to consider; and responsive to the changing needs and aspirations of the public? There are at least two important parameters to these questions. One concerns the amount of money that will be needed to get to where we want to go with those policies and programs. The other is concerned with the amount of time it will take to get there by that route. Will these policies and programs reverse the deterioration process before it is irreversible? Does anyone really know how much time is available to prevent irreparable damage to the Lakes? Has anyone ever calculated with some scientifically valid measures whether there is enough time, even allowing for generous margins of error to cover our ignorance, to do the job with the tools being used? There is some concern being expressed that progress is being measured in negative terms; i.e., of how much less rapidly the race is being lost than previously. Is it likely that, by continuing to apply the remedies now in vogue, the rate at which the Great Lakes environment is being degraded will only be slowed to a pace which is less noticeable to the public?

There is also the question of the money cost of achieving significant gains in the battle against environmental deterioration of the Lakes.[1/] Very expensive measures are being used to reduce pollution when we set out to build large numbers of capital-intensive secondary and tertiary treatment plants, separate many miles of combined storm and sanitary sewers, and treat the tremendous quantity of storm waters. Our management system is administratively very expensive, with large numbers of highly-paid professionals attending innumerable meetings to coordinate activities, many of which seem to have little useful purpose in affecting the actions of the real decisionmakers. Large numbers of expensive studies and plans are produced which seem to receive little in the way of follow-through action. Even if it were possible to correct our environmental disorders with these policies and programs, could we afford to divert the huge sums of money that would be needed to build and operate all the plants that it will take to treat the entire sewage load adequately, to assemble all the data that are needed to support a management operation that is able to regulate the impact of all those discharges, and to organize and finance the kind of administrative apparatus that would be required to oversee the planning, development, scheduling, financing, and operation of this elaborate treatment system? The scope and seriousness of the Great Lakes problems appear to be beyond the powers of present programs and policies.

1/ Spangler, M.B., op. cit., p. 4: "...in the case of Lake Erie, the cost for solving the water pollution problem--with present technology--is roughly estimated to be $4.5 billion."

Balancing Environmental and Developmental Values

Few disagree about the need to balance our concern for protection of the environment with a concern for the development of the goods and services that people need to live with reasonable security from hunger and disease. Those who are among the deprived segments of our society, particularly the racial minorities, have shown little sympathy for middle-class conservationists who would curtail industrial growth in the interests of better air and water quality while minority wage earners and their families are still competing for the necessities of life. However, even the poor who are trapped in the slums of the central cities are beginning to appreciate the need for environmental protection as air pollution increasingly threatens their health and well-being.

Considering the highly competitive nature of the relations among local, state, and national governments and among private businesses and industries, it is difficult to see how any individual unit could afford to take the initiative to exercise alone the production and consumption restraints that the whole system may in time have to endure collectively for its common survival. However, there is a critical absence of dialogue about how to break out of the impasse created by that competitive situation and to begin moving toward agreement on the actions required to reach a more viable way of life.

In the Great Lakes, the question about the ability of the Lakes to sustain continued growth indefinitely has not been examined by

our basin agencies. The only estimate made is the traditional one bearing on the availability of water and land in amounts deemed sufficient to meet the projected increases in population and economic development. Whether the Great Lakes environment will be able to accommodate the increases in air and water pollution that would accompany that growth is a question that the present study assignments are not equipped to answer. While environmental impact statements will be filed by the Great Lakes Basin Commission in connection with its plans for the development of the Great Lakes, there is no reason to believe that it has been able to collect the data or make the analyses that would permit it to make authoritative statements about the environmental consequences for the Lakes of continuing the historical patterns of growth and consumption over the fifty-year planning period.[1/] Nor is it likely that its failure to make such analyses can be challenged at this point by the Environmental Protection Agency or the Council on Environmental Quality when they are called upon to review the impact statements prepared by the Commission. In addition to the data deficiencies that stand in the way of making that kind of an impact analysis, there is also the probability that the individual states and many of the Federal agency members of the Commission would be extremely reluctant, at this stage in our understanding of environmental matters, to authorize the publication of

1/ The Great Lakes Commission is seeking funding for an environmental study to investigate the response of the Lakes to various levels of pollution and to alternative treatment measures.

any statements that recommended a curtailment of growth or that cast doubt upon the ability of the region to support the jobs and industry needed to provide full employment of the Basin labor force.

The growth ethic is not only a strong and continuing element in our planning programs, it is one that is deeply imbedded in our whole system of values and beliefs. It will be neither easy to do nor quick to accomplish should we agree that it is time to follow a different economic philosophy. We will not turn quickly away from an approach to life and the natural world which has colored all our thinking and all our traditions. What it will take to convince us that there is no other reasonable choice is hard to imagine. It may be so unpalatable a notion that it will be resisted until significant parts of the environment will have suffered irreversible damages. Before that happens, however, there may still be time to develop enough data to convince the policymakers that change is urgently needed and to propose feasible sets of actions that might be taken to steer the Basin's development into more sustainable directions.

It is not likely that the Great Lakes community could make a unilateral determination to redirect its social and economic policies into a more restrained and stable way of life, for it is linked inextricably to the rest of the Nation. Nevertheless, a start must be made somewhere. It can be argued that it is appropriate that the dialogue be started in the Great Lakes Basin because there the

environmental threat is more obvious and more urgent than in many other regions. Unlike communities using the oceans and the large rivers for waste disposal purposes, the Lakeside communities are relying upon relatively small bodies of water as their wastewater receptacles; water bodies whose capacities for absorption and recovery are much more limited than large oceans and fast-flowing rivers.[1/] In the industrial heartland of America, the Lakes are ringed by the Nation's largest concentrations of people and industrial enterprises; and the growth ethic rules there without serious challenge. The consequences of continued urban and industrial growth on the fragile ecology of the Lakes ought to be demonstrable given any purposeful analytic effort. If analysis shows the consequences are as suspected, then we have not only a Basin problem but a national one and the dialogue will be launched. For, if we find that we cannot grow and expand ad infinitum in the place where we make much of our living as a Nation, then we may have to give the question of balancing developmental and environmental values much closer attention than we have in the past.

1/ Lyon, Walter A., "Water Conflicts on Lake Erie," Great Lakes Water Resources Conference, op. cit., p. 116.

Conclusions and Recommendations

In conclusion, it can be stated that the Great Lakes are in trouble but we do not yet have a clear and precise picture of the nature and extent of the environmental degradation which we can observe to be occurring. We are doing many things to find out more about the Lakes, to improve our waste management practices in the Great Lakes Basin, and to organize our administration of the Lake-oriented development activities into a more effective management structure. While there is concern about the deterioration of Lake Erie and about the quality problems on Lake Michigan and Lake Ontario, it is not yet generally doubted by most Lake management agencies that these problems can be corrected in time by an aggressive program of building more and better waste treatment plants for the industries and municipalities in the Basin. The ability of the Lakes to continue indefinitely to supply water of good quality in adequate amounts at low cost, and to absorb the treated effluents of an expanding urban and industrial society is not yet being challenged officially by any of the regional organizations designed to guide the use and development of the land and water resources of the Great Lakes. It can be argued, however, that there is no irrefutable evidence yet that we must abandon our present policies. While many will acknowledge that they believe that industrial and urban growth must be curbed and our consumption patterns changed, there is no agreement yet about the urgency of the need to make that change nor

any recognized program of feasible actions that could be taken to accomplish such a change.

Better Analytical Tools Required

Probably the most vital missing ingredient to reaching agreement about the severity of the damage being inflicted upon the Great Lakes environment by present practices and about the efficacy of the remedies being employed is the knowledge of how the Lakes function. While there are many opinions about the subject of the environmental status of the Lakes, it is evident that there is not yet an adequate collection and assessment of data to make conclusive findings about the conditions of the Lakes or about their recovery capabilities under various alternative treatment programs.[1/]

This does not mean, however, that we should hold back on our abatement programs until we have all the answers. There is always the danger that some will misconstrue demands for research as an excuse to delay taking actions based on present knowledge. There is an urgent need, however, to apply all our present technology as vigorously as possible to reduce the rate at which the Lakes environment is being damaged. In the war on pollution, we must accept the

1/ Lyon, Walter A., op. cit., p. 118: "One of the least understood areas...is the cause and effect relationship between hydrology, the inputs and outputs of degrading substances, aquatic life and biochemistry of the lake. It is essential that we establish a mathematical model which will allow us to forecast the effect of changing key variables on water quality....This is probably the single most important task to which we must dedicate ourselves if Lake Erie is to be a healthy lake again."

fact that some of our weaponry will become obsolete. Until we have more effective means, however, we must continue to use what we have. If we do what we know we can and should do now, the situation can be improved considerably in the major areas of critical degradation. Our failures there are not failures of ignorance or technology but of funding and administration.

Not enough is known to prescribe with confidence the pollution abatement measures which are both necessary and sufficient to satisfy our water quality needs. A multi-billion dollar investment will be required to install and operate the treatment facilities that will be provided by lakeshore communities and industries to meet a particular water quality standard in the Great Lakes Basin. It is imperative, therefore, that the standards selected be founded as firmly as possible on facts and not on speculation. They must also be precise, in view of the wide variation in and among the Lakes regarding their abilities to accommodate different types and amounts of waste materials. Because of their widely differing capacities, it is not likely to be either necessary or desirable to apply the same treatment requirements or discharge standards to all parts of an individual Lake or to all the Lakes in the Basin.

It is not suggested that we begin to gather more data, although that too will be needed. The problem which is more urgent at the moment is that we do not have the analytical tools to make effective use of the data we have already acquired. What we need first, therefore, is a method for assembling and integrating the data we have.

We need to organize and systematize our data into a model or models which will simulate the Lake processes and illustrate how the Lakes function. Through the process of constructing the models, we will learn: (1) where the gaps in our data are most critical and (2) the nature, scope, and sequence of the studies that should be started to fill in those missing pieces. When completed models are developed, we will be able to use them to test very economically the responses the Lakes are likely to make to a range of different treatment methods.

There is no iron-clad guarantee that complete and useful models of the Lakes can be constructed. However, given time to pursue the task and a research budget large enough to acquire the necessary data, there is no reason to believe that the effort would fail. Properly conceived and funded, the work on the modeling should produce a steady stream of interim products which will help to strengthen our current water quality management programs.

The work on the Great Lakes models should proceed through the following stages of development:

Stage 1: Inventory and analysis; assembling and evaluating the existing collections of data; determining their validity, utility, and comparability. Review and evaluation of current modeling efforts in the Great Lakes Basin. Initial designs of the models are constructed to determine the level of modeling that is feasible.

Stage 2: Programs of research and data-gathering are started and the new data are added to the models as they become available.

Stage 3: The model is completed and testing begins to identify the different effects that will follow from alternative types of pollution abatement measures.

Stage one of this progression toward a model of the Lakes has been started by the Great Lakes Basin Commission. Their Limnological Systems Analysis is designed to explore the feasibility of undertaking such a modeling project within the limits of the existing data base. Funding problems are preventing the Commission from continuing its work on this important project. There are few research studies with as high a potential for strengthening our capabilities for managing the Lakes. It is recommended, therefore, that Federal funds for research be allocated to the Great Lakes Basin Commission over a period of at least five years to develop methods for analyzing the impact on the Lakes of alternative pollution abatement measures.[1/]

New Institutional Arrangements Needed

It is not enough to have information about what could be done or what ought to be done. Before that information can affect performance, there must be a means for putting the information to use. This implies a management organization or organizations which have the capability to utilize such information to make decisions which will result in an improved environment for the Great Lakes. None of

1/ "The Planning Directors Report" of the Great Lakes Basin Commission for Feb. 1, 1972, notes on p. 24: "Preliminary review of the President's budget for fiscal year 1973 indicates that the proposed Level B Great Lakes Environmental Planning Study, of which the Phase II portion of the Limnological Systems Analysis work comprised a major and integral part, was not included in the President's budget for 1973."

the three existing regional organizations is fully capable of the task with their present array of powers and resources. The proposed Federal-interstate authority being proposed by the Great Lakes Commission seems inappropriate to the unique environmental circumstances of the Great Lakes. Proposed legislation that would create a regional water and land planning commission in place of the river basin commission will not produce a solution to the management organization problems of the Great Lakes Basin. A recent study of the question of institutional arrangements for guiding the development of the Great Lakes concluded that none of the alternative organizational arrangements already in operation would suit the peculiar characteristics of the Great Lakes scene. Without going into the details of the tentative institutional arrangements that were suggested, it should be noted that they were innovative approaches which followed no previous pattern of water management organizations.[1/]

It has been argued that we would not need new institutional arrangements for the Great Lakes if we had a complete understanding of the way the Lakes function and of how they are affected by different types of waste discharges. The implication is that most

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1/ Craine, Lyle E., "Final Report on Institutional Arrangements For the Great Lakes," a preliminary draft for the Great Lakes Basin Commission, Ann Arbor, Michigan, 1972. In addition to Craine's work for the Great Lakes Commission, other studies on institutional arrangements for the Great Lakes are in process or recently concluded by the Great Lakes Commission, Office of Water Resources Research (Leonard B. Dworsky), Battelle Memorial Institute, et al.

users of the Lakes are adequately motivated to conserve and protect the water resources; that they damage the water environment now out of ignorance about the nature and extent of the harm caused by their waste disposal practices; or because they do not respect present controls as being scientifically valid requirements. If the full effects of pollutants on the Lakes were known, it is alleged, the existing agencies would be able to take care of the few dishonest or careless polluters while most water users would voluntarily meet the prescribed standards.

It is true that uncertainty about the effects of pollutants and their sources makes the task of managing the Lakes much more difficult. It does not follow, however, that reduction of ignorance in this area would obviate the need for new institutional arrangements. Judgments of a policy nature must be made regarding the level of water quality to be maintained not only in the system but also in particular parts of the Lakes, in individual Lakes, and in the tributaries. The quality requirements may vary, also, by season and by time of day as our knowledge of the Lakes processes becomes more detailed and as our monitoring technology improves. The quality questions are related directly to the decisions about levels and flows and, together, they will reflect judgments about use preferences; i.e., swimming versus navigation, or water supply versus waste dilution.

As our knowledge of the Lakes and their functioning grows, we are likely to increase the range of discretion available to pollution control administrators. We may, for instance, learn enough to be able to predict the specific effects of particular pollutants on the variables affecting the critical functions of a number of Lake-dwelling life forms. Alternative pollution abatement measures, having an attendant array of environmental and economic costs and benefits, will present problems of choice whose effects are often multi-jurisdictional in scope. The need for an institutional body or bodies to deal with these complex choice problems increases as the number of alternative courses of action becomes larger and the extent of their effects becomes more closely discernible. Should our knowledge of the Lakes and the pollution processes show that variations in quality levels are permissible according to considerations of location, use, physical site conditions, and season of the year, the job of managing the water resources in an area as large as the Great Lakes basin could become a very large undertaking.

Role of Canada

More than two-fifths of the Great Lakes Basin lies in Canada. It is not practical, therefore, to make plans for managing the water of the Great Lakes without considering how Canadian authorities will be brought into the planning. It is not practical, either, for the United States to attempt to spell out for Canada the role that country should play in these planning operations. The Dominion of

Canada and the Province of Ontario have their own separate views about the proper use and development of the Great Lakes and about the conduct of Canadian-American relationships. Any proposal for a Great Lakes governing arrangement involving Canadian authorities must take note of two important factors: the high degree of autonomy enjoyed by the provinces in the Canadian federation, and the sensitivity of Canadians to American influence in their internal affairs.

Under the circumstances, it is unlikely that a more intimate arrangement than the existing International Joint Commission can be achieved in the short run. The IJC has been a fairly successful body in the exercise of its missions. A large part of its acceptance to both nations, the states, and the provinces is due, no doubt, to the sensitive manner in which it has conducted its business. Provided with only a skeleton staff and a minimum budget, it has had to rely almost entirely upon the service contributions of state, provincial, Federal, and Dominion agencies in making its investigations and discharging its operating responsibilities. Because the IJC has been given only a limited authority, it has had to pursue its objectives not by edict but by patient negotiation, persuasion, and the building of a consensus.

This type of moderate and unobtrusive performance has enabled cooperating government agencies to work harmoniously with the Commission, regarding it as an ally rather than as a competitor. The weakness of the IJC, however, has prevented it from taking the

forthright measures required to halt the spread of pollution in the Lakes; although the prevention of transboundary pollution is cited as one of the objectives in the Treaty. When bacterial pollution of the Lakes menaced the drinking supplies of the lakeshore communities in 1920, steps were initiated then which would have authorized the IJC to prevent or remedy the pollution of boundary waters. The introduction of chlorine as a purifying agent for water supplies occurred at that time, however, and there was no further incentive for extending the authority of the Commission. In 1970, when critical water quality problems prompted Ontario to call an environmental conference on the Great Lakes, the IJC was nominated as the most appropriate organization for coordinating pollution abatement programs on the Lakes. It should be noted, however, that there was no intent expressed at that time to expand the authority of the Commission or to give it enforcement powers. Despite the very limited nature of the Great Lakes Water Quality Agreement that was concluded between Canada and the United States in 1972, it took six years of study and two years of negotiation to achieve it.

Based on that experience, it is unlikely that Canada and the United States are ready at the present time to consider a new binational agency with more extensive management authority to guide the use and development of the Great Lakes. The present IJC, with its highly restricted powers, seems to represent the limit to which the two nations are ready to go now in taking joint actions on the

water problems of the Great Lakes. Should there be a dramatic worsening of the water conditions in the Lakes, the climate could improve for moving to a stronger international body. Until such an incentive arises, however, there seems to be no desire to change the status quo in our international arrangements on the Great Lakes.

The United States would be well advised, therefore, to make its own institutional arrangements for governing the development of its portion of the Lakes. Canadian representatives can be invited to participate as observers in the meetings of the American organizations. If the American arrangement proves to be an effective way to deal with the problems of the Lakes, the Canadians may be encouraged to create parallel organizations for their portion of the Great Lakes. When that happens, joint meetings could be held between the American and Canadian Lake management bodies on some regular basis to exchange views, coordinate operations, and conduct joint operations. This type of an evolutionary approach to cooperation introduces no pressures, obligations, or risks in the relations between the two nations. For that reason, it seems to be a more viable way to improve international cooperation on the Great Lakes than attempting a direct appeal for the establishment of a new bi-national management arrangement.

Special Arrangements are Necessary

Whatever type or types of institutional arrangements are fashioned for the Great Lakes, they are not likely to be replicas of

anything already used in other parts of the Country. The Lakes are so large and so diverse that it seems quite unlikely that any single agency would be able to deal adequately with all the problems that will need attention. Instead, we can expect an organization featuring a constellation of agencies of varying sizes, jurisdictions, functions, and powers. While we have such an array of disparate entities now, hopefully the new arrangement, unlike the present one, would have the separate parts linked together to form a system of integrated management.

Any design of institutional arrangements for the Great Lakes must recognize the territorial limitation on the states' interest. The individual Lake states, as a whole, seem to be generally reluctant to devote their limited financial and technical resources to the solution of those Lake problems that are removed from their own state borders. Ideally, then, an institutional arrangement for the Great Lakes should be one which permits each of the states to place its major emphasis on dealing with the problems of the individual Lakes on which it fronts. At the same time, the system of Lakes must be treated as a unit, with proper consideration given to the interlake effects of the states' design and operation of separate development projects and programs. While the states accept the need for integration and do appreciate its importance, they do not demonstrate that they will readily accept the major responsibility for attending to it. They would be willing, undoubtedly,

to bear an appropriate share of the costs of operating a planning and management organization which focused on the particular Lake whose shores they occupied. Experience indicates that they would expect the Federal Government, however, to pay most, if not all, of the costs of any organization which was designed to do systemwide planning and management work on the Great Lakes.

It is no easy task to design an institutional arrangement for the Great Lakes which will be effective, responsive, and equitable. In assigning important management powers to a Great Lakes agency, the political, economic, and environmental consequences of miscalculation could be very great. It is appropriate, therefore, that this institutional design task be approached with caution. The problem of organizing any large multigovernmental management organization is of such a political nature that it is hard to predict which of a number of possible combinations of agencies and power relationships will prove acceptable. Despite these reservations, it would be helpful to explore the general features of one approach to this organizational problem. Through this process it may be possible to see at least the broad outlines of the kind of institutional arrangement that can be expected to emerge in time on the Great Lakes.

One of the aims of the proposed arrangement is to do what is necessary but to do no more than that. The problem on the Great Lakes is not so much one in which nobody is doing the work, but rather of the disorganized way in which it is being done. Thus, the

need is not to create new agencies to do planning, or research, or promotion but to create a system in which the work that is being done can be better integrated. At the same time, responsibility for results can be fixed, and greater political accountability achieved for those who are making policy decisions about the use and development of the resources of the Great Lakes.

One Possible Arrangement

The institutional arrangements for the Great Lakes should include both a systemwide organization and five individual Lake organizations. Each of the Lakes should have its own separate council (or board). Systemwide, the Great Lakes council (or board) should serve as the integrating body for the councils of the five different Lakes. The two-tiered system of administration should be established under the terms of a Federal-state compact. By using a compact, the individual states and the Federal Government can establish the rules by which they will abide in making decisions affecting their common interests.

Under the terms of such a compact, the states and the Federal Government could establish a semi-independent council for each one of the Great Lakes. A Lake Superior Council, for example, would have a body of governors, or directors, composed of representatives of the States of Minnesota, Wisconsin, and Michigan, an equal number of representatives of the Federal Government, and representatives of the residents of the Lake Basin equal in number to the combined state

and Federal delegation, a total of 12 members. For Lake Michigan, the States of Michigan, Wisconsin, Illinois, and Indiana would serve along with Basin residents and Federal representatives, for a total of 16 members. Lake Huron would have only one state, Michigan, on its council, along with Federal and Basin resident representatives, a council of four, unless special steps were taken to enlarge the membership. This would also apply to Lake Ontario. Lake Erie's council would consist of 16 members. In addition to regular members, as enumerated, the five councils would invite Canada to provide a permanent observer to serve in an ex-officio capacity, i.e., one for each of the five councils.

Because these councils will be making political judgments, it is important that they be selected in a manner to ensure their political accountability. Representatives of the Basin residents should be selected through a political process. In councils involving two or more states, Basin residents representation should not be divided equally among the states, because of the wide disparity among states in the amount of population and geographic area each has in the Basin. A formula should be specified for apportioning the resident representation among the member states, with the counties in the Lake Basin nominating representatives. Each county board could submit a name for election, with the required number of representatives being elected by a vote of the county commissioners of each of the Basin counties.

Each of the Lake councils would employ a small staff to undertake its planning and administrative duties, with most of the council's services coming through contributions from member governments. State and Federal line agencies involved in the work programs of the councils would contribute members to technical advisory committees to the council. These technical committees would be permanent parts of the councils' administrative organization and would be given specific functions to perform, outside of the policymaking role of the directors.

The councils would have, also, policy advisory committees. Membership on the policy advisory committees would be offered to the county board chairman or another designated county commissioner from each of the counties in the Lake's basin. Staff resources required in the performance of these advisory functions would be budgeted to the two types of advisory committees.

The five individual Lake councils would prepare consolidated work programs and budgets to cover a full range of Lake-related water development activities: research, planning, development, and operation. The cost of preparing these work plans and budgets would be apportioned among the participants; with the Federal Government paying one-half and the states paying the other half. It would be the policy of the councils to take on none of the activities which are already being responsibly undertaken by local, state, or Federal agencies. They would provide the overview function and the integrating service at the Lake level. In addition, the councils would

undertake some monitoring duties and would direct attention to those Lake problems which are neglected for various reasons by an existing agency of government. Through their intervention, more effective or more economical solutions, e.g., regional treatment plants, would be designed and promoted for environmental and other problems affecting the Lake area. The council would also use its special abilities to secure financial assistance where the solutions for Lake-related problems are found to have costs which are beyond the fiscal capacities of responsible public or private agencies. The policy of avoiding direct involvement in operating responsibilities would lead the councils to seek solutions to area problems through the use of intergovernmental contracts and the creation of new sub-Lake agencies designed to provide specific resource management duties.

Each of the Lake councils would be linked together and their work harmonized under the overall guidance of a Great Lakes Council for Environmental Management (GLCEM). The GLCEM would be a federally-funded body with a Presidentially-appointed chairman. The eight governors of the Lake states and ten Basin residents, two from each of the five Lake councils, would serve on the GLCEM. Seven additional Federal members would be appointed to GLCEM to balance the state representation; making a governing body of 26 members. As in the case of the Lake councils, one or more permanent observers to serve in an ex-officio capacity should be invited from the provincial and

dominion governments of Canada. A policy advisory committee, made up of the chairmen of each of the five policy advisory committees serving the Lake councils, would be given specific duties to perform in assisting the directors of the GLCEM. A technical advisory committee, similarly constituted from the chairmen of the technical advisory committees of each of the five Lake councils, would provide technical advisory duties of a substantive nature in the operation of the GLCEM.

The two principal functions of the GLCEM would be: to assure an integrated and comprehensive program of resource use and development; and to resolve policy conflicts regarding resource use among and between public and private users. The GLCEM might operate through five divisions or standing committees: research, planning, funding, implementation, and operation. Each of these units would prepare its own functional program and budget, incorporating program elements from each of the separate budgets prepared by the five Lake councils. The research program and budget, for example, would seek to consolidate in one document all the Lake-related research activities being programmed by public agencies in the Basin, and those activities which the GLCEM itself wished to pursue through contracts, technical or financial assistance, or the use of its own staff resources. The preparation of the work program and budget along functional lines requires that an inventory and screening be made of the on-going programs of other agencies in the Basin to determine

what part of the designated work is being done, where help would be useful to improve performance, and where gaps exist which no existing agency is planning to fill.

The functional budgets of the GLCEM and the five consolidated work programs and budgets prepared by the Lake councils would be consolidated into one overall work program and budget for the Great Lakes. The Federal portion of the Great Lakes budget would be segregated, and that portion to be allocated to the GLCEM would be detailed separately for presentation to the Water Resources Council and the Office of Management and Budget. After their review and comments, it would be transmitted to Congress for funding. Each of the member states would separate from the GLCEM budget that portion which covers the work to be performed by its own state agencies for presentation to their respective state legislatures for funding.

The GLCEM would be charged with identifying development, research, and management needs of the Great Lakes which transcend the objectives of the individual states, the separate programs of the Federal and state line agencies, and the special needs of each of the five state councils. To do this, it will need to produce and maintain an up-to-date framework plan which forms a basis for determining how well project proposals and development trends conform to the long-run needs and capacities of the Great Lakes system. The planning being done by the Great Lakes Basin Commission could be utilized by the GLCEM. There would be no need to duplicate this work or to supplant this planning agency with one created by the GLCEM.

Another important task for the GLCEM in assuring a comprehensive and integrated program of resource use and development is to supply funding to enable local public agencies to obtain help when needed to meet their respective environmental management responsibilities. The fund could derive its capital from fees, assessments, and state and Federal block grants. It would give the GLCEM leverage in dealing with those problems where the responsible local entity may be economically unable to do the work that is needed. It would also give the GLCEM the economic muscle to impose its own solution where, in rare instances, the most effective response to an environmental issue is being blocked by interlocal quarrels and protracted disputes which are peripheral to the environmental problem. With funds of its own, GLCEM would be able to underwrite the risks that may be entailed in testing out promising but non-traditional approaches to the alleviation of environmental problems and would have a final degree of authority which would enable it to accept responsibility for achieving results. If GLCEM had to rely wholly on the good will, initiative, and readiness of other agencies to accomplish all the work that is necessary to preserve and improve the Great Lakes environment, it would not be able to accept such a responsibility. It is vitally important that it be given these tools if it is to be accountable for the successes and failures of the collective public efforts being made to preserve the quality of the Great Lakes. One of the fundamental arguments for establishing a Lakeswide council

after all, is to place responsibility for results unequivocally in one agency.

An organizational component should be established in GLCEM to resolve policy conflicts between and among other elements in the Lakes institutional complex. This component of GLCEM could hear and decide appeals that might be made from the actions of Great Lakes organizations. The actions subject to this type of appeal procedure should be specified in advance. Where policy conflicts between governments or agencies regarding uses of the Lakes' resources are brought to it, the GLCEM's hearing component should intervene to render its judgment. It should act also when it receives assertions that policies followed by an agency or government are undesirable or improper and need to be corrected. In addition to its intervention to resolve policy disputes, this component of GLCEM should also take the initiative to propose policy and standards which it believes would be helpful to GLCEM in its deliberations. The intent here, however, is to keep the GLCEM clear of those kinds of disputes which the existing judicial system is structured to resolve. The role, again, is to be one of supplementing, not supplanting, other agencies.

In summary, the institutional arrangement outlined here answers many of the needs of the Great Lakes situation. Given an independent funding ability, GLCEM can meet the test of being responsible because it can act itself or provide the economic tools to allow or encourage others to act. Its hearing component can speak with authority to

settle conflicts. Given elected local representation on the five Lake councils and on GLCEM, there is a measure of political accountability. The addition of the policy and technical advisory committees achieves representation of local, state, regional, and national interests on the councils and on GLCEM. With five Lake councils provided, there is a good prospect that people making decisions about problems will not get too far removed from those who are wrestling with the problems. By maintaining the existing agencies and organizations, the arrangement utilizes the strengths and skills already available that would otherwise have to be duplicated, saving money and, equally important, avoiding costly political battles. It also allows GLCEM to proceed to test out the necessity of substituting with its own forces, in whole or in part, to make up for any deficiencies in established agencies that may detract from the attainment of its purposes. By making the Federal Government pay the costs of multi-Lake management work, the states will be more inclined to participate and carry their proper share of the costs on their individual Lakes.

The management proposal outlined above is one that could work. This is not to say that it is perfect nor that it represents the only approach to the problem. Anyone who delves into the Great Lakes problem of institutional arrangements is likely to conclude that

> ...it is not possible at this time to suggest specific institutional forms or procedures, but that it is desirable to suggest a framework for institutional design which may provide a guide to changes when conditions for actions are favorable.[1]

The proposals contained in this monograph illustrate the framework for institutional design that is needed in the Great Lakes. These proposals recognize that there is no single best way to organize, and that attention to organization and institutional arrangements is a continuing requirement.

Federal Leadership Recommended

Traditionally, the states have taken the leadership in the formation of Federal-state compacts for water resources development. There is a reasonable prospect that the Lake states do not have yet the unanimity of purpose and degree of interest to take comparable action for the Great Lakes. There is some urgency, however, which makes timing a consideration. Because of the tremendous size and international character of the Great Lakes, the Federal Government has the primary responsibility there for taking the initiative in fashioning a proposal for a management solution. By taking the lead, the Federal Government can demonstrate that it no longer considers the Great Lakes as a local, regional concern to be left to the Lake states to deal with as best they can. In assuming a lead role in the development of an institutional system for the Lakes, the Federal

1/ Ibid., p. II-7; italics furnished.

Government will be giving evidence that it is prepared to apply the attention and the funding that may be required to preserve and protect the Great Lakes for the maximum long-run benefit of the whole Nation.

It is recommended that the President take the initiative in the creation of a Great Lakes Task Force For Environmental Management to draft a Federal-interstate compact especially designed to suit the unique circumstances of that basin. Members of the Task Force should be residents of the region with outstanding qualifications in law, government, public administration, and ecology. State governments in the area should be invited to send representatives from the office of the governor and the legislature to serve on the Task Force and to participate in the deliberations. The Great Lakes Basin Commission could be directed to provide secretarial services to assist the Task Force.

To work out the details of an organizational scheme that will fit the particular needs of the Great Lakes and to negotiate its acceptance and ratification by all the parties whose official participation will be necessary is an undertaking which will take many years of patient and skilled work to accomplish. While it would be premature to lay such a management proposal on the table now for the governments of the area to consider, it is not too early to begin the long and laborious work of preparing the way for it. It takes from one to two years, at least, to draft a preliminary

design of the institutional arrangement desired and a minimum of three to five years to secure its adoption by all the signatories. From that perspective, then, we can look forward to a delay of at least four to seven years before a new organizational arrangement can be made operational and be ready to tackle the management problems that have been accumulating.[1/] Thus, while it may not be urgent to have such an institutional arrangement available today, if we wait until the demand for its services is inescapable, we may not have the time for the careful deliberation that ought to attend its design. Instead, we will more likely be rushed by the pressures of the problems then demanding remedy to put something together in haste which may soon prove unequal to the long-run needs of the area.

Finally, it should be noted that the environmental problems of the Great Lakes are at least partially, if not largely, the product of unregulated and undirected urban growth. Any studious attention to the environmental problems of the Lakes must confront the question of how the Nation's and the Basin's population should be distributed over the land and in what densities. An urban growth policy must be part of any solution to the environmental dilemma of the Great Lakes. It does not seem feasible, however, for the

1/ "A staff member of the Second Hoover Commission reported that for 19 successful compacts which deal with various aspects of river management and control, the average time for negotiating, ratifying, and securing consent was eight years and nine months." Martin, Roscoe, et al. River Basin Administration and the Delaware, Syracuse Univ. Press, 1960, p. 132.

Basin to attempt to solve that problem by itself without a national framework to which it can relate its local efforts. What we see, then, is that the environmental problems of the Great Lakes are a reflection, on a regional scale, of very deep-seated national problems. Until the Nation is prepared to deal forthrightly with these problems, there is not too much hope that the Great Lakes or any other region can work out its local share of those national problems independently. It is, however, feasible for the Great Lakes to become the target, or pilot, area where the Nation makes its first deliberate moves to test out methods for resolving these issues.

REFERENCES

Ayers, John C., "Remarks on Thermal Pollution in the Great Lakes," Research Division, University of Michigan, Ann Arbor, Michigan, 1969, distributed by the Great Lakes Commission.

Beeton, Alfred M., "Man's Effects on the Great Lakes," Environmental Quality and Water Development, prepared for the National Water Commission, National Technical Information Service, Springfield, Va., 1972, Vol. 2, pp. XIV-1-59.

Butrico, F.A., et al., editors, Resource Management in the Great Lakes Basin, Battelle Memorial Institute, Heath Lexington Books, Lexington, Mass., 1971.

Carter, Elsie, "Budget Office Bars EPA's Program to Save Lakes," The Washington Post, Washington, D.C., Feb. 22, 1972.

Craine, Lyle E., "Final Report on Institutional Arrangements For The Great Lakes," Great Lakes Basin Commission, Ann Arbor, Michigan, January 22, 1972 (preliminary draft).

Davis, Richard M.; Hessel, Darryl L.; Stacy, Gary S., Urban Public Policy and Political Institutions for Water-Quality Management on Lake Erie: Year One, Battelle Columbus Laboratories (for Office of Water Resources Research), Columbus, Ohio, April 28, 1972.

Engineering Institute of Canada and the American Society of Civil Engineers, Great Lakes Water Resources Conference, Toronto, Canada, 1968.

Environmental Protection Agency, "Accelerated Great Lakes Program," The Agency, Washington, D.C., unpublished, 1972.

Forrester, Jay W., "Counterintuitive Behavior of Social Systems," Technology Review, MIT Alumni Association, Cambridge, Mass., v. 73, no. 3, January 1971 (reprint).

Goodsell, Leonard J., "The Great Lakes-Water Levels, Flooding and Erosion," A statement before the Committee on Public Works of the House of Representatives, The Great Lakes Commission, Ann Arbor, Michigan, 1968.

Great Lakes Basin Commission, Annual Report, The Commission, Ann Arbor, Michigan, 1970.

_____ "Annual Report" (in draft form, The Commission, Ann Arbor, Michigan, 1970).

_____ Challenges For the Future, The Commission, Ann Arbor, Michigan, 1971.

_____ Great Lakes Basin Framework Study-Plan of Study, The Commission, Ann Arbor, Michigan, Revised 1970.

_____ Long-Range Schedules of Priorities For Water and Related Land Resources Programs, The Commission, Ann Arbor, Michigan, April 1971.

_____ "Minutes of the Great Lakes Basin Commission Meeting," The Commission, Ann Arbor, Michigan, issues from June 1967 to November 10, 1971.

_____ "Report of the Planning Director," The Commission, Ann Arbor, Michigan, issues from 1 to 15, dated Oct. 7, 1968, to Feb. 1, 1972.

_____ "Water Supply-Municipal, Industrial, Rural," Appendix No. 6, Framework Study, The Commission, Ann Arbor, Michigan, July 1971 (first draft).

_____ "Water Quality and Pollution Control--Lake Michigan," Appendix No. 7, Framework Study, The Commission, Ann Arbor, Michigan, December 1971, v. 2 (first draft).

_____ "Water Quality and Pollution Control--Lake Huron," Appendix No. 7, Framework Study, The Commission, Ann Arbor, Michigan, July 1971, v. 3 (first draft).

_____ "Water Quality and Pollution Control--Lake Erie," Appendix No. 7, Framework Study, The Commission, Ann Arbor, Michigan, November 1971, v. 4 (first draft).

_____ "Fish," Appendix No. 8, Framework Study, The Commission, Ann Arbor, Michigan, April 1971 (first draft).

_____ "Levels and Flows," Appendix No. 11, Framework Study, The Commission, Ann Arbor, Michigan, January 1971 (second draft).

_____"Land Use and Management," Appendix No. 13, Framework Study, The Commission, Ann Arbor, Michigan, August 1970 (first draft).

_____"Drainage," Appendix No. 16, Framework Study, The Commission, Ann Arbor, Michigan, July 1971 (second draft).

_____"Erosion and Sedimentation," Appendix No. 18, Framework Study, The Commission, Ann Arbor, Michigan, October 1970 (second draft).

_____"Federal and State: Laws, Policies and Institutional Arrangements," Appendix No. 20, Framework Study, The Commission, Ann Arbor, Michigan, 1971 (in draft form).

_____"Outdoor Recreation," Appendix No. 21, Framework Study, The Commission, Ann Arbor, Michigan, August 1971 (second draft).

_____"Aesthetic and Cultural," Appendix No. 22, Framework Study, The Commission, Ann Arbor, Michigan, October 1971 (first draft).

Great Lakes Basin Commission and Great Lakes Panel of the Committee on Multiple Use of the Coastal Zone, National Council on Marine Resources and Engineering Development, Great Lakes Institutions, The Commission, Ann Arbor, Michigan, June 1969.

Great Lakes Commission, "Initial Draft of the Subcommittee on GLBC Activities, as of July 1, 1968," (draft of a proposed Federal-state compact for the Great Lakes), The Commission, Ann Arbor, Michigan, 1968.

_____"Minutes of the Meeting of the Great Lakes Commission," The Commission, Ann Arbor, Michigan, from November 1969 to August 1970.

_____Report to the States 1969-1970, The Commission, Ann Arbor, Michigan, 1971.

_____The Great Lakes Newsletter, The Commission, Ann Arbor, Michigan, various issues from 1971 to Nov.-Dec. 1969.

International Joint Commission, Interim Report on the Regulation of Great Lakes Levels, The Commission, Washington, D.C., July 1968.

International Joint Commission, Pollution of Lake Erie, Lake Ontario, and the International Section of the St. Lawrence River, The Commission, Washington, D.C., 1970.

International Lake Erie Water Pollution Board and International Lake Ontario-St. Lawrence River Water Pollution Board, Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River - Volume I - Summary, The International Joint Commission, Washington, D.C., 1969.

Martin, Roscoe, et al., River Basin Administration and the Delaware, Syracuse University Press, Syracuse, N.Y., 1960.

Muys, Jerome C., Interstate Water Compacts, prepared for the National Water Commission, National Technical Information Service, Springfield, Va., 1971.

National Oceanic and Atmospheric Administration, News Release: International Field Year for the Great Lakes, Department of Commerce, Washington, D.C., January 23, 1972.

Pickard, Jerome P., "U.S. Metropolitan Growth Expansion, 1970-2000, With Population Projections," prepared for Commission on Population Growth and the American Future, Urban Land Institute, Washington, D.C., December 1971.

Spangler, Miller B., The Role of Marine Sciences in the Multiple Uses of the Coastal Zone of Lake Erie and Lake Superior, National Planning Association, Washington, D.C., 1969.

Time Magazine, "The Worst is Yet to Be," TIME, v. 99, no. 4.

U.S. Army Corps of Engineers, Dredging and Water Quality Problems in the Great Lakes, Buffalo District, Buffalo, New York, 1970.

_____ Great Lakes Inventory Report, National Shoreline Study, North Central Division, Chicago, Illinois, August 1971.

_____ Water Levels on the Great Lakes, Report on Lake Regulation: Appendix A, Hydraulics and Hydrology, North Central Division, Chicago, Illinois, December 1965.

U.S. Department of State, "Great Lakes Water Quality Agreement Between the United States of America and Canada," an unpublished working draft, Washington, D.C., February 7, 1972.

St. Paul Pioneer Press, "Progress Peril, Scientists Say," St. Paul Pioneer Press, St. Paul, Minnesota, February 27, 1972, p. 9.

Zuckerman, Ed., "Great Lakes Cleanup Rejected," St. Paul Pioneer Press, St. Paul, Minnesota, February 23, 1972, p. 5.

Zuckerman, Ed., "Great Lakes Cleanup Still Alive-Ruckleshaus," St. Paul Pioneer Press, St. Paul, Minnesota, p. 7.