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APPENDIX R9 Recreational Boating

GREAT LAKES BASIN FRAMEWORK STUDY

Great Lakes Basin Framework Study

APPENDIX R9

RECREATIONAL BOATING

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STATE OF MINNESOTA

GREAT LAKES BASIN COMMISSION

**Prepared by the Recreational Boating Task Group
of the Navigation Work Group**

**Sponsored by U.S. Department of the Army, Corps of Engineers
and the State of Michigan**

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Cover photo by Kristine Moore Meves.

This appendix to the *Report of the Great Lakes Basin Framework Study* was prepared at field level under the auspices of the Great Lakes Basin Commission to provide data for use in the conduct of the Study and preparation of the *Report*. The conclusions and recommendations herein are those of the group preparing the appendix and not necessarily those of the Basin Commission. The recommendations of the Great Lakes Basin Commission are included in the *Report*.

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OUTLINE

Report

- Appendix 1: Alternative Frameworks
- Appendix 2: Surface Water Hydrology
- Appendix 3: Geology and Ground Water
- Appendix 4: Limnology of Lakes and Embayments
- Appendix 5: Mineral Resources
- Appendix 6: Water Supply—Municipal, Industrial, and Rural
- Appendix 7: Water Quality
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- Appendix S20: State Laws, Policies, and Institutional Arrangements
- Appendix 21: Outdoor Recreation
- Appendix 22: Aesthetic and Cultural Resources
- Appendix 23: Health Aspects
- Environmental Impact Statement

SYNOPSIS

The Great Lakes, rivers and streams, and many inland lakes that make up the Great Lakes Basin provide a wealth of recreational boating water. Unfortunately, the supply and demand often are not located in the same area. Many boaters are forced to travel hundreds of miles to find suitable boating water. The surplus of boating waters in some areas and the great lack of boating waters in others are illustrated in this appendix.

The number of registered boats in the Basin is expected to nearly double from 900,000 in 1968 to 1,754,000 by the year 2020. Satisfying the needs of these additional boaters will require doubling the facilities now available. Latent boating demand, boat movements, and boat use in terms of user days and location require future study due to the current lack of data.

In fact, such data are absolutely necessary if future facilities are to be responsive to the desires of recreational boaters. Congressional authorization is sought for a Basinwide study to determine boater desires and boat-use patterns. Such information is necessary as a basis for construction of new facilities or modifica-

tion of existing facilities. New facilities or modifications could be recommended in interim reports. A final report could be completed within 10 years after the first year of funding.

Only a major program can provide the facilities desired. Capital expenditures of more than \$272 million in the 1970 to 1980 period and nearly \$408 million in the 2001 to 2020 period are necessary. If a program of this magnitude is not implemented, boating will move out of the Basin or the pattern of recreational activities will change to non-water-related activities.

The Basin provides a good quality of life through its beautiful scenery, fishing, swimming, power boating, and sailing, and through agriculture, mining, manufacturing, power supply, and transportation. These are all dependent upon the water resources of the Basin. Some uses are complementary, others are competitive. Prime consideration must be given to effects on the environment of any action and to restoring, preserving, and improving the Great Lakes for the benefit of all users.

FOREWORD

The appendix was prepared by the Recreational Boating Task Group. Technical reports, statistics, and views of private interests and State and Federal agencies have been used as sources of information for this appendix. Principal contributors were the Michigan Waterways Commission, the Bureau of Outdoor

Recreation, and the Corps of Engineers. The preparation of the final draft was coordinated by Alfred P. Behm of the Corps of Engineers. Francis J. Baker of the Bureau of Outdoor Recreation was principal contributor. Other Federal, State, and private boating interests have participated in preparing this appendix.

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INTRODUCTION

The Recreational Boating Task Group was responsible for preparing an assessment of recreational boating activities in the Great Lakes Region. This study was made with full cooperation of the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Penn-

sylvania, and Wisconsin; the U.S. Army Corps of Engineers; Department of Transportation, U.S. Coast Guard; and the Department of the Interior, Bureau of Outdoor Recreation. The private sector of boating was represented by the Boating Industries Association.

Section 1

A STUDY OF RECREATIONAL BOATING

1.1 Study Purpose

This appendix develops information regarding existing and future boating activities in the Great Lakes Region. It lays part of the foundation for development of water and related land resources of the Region to meet projected needs in a timely and efficient manner. On the basis of data developed in this volume, the task group prepared a broad framework for additional data collection, selected research, special studies, and quantitative and time-phased structural and nonstructural requirements for management of water and related land resources in the interest of recreational boating.

1.2 Relationship to Other Appendixes

The *Great Lakes Basin Framework Study* consists of a Report, 25 supporting appendixes, and an Environmental Impact Statement. Navigation is covered by Appendix C9, *Commercial Navigation*, and Appendix R9, *Recreational Boating*.

Recreational boating is a major component of the total navigational scene and requires the construction of marine facilities, installation of navigational aids, and adherence to marine law, especially on the Great Lakes. Recreational boating is also closely related to Appendix 8, *Fish*, and Appendix 21, *Outdoor Recreation*. Boating is one of the principal recreational activities in the Great Lakes Region. Boats are necessary for water skiing and are often used by fishermen.

This recreational boating survey covers the Great Lakes Basin and economically related areas (Figures R9-1 and R9-2). The study area includes portions of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. Planning subareas (PSAs) are delineated by county boundaries that approximate groups of drainage basins drained by tributaries of the Great Lakes. The PSAs had a population of 29 million in 1970. The river basin groups (RBGs) cover a tribu-

tary drainage area of 176,000 square miles, of which 111,000 are land area, 4,000 are inland water surface, and 61,000 are Great Lakes water surface.

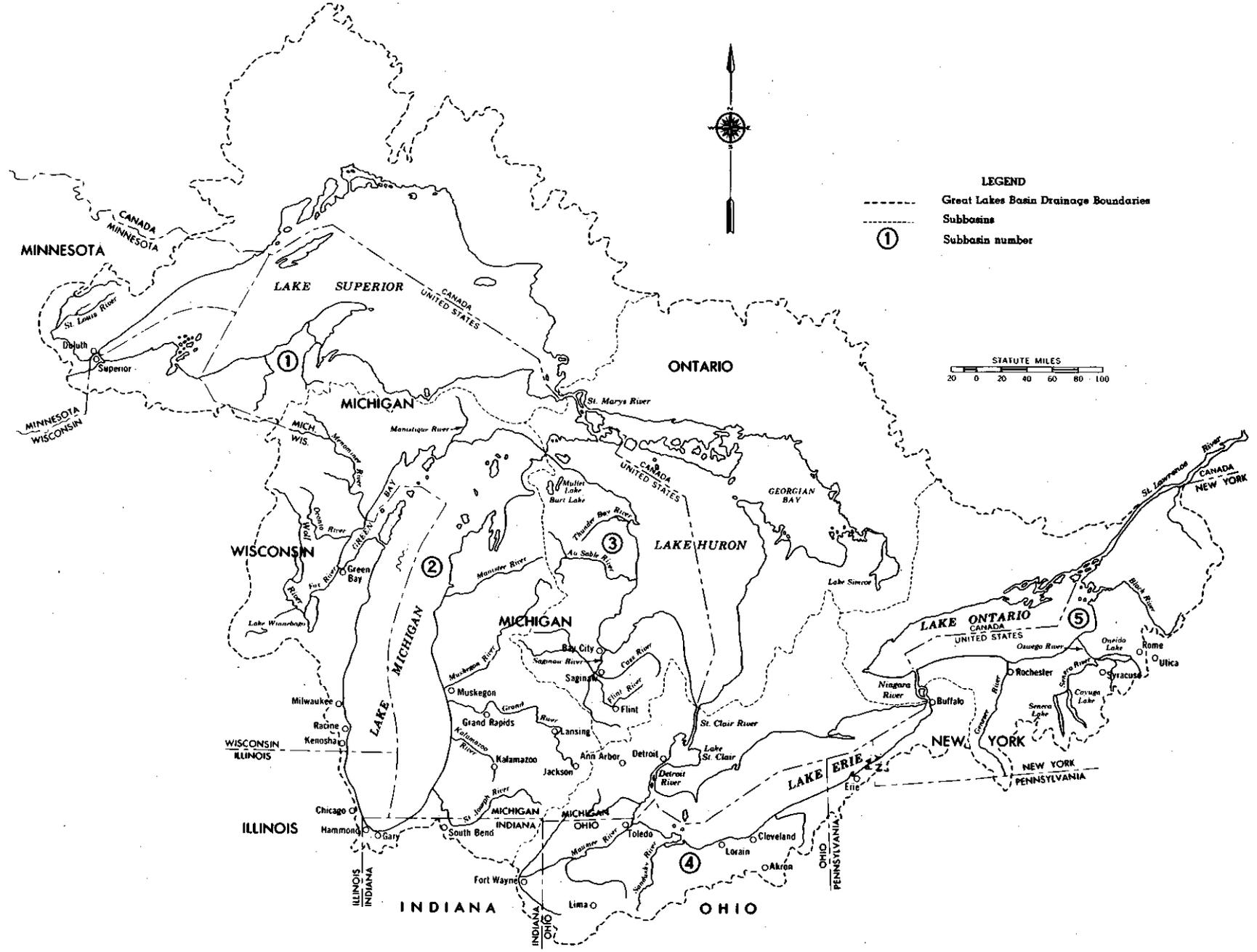
1.3 Historical Trends in Recreational Boating

Prior to 1900 little thought was given to recreational boating potential of our rivers and lakes. Waterways were routes of commerce. With the development of the internal combustion engine at the turn of the 20th century, engine and boat manufacturers joined together in the design and construction of boats and marine engines. Since that time recreational boats in use in the United States have increased from an estimated 15,000 in 1904 to almost 9 million registered boats in 1970.

Growth in recreational boating can be attributed to a number of factors. These include the development of the modern outboard motor with its higher horsepower and its capabilities for high speed water travel, which makes water skiing possible; the use of fiberglass for the construction of boats, reducing the cost of maintenance; and the development of the self-launching boat trailers, which make boating enthusiasts mobile (Figure R9-3). These advances, coupled with the general trends of a higher standard of living, more leisure time, and more personal income, have brought people in ever-growing numbers to the Basin's waterways. To meet their needs, private enterprise, local and State government, and the Federal government have developed various programs and projects for using, conserving, and developing water resources through classification and zoning of rivers, and construction, operation, and maintenance of reservoirs, harbors, launching facilities, and marinas.

Data released by the Boating Industry Association indicate that in 1970 Americans spent \$3.4 billion on boats and boat-related expenses such as motors, insurance, and repairs. The occupations of outboard motor purchasers and the estimated number of recrea-

FIGURE R9-1 Great Lakes Basin Drainage Boundaries

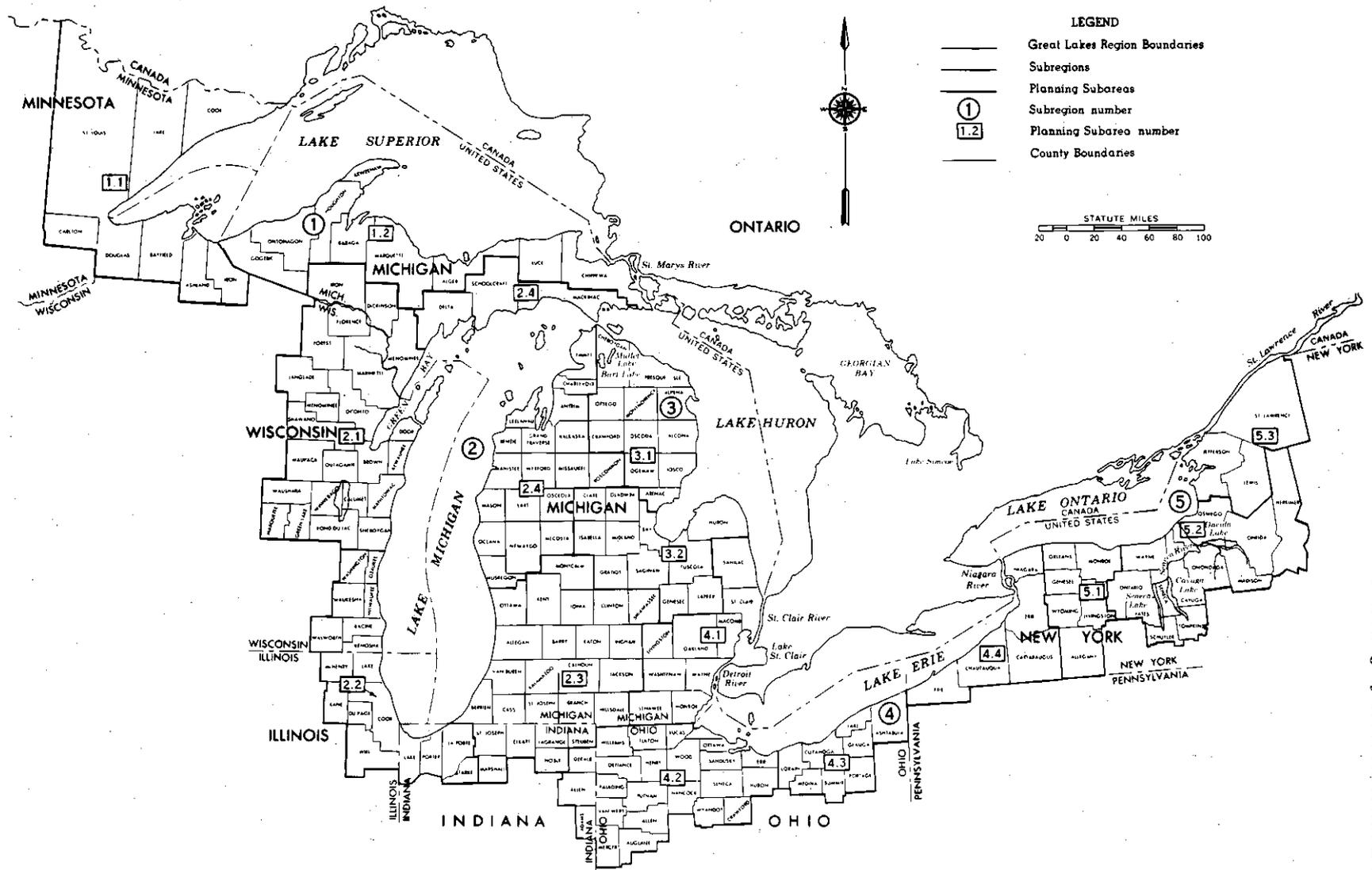


LEGEND
 - - - - - Great Lakes Basin Drainage Boundaries
 Subbasins
 ① Subbasin number

STATUTE MILES
 20 0 20 40 60 80 100



FIGURE R9-2 Great Lakes Region Planning Subareas



tional boats in use during selected years are shown in Tables R9-1 and R9-2.

The National Association of Engine and Boat Manufacturers (NAEBM) has conducted a number of national surveys of boat club members. These reports, substantiated by other reports, give insight into the use factors that affect the current level of recreational boating.

TABLE R9-1 Occupations of Outboard Motor Purchasers (in percent)

Occupations	Employed Buyers*	Employed Population
Professional	17.6	14.4
Managers, Proprietors	14.3	10.5
Clerical, Sales	17.2	23.7
Skilled Workers	24.5	12.8
Semiskilled	13.9	17.6
Farmers, Farm Labor	2.6	4.0
Service Workers	7.9	12.4
Factory Labor	2.0	4.6
	100.0	100.0

*In addition, the equivalent of 13.3% of total sales was made to retired persons, students, etc.

Since the data were first collected in 1953, fishing has been the most popular reason given by purchasers of outboard equipment (Figure R9-4). Although cruising and water skiing moved up in importance in the early 1960s, fishing increased its lead over the second and third most frequently mentioned uses. Seventy-eight percent of the purchasers of outboard motors in 1965 mentioned fishing as an intended use of the equipment; 35 percent said cruising; and 27 percent cited water skiing. These percentages exceed 100 percent (140%) because outboard motor equipment serves multiple purposes.

1.4 Factors Affecting Boating Participation

Boating opportunity is the principal factor affecting boating participation. If the opportunity is available, people will participate. The

TABLE R9-2 Number of Recreational Boats in Use (by year)

Year	Boats	Year	Boats	Year	Boats
1913	400,000	1952	4,333,000	1967	8,275,000
1930	1,500,000	1962	7,468,000	1968	8,440,000
1947	2,440,000	1965	7,865,000	1969	8,646,000
1950	3,510,000	1966	8,074,000	1970	8,814,000



FIGURE R9-3 Outboard Motor Boating

Courtesy of Evinrude Motors

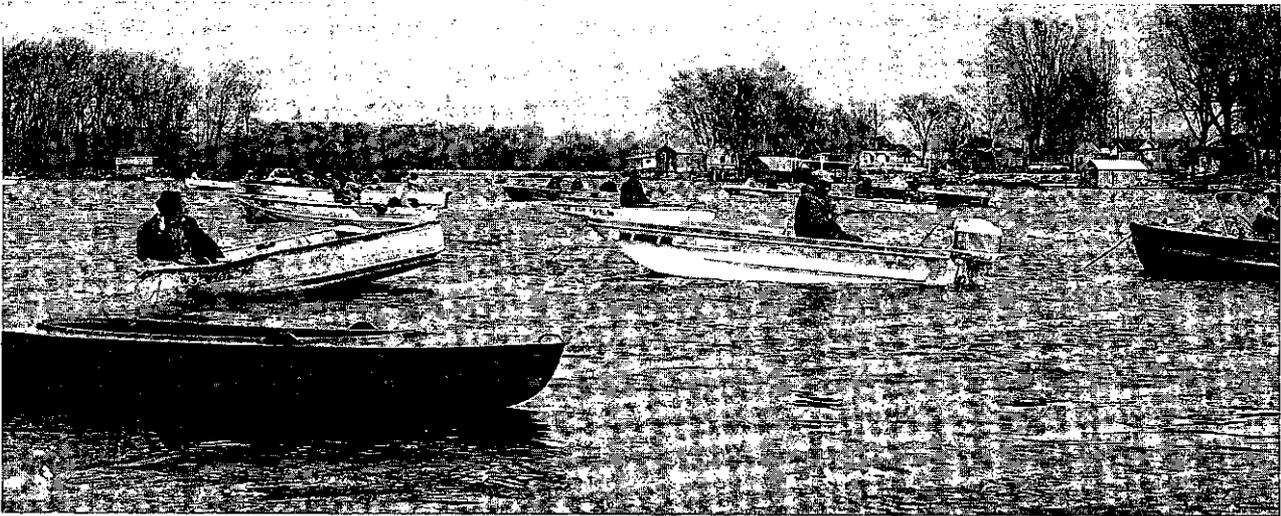


FIGURE R9-4 Walleye Fishing

Courtesy of Wisconsin Department of Natural Resources

degree of participation is related to such socioeconomic factors as per capita personal income, the amount of leisure time, and mobility of the boater. The closer the boating opportunity is to a population center, the more intensive the boating participation is likely to be.

Good boating conditions depend on forces of nature and actions of man. Fluctuating water levels on the Great Lakes may hamper boater access and boat operation. Storms on the Great Lakes develop quickly and can be severe. The threat of storms is a constant concern of Great Lakes boaters (Figure R9-5). Boaters want water that is aesthetically desirable and free from any materials that could damage their equipment. Extreme acidity or alkalinity, floating debris, excessive aquatic plant growth, and a wide range of chemicals can contribute to an undesirable aesthetic situation or cause damage to the boater's equipment.

The Federal Boating Act of 1958 requires that boats be numbered by the State in which they are principally used. The number of boats registered in each State is a function of the State's numbering requirements. Although only motorboats over 10 horsepower are required to be numbered by the Federal Boating Act of 1958, most States have broadened the scope of their numbering system. The resultant data are not uniform in many cases, and this fact should be kept in mind when analyzing the numbering data.

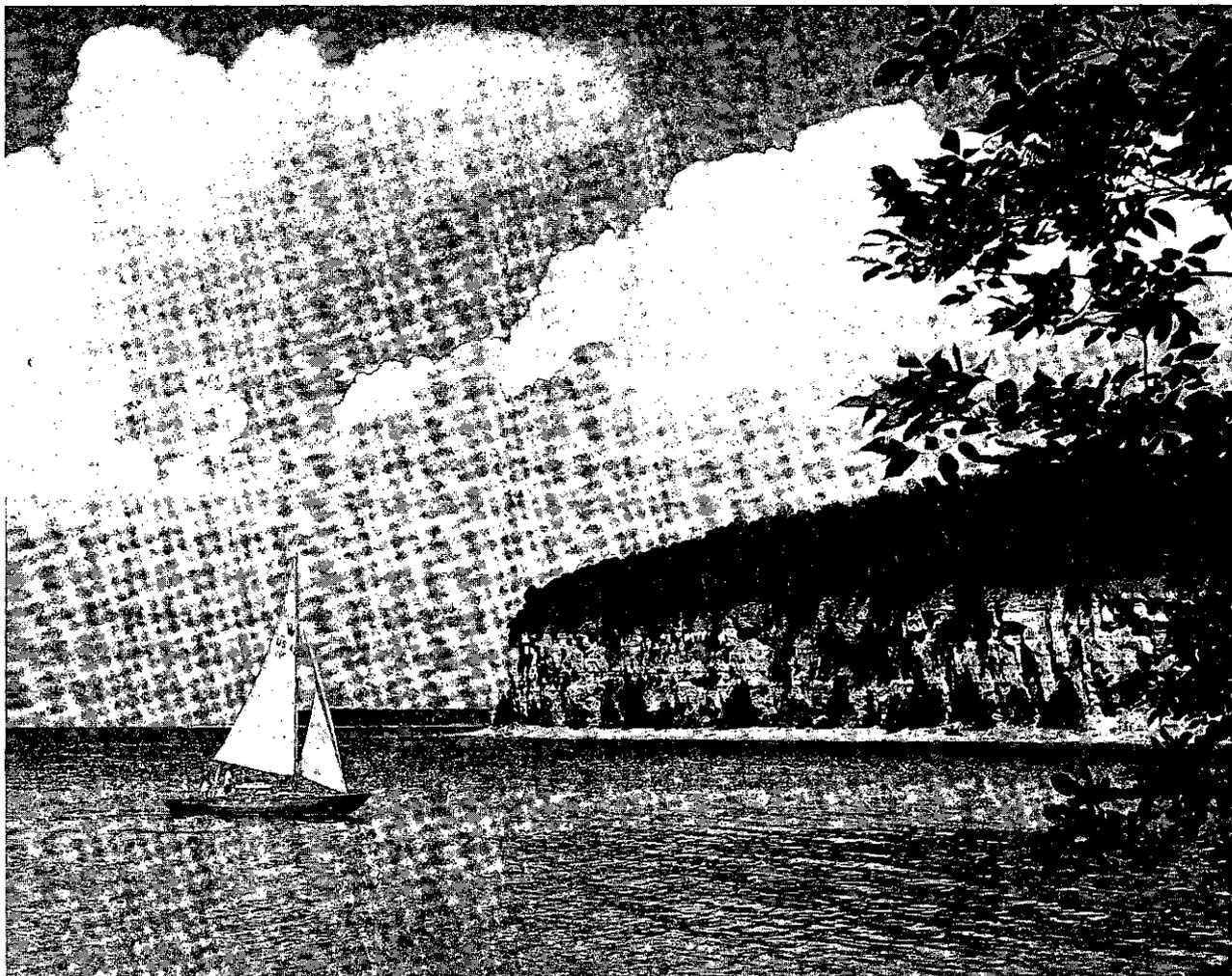
Table R9-3 shows the total number of boats

registered in each of the Great Lakes States for the year 1968. The Great Lakes States, with approximately 36.8 percent of the nation's population, have approximately 40 percent of the registered boats. The Great Lakes Region, with approximately 14.8 percent of the nation's population, has 17.3 percent of the registered boats.

Michigan, Minnesota, and Wisconsin, with a population of 16 million, have one million registered boats. These three States, with only 22 percent of the population of the eight Great Lakes States, have 50 percent of the registered boats. Their dominance of the boat market is due primarily to the fact that these States have within their boundaries the greater share of available boating water area. This factor has the greatest effect on the distribution pattern and the extent of boating participation.

The Great Lakes Basin was created by glaciation less than 15,000 years ago. Some of the physical characteristics of the Great Lakes system, which have not significantly changed since their glaciation, are shown in Table R9-4. Outlets of Lakes Superior and Erie are controlled by bedrock uncovered by erosion of glacial overburden at Sault Ste. Marie and Niagara Falls. The Lake Huron-Lake Michigan control is glacial overburden in the St. Clair River.

The large surface area and depth of the Great Lakes causes moderate temperatures in the Basin. Average annual temperatures range from 39°F on Lake Superior to 49°F on



Courtesy of Michigan Department of Natural Resources

FIGURE R9-5 Burnt Bluffs—Lake Michigan

Lake Erie. Average annual precipitation ranges from 30 inches on Lake Superior to 33 inches on Lake Erie.

Great Lakes tributaries are generally short with small drainage areas. The largest is the Maumee River basin in Ohio, with 6,600 square miles. There are more than two million acres of inland lakes and many streams in the Region.

1.4.1 Lake Superior Basin

The cool northern climate, a great number of inland lakes, and several thousand miles of clear, cool streams attract recreational boaters to the Lake Superior basin. Except in the Duluth-Superior metropolitan area, the basin is sparsely populated. Substantial distances

between boating opportunities and large population centers and the short summer tourist season tend to limit boating activity.

Lake Superior (Figure R9-6) is so large that there are significant differences in climate between the north and south shores. The heat storage capacity of the Lake has a warming effect (15–20°F) on the moving air masses. The average maximum July temperature is 80°F, while the average minimum July temperature is 58°F. On the average there are 30 days during the five-month boating season when the wind velocity exceeds 30 mph. During the 1968 season small-craft warnings were issued for all or a portion of 24 days each month and fog occurred 10 days in the Michigan portion and 28 days in the Minnesota and Wisconsin portions. Seiches and lunar tides are insignificant on Lake Superior.

TABLE R9-3 Registered Boat Numbering Data, Great Lakes States and Great Lakes Region, 1968

State	Total Boats Numbered		Scope of Current Boating Numbering
	Total State	Great Lakes Region	
Illinois	188,046	66,041	All motorboats and sail- boats over 12' in length
Indiana	115,268	10,948	All motorboats
Michigan	437,361	437,361	All motorboats
Minnesota	259,983	34,000	All watercraft (with exceptions) ^a
New York	415,720	172,000	All motorboats
Ohio	188,075	82,897	All watercraft
Pennsylvania	94,800	3,150	All motorboats
Wisconsin	<u>302,957</u>	<u>105,630</u>	All motorboats and sail- boats over 12' in length
Total	2,002,210	912,000	

^aMinnesota excludes (a) duckboats during duck hunting season, (b) sailboats, (c) canoes, (d) rice boats during harvest season, and (e) sea planes.

Note: The 1969 registration included 969,434 boats in the Great Lakes Region.

Lake Superior's shoreline consists of mostly rugged, rocky bluffs or cliffs on the north shore and low bluffs or wetlands on the south shore. There are approximately 900 miles of mainland shoreline and 500 miles of island shoreline in the United States portion. More than 90 percent of this shoreline is bluff. Approximately 22 percent of the mainland shoreline is publicly owned.

The Lake Superior basin has approximately 58,000 acres of inland lakes, each of which is more than 40 acres in size. Lake Gogebic is the largest, covering 8,700 acres. There are thousands of miles of streams in the basin. Section 4 of this appendix contains additional information on lakes and streams.

Resorts and other privately operated tourist accommodations often offer boat rentals and marina facilities. There are very few private canoe liveries in the Lake Superior

basin since streams suitable for canoeing are far from population centers. Many basin streams, particularly those along Minnesota's north shore, are unsuitable for canoeing. Most canoeists using basin waters are either residents or persons living near the basin. Most marinas and harbors of refuge on Lake Superior are publicly owned and operated, but privately owned marinas exist in various inland waters where public facilities are lacking.

Small motor-driven boats in Lake Superior are limited to readily accessible inland lakes and protected bays. Inland lakes, such as Au Train Lake, Lake Independence, Lake Gogebic, Giles Flowage, and lakes and larger reservoirs near Duluth, offer opportunities for fishermen, water skiers, and pleasure boaters. In Lake Superior, the operation of smaller boats occurs primarily at Duluth-Superior Bay, the Chequamegon Bay area, the waters

around the Apostle Islands, the Sault Ste. Marie area, and Munising Bay.

Large pleasure boats also cruise Lake Superior Bay areas. Occasionally some brave the open waters of Lake Superior proper, but rough waters, dangerous fogs, and scarcity of protected harbors tend to throttle the enthusiasm of even the most intrepid yachtsmen. The larger craft are used by char-

ter fishermen and wealthy residents. A few of the larger yachts enter Lake Superior through the Soo Locks.

The Lake Superior basin contains approximately 950 miles of existing and proposed canoe trails, primarily located in wilderness settings. They range in character from white-water streams like the Black and Presque Isle Rivers to the slow meandering

TABLE R9-4 Physical Characteristics of the Great Lakes System

Description	Lake Superior	Lake Michigan	Lake Huron	Lake St. Clair	Lake Erie	Lake Ontario
Dimensions in miles:						
Length	350	307	206	26	241	193
Breadth	160	118	183	24	57	53
Total shoreline including islands	2,980	1,660	3,180	169	856	726
U. S. mainland shoreline	912	1,367	565	46	342	290
Areas in square miles: ^a						
Drainage basin in U. S.	37,500	67,900	25,300	2,370	23,600	16,800
Drainage basin in Canada	42,600	0	49,500	4,150	9,880	15,300
Total drainage basin (land and water)	80,100	67,900	74,800	6,520	33,500	32,000
Water surface in U. S.	20,600	22,300	9,100	162	4,980	3,460
Water surface in Canada	11,100	0	13,900	268	4,930	3,880
Total water surface	31,700	22,300	23,000	430	9,910	7,340
Volume of water in cubic miles: ^a	2,935	1,180	849	1	116	393
Depths of water in feet: ^a						
Average over lake	489	279	195	10	62	283
Maximum observed	1,333	923	750	21 ^b	210	802
Outlet river or channel						
	St. Marys River	Str. of Mackinac	St. Clair River	Detroit River	Niagara River	St. Lawrence River
Length in miles	70	--	27	32	37	502
Average flow in cfs (1860-1968)	74,500	52,000	187,000	190,000	202,000	239,000
Low water datum (LWD) elevation in feet IGLD (1955)	600.0	576.8	576.8	571.7	568.6	242.8
Monthly elevations in feet ^c						
Average (1860-1973)	600.37	578.68 ^d	578.68 ^d	573.01 ^e	570.37	244.77
Maximum	602.06	581.94	581.94	576.23 ^f	573.51 ^f	248.06
Minimum	598.23	575.35	575.35	569.86	567.49	241.45
Average-winter low to summer high	1.1	1.1	1.1	1.6	1.5	1.8
Maximum-winter low to summer high	1.9	2.2	2.2	3.3	2.7	3.5
Minimum winter low to summer high	0.4	0.1	0.1	0.9	0.5	0.7

^aLake level at lowwater datum elevation. LWD is a reference elevation for nautical charts and projects.

^bMaximum natural depth.

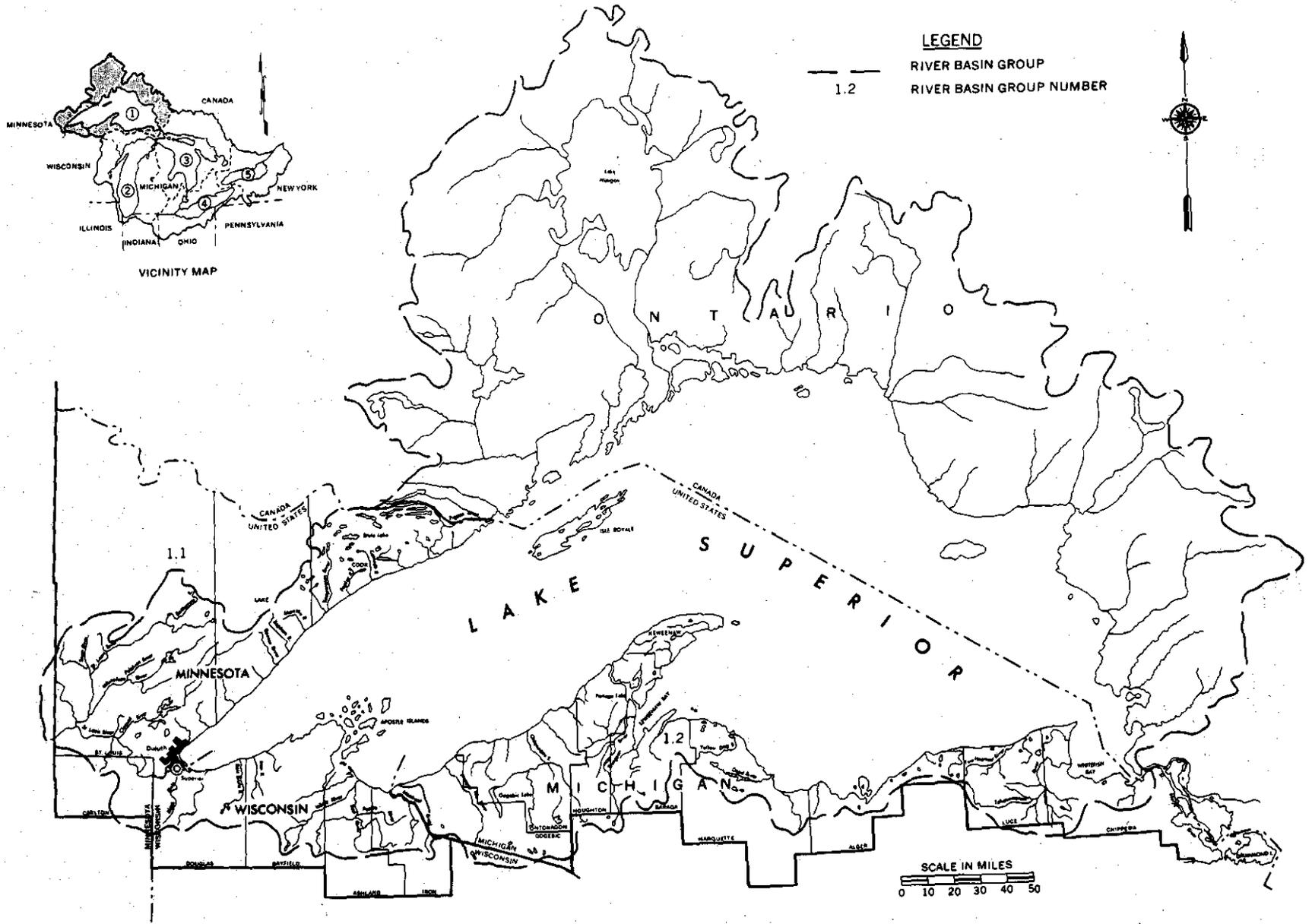
^cLake elevations are as recorded at Marquette (Lake Superior), Harbor Beach (Lake Michigan-Huron), Grosse Pointe Shores (Lake St. Clair), Cleveland (Lake Erie), and Oswego (Lake Ontario).

^dThe Straits of Mackinac between Lakes Michigan and Huron is so wide and deep that the difference in the monthly mean levels of the lakes is not measurable.

^eLake St. Clair elevations are available only from 1898.

^fMaximum elevations reached during June 1973.

FIGURE R9-6 Plan Area I, Lake Superior



waters of the Au Train River and the St. Louis River. Recreationists could enjoy the scenery along these streams if additional wilderness campsites, portages, and access sites were available. The St. Louis River, located near the Duluth metropolitan area, is a scenic, gentle, and undeveloped river especially appreciated by canoeing families.

Sailing is primarily limited to Lake Superior's inland lakes and protected bay areas. Very little sailing takes place in the remainder of the Lake Superior basin because of cold temperatures, inclement weather, the steep rocky shoreline, and the lack of adequate harbor facilities. Fog, which occurs on Lake Superior more frequently than on the other Great Lakes, is also a problem. Nevertheless, it offers varied cruising amid dramatic settings.

The stocking of coho and chinook salmon in certain Lake Superior streams and the restoration of lake trout may attract more and more anglers in the future. In the early 1960s Lake Superior had only nine charter boat operations. By 1970 approximately 50 such operations were available.

1.4.2 Lake Michigan Basin

Lake Michigan tempers prevailing winds and makes the area a climatic island. Counties that lie along Lake Michigan's eastern shore enjoy prevailing westerly winds, which blow cool in summer and warm in winter after passing over the Lake. The deeper waters of the Lake remain near 39°F. This warmth brings heavy snows to Michigan but keeps the temperatures moderate.

The basin's climate in Wisconsin is influenced to a lesser degree than that of Michigan. Wisconsin temperatures are generally colder in winter and warmer in summer than Michigan's.

Lake Michigan is the only Great Lake contained within the United States (Figure R9-7). It has the longest Great Lakes shoreline entirely within the U.S. Its numerous islands, peninsulas, and bays offer 1,660 miles of shoreline, of which approximately 1,300 miles is suitable for recreation. Approximately 18 percent of this shoreland is publicly owned. Although there are no tides on Lake Michigan, there are short-term changes in the lake level called seiches, surface oscillations which may be compared to water sloshing back and forth in a bathtub. Lasting anywhere from a few minutes to several hours, seiches are caused

either by the wind blowing in a specific direction for a long period of time or by differences in barometric pressure in different parts of the Lake. In either case, water is forced from one end of the Lake and piled up on the other. Once the wind stops blowing or the pressure changes, the water moves back and forth across the Lake causing a rise and fall of levels at the Lake ends. With each swing there is a little less rise or fall until the Lake returns to normal.

A seiche may be observed by watching the water level around a dock or pier. At least seven lives were lost in Chicago in 1954 when such a wave caught many people on a pier.

In addition to seiches, sizable variations in lake levels, caused by more or less than average precipitation over several years, are a major consideration in recreational development along the shore. Erosion along bluffs is a result of high lake levels and storms. During periods of low water as in 1964, sand bars and recession of water from mooring and launching facilities hampered recreational boating in many areas.

Wisconsin, Michigan, and that portion of Indiana that drains into Lake Michigan are well endowed with natural inland lakes. According to State listings, Lake Michigan basin has a total of 8,186 lakes. Total surface acreage of the lakes in the basin exceeds 680,000 acres.

Northern Indiana contains more than 300 lakes, comprising approximately 22,000 acres. These lakes, formed by glaciation, constitute a considerable recreational asset. They vary in size from a few acres to several square miles. The largest, Lake Wawasee, covers 2,618 acres.

More than 1,000 lakes comprising 267,000 acres lie within the Wisconsin portion of the Lake Michigan basin. Lake Winnebago in east central Wisconsin, the largest lake in the Lake Michigan basin, covers 215 square miles.

Michigan has over 6,800 inland lakes, comprising more than 392,000 acres, within the basin. Only ten are more than 10 square miles in size. Many are quite small and shallow.

The river systems of the basin are the products of glaciation and later erosion. The rivers and streams of the basin are short and have limited drainage basins. The Grand River basin, draining 5,622 square miles, is the largest in Michigan.

Many of the rivers of northern Wisconsin and the Upper Peninsula of Michigan either have their sources in or flow through national or State forest lands, which protect their watersheds from major sources of pollution. Pro-

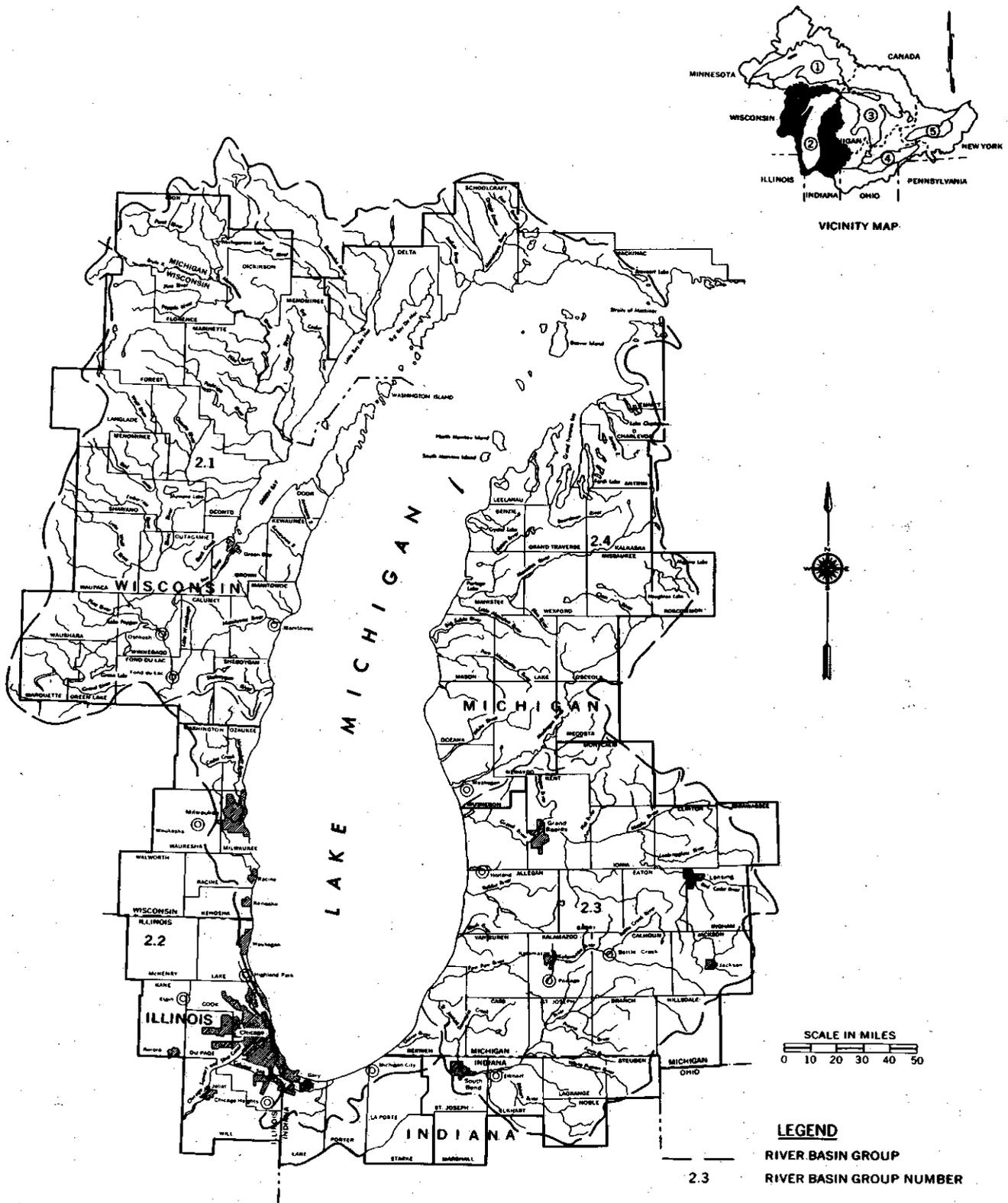


FIGURE R9-7. Plan Area 2, Lake Michigan

tection, however, does not extend to the lower portions of certain of these streams. They flow through heavily urbanized sections where water quality is impaired.

Most rivers and streams are important for fishing, boating, and canoeing. Embayments near mouths of rivers emptying into Lake Michigan provide mooring areas for recreational craft.

Lake Michigan, inland lakes, rivers, trout streams, and warmwater creeks offer good fishing. This appendix will not evaluate fishing statistics, but it will consider public access to fishing areas which are also used by recreational boaters. Recreational use of bodies of water is often limited by lack of access. The right of public access to bodies of water depends principally on whether the water or shoreline is privately owned. Navigable waters are considered public property, to be used not only for navigation, but for other purposes including recreation, but they must be used without abusing private property rights.

Demands for the use of the total available water surface of the basin, which remains constant, will continue to grow. Pleasure craft are becoming more powerful and elaborate. Some are inhabited during weekends and during the summer while moored in marinas. Boating on Lake Michigan proper generally requires a larger and more powerful boat than those used on inland lakes and streams, and harbors-of-refuge are necessary. Few good natural harbors exist along the Lake Michigan shoreline. Those that existed before improvement by the Federal government were at mouths of creeks and rivers, or outlets of small lakes near the lakeshore. They were either in their natural condition or partially improved by local interests. Build-up of sand bars continues to be a problem around these natural harbors. Even though recreational harbors for small craft are being constructed, development within the basin is not keeping pace with increasing demand.

Lake Michigan itself is not suitable for canoeing but most of the basin's major rivers and their tributaries offer good canoe routes, as do certain sections of other streams, rivers, and lakes in the basin. Canoeing on these waters has been important since the days of the Indian, early explorers, and fur trappers, but today, it is done for pleasure. An increasingly popular sport, it is often done in rented canoes. There are many small canoe liveries throughout the basin and several large livery establishments in Michigan. Most of the en-

thusiasts are youngsters between junior high school and college age.

1.4.3 Lake Huron Basin

The United States portion of Lake Huron basin lies entirely within Michigan. Two-thirds of the eastern half of the State and a small section of the Upper Peninsula drain into Lake Huron (Figure R9-8).

Prevailing westerly winds passing over adjacent Lake Michigan produce more moderate summer and winter temperatures than those experienced by States directly to the west of Lake Michigan. Moderate summer temperatures in the northern portion of the basin restrict water contact sports but attract recreationists seeking relief from the warm, humid climate to the south.

The number of days on which dense fog occurs annually ranges from 10 days in the vicinity of Port Huron to 20 days in the Mackinac Straits area. The fog usually burns off shortly after sunup. Winds average from 8 to 10 miles per hour with the greatest velocities occurring along the Lake Huron shoreline. The western shoreline is shielded from prevailing southwesterly winds by the land mass, which permits greater recreational boating activity along the shoreline.

Lake Huron has more islands than any other inland lake in the world. These include Canada's Manitoulin Island, reputedly the world's largest freshwater island. Seiches do not build up on Lake Huron to the extent they do in relatively shallow Lake Erie. The lunar tides cause 1½ to 3 inches of variation in the lake level, which is considerably less than the water displacement caused by seiches. Both are insignificant on Lake Huron from a recreational standpoint. Long-term fluctuations in the water level caused by variations in precipitation do effect recreational use of the Lake. When water levels are too low to permit boat traffic, marinas and other boating facilities are often inoperable. During extremely high levels, many recreation facilities are extensively damaged.

The mainland and island shoreline of Lake Huron in the United States is 740 miles long, of which 564 miles are mainland shoreline. The shoreline is characterized by sand and gravel beaches, marsh, clay bluffs, and sporadic rock outcrops. The exceptionally gradual shoreline is considered desirable for recreational purposes, even though offshore bottomland con-

sists of limestone overlaid with erodible glacial material, which is detrimental to recreational boating when exposed by low water levels.

Lake Huron basin has 208,000 acres of inland lakes and approximately 8,000 miles of streams and rivers. The lakes range in size from thousands of acres to small glacial ponds measuring a tenth of an acre. These waters are heavily used for recreational boating. The rivers are generally small due to their shallow drainage basins.

The Lake Huron basin contains one of Michigan's most popular canoe trails, the Au Sable River. On ideal canoeing weekends it is estimated that privately owned canoes on the Au Sable nearly equal the number rented from liveries. Currently there are 814 miles of waterways designated as canoe trails, some of which offer no more than bare, eroded banks and poorly developed flood plains. The Au Sable has a wilderness shoreline environment which partially accounts for its popularity while many other waterways in the basin are hardly used.

What sailing lacks in participants, it gains in shoreline spectators. Thousands throng the shoreline during the annual Port Huron-to-Mackinac Island yacht race. It is inconceivable that Lake Huron will become crowded with sailboats, but harbor and docking facilities are already showing signs of congestion during peak recreation period.

The State of Michigan has provided many access sites which are complemented by public access sites in State, county, and national forests. Public marinas provide facilities which satisfy a significant portion of the demand for access to fishing waters. Approximately 50 percent of the State's boaters use public marina facilities on the Great Lakes. State plans call for boating facilities every 15 miles along the shoreline of heavily used waters. On mild summer days the number of people fishing from breakwaters designed to shelter watercraft may equal or exceed the number of boaters using harbor facilities. Thus breakwaters satisfy a significant portion of the fishing demand.

1.4.4 Lake Erie Basin

Only in the eastern section of the U.S. portion of the Lake Erie basin is the climate influenced directly by the Lake (Figure R9-9). The prevailing winds in the basin are from the south and west, making the influence of the

Lake upon weather conditions most evident in Canada. In the United States, New York is the major recipient of weather modification directly related to Lake Erie. Summer winds contribute to excessively humid conditions. The other sections of the basin, except lake frontage fringes, experience more of a continental climate with much less humidity. Although climate makes Lake Erie the most desirable Great Lake for water sports, poor water quality lessens its desirability in certain areas.

The basin has a mean annual temperature of approximately 50°F with extremes of -30°F and 100°F. Most of the basin has more than 150 frost-free days with the first killing frost coming in late October. The basin averages less than 100 clear days a year with 120 to 160 cloudy days. The remainder are partly cloudy days. Thunderstorms occur in the vicinity of the Lake on an average of 34 days a year. Fog is common near the Lake. Buffalo averages 20 foggy days a year while Detroit averages 11. Many more days are foggy a portion of the day.

Wind velocities are as high as 91 mph, but they average 10 mph. According to Weather Bureau information, during 1961 to 1965, small-craft warnings were in effect somewhere on Lake Erie during the boating season, May to October, on an average of all or part of 19.2 days per month. On Lake St. Clair such warnings were in effect an average of 7.7 days per month.

Recreation on Lakes St. Clair and Erie is hampered by fog, the large number of cloudy days with frequent thunderstorms, and the frequent occurrence of windy days which prevent use of small boats, but the relatively warm water in summer makes these Lakes much more suitable than the other Great Lakes for water skiing.

Lake Erie, though not as small as Lake Ontario, is the shallowest and the most southern of the Great Lakes. Its deepest sounding is 210 feet while its mean depth is 58 feet. It is the only Great Lake whose bottom does not extend below sea level. Most of the eastern section, containing the maximum lake depth, is deeper than 100 feet. The western section is the shallowest, having a maximum depth of 54 feet and a mean depth of just under 25 feet. Along the south and west shore, the slope of the bottom is very slight, with the 21-foot contour five to seven miles offshore. There is a small group of islands north and east of Sandusky. The largest of these, Pelee Island, lies in Canadian waters. Kelleys Island and North, South, and Middle Bass Islands are the principal islands

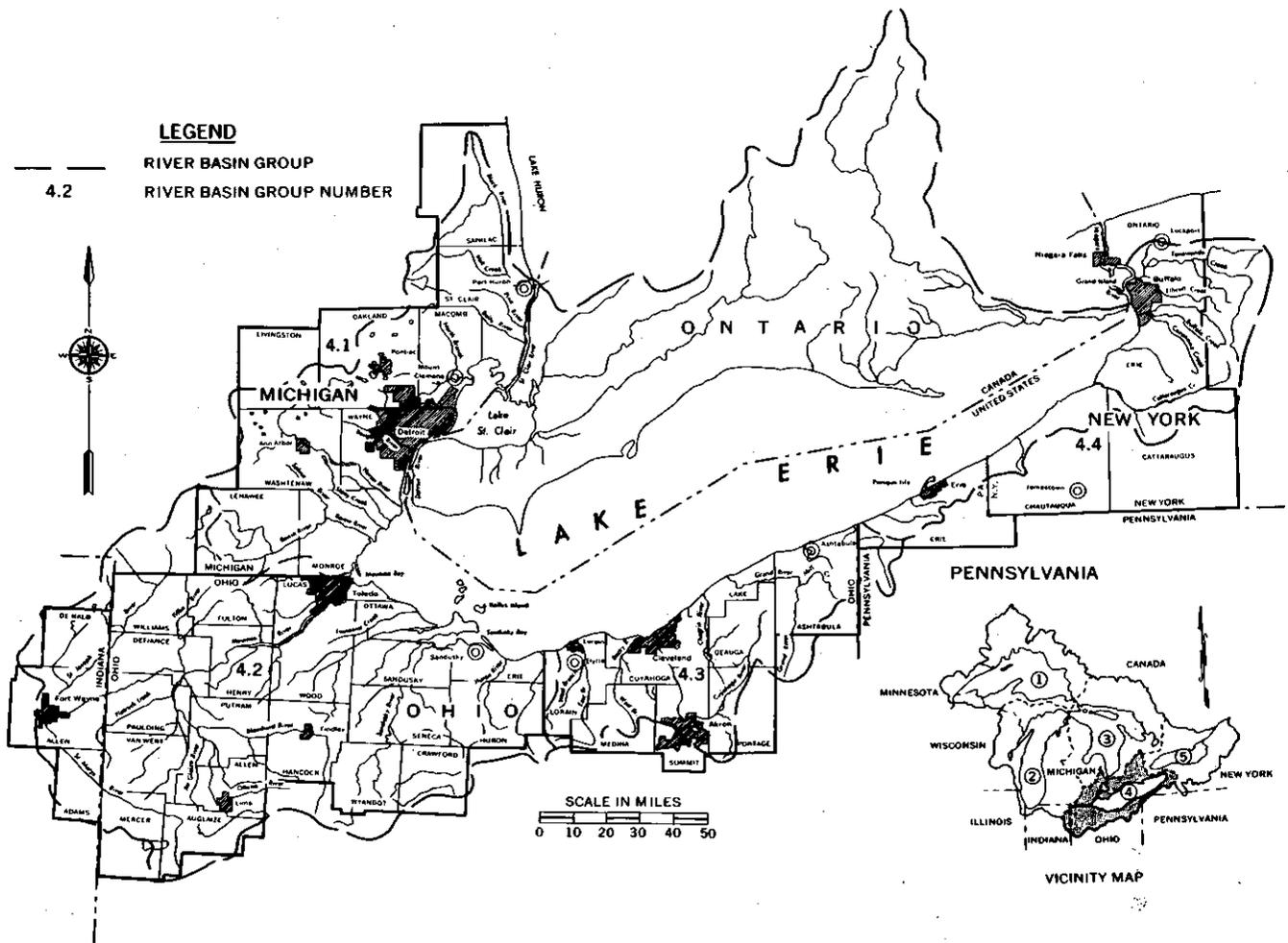


FIGURE R9-9 Plan Area 4, Lake Erie

of the group in United States waters. Because of its shallowness and relatively southern location, Lake Erie is warmer than other Great Lakes, with a surface temperature reaching 75°F in late summer. These qualities produce a varied, abundant aquatic life and make this Lake the most desirable of the Great Lakes for many water sports.

While lunar tides are insignificant from the recreational standpoint, seasonal fluctuations of water levels on Lake Erie have some effect on recreational boating, though low water ordinarily occurs in winter with the high level occurring in July. High or low water cycles caused by long-term variations in precipitation have the most pronounced effect on recreational use of the Lake.

Lake levels also fluctuate because of wind, barometric disturbances, and seiches. The Lake's shallowness and the fact that the pre-

vailing wind blows in the direction of the Lake's long axis make short-period fluctuations appreciable. Records show that water levels at Toledo, Ohio, and Buffalo, New York, have differed by as much as 13 feet. Once the wind stops blowing or the atmospheric pressure changes, the water sloshes back and forth, causing rise and fall of levels at the ends of the Lake.

Lake St. Clair, a small lake in comparison to the Great Lakes, connects Lakes Huron and Erie. Essentially round, it has a maximum natural depth of only 21 feet and a mean depth of 10 feet. A navigation channel of 27.5 feet is maintained along its length. Lake St. Clair is far more important to residents of Michigan than is Lake Erie because Lake St. Clair's numerous islands are used intensively by boaters for recreational purposes.

The United States shoreline of Lake Erie

and its islands is approximately 490 miles in length, with Lake St. Clair and its islands adding about 98 miles. The shoreline is extremely regular, with the Marblehead-Sandusky Bay area of Ohio and Presque Isle peninsula of Pennsylvania offering the only major discontinuities. Michigan frontage on Lake St. Clair and Lake Erie is predominantly marsh. This shoreline character extends eastward along the south shore of Lake Erie to Huron, Ohio. Two distinctive peninsulas in Ohio are the Marblehead peninsula, containing limestone bluffs, and Cedar Point peninsula, with the most extensive beach formation in the State. The remainder of the Ohio shore is characterized by eroding bluffs, varying in height from a few to 50 feet. Eroded bluff materials form narrow strip beaches of sand and gravel at the foot of bluff areas. The Pennsylvania shore consists of bluffs varying between 30 and 60 feet high, which also are bordered by narrow strip beaches. Presque Isle peninsula, a recurved sand spit, presents the only extensive beach area on this portion of the coast. The New York shoreline is also one of bluffs, with a few sand beaches.

The Lake Erie basin has few natural inland lakes. They are found primarily in the Michigan portion of the basin. Artificial impoundments, established principally as a source of domestic water supply, appear frequently throughout the basin, but they are seldom available for recreation other than fishing.

Continental ice sheets covered what is today's Lake Erie basin, and glacial features control the drainage patterns of the Lake's tributaries. Glacial moraines predominantly control drainage in the western half of the basin. After leaving peripheral morainal areas, streams traverse rather irregular till plains until they are deflected by intermediate moraines. Then they enter the level lake bed of the former glacial Lake Maumee. This route is best exemplified by the Blanchard-Auglaize-Maumee system. The irregular topography of the moraines and the flat former lake bed combine to produce a poorly drained area.

In the eastern portion of the basin, most river headwaters are in the glaciated plateau region. From Cleveland, Ohio, eastward into Pennsylvania, the Portage Escarpment acts as a deflector to the lakebound rivers between the plateau and the Lake. Examples are the Grand River and Conneaut Creek. From Erie, Pennsylvania, to Dunkirk, New York, plateau escarpment is generally within 5 to 10 miles of Lake Erie, and the streams in this section

normally have straight, short courses to the Lake. The basin then expands to the east as the plateau escarpment trends eastward away from the Lake. Stream patterns in this region are influenced by the Niagara Escarpment, which forms the watershed boundary, and a smaller scarp to the south, both of which trend east to west.

The rivers of the basin primarily supply municipal, agricultural, and industrial water, and effluent disposal and recreation needs, including fish and wildlife conservation. Commercial navigation is limited to the mouths of those larger rivers that terminate in metropolitan areas.

All rivers in the basin are scenic, but many lose their attractiveness as they progress downstream because of less varied topography as the rivers leave the moraine or plateau areas, the increasing and concentrated population, and the reduced quality of the waters.

The St. Clair River, Detroit River, Niagara River, and the Erie Canal are considered as connecting waterways rather than rivers because they support heavy commercial traffic in addition to providing most of the uses mentioned before.

Population concentration along the shore, which makes demand for all water-oriented activities extremely large, is another factor that accounts for the vast amount of boating done in the area. The proximity of a body of water large enough to permit all types of boating also stimulates participation. If recreation opportunity exists nearby, families sacrifice other items in order to purchase the necessary equipment to take advantage of the opportunity. Water quality problems that curtail body-contact activities do not affect boating as much.

As on all the Great Lakes, cyclical low and high water periods deter boating by adversely affecting many marina-type facilities along the shore. These effects are more pronounced in Lake St. Clair and the western end of Lake Erie where offshore gradients are slight. Boating is also deterred by shallow water that makes wind-caused turbulence a severe problem on Lakes Erie and St. Clair.

The frequency with which small-craft warnings are issued for Lake Erie greatly diminishes participation in boating activities on the Lake. Because of the orientation of the Lake, hazardous conditions most often occur when the wind is blowing from a northerly direction. There are often periods of several days when boating is impossible except in lee-

ward coves and bays.

Of major significance in Lake Erie are the group of islands in the western end of the Lake and the waters around the Catawba peninsula, which are close to the metropolitan centers of Cleveland and Toledo. Access to the Catawba area is excellent via the Ohio Turnpike.

Natural lakes and reservoir impoundments around Detroit support very heavy boating use. Public access is provided at 14 percent of the lakes. A few boating areas are found at impoundments near Lima, Ohio, and Ft. Wayne, Indiana, and at several points along the Maumee River where launching facilities are available, but these rivers are generally too shallow for all but the smallest craft.

Boating is pursued on inland lakes wherever sufficient water is available and access is provided. Access points, ranging from small tracts that provide only launching ramps to marina developments that provide a full complement of boating services, are provided by various levels of government and the private sector.

Canoeing opportunity is largely limited in the Lake Erie basin because of intensive metropolitan and industrial development. Because canoeing relies heavily upon aesthetic values, the popularity of certain rivers as canoe routes decreases as development increases. River valleys can remain untouched in the midst of urban development if a buffer strip of trees and other dense vegetation is left on the banks. The buffer strip effectively shields adjacent areas and enhances the canoeing experience. Water quality plays a more important role in canoeing than in other boating because of the close association of participants and the water. Approximately 300 miles of streams have been designated as canoe routes within the basin by the respective State conservation agencies.

Sailing is a popular activity on many of the inland lakes of the basin, as well as on Lakes St. Clair and Erie and their connecting waters.

1.4.5 Lake Ontario Basin

The climate of the Lake Ontario basin is determined by three factors: the presence of Lakes Erie and Ontario; the existence of relatively high mountains in and adjacent to the eastern reaches of the basin; and the westerly direction of the prevailing winds, from west to east in the summer and from southwest to northeast in the winter. As these winds pass

over the Lake they absorb considerable moisture, which precipitates when the winds meet the high land masses of the Tug Hill plateau and the Adirondack Mountains (Figure R9-10).

Cool, pleasant temperatures make the basin desirable for summer recreation. The mean daily July temperature ranges from 78°F to 84°F. The temperature rarely exceeds 100°F. The number of frost-free days varies from 160 to 200 along the lakeshore to 120 to 160 in the interior. Wind velocity has a distinct bearing upon participation in recreational boating. Although the wind velocity of the basin averages about 10 mph, velocities as high as 73 mph have been recorded. From 1963 through 1965 small-craft warnings were in effect somewhere on Lake Ontario all or parts of 17 days per month during the boating season, May through October. There are, on an average, 23 days annually during the boating season when wind velocities exceed 30 mph. Approximately seven days are foggy during this six-month period. Ice usually begins to form on the Lake by mid-December and lasts until the first of May.

As the furthest east and smallest of the five Great Lakes, Lake Ontario receives most of its inflow from the Niagara River. The surface of the oval-shaped Lake is approximately 245 feet above mean sea level. It is relatively deep near the United States shore with depths of 40 to 100 feet occurring about a mile from the shore. Six small islands are located on the United States side near Sackets Harbor at the eastern end of the Lake.

Seiches occur on Lake Ontario but not to the extent or amplitude found in Lake Erie. Both seiches and the less prominent lunar tides are insignificant on Lake Ontario from a recreational standpoint.

The Lake's inflow is controlled partially by hydro developments on the Niagara River. The Iroquois Dam, located on the upper St. Lawrence River, regulates the water level by controlling outflow from Lake Ontario. High or low water cycles, caused by long-term variations in precipitation, have a pronounced effect on recreational use of the Lake. During periods of low water, marinas and other boating facilities are often inoperable because water levels are too low to permit boat traffic. During periods of high water, many recreation facilities, especially those on private lands, are damaged.

The southern shore is extremely regular with few natural embayments. The shoreline consists principally of eroded clay and silt

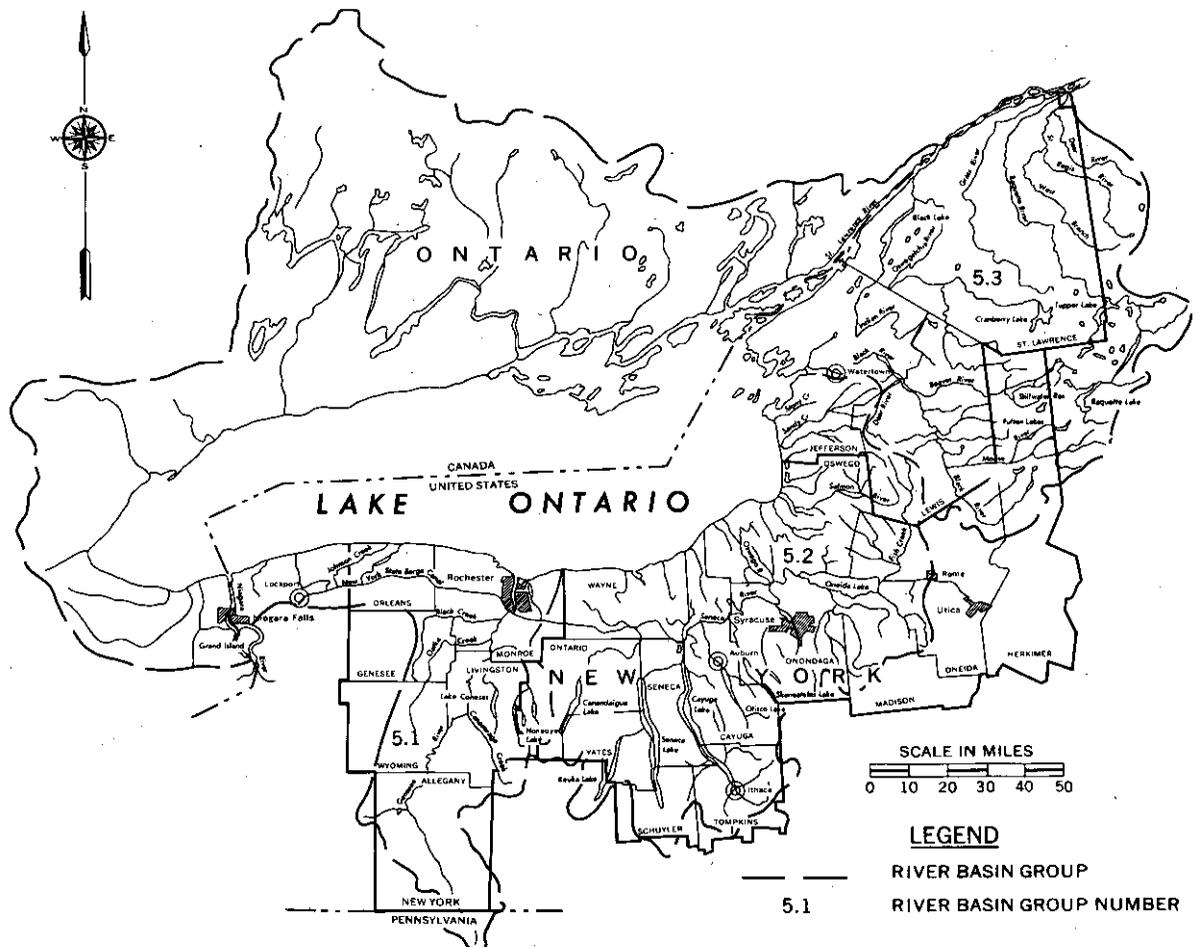


FIGURE R9-10 Plan Area 5, Lake Ontario

bluffs, but from Braddock Bay eastward there are occasional ponds or bays. These bays have sandbar barriers across their mouths which make them poor recreational boat harbors.

Sand beaches are narrow and few west of Oswego, but there are good beaches at Fair Haven and Hamlin Beach State Parks and at Ontario Beach in Rochester. Excellent sand beaches are common east of Oswego up to Henderson Harbor. From Henderson Harbor northward to the head of the St. Lawrence River, the shore is low and rocky, and unsuitable for beach use.

One of the more striking shore formations lies east of Sodus Bay where the erosion of drumlins has created unusual topography. The Thousand Island Region at the head of the St. Lawrence River cuts through an area of glaciated crystalline rocks forming an isthmus between the ancient Laurentian High-

lands of Canada and the Adirondacks of New York. "Granite knob" country, though low in relief, has a jumbled topography that creates such picturesque sights as the St. Lawrence River flowing through the Thousand Islands.

The Lake Ontario basin contains three major rivers, the Genesee, Oswego, and Black, which are part of the basin's approximately 28,000 miles of rivers and streams. Important tributaries of the St. Lawrence River are the Oswegatchie, Raquette, and Grass Rivers, which originate in the Adirondacks.

The Oswego, Seneca, Oneida, and Clyde Rivers have been made into canals for barge traffic and are part of the New York State Barge Canal system. Power generation facilities have been extensively developed in the Black River basin, along the St. Lawrence River, and on the lower Niagara River. The St. Lawrence Seaway, which ties the Great Lakes

to the Atlantic Ocean, is a major transportation artery serving the shipping interests of Canada and the United States.

Several rivers in the basin have natural features such as the rapids of the Niagara, the gorge of the Genesee, and the falls on Taughannock Creek which are extremely attractive from a recreational standpoint. Taughannock Falls, a 215-foot cataract, is the highest straight-drop falls east of the Rocky Mountains. Most of the rivers rise in the forested interior and run clear and cold in their initial stages. All of the rivers in the basin are scenic.

The Lake Ontario basin is well endowed with natural lakes. Glaciation, erosion, and surface upheaval have created the spectacular Finger Lakes, which occupy a series of nearly parallel troughs in the southwestern portion of the Oswego basin. Of the Finger Lakes, Seneca and Cayuga are the largest, each having approximately 66 square miles of water surface. Oneida Lake, also in the Oswego basin, is the largest lake in the basin, covering 80 square miles.

The New York State Barge Canal, from Oswego on Lake Ontario to Tonawanda on the Niagara River, is an inland waterway system connecting several major drainage basins in the State. There are 57 concrete locks in the system with electrically operated gates. Twenty of the locks are in the 230-mile portion of the system that lies within the basin. A 12-foot channel depth is maintained throughout most of the canal. Although the system was originally constructed for commercial purposes, only 82 commercial barge permits were issued in 1965, while 10,026 permits for use of the locks were issued for recreational boats.

1.5 Ongoing Recreational Boating Programs

Recreational boating needs are now considered in a number of programs sponsored by Federal, State, and local governments. These programs cover the classification and zoning of rivers and the construction, operation, and maintenance of reservoirs, harbors, launching facilities, and marinas.

1.5.1 Federal Programs

The Act of 10 February, 1932, generally known as the Fletcher Act, enlarged Federal interest in navigation to include under com-

merce the use of waterways by "passenger craft, yachts, houseboats, fishing boats, and other seasonal water craft, whether or not operated for hire." The nature of recreational benefits to individuals has resulted in the present basis for Federal and local cost-sharing in recreational small boat harbor projects (Figure R9-11). The Federal government contributes not more than 50 percent of the costs of general navigation facilities serving recreational traffic. Local interests are required to provide all lands, easements, rights-of-way, a public wharf open to all on equal terms, and servicing facilities, including dredging in berthing areas and necessary policing. The Federal government assumes study costs, the costs of navigation aids, and the costs of maintaining general navigation facilities, which include a safe entrance channel protected by breakwaters or jetties if needed, protected anchorage basins, major interior access channels, and turning basins. Minor access channels for maneuvering into the berths, stalls, or slips are provided by local interests. Berthing areas, docks, landings, berths, stalls, slips, and mooring areas at marinas, are provided and maintained at non-Federal expense. Under the Federal Water Project Recreation Act (PL 89-72), the Federal government may contribute up to 50 percent of the cost of construction basic onshore recreational facilities.

Section 107 of the River and Harbor Act of 14 July 1960 (PL 86-645), as amended, authorizes the Corps of Engineers to develop, construct, and maintain small navigation projects at Federal cost not exceeding \$1,000,000. A Section 107 project can be initiated only if a State, municipality, or other public agency of the State has sufficient legal and financial authority under State law to provide local cooperation and participation. Non-Federal interests must agree to meet the same cooperation requirements stipulated for regularly authorized commercial and recreational navigation projects, and assume all project costs in excess of the Federal cost limit of \$1,000,000.

Land and water conservation funds are available through PL 88-578 for the construction of boat launching, marina, and harbor facilities on a 50-50 basis with local interests. Such funds cannot be cost-shared against other Federal monies. These funds can be used to purchase land and construct ramps, docks, parking, concession facilities for support, public marina facilities, and small recreational boat harbors, including recreational navigation aids and harbor deepening.



Courtesy of Frank Fulkersin

FIGURE R9-11 Harbor at Marquette, Michigan

1.5.2 State Programs

State programs to enhance recreational boating in the Great Lakes Region vary considerably in scope and authority. Congress, in authorizing construction of small-boat harbors, required that there be local participation through the provision of local assurances. Only Wisconsin and Minnesota lack the authority to provide assurances of local cooperation. The other States have positive programs defined by statute (Figure R9-12). A summary of State programs follows.

1.5.2.1 Illinois

The Departments of Transportation and Conservation are primarily responsible for representing the State's interest in projects for navigation improvements. The Department of Conservation is active in the area of recreational navigation and has many long-

range plans for developing water area for boating.

1.5.2.2 Indiana

The State of Indiana's recreational navigation access program is administered by the Division of Fish and Wildlife, Department of Natural Resources. Access sites are constructed basically for fishermen, but the facilities may also be used, if the lake size permits, by those desiring to water ski or cruise. Information concerning specific sites under study for development is not readily available. The Division of Water participates in water resources planning.

1.5.2.3 Michigan

The Michigan State Waterways Commission, Department of Natural Resources, is re-



Courtesy of Michigan Department of Natural Resources

FIGURE R9-12 Harbor at South Haven, Michigan

sponsible for the development of recreational boating facilities. It publishes biennial reports containing information about specific site development.

The Waterways Commission was created in 1947 so Michigan could take advantage of the River and Harbor Act of 1945, which authorized construction of 15 harbors-of-refuge on the Michigan shores of the Great Lakes. These harbors were designed to provide shelter for recreational boat users at approximately 30-mile intervals along the Great Lakes shoreline.

In 1958, the Commission inaugurated its program of 15-mile interval refuge harbors. By constructing such installations in or near large metropolitan centers, the program intends to encourage the use of the Great Lakes by larger numbers of recreational watercraft, which will reduce boating demand on inland waters.

The Commission's transient dock program provides for the construction of docking

facilities at refuge harbors or existing ports to accommodate cruising boatmen. These facilities are to provide safety and comfort to the visiting boater while encouraging boat owners to visit other harbors. Coupled with this program is the Great Lakes Ramps Program, which provides for the construction of boat launching ramps on the Great Lakes. These facilities are usually located within harbors or naturally sheltered areas and are designed to accommodate the transient boater who moves his boat from place to place on a trailer. Michigan's successful anadromous fish program has brought large numbers of trailer-borne boats to the Lakes, which have required more and larger launching ramps.

The Waterways Commission also administers the Public Access Site Program, which provides for development of boat launching ramps on Michigan's inland lakes and streams. The Commission administers 934 such sites; 569 are in use. Development of such facilities includes the construction of access

roads, parking areas, the ramps themselves, and rest rooms.

The Commission's seasonal marina program intends to provide facilities for the 20- to 30-foot boats not being accommodated by commercial marinas. It is not economically feasible for commercial operators to accommodate large numbers of these boats, so a considerable unmet demand for such facilities has developed in large metropolitan areas. Construction of these facilities is economically beneficial because it creates a market for larger boats, marine repairs, winter storage, gasoline, and marine equipment.

The development of island parks exclusively for boaters is the last development program of the Commission. These islands will provide docking facilities in protected shelters or harbors and will offer day-use facilities such as beach and swimming areas. At present, development of such islands is being considered only in the metropolitan Detroit area.

The Waterways Commission's development program is financed entirely by taxes paid by recreational boat owners. In 1970, these taxes permitted development costing some \$3,000,000 and financed administration of facilities at a cost of approximately \$1,500,000.

The Marine Safety Section supervises marine safety on Michigan's waters. Political bodies can petition it for help when they face boating problems that cannot be solved by State laws. At the request of these local units of government, the Section holds public hearings and investigates lakes where there are boating hazards. The Section also analyzes traffic problems, size and character of each lake involved, and its potential for water skiing, sailboating, fishing, swimming, and other such activities.

If special boating regulations are necessary, the Section drafts recommendations for the township, county, or village to consider. If the local political body approves, the Marine Safety Section begins action to establish a State regulation, while the local political body enacts a local ordinance.

The Section also annually channels approximately \$500,000 in State aid to sheriff department marine safety programs. It provides technical assistance to carry out these programs by offering an annual marine safety training school for sheriffs, marine deputies, and others who patrol local waters.

Through sheriffs' departments, which handle the actual teaching, the Section also develops and coordinates courses in boating safety, and cooperates with U.S. Power

Squadrons, the U.S. Coast Guard, and the American Red Cross in promoting other classes in boatmanship. Adding impetus to such programs is a recent law that requires youngsters (12 through 15 years old) to successfully complete this training before they may operate six or more horsepower motorboats without adult supervision.

Under direction from the Governor, the Section is tackling its newest responsibility, developing a comprehensive nonboating water safety program that will spell out safeguards for swimmers, scuba divers, and other water users.

The Section issues permits under which races and regattas are regulated, and marks restricted water areas with buoys, beacons, and other navigational aids.

1.5.2.4 Minnesota

Several divisions within the Minnesota Department of Natural Resources are involved in purchase of land and construction of water access and boat launching facilities. The Division of Parks and Recreation, the Division of Lands and Forestry, and the Division of Enforcement and Field Services construct access sites and launching facilities in conjunction with normal management of their lands. The Division of Game and Fish is also involved in access development because its normal operation includes operating many access sites on properties under its control and purchasing new sites and completing the necessary development. The Department of Natural Resources receives approximately one-fourth of one percent of all State gasoline tax revenues, to be used for the construction of inland lake access sites. When combined with a share of the boat licensing fee, this amounts to nearly \$500,000 annually. The State of Minnesota currently is not involved in a Lake Superior harbor construction project.

1.5.2.5 New York

The New York State Parks and Recreational Division of Marine and Recreational Vehicles has the principal responsibility for providing recreational boating services. It has a five-part program consisting of:

- (1) registration
- (2) enforcement
- (3) maring inspection and licensing of public vessels and operators

- (4) marine services
- (5) education and safety

Registration is required of all mechanically propelled craft. The State is seriously considering a change from the three-year to a more efficient annual registration.

Navigation laws are enforced by the Enforcement Bureau of Marine and Recreational Vehicles through county sheriffs' offices that receive aid for this purpose. All counties in the Great Lakes Basin except one have availed themselves of this aid. The exception has local patrols. Enforcement is also provided by State, municipal, and park police, as well as by the Coast Guard.

Marine inspection and licensing of public vessels and operators have long been functions of the State government. In 1970, 306 public vessels were inspected and 1,208 licenses and permits were issued.

Marine services include the Harbor of Refuge Program, which has planned 28 harbors and completed two. The main problem has been lack of Federal funding to allow the Corps of Engineers to proceed.

The Local Marine Facility Section is a State aid program that usually shares the cost 50-50 with a community. It funds upland development required in the Harbor of Refuge Program as well as providing for the construction of marinas, boat launching sites, and related aids to communities. Actual design and construction is done by the community, but the State must approve plans and specifications. There are 19 active projects and 20 more under consideration.

State marine projects within State parks are continually being developed. There are approximately 33 such projects but not all are within the Great Lakes Basin.

The State has also constructed 75 minor boat launching and fishing access sites. Much of this work was accomplished by State personnel rather than by private contractors.

Marine services have installed navigation aid systems on 15 interior lakes and chartered 12 of the lakes for the first time. These lakes vary in length from 9 to 32 miles with perimeters up to 145 miles.

The Office of Education and Safety, with the help of volunteer instructors and television media, developed an educational program for young boaters between the ages of 10 to 14. By September 30, 1970, 140,149 young people had passed this 4-hour course, which should result in a much better safety record for many years to come.

Other State agencies having an interest in

recreational boating include the Department of Environmental Conservation, which provides launching facilities and access points in State forest areas, and the Department of Transportation, which operates the New York State Barge Canal system, which is used extensively by recreational craft. The system includes public docks that may be used by vessels transiting the canal.

1.5.2.6 Ohio

The State of Ohio has an extensive grant-in-aid program which provides public access for boating and determines carrying capacity. State water resources agencies have many ongoing studies and authorized projects. Major studies include the Northwest Ohio Water Development Plan, which is a plan for all phases of water management, and the Maumee River Basin Study. There are authorized recreational boat harbors at East Harbor and Kelleys Island.

1.5.2.7 Pennsylvania

In Pennsylvania general responsibility for small-boat activities rests with the Department of Environmental Conservation which was recently formed as part of a reorganization of State government. Exact status and responsibilities of various elements still are being developed.

1.5.2.8 Wisconsin

There are several bureaus within the Wisconsin Department of Natural Resources involved in the purchase of land and the construction of water access and boat launching facilities. Harbor construction, including breakwaters, channel and basin dredging, is beyond the scope of Wisconsin's present program. The Bureau of Parks and Recreation, the Bureau of Forest Management, and the Bureau of Game Management construct access sites and launching facilities in conjunction with the normal management of their lands. The Bureau of Fish Management is specifically involved in access development programs. This Bureau constructs many access sites on properties under its control, and in its normal operation purchases access sites and completes the necessary development. In addition to the above, \$100,000 of the Depart-

ment of Transportation's State gasoline tax money is set aside annually to aid local municipalities in developing access sites. Access sites constructed under this program are approved by the Wisconsin Department of Natural Resources.

1.6 Availability and Extent of Data

Data used in this appendix are limited. Because this study does not provide for collection of new data, only published information was used in this analysis. Economic and demographic data were obtained from Appendix 19, *Economic and Demographic Studies*. Industry and State surveys of boater participation, boat use, and boating water carrying capacity are used throughout this analysis to establish study criteria.

Boater participation was determined by using 1968 boater registration data by county in the Great Lakes Region. Only registered boats were counted. Data on unregistered canoes and sailboats were developed from the participation data of the Bureau of Outdoor Recreation.

Three classifications of boating water area are inland lakes, boatable rivers and streams, and effective Great Lakes waters. The inland lake area was obtained from State inventories of surface water area. Where available, data are given by river basin group (RBG) for lakes and ponds more than 10 acres in area. The miles of rivers and streams suitable for canoeing and boating were identified by the Bureau of Outdoor Recreation. The estimated amount of effective boating waters on the Great Lakes consist of two components, sheltered waters and high use offshore waters. Sheltered waters are bays and inlets that are not subject to the full forces of lake storms. High use Great Lakes open waters are located offshore of the existing harbors. The work group defined offshore waters as the semi-circular zone around each harbor having a radius of approximately 5 miles. These zones are adjusted to eliminate overlap and double counting.

Data on facility development are more dif-

ficult to obtain. The Corps of Engineers inventoried the mooring and access facilities in each harbor on the Great Lakes. Data on facility development on inland lakes and streams generally were not available. The work group assumed that existing demand for inland lake and stream facilities is equal to the available supply.

More detailed studies on the interaction of population with socioeconomic factors, boating opportunities, and travel distances are necessary to establish the critical relationships between elements in any program for recreational boating.

1.7 Scope of Investigation

Framework studies are preliminary or reconnaissance investigations intended only to provide broad-scale analyses of water and related land problems, and to furnish general appraisals of the probable nature, extent, and timing of solutions. To meet these requirements, framework plans are based on general relations, reasoned approximations, available data, and the judgment of experienced planners.

Data pertaining to recreational boating are developed as follows:

- (1) determine the size, composition, and areal distribution of the small-boat fleet
- (2) determine the opportunities available for meeting recreational boating requirements by evaluating the existing and potential capacity of the basin's surface waters
- (3) forecast fleet size and demand-supply relationships for the periods 1980, 2000, and 2020
- (4) evaluate a number of relevant structural and nonstructural alternatives to meet existing and projected requirements
- (5) prepare a water resources development and management program for recreational boating and provide cost estimates for program elements
- (6) develop priorities for future studies, investigations, and research to be considered as part of the Great Lakes Basin framework

Section 2

RECENT STUDIES OF BOATING ACTIVITIES

Knowledge of the origin and destination of trailered boats and the factors producing these use patterns is vitally important in defining future boating needs. Some information has been generated in various studies conducted by the Michigan Waterways Commission, the Boating Industry Association, and the Corps of Engineers. Results are presented in the following subsections.

2.1 1971 Michigan Recreational Boating Study

The State of Michigan conducted its fourth boating study on the extent and patterns of boat use throughout the State in 1971. Previous studies were conducted in 1964, 1965, and 1968.

The 1964 Michigan boating survey involved mailing 9,902 questionnaires to boat owners selected from registration lists by placing cardboard templates punched with randomly spaced holes over the list. The sample was not stratified by county or boat size. The goal was a uniform three percent of all registrations. Questionnaires were mailed during March, 1965; 3,788 (or 38.3 percent) were returned and 3,566 were used in the analysis. This was equal to 1.1 percent sample of the 331,606 registrations on the list. Problems with the 1964 study make it difficult or impossible to compare its results with subsequent investigations. Its most serious handicap is that, in the case of multiple-boat owners, data were requested for "the boat you used most," which tended to exaggerate the amount of use.

The 1965 survey recognized that large boats, being comparatively few in number, were not adequately represented when a small percentage of total registrations was drawn as a survey sample. The 1965 study used a 2.5 percent sample of boats less than 20 feet long and a 20 percent sample of boats more than 20 feet long in each county. In order to make the data comparable to the 1964 study, use data were again requested in terms of the "boat you use most often."

The 1968 survey benefited from the experi-

ence gained in the two earlier studies. Instead of proceeding on an intuitive basis, the statistical variance of data on boat use was determined from a sampling of 1965 survey questionnaire responses. Assuming that approximately 38 percent of the questionnaires would be returned and used, it was determined that approximately 23,000 questionnaires should be mailed to obtain the statistical confidence desired. Ten percent of samples drawn were boats more than 20 feet long and five percent were less than 20 feet. A total of 21,764 questionnaires was actually mailed and 6,800, 31 percent, were returned. Techniques and results are described in detail in the 1968 Michigan Recreational Boating Study report.

In discussions regarding the 1971 study, it was decided to use a smaller sample with follow-up procedures instead of a single large mailing as in the 1968 survey. This method was selected because checking off questionnaires as they returned was easier than drawing up a sample, preparing labels and mailing 23,000 questionnaires in a short time, which was done in 1968.

The statistical tests conducted on the 1965 data indicated that a total of 200 usable responses from each areal unit for which analysis was planned was desirable to assure that boat-use information was reliable. A total sample of 13,000 registrations, from which some 9,100 usable responses (70 percent) would be obtained by means of intensive follow-up procedures, was the Commission's goal. Since population distribution patterns and previous studies indicated that most of the boating activity in Michigan comes from less than one-third of the State's 83 counties, an attempt was made to obtain approximately 150 responses for boats less than 20 feet long from the 25 most important counties.

The 1971 study divided the registered boats into two groups: boats 20 feet in length or less and boats more than 20 feet in length. Questionnaires were mailed to a random sample of 13,204 boat owners. The sample was drawn so as to assure an adequate representation of boats more than 20 feet long in all counties and

to reduce excessive sampling of boats 20 feet or less in length in counties with large boat registrations. Through the use of follow-up mailings, 73 percent of the potential respondents replied to the questionnaire.

Of the 11.3 million boat-days of use in the State in 1971, 29 percent occurred on the Great Lakes and 71 percent occurred on inland lakes. Approximately 75 percent of total use generated by boats longer than 20 feet took place on the Great Lakes while nearly 77 percent of all use from boats 20 feet or less in length occurred on inland waters.

The study shows that nearly 46 percent of all boats were trailered for use. The remainder were moored. Approximately 48 percent of boats 20 feet or less in length and only 18 percent of boats longer than 20 feet were trailered for use. The number of boat-days of use was projected to increase from 11.3 million in 1971 to 16.3 million in 1980. Approximately 11.6 million boat-days of use were projected to occur on inland waters by 1980 and 4.7 million were expected on Great Lakes waters. Table R9-5 shows percentages of boat use by boat size and area of use.

2.2 Michigan Marine Gas Tax Study

Although the Michigan marine gas tax study was supposed to determine the amount of gasoline tax generated by boating use, the study also provides some useful origin-destination information. The study concerned the following five categories of the boating population:

- (1) privately used boats registered by Michigan owners
- (2) rental boats located at commercial liveries
- (3) documented boats
- (4) out-of-State boats entering Michigan via waterways
- (5) out-of-State boats entering Michigan via highways

Categories (1), (2), and (3) were handled by mailing selected individuals questionnaires that were to be mailed back.

The survey of out-of-State boats entering Michigan via waterways was conducted by asking 100 Great Lakes marinas to record all gas sales to nonresident boaters. Each wholesale gas distributor was asked to record the total gallons of gas delivered to each marina. The percentage of gas sold to non-residents at the selected marinas was applied to the other marinas selling gas.

TABLE R9-5 Summary of Boat Days Spent in Various Boating Activities (in percent)

	Great Lakes		Inland Lakes	
	20 Feet and Under in Length	More than 20 Feet in Length	20 Feet and Under in Length	More than 20 Feet in Length
Salmon/Trout Fishing	19.8	7.6	3.6	1.8
Other Fishing	34.3	16.4	48.9	24.5
Water Skiing	11.8	3.7	20.5	12.6
Cruising	27.1	66.9	25.0	55.4
Hunting	1.9	0.6	0.5	0.1
Other	5.1	4.8	1.5	5.6
Total	100.0	100.0	100.0	100.0

Out-of-State boats leaving Michigan via highways were surveyed by two different methods, traffic counts and interviews with those driving nonresident cars with boats. The traffic counts were conducted periodically, during a 120-day period (June through September), at 35 major points. All vehicles leaving Michigan hauling boats were stopped to determine:

- (1) origin (where was boat used)
- (2) destination (home)
- (3) where boat is kept (origin, destination, or other)
- (4) length of boat
- (5) horsepower of motor used
- (6) gallons of marine gas purchased in Michigan
- (7) miles from origin to destination

Results of the study of particular importance to this appendix are shown in Tables R9-6 and R9-7.

2.3 Recreational Boating Needs of 1980

In the late 1960s the Michigan State Waterways Commission completed a study of recreational boating designed to predict the needs of boat owners in 1980. At the time of the study, 30 percent of all registered watercraft were used principally on the Great Lakes, and 70 percent were used on inland waters of the State. However, as a result of establishing the trout and salmon fishery in the Great Lakes, use of Great Lakes waters is expected to increase to 40 percent by 1980.

The 20,660 mooring slips in 1965 on the Great Lakes in the State of Michigan were provided as follows: commercial marinas, 15,431 (74.7 percent); boat and yacht clubs, 2,972 (14.4 percent); and public marinas, 2,257 (10.9 percent).

The study indicated a total of 9,617 mooring slips on inland lakes in Michigan. Since there

TABLE R9-6 Allocation of Resident and Nonresident Boating Demand in the State of Michigan by River Basin Group

River Basin Group	Resident Demand (1,000 Boat Days)	Resident Demand Met In Area (1,000 Boat Days)	Nonresident Demand Met In Area (1,000 Boat Days)	Total Demand Met In Area (1,000 Boat Days)
1.2	415	378	164	542
2.1	112	101	28	129
2.3	3,542	2,378	398	2,776
2.4	1,569	1,442	2,054	3,506
3.1	424	398	854	1,252
3.2	1,426	629	267	896
4.1	4,528	2,811	177	2,988

TABLE R9-7 Percentage Distribution of State of Michigan Resident Demand to River Basin Groups

River Basin Group	1.2	2.1	2.3	2.4	3.1	3.2	4.1	Out of State
1.2	94.3	0.3	1.5	3.1	0	0.3	0	0.5
2.1	3.5	91.3	0.6	4.4	0	0.2	0	0
2.3			Not Available					
2.4	1.1	0.2	2.3	91.9	1.1	0.5	1.7	1.2
3.1	0.5	0	0.1	4.3	92.7	0	2.4	0
3.2	1.6	0.2	2.4	20.3	15.7	55.8	3.2	0.8
4.1	1.9	0.1	3.1	17.2	10.2	4.2	62.0	1.3

are no public marinas on inland lakes, these slips were provided solely by commercial marinas and boat clubs.

The study also indicated that 11,661 boaters (6,562 on the Great Lakes and 5,099 on inland lakes) failed to find mooring berths of desired size and location. Some of these boaters eventually found larger, more expensive berths or berths at other locations, as shown in Table R9-8.

Boats unable to moor had to be transported for each use, left in dry storage, or beached. Available berths were used as shown in Table R9-9.

By 1980 the total number of boats desiring a berth on the Great Lakes is projected to be 47,600; 27,500 berths will be desired in inland waters. To satisfy this demand the number of berths in 1965 must be increased by a factor of

2.3 (47,600/20,661) for the Great Lakes and 2.9 (27,500/9,617) for inland lakes.

2.4 Survey of Boat Club Members

Information gathered by the Boating Industry Association (BIA), the Outboard Boating Club (OBC), and the Boat Owners Council of America (BOCA) is summarized in Table R9-10.

2.5 Lake Michigan Regional Boating Survey and Analysis

Objectives of the Lake Michigan Boating Study were to describe and analyze the present patterns of boating on Lake Michigan ac-

TABLE R9-8 Alternatives to Berths

Alternatives	Number of Boats	
	Great Lakes	Inland Lakes
Found larger berth or alternate location	2,321	343
Obtained cottage mooring	1,190	2,091
Unable to moor	<u>3,051</u>	<u>2,665</u>
	6,562	5,099

TABLE R9-9 Berth Availability

Berth Availability	Number of Boats	
	Great Lakes	Inland Lakes
Obtained desired berth size and/or location	18,340	9,274
Did not obtain desired berth size and/or location	<u>2,320</u>	<u>343</u>
	20,660 ^a	9,617 ^b

^aComprises 83 percent of total number of boats (24,902) desiring a berth on the Great Lakes

^bComprises 67 percent of total number of boats (14,373) desiring a berth on the inland waters.

cording to a sample survey of boaters in the region, and to estimate the change in demand for Lake Michigan boating facilities. A comparison of present boating patterns and the demand projection with an inventory of existing facilities gives an indication of how many new small-boat harbor facilities are likely to be needed in the future. This information is intended as a guide to the quantity and combination of changes needed in small-boat harbors along the shores of Lake Michigan. These changes would include both the expansion of existing harbor areas and the construction of new harbors.

The people surveyed were registered and documented boaters from counties within approximately 50 miles of Lake Michigan's western shore, Green Bay, and Lake Winnebago, having boats longer than 15 feet. The ques-

tionnaire included questions on the boater and his boat in addition to a detailed section in which the boater outlined his 1971 trip patterns. The trip pattern information was divided into two sections, one for those boaters who haul and launch their boat and another section for boaters who had their boat berthed, moored, or in dry storage. The launch boaters were asked to list their trips by launch site (which was found on a map by harbor number), their departure and arrival times, the day of week, and the month. The boaters who had their boat permanently based were asked to provide the above information plus their sequence of harbor stops and the reason for stopping on representative trips in the 1971 season.

The demand projection involved noting boat ownership by boat type and county of residence, using a cross-section regression analysis. The independent variables in the regression were projected in order to obtain a forecast of the change in boat ownership. The predicted change in boat ownership was transformed to the estimated number of boats likely to use Lake Michigan and to the storage mode that these boats would likely need. Storage demand by county of residence was transformed to storage demand at existing harbor sites. The predicted increase in demand for storage facilities only reflected projected increases in population, population density, income, and travel time. The initial boat ownership regression included variables to reflect the quantity of harbor facilities within a one-hour travel time of each county. Increases in harbor facilities such as launch lanes, berths, and moorings would also increase demand.

The report provides information on estimated future site demand for various storage areas along the Lake Michigan shore and explains the relationship between transient and refuge demand and site demand. This was determined by using simulated transient traffic patterns in the study region.

TABLE R9-10 Data from Surveys of Boat Club Members

	OBC	BIA	BOCA		OBC	BIA	BOCA
Need for additional boating facilities:	85.4	--	81.7	Size distribution of utility boats:			
Type of facilities:				Less than 10 feet	11.8	10.2	9.6
Launching	60.4	--	65.5	10 - 12 feet	22.4	12.5	19.3
Docking	54.0	--	51.2	12 - 14 feet	39.5	33.0	28.9
Dry storage	18.8	--	21.0	More than 14 feet	26.3	44.3	42.2
Wet storage	13.2	--	11.9	Inboard boat ownership:			
Number of times a year boating equipment is used:				Cruisers	79.1	72.2	81.1
1 - 10	11.1	10.0	8.5	Runabouts	29.9	27.8	18.9
11 - 20	24.2	30.1	25.5	Size distribution of cruisers:			
21 - 40	32.2	36.2	33.5	Less than 20 feet	--	7.7	--
41 - 60	17.7	13.3	19.9	20 - 24 feet	--	28.8	--
More than 60	14.8	10.4	12.6	24 - 26 feet	--	25.0	--
Average	40.4	34.5	36.7	26 - 30 feet	--	21.2	--
Number of hours spent each time:				More than 30 feet	--	17.3	--
Less than 3	20.4	14.1	15.2	Size distribution of runabouts:			
3 - 5	43.6	43.2	49.0	Less than 16 feet	--	10.0	--
6 - 8	25.2	27.0	23.6	16 - 18 feet	--	50.0	--
More than 9	10.8	15.7	12.2	More than 18 feet	--	40.0	--
Average	5.0	6.9	5.8	Average value of boating equipment:	\$3,097	\$2,839	\$4,029
Distance from favorite boating water:				Inboard/outdrive ownership: ^a			
Less than 5 miles	24.6	25.0	19.8	Cruisers	46.4	42.2	48.5
5 - 10 miles	10.3	10.1	8.3	Runabouts	53.6	57.8	51.5
10 - 25 miles	14.0	14.8	17.1	Buying intentions (kind of boat):			
25 - 50 miles	19.6	17.9	19.1	Inboard/outdrive	45.4	45.2	46.5
More than 50 miles	31.5	32.2	35.7	Outboard	26.8	33.8	25.5
Boat transportation				Inboard	14.2	14.4	17.1
Always trailered	59.7	68.3	54.5	Sailboat	6.5	1.4	4.2
Boat left in water	36.5	27.9	41.1	Houseboat	4.6	2.9	4.3
Both	3.8	3.8	4.4	Pontoon	1.0	1.2	1.2
Type of boat owned:				Canoe and others	1.5	1.1	1.2
Outboard	65.2	77.4	66.2	Average intended expenditures: ^b	\$4,329	\$3,980	\$4,794
Inboard	7.1	6.7	8.8	Water most often used:			
Inboard/outdrive	13.4	6.0	16.2	Lakes	38.8	--	43.2
Rowboat	6.3	4.2	4.9	Rivers	25.8	--	22.6
Sailboat	3.2	2.3	2.3	Coastal	15.7	--	13.4
Canoe	1.9	1.2	1.0	Great Lakes	10.0	--	9.9
Houseboat	1.6	1.4	0.2	Reservoirs	10.2	--	10.9
Pontoon	1.3	0.8	0.4	Facilities used:			
Outboard boat ownership:				Public	80.3	--	76.7
Cruisers	16.4	22.9	12.4	Private	17.1	--	18.0
Runabouts	65.4	64.6	66.2	Both	2.6	--	5.3
Utility	18.0	10.1	20.0	Boating activities (percent of boaters):			
Racing	0.2	0.8	3.0	Fishing	72.1	--	76.4
Size distribution of cruisers:				Water skiing	63.3	--	63.4
Less than 20 feet	81.2	80.4	79.2	Cruising	86.6	--	86.0
20 - 24 feet	13.0	17.1	15.1	Hunting	6.6	--	6.0
More than 24 feet	5.8	2.5	5.7	Racing	2.0	--	2.6
Size distribution of runabouts:				Skin or Scuba Diving	1.4	--	2.6
Less than 14 feet	13.6	7.5	12.0				
14 - 16 feet	41.2	41.0	43.6				
16 - 18 feet	35.1	41.3	38.5				
More than 18 feet	10.1	10.2	5.9				

^aSize distribution of inboard/outdrives not available.

^bAt least 60% intend to buy a new boat within the next five years.

Section 3

STUDY METHODOLOGY

3.1 Determination of Boating Requirements

3.1.1 Size, Classification, and Distribution of the Small-Boat Fleet

Data on the number and types of recreational boats in each river basin group were obtained from agencies of the Great Lakes States. All motorboats were classified by length as follows: less than 12 feet; 12 to 20 feet; 20 to 30 feet; 30 to 40 feet; and over 40 feet. However, not all of the Great Lakes States could provide boat classifications in this format. To obtain consistency, Coast Guard classifications were converted to the classification used in this report.

Table R9-11 shows the number of boats registered in each of the 15 river basin groups. In those areas where boating waters are abundantly available, per capita ownership is correspondingly high. Where boating waters are lacking, there is lower per capita ownership, and it is assumed the existing facilities are overcrowded. The highest ownership rates in the Basin are in the northern areas where there is abundant boating opportunity. Per capita income in these areas is lower than the regional average.

The value of the small-boat fleet was determined by the Corps of Engineers' surveys of boat owners and industry representatives.

3.1.2 Forecast of Small-Boat Fleet Size

The problem of projecting future demand for boating opportunities and facilities can be approached after having established that boat ownership is strongly correlated to water availability. The probable size of the small-boat fleet and the corresponding demand for boating opportunity and facilities can be estimated, given the following considerations:

(1) Population, boater registration, and available effective water surface area are important in analyzing boating participation. Projections of boating demand can be made on

the basis of population increases, boating industry growth, and opportunity factors.

(2) Time and distance to water surface areas are major factors in boat ownership. The analysis of demand-supply relationships is given by river basin group areas. Adjustment is made for transfer of boater demand from high demand areas to high supply areas.

(3) The attitude of government toward the need for recreational boating will, to a major extent, determine the level of boating participation in the projection period.

Recreational boat ownership in the Great Lakes Basin has increased steadily in recent years, despite the severe lack of boating opportunity in the urbanized portion of the Region. The ratio of boats to people in the future is expected to depend on many complex variables, such as amount of leisure time, growth in per capita income, access to water, and amount of water surface available for boating. If these variables remain constant, the change in number of boats registered will be proportional to the population change. In the past these variables have changed in such a way as to increase the demand for boats and boating opportunity faster than the population grew.

Three alternative assumptions produced high, medium, and low projections of future levels of recreational boating in each river basin group.

The high projection of boat ownership (Table R9-12) is based on the growth in boating sales averaged over the last 10 years. The demand for boating has been growing about twice as fast as the population. This growth, which is expected to continue for some time, has been attributed to a rising standard of living and greater mobility. It has been estimated that the demand for boating facilities is growing three to five percent per year. The projection of three percent agrees closely with the growth in boating activities (sailing, canoeing, boating, and water skiing) given in Appendix 21, *Outdoor Recreation*.

The medium projection of boat ownership (Table R9-13) is based on the assumption that

TABLE R9-11 Boat Ownership Data in the Great Lakes Region, 1968

Planning Subarea	Population (1,000s)	Inland Water Area (1,000 Acres)		Usable Inland Water Area per Capita	Registered Boats (1,000s)	Boat Registration Per Capita
		Total	Usable			
1.1	347.6	632	291	.837	46	.132
1.2	195.2	146	117	.599	15	.077
2.1	948.0	314	250	.264	58	.061
2.2	9,094.7	79	63	.007	136	.015
2.3	2,393.8	132	106	.044	142	.059
2.4	464.8	285	228	.491	47	.101
3.1	128.1	139	111	.867	15	.117
3.2	1,031.4	30	24	.023	55	.053
4.1	4,649.9	50	39	.008	157	.034
4.2	1,668.7	33	26	.016	43	.026
4.3	3,029.5	18	14	.005	47	.016
4.4	1,811.0	15	12	.007	41	.023
5.1	855.1	12	10	.012	33	.039
5.2	1,332.1	212	180	.135	68	.051
5.3	277.8	40	32	.115	19	.068
Total	28,277.7	2,136	1,503	.053	922	.033

the number of boat owners will increase in direct proportion with the population. This method of projection ignores latent demand and projects boat ownership by extending the 1968 ratio of registered boats per capita to the projected population of each basin. This method of projection was also used in Appendix 8, *Fish*. A definite correlation exists between fishing license sales and registered boats in each area. This correlation varies from four to two licenses per boat and averages 2.96. A base line framework plan will be developed for this projection in each area.

The low projection of boat ownership (Table R9-14) is based on the amount of boating supply available in each area. The low projection assumes that boating will grow in only those areas of surplus supply.

3.1.3 Number of Boats

Thirty percent of the boats using waters within any river basin group use Great Lakes waters. The remaining 70 percent use inland waters.

3.1.4 Boat-Days of Use

The boat-days of use were determined by multiplying the number of boats by 30 days of use per season for both Great Lakes and inland waters. The exception is Lake Superior where only 13 days of use per boat per season was used.

3.1.5 Great Lakes Boating

The number of launchings and boat berths required was determined by examining the composition of the fleet. It was assumed that all of the boats longer than 30 feet were permanently berthed in the Great Lakes. It was also assumed that some of the smaller boats, especially those 20 to 30 feet long, were either moored or wanted to moor on the Great Lakes. The difference between the number of boats using Great Lakes waters and the number of boats requiring berths is the number of boats requiring launching facilities. The number of launchings was found by multiplying the number of boats by 30 days of use per season.

TABLE R9-12 Projected Growth in Boat Registration in the Great Lakes Basin Based on National Growth Trends and Bureau of Outdoor Recreation Growth Index

River Basin Group	Boats (1,000s)			
	1968	1980	2000	2020
1.1	46	65	119	214
1.2	15	21	38	70
2.1	58	83	149	269
2.2	136	194	350	632
2.3	142	188	340	614
2.4	47	67	120	219
3.1	15	21	39	70
3.2	55	78	142	256
4.1	157	223	405	730
4.2	43	61	111	200
4.3	47	67	120	219
4.4	41	58	106	191
5.1	33	47	85	153
5.2	68	97	175	316
5.3	19	27	49	88
Total	922	1,297	2,348	4,241
Indexes (based on 1968 = 100)				
1.1	100	141	258	465
1.2	100	140	253	467
2.1	100	143	257	464
2.2	100	143	257	465
2.3	100	132	239	432
2.4	100	143	255	466
3.1	100	140	260	467
3.2	100	142	258	465
4.1	100	142	258	465
4.2	100	142	258	465
4.3	100	143	255	466
4.4	100	141	259	466
5.1	100	142	258	464
5.2	100	143	257	465
5.3	100	142	258	463
Total	100	141	255	460

TABLE R9-13 Existing Boat Registration and Projected Growth Based on Increase in Population

River Basin Group	Boats (1,000s)			
	1968 ^a	1980	2000	2020
1.1	46	49	55	63
1.2	15	15	15	17
2.1	58	63	80	102
2.2	136	178	224	280
2.3	142	198	257	332
2.4	47	55	68	85
3.1	15	19	24	30
3.2	55	67	85	109
4.1	157	194	215	222
4.2	43	51	64	81
4.3	47	53	70	86
4.4	41	42	50	62
5.1	33	38	47	60
5.2	68	80	102	130
5.3	19	19	22	25
Total	922	1,121	1,378	1,684
Indexes (based on 1968 = 100)				
1.1	100	107	120	137
1.2	100	100	100	113
2.1	100	109	138	176
2.2	100	131	165	206
2.3	100	139	181	234
2.4	100	117	145	181
3.1	100	127	160	200
3.2	100	122	155	198
4.1	100	124	137	141
4.2	100	119	149	188
4.3	100	113	149	183
4.4	100	102	122	151
5.1	100	115	142	182
5.2	100	118	150	191
5.3	100	100	116	132
Total	100	122	149	183

^aAbout 64,800 boats in the Region are now moored on Great Lakes waters.

TABLE R9-14 Existing and Projected Growth in Recreational Boat Registration Based on No Increase in Existing Supply of Boating Waters

River Basin Group	Boats (1,000s)			
	1968	1980	2000	2020
1.1	46	50	57	64
1.2	15	15	15	17
2.1	58	68	85	109
2.2	136	136	136	136
2.3	142	142	142	142
2.4	47	55	68	85
3.1	15	19	21	30
3.2	55	55	55	55
4.1	157	157	157	157
4.2	43	43	43	43
4.3	47	47	47	47
4.4	41	41	41	41
5.1	33	33	33	33
5.2	68	80	80	80
5.3	19	19	22	25
Total	922	960	1,002	1,064
Indexes (based on 1968 = 100)				
1.1	100	109	124	139
1.2	100	100	100	113
2.1	100	117	147	188
2.2	100	100	100	100
2.3	100	100	100	100
2.4	100	117	145	181
3.1	100	127	140	200
3.2	100	100	100	100
4.1	100	100	100	100
4.2	100	100	100	100
4.3	100	100	100	100
4.4	100	100	100	100
5.1	100	100	100	100
5.2	100	118	118	118
5.3	100	100	116	132
Total	100	104	109	115

3.1.6 Boating on Inland Waters

Seventy percent of the total fleet (resident and nonresident boats) use inland waters. The demand for berths on inland waters was between 50 percent and 70 percent of the resident small-boat fleet and 30 percent of the nonresident fleet using inland waters. The great majority of the berths are provided by private cottages and a few inland marinas (including boat liveries and resorts).

3.2 Capacity of Boating Waters

Determining safe carrying capacity of water area is complex and beyond the scope of this study. Variables that influence the carrying capacity of water for recreational boating include user safety, especially while water skiing and boating at high speeds, physical characteristics of the body of water, such as depth and shape, and the number of islands or shoals. Winds can affect all types of boating. The point to which crowding will be tolerated depends upon the activity, the existing conditions, and individual preference or tolerance.

3.2.1 Great Lakes Waters

Much of the Great Lakes is not used by small craft because of the general lack of access to Great Lakes waters and the hazards associated with open lake use. Relatively protected bays do offer shelter to small craft and can be used when open lake use would be hazardous. An area of open waters that is highly used exists offshore from each harbor. While more study is needed to determine the shape of this zone, it should be circular with a radius of approximately five miles. The majority of boats now operate within this area. Comparative data also indicate that offshore waters out to 10 miles become available when harbors are provided at intervals of 10 miles or less.

Sheltered waters, those areas that are protected to some degree from wave action created by adverse climatic factors, are among the water areas in the Great Lakes usable for recreational boating. Such areas are found in bays where the headlands are less than 10 miles apart and among island groups that protect significant areas of water surface from wind action. The number of harbors that are located in sheltered waters was determined

and subtracted from the total number of harbors in each river basin group.

The capacity of sheltered waters was computed for each time frame by the following formula:

$$\text{Annual boat-days of use} = \frac{\text{Acres of water}^a \times \text{Use factor}^b \times \text{Number of boatable days}^c}{10^d}$$

Where a = Acres of sheltered waters

b = The following use factors:
33% for 1968 and 1980
40% for 2000
50% for 2020

c = 90 days for RBGs 1.1, 1.2, and 2.1
112 days for all other RBGs

d = Acres of water per boat

Offshore waters include the water area calculated to be within a 180° arc with a radius of five miles. Where the harbors are less than 10 miles apart along unsheltered shorelines, the area of the arc was decreased depending on the extent of overlap of the arc from the next adjacent harbor.

The capacity of offshore water was computed by the following formula:

$$\text{Annual boat-days of use} = \frac{\text{Acres of usable water}^a \times \text{Use factor}^b \times \text{Number of boatable days}^c}{10^d}$$

Where a = Acres of usable offshore waters

b = The following use factors:
33% for 1968 and 1980
40% for 2000
50% for 2020

c = 60 days for RBGs 1.1, 1.2, and 2.1
75 days for all other RBGs

d = Acres of water per boat

The number of boats accommodated by sheltered and offshore waters was determined by dividing the total number of annual boat-days of use by 13 in RBGs 1.1, 1.2, and 2.1, and 30 in all other RBGs.

3.2.2 Inland Waters

In the absence of firm data, the following assumptions were used to develop carrying capacity of inland lakes for boating and streams for canoeing:

- (1) cruising boats: 10 acres of water per boat
- (2) fishing boats: 2 acres of water per boat
- (3) trip canoeing: ¼ mile of stream per canoe

- (4) desirable turnover factor: 2
- (5) intensively managed turnover factor: 4
- (6) boating season: 120 to 150 days
- (7) percent of "good weather days": 80 percent
- (8) percent of usable inland lake acreage: 80 percent.
- (9) percent of maximum capacity usable (limited by changing leisure time patterns): 33 percent in 1970 and 1980, 40 percent in 2000, and 50 percent in 2020

For inland waters, an average of cruising boats (10 acres) plus fishing boats (2 acres), 6 acres per boat, is used to calculate the ultimate capacity of inland waters. This does not include an allowance for water skiing.

3.3 Methods of Meeting the Projected Boating Activity

The strategy used to meet the increased recreational boating requirements consists of increased utilization of existing waters, the creation of new boating waters, and the transfer of boating demand to other areas by developing new facilities. Elements of these programs may be structural or nonstructural.

3.3.1 Increased Use of Existing Waters

The program for increased use of existing boating waters consists of both structural and nonstructural elements directed at intensive management of the water resource. The elements of the Great Lakes program include construction of harbors, construction of marinas, and development of public access. The elements of the program for inland lakes and streams are construction of marinas, public access development, lake management (extending the season by increasing weekday boating with a 4-day work week, time and space zoning, and regulation of traffic), and improved maintenance of the existing boatable waters (i.e., improved water quality).

3.3.2 New Water Areas for Recreational Boating

Increasing the area of boating water is a direct method of enhancing boating opportunity. Large and small impoundments intensively managed for small-boat use near large metropolitan centers are generally most efficient in meeting boating needs. Many people

demand that suitable boating waters be nearby before they will make the substantial investment in recreational boating equipment. The cost per boater day is far cheaper near population centers, but the cost per acre of water developed is much cheaper in remote and rural areas. The new objective in planning for recreational boating facilities is to provide the most boating days for the money. The old approach was to provide the most opportunity for the money regardless of the anticipated level of use.

3.3.3 Transfer of Boating Demands

Many boating needs can be transferred to areas with surplus waters. Most of the northern portions of the Region have surplus opportunity that can be used to meet demands of the southern, more populated areas. In this planning strategy, the high cost of development in urban areas is avoided by providing opportunity in rural areas. Needs also can be transferred from inland waters to Great Lakes waters where the supply is several times larger.

States with surplus water surface area are reluctant to expand recreational boating opportunities for nonresident boaters, because care must be taken to prevent deterioration of the environment in unique areas.

3.4 Program Selection

The work group devised three steps to develop a framework program for recreational boating in the Great Lakes Basin. The process includes review of possible strategies and consideration of their impact on study objectives. It establishes a priority for potential alternative program elements and also analyzes the framework programs in terms of effectiveness and cost.

3.4.1 Strategies, Alternatives, Criteria, Impacts, and Priorities

Table R9-15 displays the rationale used to determine the priority given framework program elements:

- (1) increase the use of the existing water surface area by providing more recreational boating facilities
- (2) develop additional water surface area and facilities suitable for recreational boating
- (3) do nothing to provide recreational boat-

TABLE R9-15 Recreational Boating—Strategies, Alternatives, Criteria, Impacts, and Priorities

Strategies and Alternatives	Criteria				Impacts			Priority			
	Technical Feasibility ^a	Economic Expense ^b	Political Acceptance ^c	Effectiveness ^d	Economic Objectives ^{eh}	Environmental Objectives ^{fh}	Regional Objectives ^{gh}	Score	Total Score	Rank	
Increase use of existing water surface area											
GREAT LAKES											
Construct harbors	20	25	75	90	210	60	-40	90	110	320	2
Construct marinas	40	50	75	60	225	60	-40	90	110	335	1
Public access	40	75	75	60	250	30	-40	30	20	270	5
INLAND LAKES & STREAMS											
Construct marinas	40	50	50	60	200	60	-40	90	110	310	3
Public access	40	50	50	90	230	30	-40	60	50	280	4
Lake restoration	40	50	75	30	195	0	40	30	70	265	6
Develop additional water surface area											
IMPOUNDMENTS											
Single-purpose	20	25	25	60	130	30	-80	60	10	140	9
Multiple-purpose	20	25	50	60	155	30	-80	90	40	195	8
RESTORATION											
	20	25	50	60	155	0	40	30	70	225	7
Do nothing											
NO PROGRAMS	60	75	25	30	190	-30	-80	-30	-140	50	10

^aWeighting: (20); rating: simple (3), moderate (2), complex (1)

^bWeighting: (25); rating: inexpensive (3), moderate (2), expensive (1)

^cWeighting: (25); rating: yes (3), maybe (2), no (1)

^dWeighting: (30); rating: high (3), moderate (2), limited (1)

^eWeighting: (30)

^fWeighting: (40)

^gWeighting: (30)

^hRating: beneficial (+), detrimental (-), great (3), moderate (2), minimal (1), no effect (0)

ing facilities with the assumption that personal preferences will change to other recreational activities

Alternative program elements that could achieve these strategies were then assigned. A set of four test criteria was established. These criteria were weighted and rated according to complexity, expense, acceptability, and degree of effectiveness. The product of the weighting factor and the rating factor produced a number for each criterion. These four numbers were added together to establish a score. Impacts were measured similarly by determining the product of a weighting factor and a rating factor. The higher the sum of the two scores, the higher the rank of the program element.

3.4.2 Program Presentation

A series of four tables presents data for recreational boating in each of the river basin groups, the five Lake basins, and the Great Lakes Basin as a whole.

The first table in this series presents the total amount of boating opportunities in each area. Recreational boating opportunities are a summary of data concerning existing capaci-

ty, potential capacity, and opportunity for both the Great Lakes and inland waters. On the Great Lakes, existing capacity includes the total water surface available for boating within sheltered areas and within five miles of existing harbors-of-refuge. It was assumed that all surface water within bays whose headlands are less than 10 miles apart and all surface water lying within island groups is sheltered. On bays with headlands more than 10 miles apart, only that surface water encompassed between the shores of the bay where they close to less than 10 miles apart is included as sheltered water. This means that the bay can provide more days of safe boating than offshore, unprotected water. The only offshore water considered is that water lying within a radius of five miles from existing harbors-of-refuge. Harbors-of-refuge lying within sheltered water areas were excluded from the offshore water analysis to avoid double counting.

For all Lakes except Lake Superior, 75 annual design days were used to determine the carrying capacity of offshore water surface, and 122 annual design days were used in connection with sheltered water surface. Lake Superior's offshore water has 60 annual design days, and its sheltered water has 90.

Computations included a design standard of 10 acres of water per boat, a turnover factor of one, and use efficiency factors of .33, .40, and .50 for 1980, 2000, and 2020, respectively (Subsection 3.2.1).

Potential capacity is the Great Lakes optimal capacity to satisfy boating demand. Since harbors-of-refuge are essential for reasonably safe boating on Great Lakes waters, especially in offshore areas, it was assumed that additional harbors-of-refuge must be developed to reduce the maximum distance between them to not more than 13 miles. Thus, the potential capacity of the Great Lakes waters includes all water under existing capacity plus all water that would become available if sufficient new harbors were constructed. The difference between the potential capacity and existing capacity represents the opportunity for additional boating on Great Lakes waters outside the five-mile radius around harbors-of-refuge.

On the Great Lakes, the difference between existing capacity and supply represents additional opportunity for recreational boating since much of the sheltered water and water within five miles of existing harbors is not being used to capacity. Only in RBGs 2.3, 4.1, and 5.2 are these waters being used in excess of capacity. The waters in RBGs 3.2, 5.1, and 5.3 are being used nearly to capacity. The installation of additional marinas and launching facilities on sheltered waters and within existing harbors will permit greater and more efficient use of the capacity of this water. The existing use on inland lakes and streams, which is equivalent to supply, represents the estimated use of these waters in 1970.

Potential capacity of inland lakes and streams was determined by the use of criteria set forth in Section 3.2.2. It was assumed that 80 percent of the inland lake acreage is either boatable or potentially boatable. Computations involved the use of 120 annual design days, except for Lake Superior where 96 days were used. Six acres of water per boat, a turnover factor of two, and use efficiency factors of .33, .40, and .50 for 1980, 2000, and 2020 respectively were used in the computations. Standards for computing stream capacity differed from those used on inland lakes only in that one-quarter mile of stream per boat or canoe was used in place of six acres of water per boat.

The difference between potential capacity and existing capacity represents the amount of additional use that these water can support using the above standards. If a negative

number appears under opportunity on inland lakes and streams, those waters are presently being used beyond their stated capacity. All data in this table are cumulative by time frame.

The second table in the series presents data on demand, supply, and needs for recreational boating. Recreational boating requirements are based on the projected demand for boating on the Great Lakes and the inland lakes and streams, and the supply available, or the estimated use, for each time frame. It was assumed that since the efficiency of the use of launching facilities will increase over time, the available supply will increase accordingly. The need is the difference between demand and supply. These data are cumulative by time frame.

The third table in the series proposes a program development for each area. Recreational boating program is shown in two parts. The upper part indicates the needs as set forth in the previous table, the portion of the needs programmed to be met by additional facilities, and the needs which will go unmet as a result of insufficient boatable water surface. A plus sign preceding a number under "Needs Unmet" indicates that the proposed program will satisfy more needs than are shown. However, the surplus would serve to alleviate the needs of adjacent river basin groups.

The lower portion of the table shows the number and type of facilities programmed to meet a portion of the needs. Program elements were not included beyond the stated capacity of the available water. Where inland lakes are being used beyond their stated capacity, the proposed inland lake marinas and accesses are limited only to newly programmed water surfaces. These data are cumulative by time frame.

The fourth table in the series summarizes cost of the proposed programs. Recreational boating program costs include both the capital costs and the operation, maintenance, and replacement (OM&R) costs. Data in this table are stated incrementally by time frame, not cumulatively as in the preceding three tables.

3.4.3 Program Costs

Program costs are of two types, capital costs and operation, maintenance, and replacement (OM&R) costs. Capital costs include the initial costs of land acquisition and facility development. They were computed by multiplying the number of units in the proposed program for

each time frame by the unit cost for respective element. The unit costs of the proposed framework elements are shown in Table R9-16.

TABLE R9-16 Capital Cost per Unit

Type of Facility	Unit	Cost Per Unit
GREAT LAKES		
Marina	Berth	\$ 2,800
Harbor	Acre	160,000
Access	Each	75,000
INLAND LAKES & STREAMS		
Marina	Berth	2,800
Lake Access	Each	75,000
Stream Access	Each	7,500
Restoration	Acre	5,000
Impoundment	Acre	5,000

Costs for both Great Lakes and inland lake access areas are based on a 50-car parking area and two launching lanes, including the necessary sanitary facilities, landscaping, and signing. The cost of a stream access is based on parking for 10 cars and launching facilities for canoes and car-top boats.

Harbor costs range from \$120,000 to \$200,000 per acre and include breakwaters, dredging, and navigation aids. An average cost of \$160,000 was used for this study. Lake restoration costs include dredging and rehabilitation of existing inland lake waters, the removal of dredge spoils, and their disposal. Costs of new impoundments include the cost of land and damages, reservoir clearing, relocation of people and utilities, and the structure.

Costs of the various proposed framework elements were distributed in the following manner to Federal, non-Federal public, and private interests. All marina costs were allocated to private development. Costs of all

other recreation boating facilities were allocated 50 percent to Federal and 50 percent to non-Federal public interests.

OM&R costs include the cost of operation of the facilities, their maintenance cost, and the cost of replacement when the original facilities must be supplanted. Annual OM&R costs for all marina development were computed as 10 percent of the capital costs. For all other facilities, they were calculated as two percent of the capital cost.

Total OM&R costs were derived by the following formulas:

$$(1) \frac{A}{2} \times K \times 10 = 1971-80 \text{ OM\&R costs}$$

$$(2) (A \times K \times 20) + \left(\frac{B}{2} \times K \times 20\right) = 1981-2000 \text{ OM\&R costs}$$

$$(3) (A \times K \times 20) + (B \times K \times 20) + \left(\frac{C}{2} \times K \times 20\right) = 2001-2020 \text{ OM\&R costs}$$

where

A = Capital costs during 1971-1980

B = Capital costs during 1981-2000

C = Capital costs during 2001-2020

K = Annual cost factor: 10% for marinas and 2% for all other facilities.

3.4.4 Program Effectiveness

Program effectiveness is measured in two ways:

(1) by comparing the portion of the computed requirement or need that was left unmet with the portion of the need that was met through either the existing supply or future programs

(2) by assessing the ability of particular program elements to meet future requirements

The first measure considers the status of recreational boating in terms of ability of existing facilities and the potential of possible programmed facilities to meet future requirements. The comparison also considers the potential capacity of the resource base and the projection of the recreational boating activity. The second measure considers the amount of output anticipated in relation to the dollar input required to meet the same need.

Section 4

LAKE BASIN ANALYSIS

4.1 Lake Superior

Lake Superior is divided into two river basin groups covering parts of the States of Minnesota, Wisconsin, and Michigan.

4.1.1 River Basin Group 1.1 (Lake Superior West)

River Basin Group 1.1 is located at the west end of Lake Superior (Figure R9-13). Planning Subarea (PSA) 1.1 encompasses a four-county area of Minnesota and a four-county area of Wisconsin. PSA 1.1 contains 16,127 square miles (10,321,300 acres), of which 8.2 percent is rivers, inland lakes, and embayments. Seven of the eight counties border Lake Superior with a mainland shoreline of 331.3 miles. The Apostle Islands, located along the Wisconsin shore, have approximately 175 miles of additional shoreline. River Basin Group (RBG) 1.1 is defined as the hydrologic area draining into the west end of Lake Superior. Major watersheds include the St. Louis River basin, the Bad River basin, the Montreal River complex, the Apostle Island complex, and the Superior Slope complex. RBG 1.1 drains 9,227 square miles (5,907,000 acres).

The only major urban center in this river basin group is the metropolitan area of Duluth-Superior. The area's population, which was 345,000 in 1970, is projected to be 366,600 by 1980, 417,200 by 2000, and 475,000 by 2020.

4.1.1.1 Boating Opportunities

Recreational boating opportunities for RBG 1.1 are summarized in Table R9-17. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

Lake Superior, especially on its north shore, does not have good harbor sites. Dangerous

storms require the construction of structures of great stability, and make safe harbors all the more necessary. Sport fishing, enhanced by the the introduction of coho salmon, will further increase the demand for harbor facilities.

There are 14 commercial and recreational navigation harbors and 10 small-craft launching sites located along the Lake Superior shoreline in this area. Approximately 1,890 small boats are berthed in these harbors. Except for the harbors mentioned above and the area around the Apostle Islands and Chequamegon Bay, there are no sheltered Lake Superior waters in this area. Most boating activities are limited to within a five-mile radius offshore from the small-craft harbors, or to the sheltered waters around the Duluth-Superior, Apostle Islands, and Chequamegon Bay areas.

Information concerning the location, number of boats, and distance between and type of installation at these harbor sites is given in Table R9-18.

River Basin Group 1.1 has many inland lakes suitable for recreational boating (Table R9-19). Most of the lakes are small, averaging approximately 210 acres per lake. However, there are 36 lakes, each covering more than 1,000 acres. Of the total water area, it was estimated that only 291,000 acres would be available for intensive use by boaters.

This area has an extensive network of rivers and streams. While some are suitable for canoeing, periodic low flows and the lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunity on 370 stream miles. The lower end of the St. Louis River has been improved for commercial navigation. Approximately 14 miles of the river, improved for small-craft navigation, is heavily used. Rivers and streams identified as good canoeing waters are the Bad, the Marengo, the Bois Brule, the Cloquet, the St. Louis, the Brule, and the Pigeon.

The Boundary Waters Canoe Area (BWCA) in Minnesota is a segment of the Superior Na-

tional Forest and is a unit in the National Wilderness Preservation System. In conjunction with the adjoining Quetico Provincial Park in Canada, it is the most outstanding canoe country in the world. BWCA's 1,060 lakes (each covering 10 acres or more), encompass 168,270 acres of water. They are interconnected by streams and 116 miles of portage

trails. Outboard motor routes are designated at certain locations, but public sentiment favors a ban on all motorized boating within the area. While BWCA provides a surplus of canoeing water for the Minnesota region, it could not support twice its existing use without regulations to preserve its unique wilderness character.

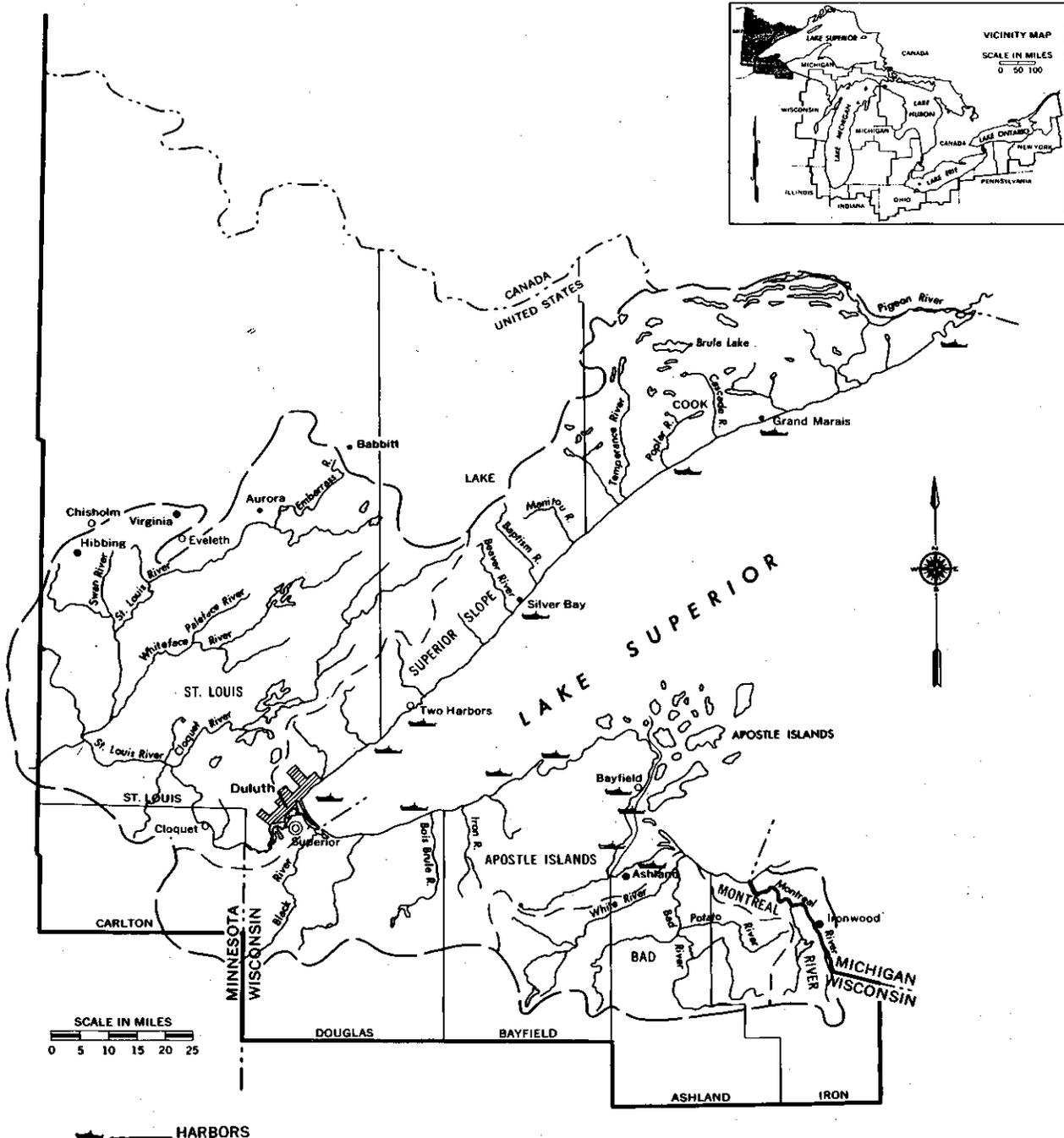


FIGURE R9-13 Harbor Facilities, RBG 1.1

TABLE R9-17 Recreational Boating Opportunities, RBG 1.1 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	132.7	160.0	200.0	183.0	220.4	275.5	50.3	60.4	75.5
Boat-Days of Use	1,724	2,081	2,601	2,378	2,866	3,582	654	785	981
SHELTERED WATERS									
Area	260	260	260	260	260	260	N/A	N/A	N/A
Boat-Days of Use	780	936	1,170	780	936	1,170	-	-	-
Number of Boats	60.0	72.0	90.0	60.0	72.0	90.0	-	-	-
OFFSHORE WATERS									
Area	477	477	477	804	804	804	327	327	327
Boat-Days of Use	944	1,145	1,431	1,598	1,930	2,412	654	785	981
Number of Boats	72.7	88.0	110.0	123.0	148.4	185.5	50.3	60.4	75.5
INLAND LAKES AND STREAMS									
Number of Boats	57.3	64.0	73.7	103.0	124.8	156.1	45.7	60.8	82.4
Boat-Days of Use	1,719	1,920	2,211	3,089	3,745	4,680	1,370	1,825	2,469
INLAND LAKES									
Acres	N/A	N/A	N/A	291	291	291	N/A	N/A	N/A
Boat-Days of Use	-	-	-	3,042	3,688	4,609	-	-	-
Number of Boats	-	-	-	101.4	122.9	153.7	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	370	370	370	N/A	N/A	N/A
Boat-Days of Use	-	-	-	47	57	71	-	-	-
Number of Boats	-	-	-	1.6	1.9	2.4	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	190.0	224.0	273.7	286.0	345.2	431.6	96.0	121.2	157.9
Boat-Days of Use	3,443	4,001	4,812	5,467	6,611	8,262	2,024	2,610	3,450

4.1.1.2 Boating Requirements

Recreational boating requirements for RBG 1.1 are summarized in Table R9-20. In 1969 the States of Minnesota and Wisconsin registered 45,800 boats in this area. The largest number of these are located along the shore of Lake Superior in urbanized areas of St. Louis County, Minnesota, and Douglas County, Wisconsin. There is an average of 13.2 boats for every 100 residents, which is primarily due to the abundance of boating opportunity located near the population. Overall population density is comparatively low and the resources are not being used to capacity.

An analysis of boat registration data shows that 95 percent of the registered boats are less than 20 feet long. This is assumed to be true of the unregistered portion of the small-boat fleet as well. The composition of the resident (registered and unregistered) small-boat fleet is shown in Table R9-21.

River Basin Group 1.1 receives a moderate influx of nonresident boaters, especially from the metropolitan areas to the south. Nonresident demand satisfied in this area is estimated at 570,000 boat days, which is approximately equivalent to 19,000 boats or 37 percent of the resident fleet. These estimates are based on data the State of Michigan obtained in a comparable area while researching origins and destinations of boating activities. Nonresident demand is assumed to increase in propor-

tion to population growth in adjacent areas. A conservative estimate indicates that the non-resident fleet in RBG 1.1 will grow to 53 percent of the resident fleet by 2020.

A survey in 1968 by the Wisconsin Department of Natural Resources indicated that a daily average of 95.2 cars with trailers used 18 launching sites from May through September. The survey included 62 days, primarily on weekends. Using these data, the number of boat-use days for launching in that area is computed as follows:

$$\begin{aligned}
 &49 \text{ weekend days} \times 95.2 \text{ (approximately 100)} \\
 &\quad \text{launchings/day} \quad \quad \quad = 4,900 \\
 &101 \text{ weekdays} \times 30 \text{ launchings/day (assumed)} = 3,000 \\
 &\text{Boat-Use Days} \quad \quad \quad = 7,900
 \end{aligned}$$

If an estimated 8,000 boat-use days occur in remaining portion of RBG 1.1 (i.e., from Duluth-Superior to the Canadian border), total boat-use days for launched boats in RBG 1.1 would be 16,000.

Additional information developed by the Wisconsin Department of Natural Resources indicates approximately 12,000 private boat trips were taken for trout and salmon in 1969, or approximately 75 percent of total boating. The remaining 25 percent (4,000 trips) includes pleasure boating and fishing for warmwater species. Adding commercial (charter) boat use to the 16,000 private boat-use days brings the total to at least 20,000 in

TABLE R9-18 Great Lakes Harbor Facilities, RBG 1.1

Harbor	Type of Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
Grand Portage, Minn.	Non-Federal small-boat ^a	30	35	No facilities available. Local interests have constructed an unprotected dock. Sec. 107 study is underway.
Grand Marais, Minn.	Federal commercial & small-boat	10	19	Facilities considered adequate for existing traffic.
Lutsen, Minn. ^{b,c}		10	38	A federal small-boat harbor has been authorized. Phase I, GDM studies to start in FY74.
Beaver Bay, Minn. ^{b,c}		0	26	A federal small-boat harbor has been authorized. Phase I, GDM studies to start in FY74.
Two Harbors, Minn.	Federal commercial	10	7	Provides refuge. Limited small-boat facilities available. Lack of local cooperation.
Knife River, Minn. ^{c,d}	Federal small-boat	20	19	Used primarily by commercial fishermen. Local interest are constructing additional small-boat facilities. A serious wave problem exists and is being investigated.
Duluth-Superior, Minn. & Wis. ^c	Federal commercial	1200	23	Local interests have constructed small-boat facilities. Provides refuge.
Amnicon, Middle, & Brule Rivers, Wis. ^a		0	11	Small-boat facilities do not exist. Funds for authorized survey study not available.
Port Wing, Wis.	Federal small-boat	40	17	Facilities considered adequate for existing traffic.
Cornucopia, Wis.	Federal small-boat	40	36	Facilities considered adequate for existing traffic.
Bayfield, Wis. ^d	Federal small-boat	10	2	Local interests have developed additional facilities. Possible modifications to correct a serious wave problem are being investigated.
La Pointe, Wis.	Federal small-boat	60	7	Serves primarily commercial fishing and ferry boats. Provides refuge. Local interests are developing a small-boat harbor.
Washburn, Wis. ^a		60	8	Some facilities are available.
Ashland, Wis. ^a	Federal commercial	300	28	Provides refuge but small-boat facilities are inadequate. Sec. 107 detailed project study is underway.
Total		1850		

^aSites which should be studied in the interest of refuge or basing small boats.

^bHarbors where construction of authorized improvements, not yet initiated, should be undertaken in the interest of small boats.

^cConstructed harbors which warrant further study to determine advisability of further improvement of general navigation facilities in the interest of small boats.

^dHarbors where improvements by local interests are needed for small boating.

TABLE R9-19 Inland Lakes, RBG 1.1

State	Number of Lakes	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Minnesota	2,642	562,500	27	130
Wisconsin	478	69,700	9	276
Total	3,120	632,200	36	406

1969. It is assumed that an additional 20,000 boat-use days occur in the Minnesota portion of RBG 1.1.

The 40,000 boat-use days in 1969 include 16,000 boat-use days by launched boats and 24,000 boat-use days by berthed boats. Since there are approximately 1,900 boats berthed in River Basin Group 1.1, there are approximately 13 (24,000/1,900) boat-use days per boat per season in RBG 1.1. This factor is used for all boating in this area on Lake Superior.

TABLE R9-20 Recreational Boating Requirements, RBG 1.1 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	11.0	12.9	15.4	3.1	3.4	3.8	7.9	9.5	11.6
Boat-Days of Use	143	168	200	40	44	49	103	124	151
BOATS BERTHED									
Number of Boats	3.7	4.4	5.2	1.9	1.9	1.9	1.8	2.5	3.3
Boat-Days of Use	48	57	68	25	25	25	23	32	43
BOATS LAUNCHED									
Number of Boats	7.3	8.5	10.2	1.2	1.5	1.9	6.1	7.0	8.3
Number of Launchings	95	101	132	15	19	24	80	82	108
INLAND LAKES AND STREAMS									
Number of Boats	62.2	73.1	87.0	57.3	64.0	73.7	4.9	9.1	13.3
Boat-Days of Use	1,866	2,193	2,610	1,719	1,920	2,211	147	273	399
BOATS BERTHED									
Number of Boats	27.4	31.9	37.4	25.4	25.4	25.4	2.0	6.5	12.0
Boat-Days of Use	822	957	1,122	762	762	762	60	195	360
BOATS LAUNCHED									
Number of Boats	34.8	41.2	49.6	31.9	38.6	48.3	2.9	2.6	1.3
Number of Launchings	1,044	1,236	1,488	957	1,158	1,449	87	78	39
RIVER BASIN GROUP TOTAL									
Number of Boats	73.2	86.0	102.4	60.4	67.4	77.5	12.8	18.6	24.9
Boat-Days of Use	2,009	2,361	2,810	1,759	1,964	2,260	250	397	550

TABLE R9-21 Composition of Resident Small-Boat Fleet, RBG 1.1

Length	Number of Boats	Percent of Total
Less than 12 feet	16,360	31.9
12 - 20 feet	32,260	63.0
20 - 30 feet	2,230	4.2
30 - 40 feet	320	0.6
More than 40 feet	140	0.3
Total	51,310	100.0

Thirty boat-use days per boat per season is used for inland waters.

Even though this area has a relatively high boating participation factor, the low population density and the abundance of water resources create a surplus of good boating waters, which could help meet water recreation demands of the more populous areas to the south.

In order to optimize use of the area's surface water resources, small-boat harbors should be constructed on Lake Superior. Access must be greatly improved and adequate facilities must be provided for optimum use of inland waters.

The total resident fleet, 51,300 in 1960, is expected to grow to 54,500 in 1980, to 62,000 in

2000, and to 71,000 in 2020. The existing resident boating demand satisfied within the area is estimated at 94.3 percent of the resident fleet. The resident demand plus the present nonresident demand is the total recreational boating demand satisfied within River Basin Group 1.1. The total number of craft using the boatable waters in the area is expected to increase from 67,400 in 1969 to 102,400 by the year 2020, as shown in Table R9-22.

TABLE R9-22 Existing and Future Small-Boat Fleet, RBG 1.1 (thousands)

	1969	1980	2000	2020
Number of Boats				
Resident ^a	48.4	51.4	58.5	67.0
Nonresident ^b	19.0	21.8	27.5	35.4
Total	67.4	73.2	86.0	102.4
Composition				
< 12 feet (31.9%)	21.5	23.4	27.4	32.7
12 - 20 feet (63.0%)	42.5	46.1	54.2	64.5
20 - 30 feet (4.2%)	2.8	3.1	3.6	4.3
30 - 40 feet (0.6%)	0.4	0.4	0.5	0.6
> 40 feet (0.3%)	0.2	0.2	0.3	0.3

^aRegistered boats + 12% (unregistered boats) x 94.3% (use in area).

^b37% of the 1969 resident fleet. Increasing thereafter as follows in percent of resident boats: 1980 (42%); 2000 (47%); and 2020 (53%).

4.1.1.3 Recreational Boating Program

The recreational boating program for RBG 1.1 is summarized in Table R9-23. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, has a

number of studies in progress to determine the feasibility of constructing additional small-boat harbors along the shores of Lake Superior. The description and status of these studies are summarized in Table R9-24.

The suggested strategy for selecting a framework program consists of increasing use of the large quantity of high quality boating waters that now exists, rather than developing new water areas. Primary alternatives to

TABLE R9-23 Recreational Boating Program, RBG 1.1 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	7.9	9.5	11.6	7.9	11.0	16.0	0	+1.5	+4.2
Boat-Days of Use	103	124	151	103	143	208	0	+19	+57
INLAND LAKES AND STREAMS									
Number of Boats	4.9	9.1	13.3	4.2	8.9	13.8	0.7	0.2	+0.5
Boat-Days of Use	147	273	399	127	267	415	20	6	+16
RIVER BASIN GROUP TOTAL									
Number of Boats	12.8	18.6	24.9	12.1	19.9	29.8	0.7	+1.3	+4.9
Boat-Days of Use	250	397	550	230	410	623	20	+13	+73
PROGRAM ELEMENT									
STRUCTURAL		N/A	N/A	N/A			N/A	N/A	N/A
UNITS									
Great Lakes									
1. Marinas	berths	-	-	-	1,800	2,700	3,300	-	-
2. Harbors	acres	-	-	-	60	90	110	-	-
3. Access	each	-	-	-	40	45	55	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	2,000	6,000	10,000	-	-
2. Lake Access	each	-	-	-	20	20	20	-	-
3. Stream Access	each	-	-	-	5	15	20	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-24 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 1.1

Locality	Purpose	Status
Beaver Bay Harbor	To provide breakwater and 12' harbor basin	Initiation of study contingent upon allocation of funds
Lutsen Harbor	To provide breakwater and 6' channel	Initiation of study contingent upon allocation of funds
Grand Portage	To provide breakwaters and maneuvering area	Inactive
Ashland	To provide small-boat recreation harbor	Detailed project report presently under way
Amnicon, Brule, & Middle Rivers	To determine the need for dredging the mouths of rivers and constructing entrance breakwaters	Initiation of study contingent upon allocation of funds

be considered for RBG 1.1 are Great Lakes marina and harbor construction, inland lake marina construction, and improvement of public access.

There is a definite need for more recreational boating facilities on Lake Superior, particularly along the Wisconsin shore, which features good harbor sites. The Minnesota shore, with its steep, rocky nature and the abundance of good inland lakes is not as conducive to Lake Superior boating as the Wisconsin portion. The Northwest Wisconsin Region Comprehensive Plan suggests a chain of small-boat harbors along the Lake Superior shore, spaced at approximately 15-mile intervals, that would tie in with similar development in Michigan's Upper Peninsula.

There will be a need for 2,000 boat berths at inland marinas by 1980. Ten thousand boat berths will be needed by 2020. An undetermined number of these berths undoubtedly will be provided at private cottages and resorts.

There is a need for launching facilities on Lake Superior. Forty facilities, each accommodating 50 cars with trailers, are required by 1980 to meet demands. The capacity of these facilities will increase with time as changes in leisure-time patterns change the use factor, so a lesser number of facilities will be required in the other planning periods. Launching facilities should be developed or improved at both existing and new sheltered sites or harbors.

The area contains enough inland water surface area to satisfy recreational boating demands for the entire planning period, but if these water resources are to be available to an increasing number of boaters, a considerable number of new access sites must be built. In some remote areas, this development must include the construction of an adequate road network, in addition to launching facilities, parking areas, and picnic and sanitary facilities at the site itself. The equivalent of 20 launching sites, each with parking for 50 cars and trailers, and five sites on streams, each accommodating 10 cars and trailers, is required to meet 1980 needs. Because of increasing capacity of existing and new sites with time (use factor), only 10 additional stream sites will be needed to meet needs in the 1981-2000 period. Five more sites are programmed for the 2001-2020 period.

Stream and lake maintenance will become increasingly important as lakes are used more. It is imperative that the high quality of

recreational boating experience now available be maintained in the future.

4.1.1.4 Program Costs

Recreational boating program costs for RBG 1.1 are shown in Table R9-25. Framework program elements are quantified, and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.1.2 River Basin Group 1.2 (Lake Superior East)

River Basin Group 1.2 is located at the east end of Lake Superior (Figure R9-14). Planning Subarea 1.2 defines the area by political (county) boundaries, encompassing a nine-county area of Michigan's Upper Peninsula and containing 10,425 square miles (6,673,900 acres), of which 3.5 percent is rivers, inland lakes, and embayments. Eight of the counties border Lake Superior, while the ninth has a shoreline along Lake Superior, the St. Marys River, and Lake Huron. These nine counties have a mainland shoreline of 555.5 miles along Lake Superior, 88.6 miles along the St. Marys River, and 18.3 miles along Lake Huron. In addition, there are 450 miles of shoreline around Isle Royale, Drummond and Sugar Islands, and 123.5 miles of shoreline around Keweenaw Bay and Portage Lake. River Basin Group 1.2 is defined as the hydrologic area draining into the east end of Lake Superior. Major watersheds include the Porcupine Mountains complex, the Ontonagon River basin, the Keweenaw Peninsula complex, the Sturgeon River basin, Huron Mountains complex, the Grand Marais complex, Tahquamenon River basin, and the Sault complex. RBG 1.2 drains 7,754 square miles (4,964,000 acres).

The only major urban centers in this area are Marquette and Sault Ste. Marie. Population losses are anticipated in several of the less populated counties, such as Keweenaw, Baraga, Alger, and Luce. The area's population, which was 186,000 in 1960 and 188,000 in 1970, is projected to decrease to 171,000 in 1980, then increase to 177,000 by 2000, and to 194,000 by 2020.

With proper development, River Basin Group 1.2 has the potential to satisfy not only

TABLE R9-25 Recreational Boating Program Costs, RBG 1.1

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020			
		Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	
STRUCTURAL											
Great Lakes											
1. Marinas	(berths)	\$ 2,800	1,800	5,040	2,520	900	2,520	12,600	600	1,680	16,800
2. Harbors	(acres)	160,000	60	9,600	960	30	4,800	4,800	20	3,200	6,400
3. Access	(each)	75,000	40	3,000	300	5	375	1,275	10	750	1,500
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	2,000	5,600	2,800	4,000	11,200	22,400	4,000	11,200	44,800
2. Lake Access	(each)	75,000	20	1,500	150	0	0	600	0	0	600
3. Stream Access	(each)	7,500	5	38	4	10	75	30	5	38	53
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS											
Federal			7,069	707		2,625	3,352		1,994	4,276	
Non-Federal Public			7,069	707		2,625	3,353		1,994	4,277	
Private			10,640	5,320		13,720	35,000		12,880	61,600	

its own recreational boating needs, but also needs of a portion of the surrounding area. Program elements selected later are suggested guides to that development. Detailed studies concerning water resource management in the interest of recreational boating are needed in this area to determine the composition of the nonresident boat fleet using the area's waters, the anticipated growth of the nonresident fleet, and the maximum desirable capacity of existing berthing and launching facilities for both Great Lakes and inland waters.

4.1.2.1 Boating Opportunities

Recreational boating opportunities for RBG 1.2 are summarized in Table R9-26. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

There are 23 commercial and recreational navigation harbors with facilities for mooring approximately 600 boats along the Great Lakes shores of this river basin group (Table R9-27).

TABLE R9-26 Recreational Boating Opportunities, RBG 1.2 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	119.6	143.4	179.3	162.1	194.3	243.0	42.5	50.9	63.7
Boat-Days of Use	1,554	1,865	2,331	2,106	2,527	3,159	552	662	828
SHELTERED WATERS									
Area	250	250	250	250	250	250	N/A	N/A	N/A
Boat-Days of Use	750	900	1,125	750	900	1,125	-	-	-
Number of Boats	57.7	69.2	86.5	57.7	69.2	86.5	-	-	-
OFFSHORE WATERS									
Area	402	402	402	678	678	678	276	276	276
Boat-Days of Use	804	965	1,206	1,356	1,627	2,034	552	662	828
Number of Boats	61.9	74.2	92.8	104.4	125.1	156.5	42.5	50.9	63.7
INLAND LAKES AND STREAMS									
Number of Boats	14.4	15.7	17.5	43.8	52.3	65.5	29.4	36.6	48.0
Boat-Days of Use	433	471	525	1,307	1,571	1,963	874	1,100	1,438
INLAND LAKES									
Acres	N/A	N/A	N/A	117	117	117	N/A	N/A	N/A
Boat-Days of Use	-	-	-	1,234	1,483	1,853	-	-	-
Number of Boats	-	-	-	41.4	49.4	61.8	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	575	575	575	N/A	N/A	N/A
Boat-Days of Use	-	-	-	73	88	110	-	-	-
Number of Boats	-	-	-	2.4	2.9	3.7	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	134.0	159.1	196.8	205.9	246.6	308.5	71.9	87.5	111.7
Boat-Days of Use	1,987	2,336	2,856	3,413	4,098	5,122	1,426	1,762	2,266

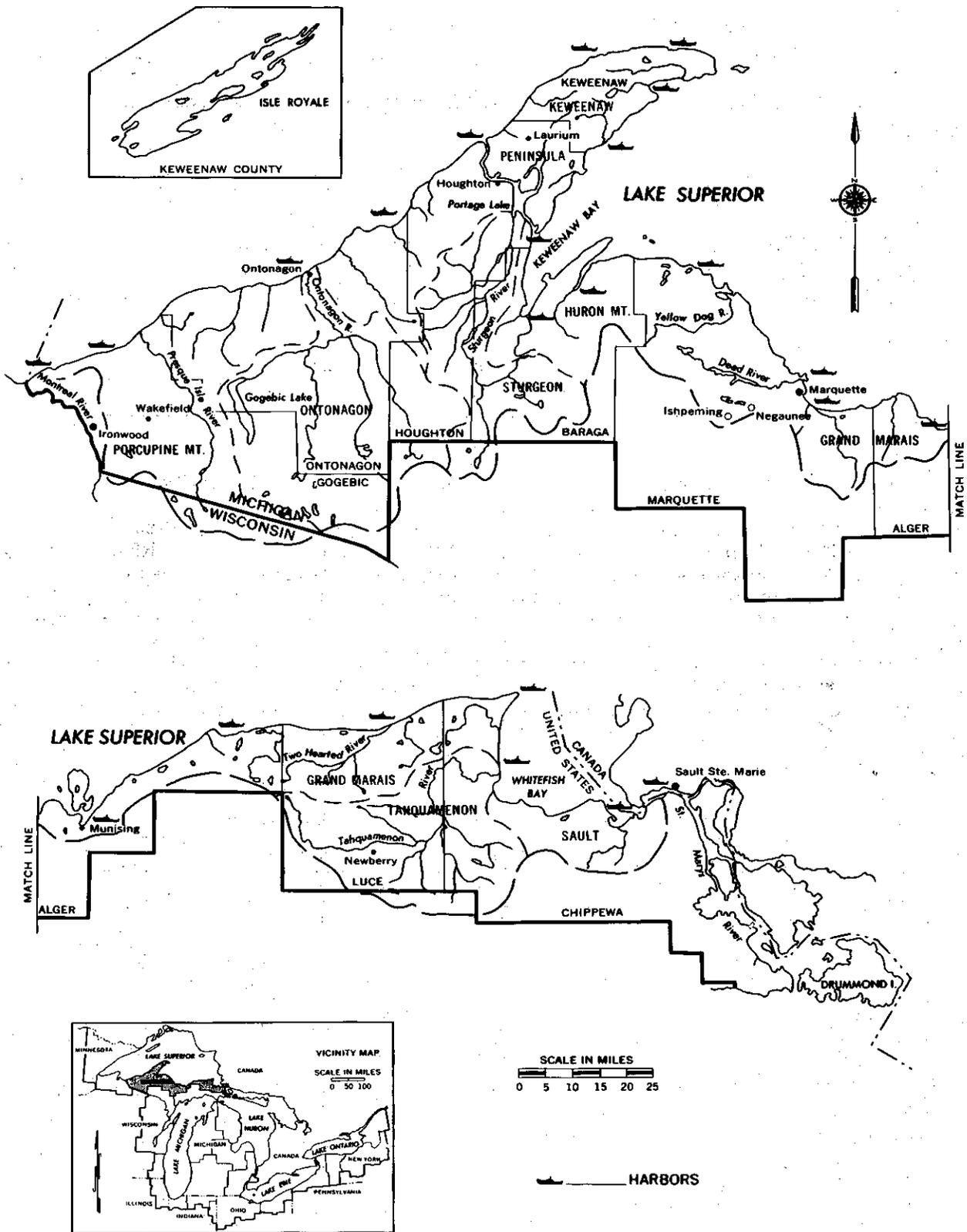


FIGURE R9-14 Harbor Facilities, RBG 1.2

TABLE R9-27 Great Lakes Harbor Facilities, RBG 1.2

Harbor	Type of Harbor	Boats Moored	Remarks
Little Girls Point, Mich. ^a		0	Limited facilities available.
Black River, Mich.	Federal small-boat	50	Facilities are being expanded.
Ontonagon, Mich. ^c	Federal commercial	30	Provides refuge. A small-boat marina is under construction.
Misery River, Mich. ^a		0	No facilities available. Survey study for small-boat harbor is currently inactive.
Keweenaw Waterway, Mich.	Upper Entry Federal commercial ^d	60	Provides refuge. Facilities for small boats have not been provided.
Eagle Harbor, Mich. ^c	Federal small-boat	10	Facilities considered adequate although a surge problem exists within the harbor. Michigan Waterways Commission has provided facilities.
Copper Harbor, Mich.	Non-Federal small-boat	30	Michigan Waterways Commission has provided small-boat facilities.
Lac La Belle, Mich.	Federal small-boat	0	Facilities considered adequate for existing traffic.
Grand Traverse, Mich. ^d	Federal small-boat	0	Serves primarily commercial fishing boats. Facilities considered inadequate for recreational craft.
Keweenaw Waterway, Mich. ^d	Portage Entry	5	Provides refuge. Limited small-boat facilities have been provided.
L'Anse, Mich. ^a		30	Some facilities are provided.
Huron Bay, Mich. ^a	Natural harbor	10	Provides refuge. Limited private development.
Big Bay, Mich.	Federal small-boat	10	Facilities considered adequate for existing traffic.
Presque Isle, Mich.	Federal commercial	90	Provides refuge. A small-boat marina has been constructed by local interest.
Marquette, Mich. ^c	Federal commercial	110	Provides refuge. Limited small-boat facilities available.
Au Train, Mich. ^a		30	No facilities available. A survey study has been authorized but not funded.
Munising Harbor, Mich. ^{a,d}	No Federal project	30	Ruins of old commercial docks. Several small private docks municipal launching ramp. Small public dock. Additional berthing and docking facilities needed. Needs breakwater protection.
Grand Marais Harbor, Mich. ^{c,d}	Federal project depth 18'	0	Part of harbor endangered by deterioration of pile dike. Expansion of docking and launching facilities needed.
Little Lake Harbor, Mich. ^c	Federal project depth 12'	0	Harbor entrance shoals rapidly. Harbor facilities are adequate.
Whitefish Bay Harbor, Mich. ^d		0	Needs new dock and launching facilities.
Tahquamenon River, Mich. ^{a,d} (mouth)		0	New harbor site. Channel dredging and piers required. Local interests would furnish dock and launching sites.
Brimley, Mich. (Waaska River) ^{a,d}		0	Natural harbor at mouth of river. Federal government has performed emergency dredging. Need additional channel dredging, breakwater protection, docking and launching facilities. Study has been authorized, but not initiated.
Sault Ste. Marie, Mich. (St. Marys River) ^{a,d}		87	Small harbor constructed by city downstream of locks. Study has been authorized but not initiated.

^a Sites which should be studied in the interest of refuge or basing small boats.

^b Harbor where construction of authorized improvements, not yet initiated, should be undertaken in the interest of small boats.

^c Constructed harbors which warrant further study to determine advisability of further improvement of general navigation facilities in the interest of small boats.

^d Harbors where improvements by local interests are needed for small boating.

Recreational boating on the Lake is generally limited to the vicinity of the harbors in sheltered waters. The largest naturally sheltered water areas are St. Marys River and Whitefish, Keweenaw, and Huron Bays.

This river basin group contains approximately 95 inland lakes, with a total water surface area of 146,000 acres of which approximately 117,000 acres are boatable. The largest inland lake in the area, Lake Gogebic, covers an area of 8,700 acres. While the lakes are larger and more numerous in the western portion of the area where many have sandy beaches and excellent water quality, poor accessibility hinders their use. Many of these lakes lie in remote forested areas with poor connecting roadways, but the potential for development of streams and lakes for recreational use is good due to the large amount of publicly owned frontage. Extensive stretches of shoreline owned by private corporations are also available for limited use.

This river basin group contains approximately 575 miles of streams and rivers suitable for canoeing, a prime summer and fall activity. The principal canoeing areas are the Ontonagon River (containing 50 percent canoeing waters), the Tahquamenon River, and the Presque Isle River. Boating opportunity in River Basin Group 1.2 is summarized in Table R9-28.

TABLE R9-28 Boating Opportunities, RBG 1.2

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	145,535	20
Streams (miles)		
Developed	575	6
Total	750	--
Great Lakes Waters		
Open Acres	402,000	16
Sheltered Acres	250,000	7
Total	652,000	23

4.1.2.2 Boating Requirements

Recreational requirements for RBG 1.2 are summarized in Table R9-29, which displays the demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the State of Michigan registered a total of 13,632 boats in the nine-county area. The four counties of Marquette, Chippewa, Houghton, and Gogebic contained 76.5 percent of the boats registered. Overall, there was an average of 7.7 boats per 100 persons.

The State of Michigan does not require the registration of canoes, sailboats, or other non-powered craft, but it is estimated that their

TABLE R9-29 Recreational Boating Requirements, RBG 1.2 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	8.7	9.9	11.6	6.1	7.4	9.1	2.6	2.5	2.5
Boat-Days of Use	113	129	151	79	96	118	34	33	33
BOATS BERTHED									
Number of Boats	0.8	0.9	1.1	0.6	0.7	0.8	0.2	0.2	0.3
Boat-Days of Use	11	12	14	8	9	10	3	3	4
BOATS LAUNCHED									
Number of Boats	7.9	9.0	10.5	5.5	6.7	8.3	2.4	2.3	2.2
Number of Launchings	102	117	137	71	87	108	31	30	29
INLAND LAKES AND STREAMS									
Number of Boats	14.4	14.8	17.4	14.4	15.7	17.5	0	+0.9	+0.1
Boat-Days of Use	433	444	522	433	471	525	0	+27	+3
BOATS BERTHED									
Number of Boats	7.9	8.1	9.4	8.3	8.3	8.3	+0.4	+0.2	1.1
Boat-Days of Use	237	243	282	249	249	249	+12	+6	33
BOATS LAUNCHED									
Number of Boats	6.5	6.7	8.0	6.1	7.4	9.2	0.4	+0.7	+1.2
Number of Launchings	195	201	240	183	222	276	12	+21	+36
RIVER BASIN GROUP TOTAL									
Number of Boats	23.1	24.7	29.0	20.5	23.1	26.6	2.6	1.6	2.4
Boat-Days of Use	546	573	673	512	567	643	34	6	30

number is approximately 10 percent of the registered small-boat fleet. This means that an additional 1,400 vessels are located in the area.

As shown in Table R9-30, 97 percent of the registered boats are 20 feet or less in length. This is also assumed to be the case for the unregistered portion of the small-boat fleet.

Poor access to inland waters and lack of good harbor facilities on Lake Superior keep the number of nonresident boaters in RBG 1.2 low, even though the area has ample boating waters. The estimated nonresident boating demand satisfied in this area is calculated to be approximately 6,500 boats, or approximately 43 percent of the resident fleet. These estimates are based on data concerning origins and destinations of boating activities obtained by the State of Michigan in a survey in this area.

Introduction of salmon and build-up of the lake trout population are expected to increase demand for fishing boat facilities. Development of the multimillion dollar Pictured Rocks National Lakeshore is also expected to draw visiting yachtsmen to this area.

The resident fleet, which was 15,000 in 1968, is expected to increase to 16,500 in 1980 and 2000, and to 18,700 in 2020. The existing resident boating demand satisfied within the area is estimated to be 94.3 percent of the resident fleet. This, combined with the present nonresident demand, is the total recreational boating demand that is being satisfied in River Basin Group 1.2. The total number of craft using the boatable waters within the area is expected to increase from 20,600 in 1968 to 29,000 by 2020. This projection and the composition of the total fleet using waters in RBG 1.2 are shown in Table R9-31.

TABLE R9-30 Composition of Resident Small-Boat Fleet, RBG 1.2

Length	Number of Boats	Percent of Total
Less than 12 feet	2,720	18.2
12 - 20 feet	11,860	79.1
20 - 30 feet	340	2.2
30 - 40 feet	60	.4
More than 40 feet	15	.1
Total	14,995	100.0

TABLE R9-31 Existing and Future Small-Boat Fleet, RBG 1.2 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	14.1	15.6	15.6	17.6
Nonresident ^b	6.5	7.5	9.1	11.4
Total	20.6	23.1	24.7	29.0
Composition^c				
< 20 feet	19.9 ^d	22.3	23.8	27.9
> 20 feet	0.7 ^e	0.8	0.9	1.1

^aRegistered boats + 10% (unregistered boats) x 94.3% (use in area).

^b43% of the 1968 resident fleet. Increasing thereafter in proportion to population increase in RBG 2.1 and 2.2 (tributary areas).

^cIn the resident fleet, 97% are 20 feet or less and 3% are more than 20 feet. In the nonresident fleet, 95% are 20 feet or less and 5% are more than 20 feet.

^dTotal includes 13.7 resident and 6.2 nonresident boats.

^eTotal includes 0.4 resident and 0.3 nonresident boats.

The resident fleet demand is expected to grow slowly, in step with the area's population growth. Nonresident fleet demand is expected to grow at the rate the population increases from 1968 in adjacent areas of Wisconsin and Illinois, i.e., 15 percent in 1980; 40 percent in 2000; and 70 percent by the year 2020. The number of boats longer than 20 feet demanding berths on the Great Lakes is estimated to be 5 percent of the nonresident fleet. This is consistent with the ratio in tributary areas (RBG 2.1, 5 percent; RBG 2.2, 10 percent). The ratio of boats longer than 20 feet to resident boats in RBG 1.2 is 3 percent.

These procedures will probably result in a very conservative estimate of needs for RBG 1.2 because as facilities in central Wisconsin and in RBGs 2.1 and 2.2 become crowded, the number of persons desiring to use water in RBG 1.2 may increase much more rapidly than population growth.

River Basin Group 1.2, with its small population, large quantity of inland water, and long Lake Superior shoreline, could satisfy its own recreation needs, as well as a portion of the demands of neighboring regions, if access to existing inland waters were greatly improved and adequate facilities were provided. In addition, recreational boat harbors along Lake Superior should be constructed and expanded.

A study entitled "The Potentials of Commercial Tourism in the Upper Great Lakes Area" indicated that in 1965 the region's effective market was within 275 miles. In 1975 the radius will be 500 miles, encompassing approximately 103 million people. Trends show that a great demand for recreational boating facilities may be exerted in this sparsely populated area by tourists and vacationists primarily from overcrowded metropolitan areas, such as Chicago-Milwaukee or Detroit.

4.1.2.3 Recreational Boating Program

Recreational boating program for RBG 1.2 is summarized in Table R9-32. The table displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program. The suggested framework consists of a combination public access sites and construction of Great Lakes marinas and harbors.

In order to take advantage of the great boating opportunities that the many inland lakes and streams of this area offer, access must be improved. Many of the inland waters lie in remote areas that lack good access roads. In addition, launching facilities at these lakes need to be constructed or improved. It has been suggested that each access site provide parking for a minimum of 50 cars. Inland lakes

currently handle approximately 14,400 boats while having a possible capacity of 41,400 boats now and 61,800 boats by 2020. Stream access is programmed at 30 sites by 2020.

Lake Superior, a great water resource, cannot be used to its fullest extent without adequate provisions for access and shelter. Harbors spaced approximately every 15 miles along the Lake Superior shore would open the entire coastline to recreational boating, and greatly encourage use of the Lake by boaters from other areas. A number of harbors already in existence need marina facilities for recreational boaters. Each harbor site should provide public launching sites.

4.1.2.4 Program Costs

Recreational boating program costs for RBG 1.2 are shown in Table R9-33. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.2 Lake Michigan

Lake Michigan is divided into four river basin groups covering parts of Michigan, Wisconsin, Illinois, and Indiana.

TABLE R9-32 Recreational Boating Program, RBG 1.2 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	2.6	2.5	2.5	1.5	2.9	4.2	1.1	+0.4	+1.7
Boat-Days of Use	34	33	33	19	38	55	15	+5	+22
INLAND LAKES AND STREAMS									
Number of Boats	0	+0.9	+0.1	0.7	1.8	2.6	+0.7	+2.7	+2.7
Boat-Days of Use	0	+27	+3	22	53	77	+22	+80	+80
RIVER BASIN GROUP TOTAL									
Number of Boats	2.6	1.6	2.4	2.2	4.7	6.8	0.4	+3.1	+4.4
Boat-Days of Use	34	6	30	41	91	132	+7	+85	+102
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	300	600	750	-	-
2. Harbors	acres	-	-	-	10	20	25	-	-
3. Access	each	-	-	-	5	10	15	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	0	0	0	-	-
2. Lake Access	each	-	-	-	5	10	10	-	-
3. Stream Access	each	-	-	-	10	20	30	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-33 Recreational Boating Program Costs, RBG 1.2

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
Great Lakes												
1. Marinas	(berths)	\$ 2,800	300	840	420	300	840	2,520	150	420	3,780	
2. Harbors	(acres)	160,000	10	1,600	160	10	1,600	960	5	800	1,440	
3. Access	(each)	75,000	5	375	38	5	375	225	5	375	375	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	0	0	0	0	0	0	0	0	0	
2. Lake Access	(each)	75,000	5	375	38	5	375	225	0	0	300	
3. Stream Access	(each)	7,500	10	75	8	10	75	45	10	75	75	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0	
TOTAL PROGRAM COSTS												
Federal				1,212	122		1,212	727		625	1,095	
Non-Federal Public				1,213	122		1,213	728		625	1,095	
Private				840	420		840	2,520		420	3,780	

4.2.1 River Basin Group 2.1 (Lake Michigan Northwest)

River Basin Group 2.1 is located on the northwest side of Lake Michigan (Figure R9-15). Planning Subarea 2.1 defines the area by political (county) boundaries, encompassing a 20-county area of Wisconsin and a three-county area of Michigan's Upper Peninsula. It contains 16,248 square miles (10,401,900 acres), of which 3.7 percent is rivers, inland lakes, and embayments. Nine of the counties border on Lake Michigan or Green Bay with a shoreline of 420 miles. River Basin Group 2.1 is defined as the hydrologic area draining into the northwest part of Lake Michigan and Green Bay. The major watersheds, the Menominee River basin and complex, Peshtigo River basin, Oconto and Pensaukee complex, Suamico complex, Fox River basin, and the Green Bay complex. RBG 2.1 drains 16,856 square miles (10,791,000 acres).

Major rivers in the area, the Menominee, Peshtigo, Fox-Wolf and Oconto, and inland lakes, which cover approximately 313,530 acres of water surface, are used for recreational boating in varying degrees, from nominal use in the northern part of the area to extensive use in the southern part. Other areas with high participation rates are the sheltered waters of Green Bay and the inland

waters which flow through the popular Lake Winnebago-Fox River region to Green Bay.

Green Bay's western shoreline generally consists of gently sloping sand and gravel beaches backed by low sand banks. From the vicinity of the City of Green Bay northward along the eastern shore of Green Bay, the shoreline configuration changes to sand and gravel beaches backed by bluffs up to 100 feet high. Then come rocky beaches backed by rugged ledge rock bluffs, extending around the northern tip of the Door Peninsula. Bays in this area usually contain fine beach material backed by less rugged bluffs. This portion of the Door County coast has high scenic and recreational value. Beginning at the northern extremity of the Door Peninsula and moving south along the Lake Michigan side, the shorelands are generally a mixture of ledge rock cliffs and banks interspersed with numerous beaches and shallow bays. The beaches are backed by either low bedrock bluffs or low plains of lacustrine sand and gravel. Many of the bays are backed by low wetlands. This type of shoreland extends southward along approximately two-thirds of the Door Peninsula. Then it changes to red clay bluffs, 10 to 70 feet high, interspersed with sand dunes and low sand bluffs with narrow sand or gravel beaches. Shorelands of this kind continue through the remaining portion of the area.

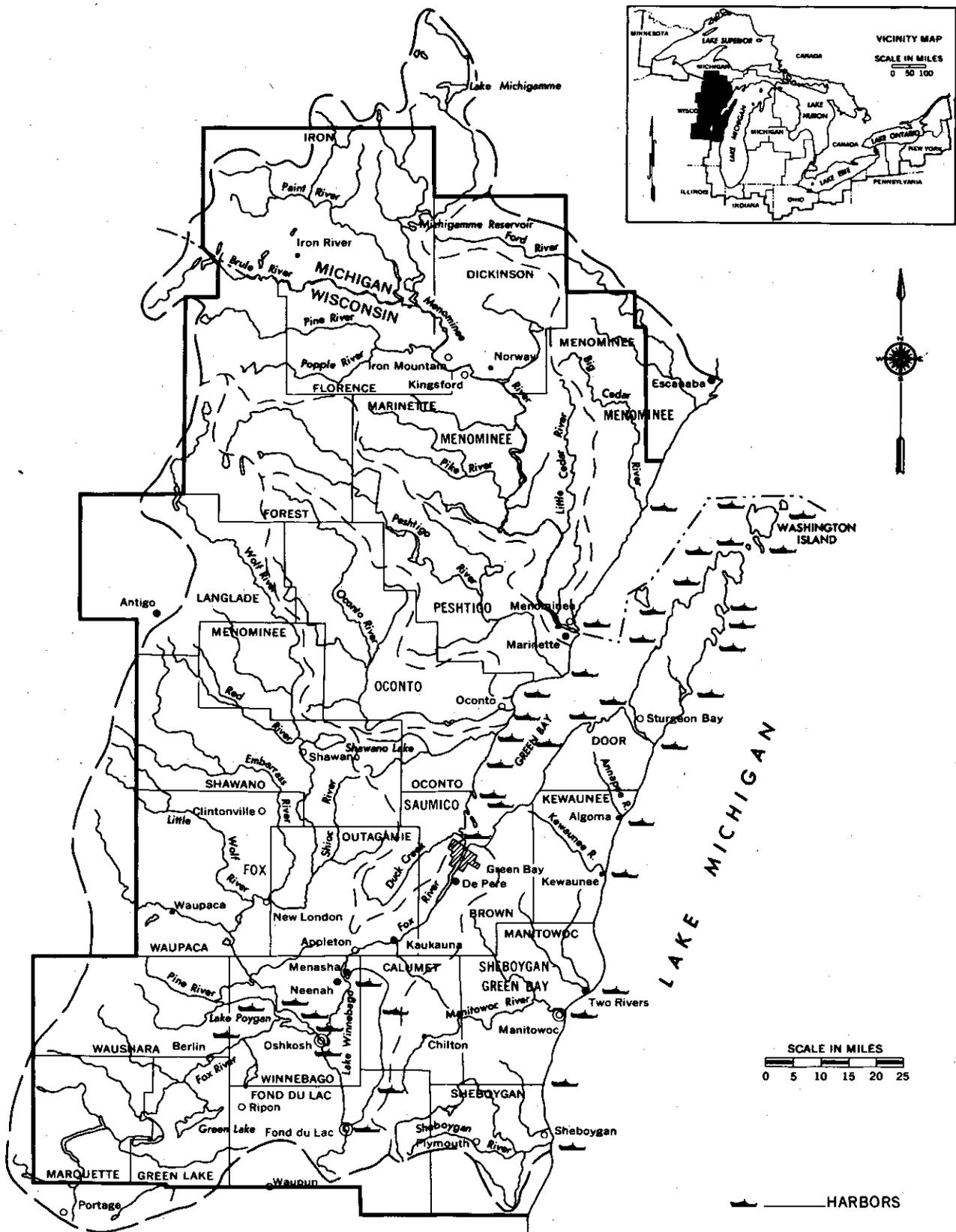


FIGURE R9-15 Harbor Facilities, RBG 2.1

4.2.1.1 Boating Opportunities

Recreational boating opportunities for RBG 2.1 are summarized in Table R9-34, which displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two. Currently there are 34 commercial and recreational navigation harbors along the Great Lakes shores of the area, which have facilities for permanently mooring an estimated 1,536 boats (Table R9-35). Recreational boating in Green Bay is reasonably developed, while it is relatively undeveloped along the area's Lake Michigan shore, generally considered somewhat hazardous because of rocky waters and storms. Recreational boating on Lake Michigan waters is largely limited to the immediate vicinity of the harbors or the sheltered waters of Green Bay.

The State of Wisconsin and private interests have constructed recreational harbors and launching facilities on Lake Winnebago and connecting inland waters, which provide berthing facilities for 1,588 boats. The boats located on Lake Winnebago have access to Lake Michigan through the lower Fox River and Green Bay.

This area has a large number of inland lakes, most of which are suitable for recreational boating (Table R9-36), but only 15 of the

lakes have areas greater than 1,000 acres. Of the total water area, it is estimated that only 250,000 acres are boatable.

This area also has an extensive network of rivers and streams, including 700 miles suitable for canoeing, but lack of access and periodic low flows diminish the recreational value of many of the streams. Main rivers and tributaries identified as good canoeing waters are the Menominee, Wolf, Waupaca, Waupaca Chain, Peshtigo, Brule, Net, Paint, Fence, Michigamme, Pine, Pike, and Popple Rivers.

Extensive reaches of the Fox and Wolf Rivers are also suitable for powered craft. The Wolf River has been improved for recreational navigation from Lake Poygan to the community of New London, a distance of 30 miles. The Fox River is developed for recreational navigation for 32 miles from the community of Berlin to Lake Winnebago. Lake Winnebago and the lower Fox River have been improved and are used extensively by recreational craft.

4.2.1.2 Boating Requirements

Recreational boating requirements for RBG 2.1 are summarized in Table R9-37. The table displays demand, supply, and need for boats berthed and boats launched in terms of the number of boats and the boat-days of use.

In 1968 Michigan registered 58,000 boats

TABLE R9-34 Recreational Boating Opportunities, RBG 2.1 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	67.8	81.3	101.8	84.6	101.4	126.9	16.8	20.1	25.1
Boat-Days of Use	2,033	2,439	3,054	2,536	3,042	3,808	503	603	754
SHELTERED WATERS									
Area	224	224	224	224	224	224	N/A	N/A	N/A
Boat-Days of Use	840	1,008	1,265	840	1,008	1,265	-	-	-
Number of Boats	28.0	33.6	42.2	28.0	33.6	42.2	-	-	-
OFFSHORE WATERS									
Area	477	477	477	678	678	678	201	201	201
Boat-Days of Use	1,193	1,431	1,789	1,696	2,034	2,543	503	603	754
Number of Boats	39.8	47.7	59.6	56.6	67.8	84.7	16.8	20.1	25.1
INLAND LAKES AND STREAMS									
Number of Boats	137.0	150.0	168.0	112.7	136.5	170.6	-24.3	-13.5	2.6
Boat-Days of Use	4,110	4,500	5,040	3,378	4,095	5,118	-732	-405	78
INLAND LAKES									
Acres	N/A	N/A	N/A	250	250	250	-	-	-
Boat-Days of Use	-	-	-	3,267	3,960	4,950	-	-	-
Number of Boats	-	-	-	109.0	132.0	165.0	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	700	700	700	N/A	N/A	N/A
Boat-Days of Use	-	-	-	111	135	168	-	-	-
Number of Boats	-	-	-	3.7	4.5	5.6	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	204.8	231.3	269.8	197.3	237.9	297.5	-7.5	6.6	27.7
Boat-Days of Use	6,143	6,939	8,094	5,914	7,137	8,926	-229	198	832

TABLE R9-35 Great Lakes Harbor Facilities, RBG 2.1

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
Cedar River Harbor, Mich.	0	27	Authorized Federal project scheduled for construction in FY70. Provides refuge for small boats.
Menominee Harbor & River, Mich. & Wis.	139	12	Menominee Yacht Basin and Marina provides facilities and adequate refuge for small boats.
Peshtigo River, Wis. ^{a,d}	0	7	Non-Federal public launching facility.
North Bay Shore Park, Wis.	0	5	Non-Federal public launching facility.
Oconto Harbor, Wis. ^{c,d}	175	14	Facilities for small boats not too good. Provides refuge. Survey report underway.
Pensaukee Harbor, Wis. ^d	6	10	No facilities available for recreational boats. Provides refuge.
Little Suamico, Wis.	0	7	Non-Federal public launching facility.
Big Suamico, Wis.	5	8	No facilities available for small boats. Provides refuge.
Green Bay Harbor, Wis.	177	12	Several marinas provide good facilities. Provides refuge.
Dyckesville, Wis. ^{a,d}	0	9	Non-Federal public launching facility.
Brussels, Wis.	0	9	Non-Federal public launching facility.
Little Sturgeon Bay, Wis.	4	13	Limited facilities available. Area well protected against all N to NE winds.
High Cliff, Wis.	25	4	Private marina. Good protection for small boats except for winds from N to NW.
Sturgeon Bay, Wis.	20	19	Private interests provide good facilities and refuge for small boats.
Egg Harbor, Wis. ^{a,d}	58	7	Good facilities and refuge are provided at private and public docks. Survey report on Door County underway.
Fish Creek, Wis. ^{a,d}	57	8	Good facilities are provided at private and public docks. Area protected from all winds except those from N to NW. Can find protection behind certain docks. Survey report on Door County underway.
Eagle Harbor, Wis. ^{a,d} (Ephraim)	100	5	Good facilities provided at privately operated docks. Well protected from all winds NE to NW clockwise. Wide open to NW except behind docks. Survey report on Door County underway.
Sister Bay, Wis. ^{a,d}	40	5	Good facilities provided at privately operated docks. Good protection in any winds from ENE to W clockwise. Wide open to N or NW except behind docks. Survey report on Door County underway.
Ellison Bay, Wis. ^{a,d}	0	5	Fair anchorage facilities available. Good protection from all winds NNE to WSW clockwise. Wide open from W to N clockwise except behind docks.
Gills Rock, Wis. ^{a,d}	5	9	Limited facilities available. Area is wide open to N, but is safe for all winds from E to W.
Washington Harbor, Wis.	0	4	No docking facilities available. Provides protection from all winds except those from N to NE.

TABLE R9-35(continued) Great Lakes Harbor Facilities, RBG 2.1

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
Jackson Harbor, Wis. ^{c,d}	0	15	No commercial facilities available for small boats. Provides shelter from all winds.
Detroit Harbor, Wis. ^{c,d}	0	4	Limited dock facilities available for small boats. Provides refuge.
North Port, Wis. ^a	0	21	Dock for Washington Island Ferry located here. No protection available. Survey report on Door County underway.
Rowley Bay, Wis.	15	14	Limited facilities. Mostly private docks. Some protection for small boats except for winds from S and SE. Launching ramp.
Baileys Harbor, Wis. ^{a,d}	15	8	Limited facilities for small boats. Open to winds from SE to SW clockwise. Has some fully protected spots. Survey report on Door County underway.
Jacksonport, Wis.	0	17	Non-Federal public launching facility.
Sturgeon Bay & Lake Michigan Ship Canal, Wis.	250	16	Arrowhead breakwaters and canal provide refuge.
Algoma Harbor, Wis.	40	12	Limited facilities for small boats available. Refuge provided by breakwaters.
Kewaunee Harbor, Wis.	15	26	Limited facilities for small boats available. Provides refuge.
Two Rivers, Wis.	98	6	
Manitowoc	36	13	
Cleveland	0	13	Non-Federal public launching facility.
Sheboygan	<u>87</u>	29	
Total	1,536		
<u>Lake Winnebago Area</u> (Wisconsin)			
High Cliff	120		
Calumet County Park	75		
Calumet Harbor	125		
Fond du Lac	195		
Pioneer Inn Harbor	190		
Millers Bay	88		
Fox River	260		
Wolf River	207		
Lake Winneconne	225		
Berlin	<u>103</u>		
Total	<u>1,588</u>		
Combined Total	3,124		

^aSites which should be studied in the interest of refuge or basing small boats.

^bHarbors where construction of authorized improvements, not yet initiated, should be undertaken in the interest of small boats.

^cConstructed harbors which warrant further study to determine advisability of further improvement of general navigation facilities in the interest of small boats.

^dHarbors where improvements by local interests in interest of small boats are needed.

TABLE R9-36 Inland Lakes, RBG 2.1

State	Number of Lakes ^a	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Michigan ^b	533	35,430	1	25
Wisconsin ^c	1,025	278,100	14	590
Total	1,558	313,530	15	615

^aLakes less than 10 acres in area are not included

^bDepartment of the Interior, Bureau of Outdoor Recreation

^cWisconsin Department of Natural Resources

and Wisconsin registered 63,200 in this 23-county area. Registered boats are distributed uniformly throughout the area, although slightly concentrated on Lake Winnebago. Currently there are approximately six registered boats for every 100 residents.

The State of Wisconsin does not require registration of canoes or sailboats less than 12 feet long. The State of Michigan does not require registration of canoes, sailboats, or other nonpowered craft. However, comparative data indicate that the number of these unregistered craft is approximately equivalent to 20 percent of the registered small-boat fleet. This means approximately 13,000 additional boats are located in this area.

Analysis of boat registration data shows that 95 percent of recreational craft are 20 feet or less in length. This is assumed to be true for the unregistered portion of the small-boat fleet, as well.

Nonresident boating demand satisfied in River Basin Group 2.1 is calculated to be 2,784,000 boat days, the equivalent of approximately 90,000 boats or approximately 150 percent of the registered fleet. These estimates are based on data obtained by the State of Michigan while investigating origins and destinations for boating activities in an area comparable to RBG 2.1. Composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet. Table R9-38 shows the composition of existing and future combined resident (registered and unregistered) and nonresident small-boat fleets using waters within RBG 2.1.

The existing resident boating demand satisfied within the area is estimated at 93 percent of the resident fleet. This, along with the present nonresident demand, is the total recreational boating demand satisfied in River Basin Group 2.1.

4.2.1.3 Recreational Boating Program

The recreational boating program for RBG 2.1 is summarized in Table R9-39, which displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, has studies

TABLE R9-37 Recreational Boating Requirements, RBG 2.1 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	26.0	33.0	42.0	11.0	13.0	16.0	15.0	20.0	26.0
Boat-Days of Use	780	990	1,260	330	390	480	450	600	780
BOATS BERTHED									
Number of Boats	2.6	3.3	4.2	1.0	1.0	1.0	1.6	2.3	3.2
Boat-Days of Use	78	99	126	30	30	30	48	69	96
BOATS LAUNCHED									
Number of Boats	23.4	29.7	37.8	10.0	12.0	15.0	13.4	17.7	22.8
Number of Launchings	702	891	1,134	300	360	450	402	531	684
INLAND LAKES AND STREAMS									
Number of Boats	147.0	184.0	235.0	137.0	150.0	168.0	10.0	34.0	67.0
Boat-Days of Use	4,410	5,520	7,050	4,110	4,500	5,040	300	1,020	2,010
BOATS BERTHED									
Number of Boats	68.0	86.0	109.0	65.0	65.0	65.0	3.0	21.0	44.0
Boat-Days of Use	2,040	2,580	3,070	1,950	1,950	1,950	90	630	1,320
BOATS LAUNCHED									
Number of Boats	79.0	98.0	126.0	72.0	87.0	103.0	7.0	11.0	23.0
Number of Launchings	2,370	2,940	3,780	2,160	2,610	3,090	210	330	690
RIVER BASIN GROUP TOTAL									
Number of Boats	173.0	217.0	277.0	148.0	163.0	184.0	25.0	54.0	93.0
Boat-Days of Use	5,190	6,510	8,310	4,440	4,890	5,520	750	1,620	2,790

TABLE R9-38 Existing and Future Small-Boat Fleet, RBG 2.1 (Thousands)

	1969	1980	2000	2020
Number of Boats				
Resident ^a	71.0	71.0	89.0	114.0
Nonresident ^b	90.0	102.0	128.0	163.0
Total	161.0	173.0	217.0	277.0
Composition				
< 12 feet (32.0%)	51.5 ^c	55.3	69.5	88.7
12 - 20 feet (63.0%)	101.5 ^d	109.0	137.0	174.0
20 - 30 feet (4.0%)	6.4 ^e	6.9	8.7	11.1
30 - 40 feet (0.7%)	1.1 ^f	1.2	1.5	1.9
> 40 feet (0.3%)	0.5 ^g	0.5	0.65	0.83

^aRegistered boats + 20% (unregistered boats) x 93% (use in area).

^bRegistered boats x 150%.

^cTotal includes 22.7 resident and 28.8 nonresident boats.

^dTotal includes 44.8 resident and 56.7 nonresident boats.

^eTotal includes 2.8 resident and 3.6 nonresident boats.

^fTotal includes 0.5 resident and 0.6 nonresident boats.

^gTotal includes 0.2 resident and 0.3 nonresident boats.

in progress to determine the feasibility of constructing additional small-boat harbors along shores of Lake Michigan in River Basin Group 2.1. The description and status of these studies are summarized in Table R9-40.

The priority ranking of alternatives determined that program elements should increase the use of existing water area rather than develop additional water surface area.

Because present programs do not provide for facilities adequate to meet the projected needs, an updated program concerning small-boat harbor development on Lake Michigan is essential to the expansion of recreational boating on these waters. A better system to inform recreational boaters of weather conditions and forecasts is also needed.

The ultimate disposition of navigation facilities in the Fox River between Lake Winnebago and Green Bay, Wisconsin, is important to the further development of recreational navigation in this area. This reach of the river was initially improved with the construction of 19 locks and nine dams, which assured six-foot water depths for commercial navigation. With the decline and subsequent disappearance of all scheduled commercial traffic on the waterway in 1960, only recreational navigation remains. The State of Wisconsin and the Corps of Engineers will determine if the locks and dams should be improved, eliminated, or maintained.

TABLE R9-39 Recreational Boating Program, RBG 2.1 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	15.0	20.0	26.0	6.1	16.2	29.8	8.9	3.8	+3.8
Boat-Days of Use	450	600	780	184	486	893	266	114	+113
INLAND LAKES AND STREAMS									
Number of Boats	10.0	34.0	67.0	2.9	7.4	10.9	7.1	26.6	56.1
Boat-Days of Use	300	1,020	2,010	86	223	327	214	797	1,683
RIVER BASIN GROUP TOTAL									
Number of Boats	25.0	54.0	93.0	9.0	23.6	40.7	16.0	30.4	52.3
Boat-Days of Use	750	1,620	2,790	270	709	1,220	480	911	1,570
PROGRAM ELEMENT									
STRUCTURAL		N/A	N/A				N/A	N/A	N/A
UNITS									
Great Lakes									
1. Marinas				1,800	4,200	6,000			
2. Harbors				60	140	200			
3. Access				35	80	125			
Inland Lakes and Streams									
1. Marinas				1,000	2,000	2,500			
2. Lake Access				6	15	15			
3. Stream Access				40	100	140			
4. Restoration				4,000	8,000	8,000			
5. Impoundments				0	0	0			

TABLE R9-40 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 2.1

Locality	Purpose	Status
Coast of Door County, including Ellison Bay, Wis.	To determine whether additional small-craft harbors are necessary along the coast of Door County	Final report on several individual harbors is scheduled for completion in 1974
Oconto Harbor, Wis.	To determine whether betterment or expansion of the existing project is advisable	Detailed project report underway
Shore of Green Bay within Oconto, Brown, Kewaunee, & Marinette Counties, Wis.	To determine whether additional small-craft harbors are necessary along the coast of the study area	Deferred. Lack of probability of local cooperation.
West Shore of Lake Michigan between Kenosha & Kewaunee, Wis.	To determine whether additional small-craft harbors are necessary along the coast of the study area	Study underway. Completion scheduled for 1975.
Cedar River Harbor, Mich.	To determine the advisability of providing a harbor for small-craft. Small-boat harbor recommended.	Improvement authorized by River and Harbor Act of 1965
Port Washington Harbor, Wis.	Improvement of outer harbor	Detailed project report underway

This area has a large quantity of inland waters, but if recreational boating is to develop as projected, additional improved waters must be provided. Development of additional access sites to these and existing waters is also required.

Additional access to Lake Michigan is essential to provide for future boating needs. It is suggested that each access site provide parking for at least 50 cars with trailers. Each facility of this kind could provide approximately 4,000, 4,800 and 6,000 user days in 1980, 200, and 2020 respectively. One hundred twenty-five sites will be required on the Great Lakes by 2020.

Inland waters would require additional marinas with 2,500 berths by 2020.

Zoning to reduce the space standard (water surface allocated to each boat) from six to five acres is another means of meeting boating demand on inland waters. Existing use is already approximately 4.8 acres per boat and this value should not be reduced.

There are 8,000 acres of inland waters in this area unsuitable for recreational boating due to poor water quality. If these waters were restored, they would provide additional boat-day use capacity and improve boating in the area. Launching and berthing facilities still would be required to provide access to waters.

Each inland lake access site should provide parking for 50 cars with trailers so that it could provide 12,000 user days annually [$50 \times$ turnover factor (2) \times length of season (150 days) \times 0.8 (weather factor)]. Because of work and leisure-time patterns, maximum capacity used will be 33 percent in 1980, 40 percent in 2000, and 50 percent in 2020, or approximately 4,000, 4,800, and 6,000 user days in 1980, 2000, and 2020 respectively.

The power boating capacity of the Wolf and Fox Rivers has not been included in these estimates. Capacities for these rivers are approximately 115,000 boat days annually or 90 miles \times 20 boats per mile (estimate) \times 120 days \times 0.8 (weather factor) \times turnover of 2.

4.2.1.4 Program Costs

Recreational boating program costs for RBG 2.1 are shown in Table R9-41. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.2.2 River Basin Group 2.2 (Lake Michigan Southwest)

River Basin Group 2.2 is located on the southwest side of Lake Michigan (Figure R9-16). Planning Subarea 2.2 defines the area by political (county) boundaries, encompassing a seven-county area of Wisconsin, a six-county area of Illinois, and a four-county area of Indiana. PSA 2.2 contains 8,303 square miles (5,315,800 acres), of which 1.9 percent is rivers, inland lakes, and embayments. Nine of the counties border Lake Michigan with a mainland shoreline of 190.5 miles. River Basin Group 2.2 is defined as the hydrologic area draining into the southwest end of Lake Michigan. The major watershed is the Chicago-Milwaukee complex. RBG 2.2 drains 2,174 square miles (1,392,000 acres).

Major urban centers in this area are Milwaukee, Racine, and Kenosha in Wisconsin; Chicago, Illinois; and the Hammond-Gary complex in Indiana. The PSA 2.2 population, which was 9.5 million in 1970, is expected to be 11 million by 1980, 13.8 million by the year 2000, and 17.4 million by 2020.

4.2.2.1 Boating Opportunities

Recreational boating opportunities for RBG 2.2 are summarized in Table R9-42. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

Currently there are 30 commercial and recreational harbors along the Lake Michigan shores of this area. Private and local interests, in addition to the States of Wisconsin, Illinois, and Indiana, and the Federal government, have engaged in the construction of these harbors. Information concerning location, estimated number of boats permanently moored, and type of installation is given in Table R9-43. Federal authorization has been given to study harbor improvements at Port Washington, south Milwaukee County, and Racine in Wisconsin; Zion and Highland Park in Illinois; and Gary, Indiana. Lake Michigan waters are unfavorable for small-craft boating except in the vicinity of the harbors where refuge is readily available.

Due to the topography and extensive development of the area, possible impoundment sites are few. Of the two potential sites currently under investigation, one is located in the Milwaukee River basin in northeastern Washington County, Wisconsin, and the other is located in the Little Calumet River basin on a small stream in Porter County, Indiana.

The area's major watersheds are the Milwaukee River, Cedar Creek, Root River, North Branch of the Chicago River, and the Calumet River. The Calumet-Sag Channel and the

TABLE R9-41 Recreational Boating Program Costs, RBG 2.1

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
		Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL										
Great Lakes										
1. Marinas	(berths)	1,800	5,040	2,520	2,400	6,720	16,800	1,800	5,040	28,560
2. Harbors	(acres)	60	9,600	960	80	12,800	6,400	60	9,600	10,880
3. Access	(each)	35	2,625	263	45	3,375	1,725	45	3,375	3,075
Inland Lakes and Streams										
1. Marinas	(berths)	1,000	2,800	1,400	1,000	2,800	8,400	500	1,400	12,600
2. Lake Access	(each)	6	450	45	9	675	315	0	0	450
3. Stream Access	(each)	40	300	30	60	450	210	40	300	360
4. Restoration	(acres)	4,000	20,000	2,000	4,000	20,000	12,000	0	0	16,000
5. Impoundment	(acres)	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS										
Federal			16,487	1,649		18,650	10,325		6,637	15,382
Non-Federal Public			16,488	1,649		18,650	10,325		6,638	15,383
Private			7,840	3,920		9,520	25,200		6,440	41,160

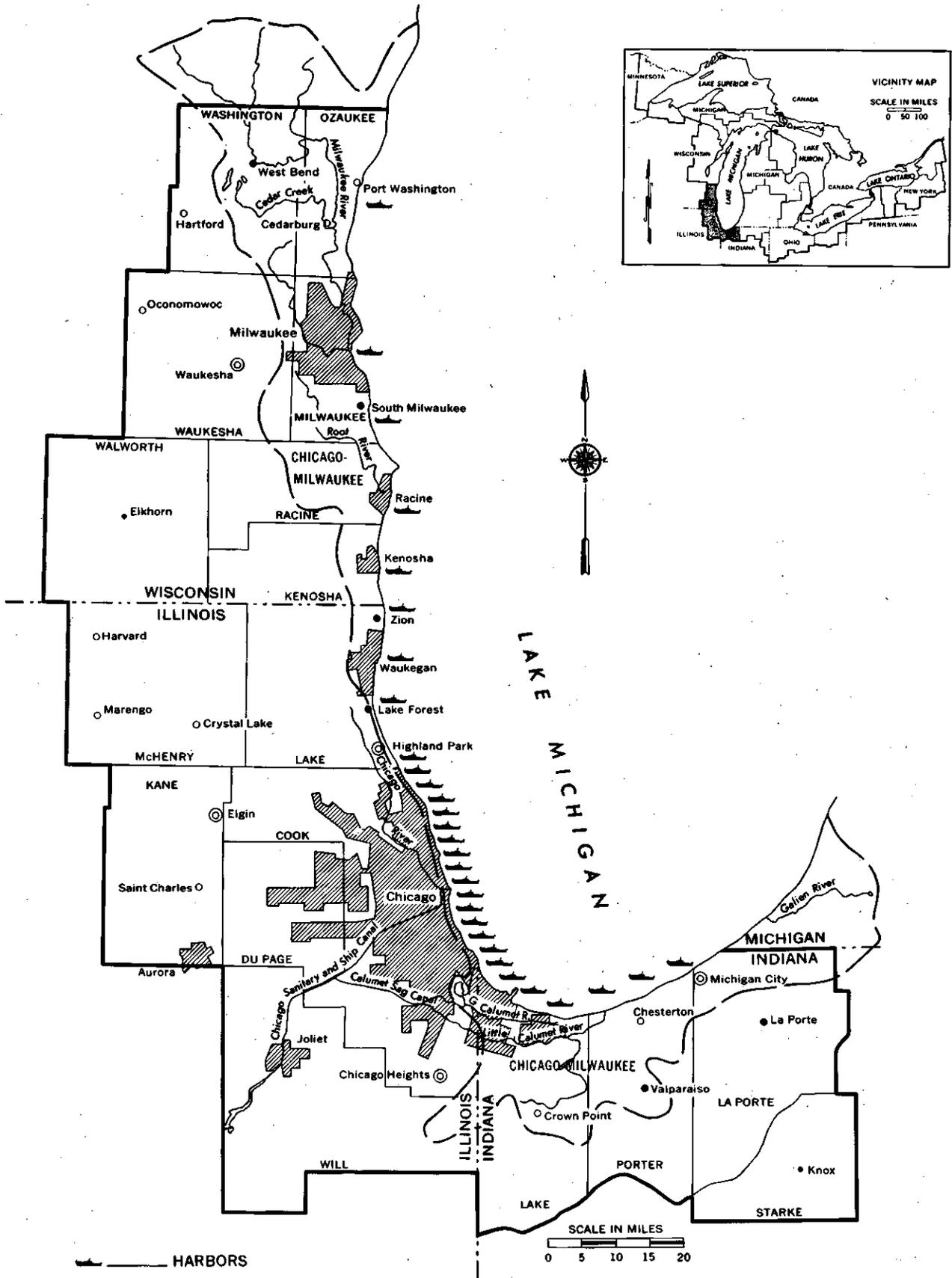


FIGURE R9-16 Harbor Facilities, RBG 2.2

TABLE R9-42 Recreational Boating Opportunities, RBG 2.2 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	37.5	45.4	56.8	45.8	55.5	69.4	8.3	10.1	12.6
Boat-Days of Use	1,123	1,362	1,702	1,373	1,665	2,081	250	303	379
SHELTERED WATERS									
Area	0	0	0	0	0	0	0	0	0
Boat-Days of Use	0	0	0	0	0	0	0	0	0
Number of Boats	0	0	0	0	0	0	0	0	0
OFFSHORE WATERS									
Area	454	454	454	555	555	555	101	101	101
Boat-Days of Use	1,123	1,362	1,702	1,373	1,665	2,081	250	303	379
Number of Boats	37.5	45.4	56.8	45.8	55.5	69.4	8.3	10.1	12.6
INLAND LAKES AND STREAMS									
Number of Boats	17.1	18.9	21.6	7.5	9.1	11.4	-9.6	-9.8	-10.2
Boat-Days of Use	511	568	647	228	274	342	-283	-294	-305
INLAND LAKES									
Acres	N/A	N/A	N/A	16	16	16	N/A	N/A	N/A
Boat-Days of Use	-	-	-	208	250	312	-	-	-
Number of Boats	-	-	-	6.9	8.3	10.4	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	125	125	125	N/A	N/A	N/A
Boat-Days of Use	-	-	-	20	24	30	-	-	-
Number of Boats	-	-	-	0.6	0.8	1.0	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	54.6	64.3	78.4	53.3	64.6	80.8	-1.3	0.3	2.4
Boat-Days of Use	1,634	1,930	2,349	1,601	1,939	2,423	-33	9	74

Chicago Sanitary and Ship Canal are in the Mississippi River basin.

Inland lakes within PSA 2.2 have a total water surface area of approximately 79,300 acres (Table R9-44). These waters, in addition to portions of the Chicago and Milwaukee Rivers, are used extensively by recreational boaters. The water surface area within RBG 2.2 is approximately 20,000 acres of which 16,000 acres are boatable.

The number of inland lakes in this area is small when compared to areas in the north. Boating opportunities are further reduced because there are few lakes in the area suitable for recreational boating, and those that are suitable are crowded beyond their desirable capacity. Existing boat-day use, as measured by the number of existing boats in the area, has reached approximately 200 percent of the total season inland lake capacity, based on six acres per boat and a turnover of two. If the turnover is two, there are, on the average, only three acres for each boat.

This area has an extensive network of rivers and streams with a combined total length in excess of 500 miles. Of this total stream mileage, approximately 125 miles have been identified as suitable for canoeing. However, canoeing is not widely pursued on these streams because of the high degree of area development and poor water quality. Available boating waters in River Basin Group 2.2 are summarized in Table R9-45.

Boat-day use on Great Lakes waters has reached 78 percent of desirable seasonal capacity, based on existing leisure-time patterns. It should be noted that changing work and leisure-time patterns will increase the capacity of existing waters in time. The use factor determines what percent of total seasonal capacity can be used under the work and leisure patterns for the planning periods.

4.2.2.2 Boating Requirements

The recreational boating requirements for RBG 2.2 are summarized in Table R9-46. The table displays the demand, supply, and need for boats berthed and launched in terms of the number of boats and the boat-days of use.

In 1968 the States of Illinois, Indiana, and Wisconsin recorded 150,486 registered boats in the 17-county study area. The majority of the registered boats, 54.5 percent, are located in Cook County, Illinois, and Milwaukee County, Wisconsin (41,000 in each). Overall there is an average of 1.54 registered boats per 100 persons.

The total number of canoes, sailboats, and similar small craft located in this area is not known. The State of Indiana does not require registration of these watercraft. Wisconsin requires registration of canoes and sailboats if they are 12 feet or longer. Sailboats must also be registered in Illinois if they are 12 feet

TABLE R9-43 Great Lakes Harbor Facilities, RBG 2.2

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
Port Washington, Wis.	35	29	Public launching facility.
Milwaukee, Wis.	805	11	Public and private marina and private yacht club.
So. Milwaukee, Wis.	88	15	Private yacht club facilities.
Racine, Wis.	224	14	Public and private marina and private yacht club.
Kenosha, Wis.	136	7	Public and private marina and private yacht club.
State Line Marina, Wis.	132	11	Private marina.
Waukegan, Ill.	145	4	Public and private marina and private yacht club.
Great Lakes Naval Training Center	131	10	
Near Highland Park, Ill.	0	9	Public launching facilities.
Wilmette, Ill.	281	9	Public marina and private yacht club.
Chicago, Ill. area	2,979		Public and private marinas and private yacht club facilities.
Montrose		1	
Belmont		1	
Diversey		3	
Chicago		2	
Burnham Park		5	
Jackson Park		2	
Rainbow Park		2	
Calumet Harbor, Ill.	0	1	Public launching facility.
Calumet Park, Ill.	0	3	Public launching and private yacht club facilities.
Whiting Park, Ill.	0	2	Public launching and private yacht club facilities.
Indiana Harbor, Ind.	44	2	Private marina facilities.
Buffington Harbor, Ind.	0	5	Commercial
Gary Harbor, Ind.	0	3	Commercial.
Gary small boat Harbor, Ind.	0	5	Public launching facilities.
Burns Ditch, Ind.	577	3	Public and private marina.
Burns Waterway Harbor, Ind.	0	14	Commercial
Michigan City, Ind.	<u>531</u>	10	Public and private marina and private yacht club facilities.
Total	6,108		

TABLE R9-44 Inland Lakes, RBG 2.2

State	Number of Lakes	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Wisconsin	200	38,000	1+	---
Illinois	91 ^a	36,500	1	---
Indiana	20	4,800	---	---
Total	311	79,300	2+	---

^aLakes less than 40 acres are not included

TABLE R9-45 Boating Opportunities, RBG 2.2

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	16,000	--
Streams (miles)		
Usable	125	--
Total	500	40
Great Lakes Waters		
Open Acres	454,000	27
Sheltered Acres	---	--
Total	454,000	27

or longer. However, data obtained in comparable areas indicate that the total number of unregistered craft is equal to approximately 20 percent of the registered small-boat fleet, or in this area, an additional 30,000 small craft.

Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length. This is assumed to be true of the unregistered portion of the small-boat fleet. Composition of the resident (registered and unregistered) small-boat fleet in this area is shown in Table R9-47.

Only a moderate number of nonresident boaters use RBG 2.2 because of its limited quantity of inland waters and lack of harbor facilities on Lake Michigan. Nonresident demand satisfied in this area is estimated at 244,000 boat days. This figure is equivalent to approximately 8,100 boats or four percent of the resident fleet. These estimates are based on data concerning origins and destinations of boating activities obtained by the State of Michigan in a comparable area.

The resident fleet, which was 180,000 boats in 1968, is expected to grow to 213,000 in 1980, to 268,000 in 2000, and to 336,000 in 2020. The existing resident boating demand satisfied within the area is estimated to be 90 percent of the resident boats more than 30 feet long and approximately 50 percent of the remaining resident fleet. The resident and the present nonresident demand total the recreational

boating demand currently satisfied in River Basin Group 2.2. Craft using the boatable waters within the area are expected to increase from 97,400 in 1970 to 184,400 by 2020 (Table R9-48).

4.2.2.3 Recreational Boating Program

The recreational boating program for RBG 2.2 is summarized in Table R9-49, which displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

An updated small-boat harbor program on Lake Michigan is essential to the expansion of recreational boating on these waters. The present programs do not provide for adequate facilities to meet the existing demand. The deficit of facilities will increase proportionately to the projected growth in boating.

This area has a limited quantity of inland waters. Additional improved waters must be provided if recreational boating is to develop as projected. Even if the potential reservoir sites in the area were developed, they would not provide adequate waters to meet the present boating demands, much less the projected increase.

The Federal government, in cooperation with State and local governments, has a number of studies in progress to determine the feasibility of constructing additional or improving the existing small-boat harbors along the shores of Lake Michigan. The description and status of the studies are summarized in Table R9-50.

The suggested framework should consist of development of harbors and marinas on Lake Michigan and development of additional access. Construction of single-purpose impoundments is not considered practical for meeting the demand for boating waters.

A standard of six acres of water surface per boat is desirable, but existing use is as low as three acres per boat. Further reduction is undesirable. Since existing waters are being used beyond desirable capacity, the remaining need must be transferred to Great Lakes waters or to inland waters either in other river basin groups or in the Upper Mississippi River basin.

4.2.2.4 Program Costs

Recreational boating program costs for

TABLE R9-46 Recreational Boating Requirements, RBG 2.2 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	35.0	44.0	55.3	25.6	29.7	35.7	9.4	14.3	19.6
Boat-Days of Use	1,050	1,320	1,659	768	891	1,071	282	429	588
BOATS BERTHED									
Number of Boats	11.4	14.2	18.0	6.0	6.0	6.0	5.4	8.2	12.0
Boat-Days of Use	342	426	540	180	180	180	162	246	360
BOATS LAUNCHED									
Number of Boats	23.6	29.8	37.3	19.6	23.7	29.7	4.0	6.1	7.6
Number of Launchings	708	894	1,119	588	711	891	120	183	228
INLAND LAKES AND STREAMS									
Number of Boats	20.5	25.7	32.3	17.1	19.0	21.6	3.4	6.7	10.7
Boat-Days of Use	614	771	969	512	568	648	102	203	321
BOATS BERTHED									
Number of Boats	9.9	12.5	15.6	8.3	8.3	8.3	1.6	4.2	7.3
Boat-Days of Use	297	374	469	248	248	248	49	126	221
BOATS LAUNCHED									
Number of Boats	10.6	13.2	16.7	8.8	10.7	13.3	1.8	2.5	3.4
Number of Launchings	317	397	500	264	320	400	53	77	100
RIVER BASIN GROUP TOTAL									
Number of Boats	55.5	69.7	87.6	42.7	48.7	57.3	12.8	21.0	30.3
Boat-Days of Use	1,664	2,091	2,628	1,280	1,459	1,719	384	632	909

TABLE R9-47 Composition of Resident Small-Boat Fleet, RBG 2.2

Length	Number of Boats	Percent of Total
Less than 12 feet	48,731	27.0
12 - 20 feet	113,706	63.0
20 - 30 feet	14,439	8.0
30 - 40 feet	2,527	1.4
More than 40 feet	1,083	0.6
Total	180,486	100.0

RBG 2.2 are shown in Table R9-51. Framework program elements are quantified, and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.2.3 River Basin Group 2.3 (Lake Michigan Southeast)

River Basin Group 2.3 is located on the southeast side of Lake Michigan (Figure R9-17). Planning Subarea 2.3 defines the area by political (county) boundaries. It encompasses a 19-county area of Michigan and a six-county area of Indiana, containing 14,225 square miles (9,126,400 acres), of which 1.8 percent is rivers, inland lakes, and embayments. Four of

TABLE R9-48 Existing and Future Small-Boat Fleet, RBG 2.2 (thousands)

	1970	1980	2000	2020
Number of Boats				
Resident ^a	89.3	108.3	136.0	171.0
Nonresident ^b	8.1	8.5	10.7	13.4
Total	97.4	116.8	146.7	184.4
Composition				
< 12 feet (27.0%)	26.2 ^c	31.3	39.1	48.9
12 - 20 feet (63.0%)	60.1 ^d	72.5	91.1	114.6
20 - 30 feet (8.0%)	7.6 ^e	9.2	11.6	14.5
30 - 40 feet (1.4%)	2.4 ^f	2.8	3.4	4.5
> 40 feet (0.6%)	1.1 ^g	1.2	1.5	1.9

^aIn the resident fleet, 50% are under 30 feet in length + 90% of the number are over 30 feet.

^bResident boats x 4%.

^cTotal includes 24.0 resident and 2.2 nonresident boats.

^dTotal includes 55.0 resident and 5.1 nonresident boats.

^eTotal includes 7.0 resident and 0.6 nonresident boats.

^fTotal includes 2.3 resident and 0.1 nonresident boats.

^gTotal includes 1.0 resident and 0.1 nonresident boats.

the Michigan counties border on Lake Michigan, with a mainland shoreline of 107.9 miles. River Basin Group 2.3 is defined as the hydrologic area draining into the southeast end of Lake Michigan. The major watersheds include the St. Joseph River basin, the Black River

TABLE R9-49 Recreational Boating Program, RBG 2.2 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	9.4	14.3	19.6	5.5	10.5	16.6	3.9	3.8	3.0
Boat-Days of Use	282	429	588	164	315	498	118	114	90
INLAND LAKES AND STREAMS									
Number of Boats	3.4	6.7	10.7	0	0	0	3.4	6.7	10.7
Boat-Days of Use	102	203	321	0	0	0	102	203	321
RIVER BASIN GROUP TOTAL									
Number of Boats	12.8	21.0	30.3	5.5	10.5	16.6	7.3	10.5	13.7
Boat-Days of Use	384	632	909	164	315	498	220	317	411
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	3,000	6,000	9,000	-	-
2. Harbors	acres	-	-	-	100	200	300	-	-
3. Access	each	-	-	-	20	30	40	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	0	0	0	-	-
2. Lake Access	each	-	-	-	0	0	0	-	-
3. Stream Access	each	-	-	-	0	0	0	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-50 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 2.2

Locality	Purpose	Status
West Shore of Lake Michigan between Kenosha & Kewaunee, Wis.	To determine necessity of additional small-craft harbors along the coast.	Study underway. Completion dependent upon future allocation of funds.
Kenosha Harbor, Wis.	To determine advisability of further improvements for navigation with particular reference to small boats and recreational craft.	Deferred pending assurances of local cooperation.
Wilmette Harbor, Ill.	To determine feasibility of providing facilities for small-boat harbor.	Initiation dependent upon allocation of funds.
Zion Harbor, Ill.	To consider advisability of providing a small-craft harbor.	Initiation dependent upon allocation of funds.
Highland Park, Ill.	To consider advisability of providing a small-craft harbor.	Deferred. Lack of local interest.
Little Calumet River & tributaries, Indiana & Illinois	Review of previous reports to determine advisability of providing improvements for flood control and recreational navigation.	Scheduled for completion in FY 72.
Small-boat Harbor at Gary, Ind.	Harbor for recreational craft.	Restudy.

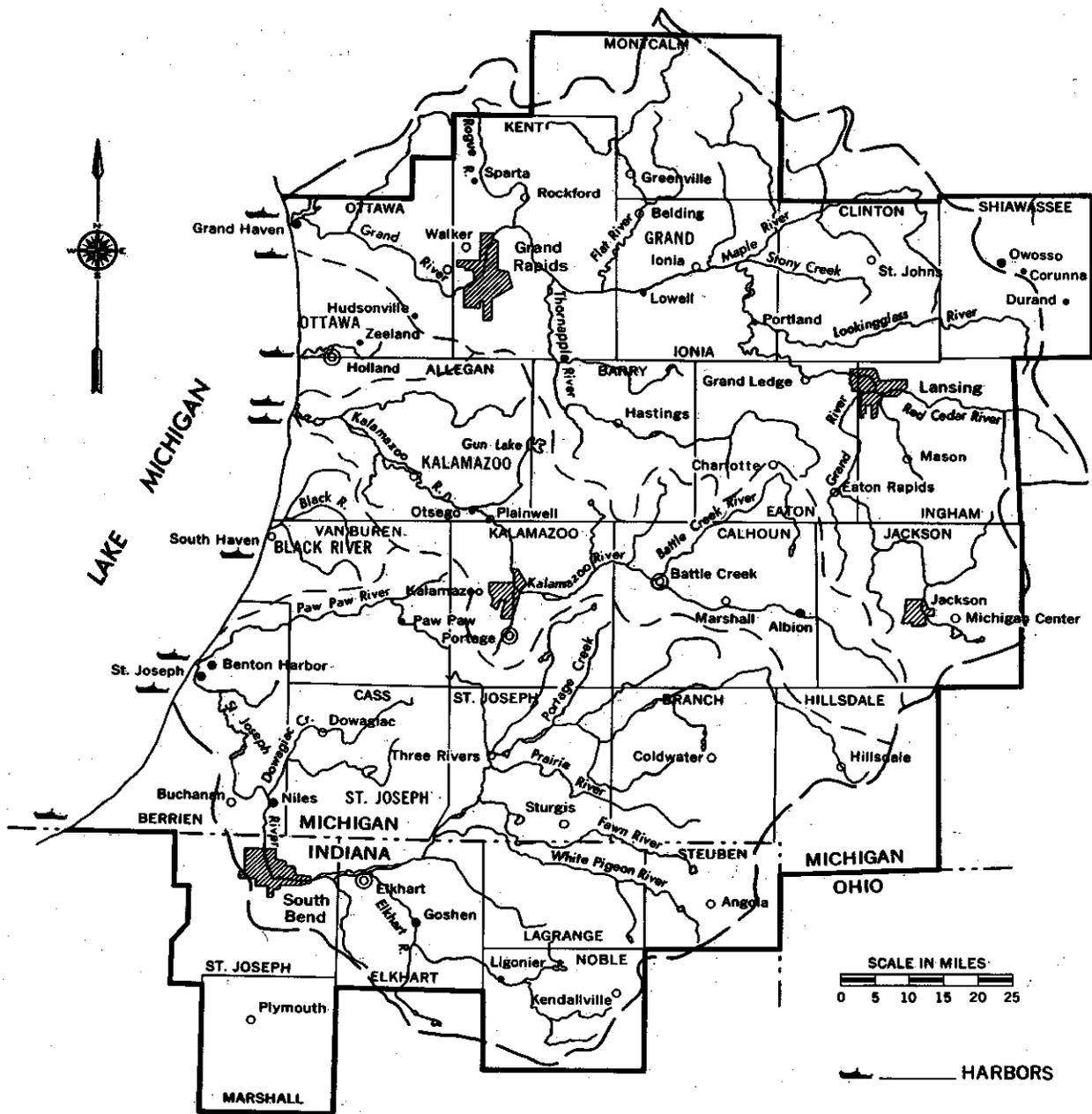


FIGURE R9-17 Harbor Facilities, RBG 2.3

complex, the Kalamazoo River basin, and the Grand River basin. RBG 2.3 drains 12,952 square miles (8,292,000 acres).

Major urban centers in this area are Grand Rapids, Lansing, Jackson, and Kalamazoo, Michigan, and South Bend, Indiana. The area's total population, 2.2 million in 1960 and 2.5 million in 1970, is projected to be 2.9 million in 1980, 3.8 million in 2000, and 4.8 million in 2020.

4.2.3.1 Boating Opportunities

Recreational boating opportunities for RBG 2.3 are summarized in Table R9-52. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The State of Michigan and the Federal government have cooperated in constructing nine

TABLE R9-51 Recreational Boating Program Costs, RBG 2.2

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
				Great Lakes								
1. Marinas	(berths)	\$ 2,800	3,000	8,400	4,200	3,000	8,400	25,200	3,000	8,400	42,000	
2. Harbors	(acres)	160,000	100	16,000	1,600	100	16,000	9,600	100	16,000	16,000	
3. Access	(each)	75,000	20	1,500	150	10	750	750	10	750	1,050	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	0	0	0	0	0	0	0	0	0	
2. Lake Access	(each)	75,000	0	0	0	0	0	0	0	0	0	
3. Stream Access	(each)	7,500	0	0	0	0	0	0	0	0	0	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0	
TOTAL PROGRAM COSTS												
Federal				8,750	875		8,375	5,175		8,375	8,525	
Non-Federal Public				8,750	875		8,375	5,175		8,375	8,525	
Private				8,400	4,200		8,400	25,200		8,400	42,000	

commercial or recreational boat harbors (Table R9-53). Except for these harbors, which provide mooring for approximately 2,600 boats longer than 20 feet, there are no sheltered Great Lakes waters in this area. The shoreline, which consists of almost continuous sand beaches backed by low and high sand dunes, is generally unbroken. Consequently, most boating activities are limited to a small area immediately offshore from the harbors.

Even though Lake Michigan has more than 156,000 acres available for boating, the lack of suitable mooring places and harbor spacing limits use of the waters. The need for additional mooring on the Great Lakes indicated by the fact that only 37.5 percent of the boats longer than 20 feet are now moored on Lake Michigan. The Great Lakes Cruising Club indicates that few moorings are available in harbors. However, it may not be desirable to load waters to capacity. Lake Michigan can support 13,000 boats on a seasonal basis. Capacity can be increased by decreasing the acres per boat or by increasing the turnover factor. Existing use is 2,600 berthed boats. Data on launching in this area are not available, but if 30 percent of boats use Lake Michigan water, approximately 30,000 boats are launched into Lake Michigan waters each season. This is much more than the capacity of existing waters, and actual use is probably much less. The use factor and the time open waters are usable affect capacity estimates. If open waters were usable 100 percent of the time every day of the 120-day season, approximately 62,000 boats could be supported, assuming each makes 30 boat trips (boat days).

Fortunately this area has a number of inland lakes, most of which are suitable for recreational boating (Table R9-54). The Indiana Department of Natural Resources has identified 278 lakes in the Indiana portion of RBG 2.3 with a total water surface area of 16,400 acres. Most of these water areas are small. Only one lake has an area in excess of 1,000 acres. Forty public fishing sites on these lakes have been developed by the State of Indiana. The Michigan Department of Natural Resources has identified approximately 2,224 lakes in the Michigan portion of RBG 2.3, with a total water surface area of 115,000 acres and 130 access sites. Six of these lakes have areas in excess of 1,000 acres. It was assumed that 106,000 acres of the total water area are boatable.

This area has an extensive network of rivers and streams, of which many are suitable for canoeing. There are approximately 1,000 main stream river miles and approximately 5,500 miles of small tributaries of the main stem. Periodic low flows and the lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunity on these streams. The lower 14 miles of the Grand River has been improved for commercial navigation and is heavily used by small recreational craft. Main rivers and tributaries identified as good canoeing waters are the Grand, Maple, Thornapple, Black, Kalamazoo, Paw Paw, St. Joseph, Fawn, and Pigeon Rivers. These rivers offer 900 miles suitable for canoeing. A summary of the total boating opportunity in RBG 2.3 is presented in Table R9-55.

TABLE R9-52 Recreational Boating Opportunities, RBG 2.3 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	13.0	15.6	19.5	25.6	30.7	38.4	12.6	15.1	18.9
Boat-Days of Use	390	468	585	768	921	1,151	378	453	566
SHELTERED WATERS									
Area	0	0	0	0	0	0	N/A	N/A	N/A
Boat-Days of Use	0	0	0	0	0	0	-	-	-
Number of Boats	0	0	0	0	0	0	-	-	-
OFFSHORE WATERS									
Area	156	156	156	307	307	307	151	151	151
Boat-Days of Use	390	468	585	768	921	1,151	378	453	566
Number of Boats	13.0	15.6	19.5	25.6	30.7	38.4	12.6	15.1	18.9
INLAND LAKES AND STREAMS									
Number of Boats	84.6	103.0	128.0	50.8	61.8	77.2	-33.8	-41.2	-50.8
Boat-Days of Use	2,538	3,090	3,840	1,523	1,863	2,315	-1,015	-1,227	-1,525
INLAND LAKES									
Acres	N/A	N/A	N/A	106	106	106	N/A	N/A	N/A
Boat-Days of Use	-	-	-	1,380	1,690	2,099	-	-	-
Number of Boats	-	-	-	46.0	56.0	70.0	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	900	900	900	N/A	N/A	N/A
Boat-Days of Use	-	-	-	143	173	216	-	-	-
Number of Boats	-	-	-	4.8	5.8	7.2	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	97.6	118.6	147.5	76.4	92.5	115.6	-21.2	-26.1	-31.9
Boat-Days of Use	2,928	3,558	4,425	2,291	2,784	3,466	-637	-774	-959

TABLE R9-53 Great Lakes Harbor Facilities, RBG 2.3

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
MICHIGAN			
New Buffalo	473	25	Small-Boat Harbor
St. Joseph	300	1	Deep-Draft Harbor
Benton Harbor	124	23	Deep-Draft Harbor
South Haven		21	Deep-Draft Harbor
Douglas		1	Small-Boat Harbor
Saugatuck		8	Small-Boat Harbor
Holland		23	Deep-Draft Harbor
Port Sheldon			Small-Boat Harbor
Grand Haven		12	Deep-Draft Harbor

TABLE R9-54 Inland Lakes, RBG 2.3

State	Number of Lakes	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Indiana	278	16,400	1	40
Michigan	2,224	115,000	6	130
Total	2,502	131,400	7	170

4.2.3.2 Boating Requirements

Recreational boating requirements for RBG 2.3 are summarized in Table R9-56, which displays the demand, supply, and need for boats berthed and launched.

TABLE R9-55 Boating Opportunities, RBG 2.3

Classification	Total Supply
Inland Waters	
Lakes (acres)	131,000
Streams (miles)	6,500
Great Lakes Waters	
Open Acres	156,000
Sheltered Acres	---
Total	156,000

NOTE: Number of access sites is estimated at 340.

In 1968 the States of Indiana and Michigan recorded 142,000 registered boats in the 25-county area. Boats are uniformly distributed throughout the area, with the maximum number registered in Kent County (Grand Rapids Standard Metropolitan Statistical Area, 24,000 boats). There are 5.9 boats in the area for every 100 people.

Analysis of registered boat classification data (Table R9-57) indicates that 95 percent of the registered boats in the area are less than 20 feet long. Approximately 7,200 recreational boats are longer than 20 feet and require mooring facilities. Many of these vessels (2,550 or 35.7 percent) are moored in nine small-boat

TABLE R9-56 Recreational Boating Requirements, RBG 2.3 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	67.0	87.0	113.0	32.6	39.6	47.6	34.4	47.4	65.4
Boat-Days of Use	2,010	2,610	3,390	978	1,188	1,428	1,032	1,422	1,962
BOATS BERTHED									
Number of Boats	8.0	11.0	14.0	2.6	2.6	2.6	5.4	8.4	11.4
Boat-Days of Use	240	330	420	78	78	78	162	252	342
BOATS LAUNCHED									
Number of Boats	59.0	76.0	99.0	30.0	37.0	45.0	29.0	39.0	54.0
Number of Launchings	1,770	2,280	2,970	900	1,110	1,350	870	1,170	1,620
INLAND LAKES AND STREAMS									
Number of Boats	101.0	131.0	168.0	84.6	91.6	101.6	16.4	39.4	66.4
Boat-Days of Use	3,030	3,930	5,040	2,538	2,748	3,048	492	1,182	1,992
BOATS BERTHED									
Number of Boats	61.6	80.0	103.0	51.6	51.6	51.6	10.0	28.4	51.4
Boat-Days of Use	1,848	2,400	3,090	1,548	1,548	1,548	300	852	1,542
BOATS LAUNCHED									
Number of Boats	39.4	51.0	65.0	33.0	40.0	50.0	6.4	11.0	15.0
Number of Launchings	1,182	1,530	1,950	990	1,200	1,500	192	330	450
RIVER BASIN GROUP TOTAL									
Number of Boats	168.0	218.0	281.0	117.2	131.2	149.2	50.8	86.8	131.8
Boat-Days of Use	5,040	6,540	8,430	3,516	3,936	4,476	1,524	2,604	3,954

TABLE R9-57 Composition of Registered and Unregistered Small-Boat Fleet, RBG 2.3

Length	Resident Fleet			Total
	Registered		Unregistered	
	Percent	No. of Boats	No. of Boats	
Less than 12 feet	32.0	45,400	7,000	52,400
12 - 20 feet	63.0	89,400	7,000	96,400
20 - 30 feet	4.0	5,700	---	5,700
30 - 40 feet	0.7	1,000	---	1,000
More than 40 feet	0.3	500	---	500
Total	100.0	142,000	14,000	156,000

harbors on Lake Michigan. Canoes and small sailing boats are not registered in Indiana or Michigan, but comparative data have indicated that these small craft include an additional 14,000 vessels, the equivalent of 10 percent of the registered resident fleet. Fifty percent of these vessels are assumed to be less than 12 feet long. The other 50 percent are said to be vessels between 12 and 20 feet long.

Information gathered by the State of Michigan indicates that the moderate number of nonresident boats using waters in RBG 2.3 is equal to approximately 17 percent of the registered boats.

The resident fleet in River Basin Group 2.3 is expected to grow to 219,000 boats by 2020. An estimated 60 percent of resident boat use is within RBG 2.3. These statistics are based on a survey of a similar area (RBG 3.2), because

data for RBG 2.3 are not available. Use by resident boats and nonresident demand makes up the total recreational boating demand for RBG 2.3 as shown in Table R9-58.

Although the existing facilities are crowded and many boaters must travel to other areas, this area has a relatively high (5.9) participation factor (boats per 100 residents), a result of the proximity of RBG 2.3 to quality Great Lakes and inland waters.

4.2.3.3 Recreational Boating Program

The recreational boating program for RBG 2.3 is summarized in Table R9-59. The table displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes and streams. Needs programmed are

TABLE R9-58 Existing and Future Small-Boat Fleet, RBG 2.3 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	94.0	131.0	170.0	219.0
Nonresident ^b	26.6	37.0	48.0	62.0
Total	120.6	168.0	218.0	281.0
Composition				
< 20 feet (95%)	114.6 ^c	160.0	207.0	267.0
> 20 feet (5%)	6.0 ^d	8.0	11.0	14.0

^aRegistered boats + 10% (unregistered boats) x 60% (use in area).

^bRegistered boats x 17%.

^cTotal includes 89.3 resident and 25.3 nonresident boats.

^dTotal includes 4.7 resident and 1.3 nonresident boats.

also shown as elements of a framework program.

Studies to determine the feasibility of constructing additional small-boat harbors under way by the Federal government in cooperation with the States and local governments are shown in Table R9-60.

Because waters in this area are already being used to capacity, a positive boat management program is essential to protect the existing water resource and meet the projected needs. Overriding features of this program include regulation and management of boating activities to better use the water resource, improvement of resource management and protection, and development of facilities to increase the resource base.

Little should be done to inland waters al-

TABLE R9-59 Recreational Boating Program, RBG 2.3 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	34.4	47.4	65.4	4.5	12.3	19.2	29.9	35.1	46.2
Boat-Days of Use	1,032	1,422	1,962	136	369	576	896	1,053	1,386
INLAND LAKES AND STREAMS									
Number of Boats	16.4	28.0	40.0	1.1	7.7	17.0	15.3	20.3	23.0
Boat-Days of Use	492	840	1,200	32	232	510	460	608	690
RIVER BASIN GROUP TOTAL									
Number of Boats	50.8	75.4	105.4	5.6	20.0	36.2	45.2	55.4	69.2
Boat-Days of Use	1,524	2,604	3,954	168	601	1,086	1,356	1,661	2,076
PROGRAM ELEMENT	N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL UNITS									
Great Lakes									
1. Marinas berths	-	-	-	750	1,800	2,400	-	-	-
2. Harbors acres	-	-	-	25	60	80	-	-	-
3. Access each	-	-	-	30	70	90	-	-	-
Inland Lakes and Streams									
1. Marinas berths	-	-	-	0	1,500	3,000	-	-	-
2. Lake Access each	-	-	-	0	25	50	-	-	-
3. Stream Access each	-	-	-	40	70	100	-	-	-
4. Restoration acres	-	-	-	0	0	0	-	-	-
5. Impoundments acres	-	-	-	0	10,000	20,000	-	-	-

TABLE R9-60 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 2.3

Locality	Purpose	Status
Grand River, Mich.	To determine solutions to water and related land resource problems, including flood control, water quality, navigation, power, fish and wildlife, recreation water supply, & others	Comprehensive Basin Study scheduled for completion in FY72
St. Joseph, Mich.	To consider improvement of the St. Joseph River from St. Joseph to Mottville (approx. 95 miles) for recreational boating	Scheduled for completion in FY76

ready used to capacity, except to provide additional stream and lake access for small boats and canoes. Harbor and marina construction on Lake Michigan should be pursued in this area to provide berthing and launching of recreational boats. A program to meet all berthing needs would require 80 acres of harbors. This is so ambitious that it is very likely that some of the needs must either be transferred or not satisfied.

Increasing boating water area is a direct method of enhancing boating opportunity in this area. In general, large and small impoundments located near the large metropolitan centers are the most efficient device for increasing boat ownership because many people demand the development of suitable boating water within a short driving distance before they will make the substantial investment in recreational boating equipment. Since few opportunities exist in this area for this kind of water resources development, potential reservoir sites should be acquired before these lands are converted into subdivisions. An element of this plan calls for 20,000 acres of new waters intensively managed for recreational boating.

Federal and State water resource agencies have many continuing studies and authorized projects that can be integrated into this framework, including the Grand River Type II Study, which proposes a number of reservoirs and channel improvements for boating. The State of Michigan has an extensive grant-in-aid program that provides public access for boating and fishing. This program involves a review of all lakes in the State to determine their carrying capacity, in order to establish a desirable public boating capacity for each lake. A program with an annual appropriation level of \$200,000 is now under way in this area.

4.2.3.4 Program Costs

Recreational boating program costs for RBG 2.3 are shown in Table R9-61. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.2.4 River Basin Group 2.4 (Lake Michigan Northeast)

River Basin Group 2.4 curves around the

northeastern part of Lake Michigan (Figure R9-18). Planning Subarea 2.4 defines the area by political (county) boundaries and encompasses a 21-county area of Michigan. It contains 13,182 square miles (8,439,000 acres), of which 4 percent is rivers, inland lakes, and embayments. Thirteen of the counties border on Lake Michigan, having a mainland shoreline of 784.1 miles and an island shoreline of 72.1 miles. River Basin Group 2.4 is defined as the hydrologic area draining into the northwest end of Lake Michigan. Major watersheds include the Muskegon River basin, the Manistee River basin, the Sable River complex, the Traverse complex, the Seul Choix-Groscap complex, the Manistique River basin, the Escanaba River basin, and the Bay de Noc complex. RBG 2.4 drains 13,333 square miles (8,536,000 acres).

Major urban centers in this area are Escanaba, Traverse City, Frankfort, Cadillac, Ludington, Big Rapids, Manistee, and Muskegon. Its population, which was 453,000 in 1960 and 497,000 in 1970, is projected to be 547,000 in 1980, 671,000 by 2000, and 841,000 by 2020.

4.2.4.1 Boating Opportunities

Recreational boating opportunities for RBG 2.4 are summarized in Table R9-62, which displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

There are 23 recreational harbors along the Great Lakes shores of the area (Table R9-63), which provide mooring space for 2,400 boats (all of the boats more than 20 feet long). Boating activities are limited to sheltered waters or to the area immediately adjacent to these harbors.

The Michigan Department of Natural Resources has identified 2,297 natural lakes totaling 285,600 acres of water surface in this area, of which approximately 228,000 acres are considered boatable. Many of the lakes are large. Twenty have areas ranging from 1,000 acres to 10,000 acres, and four range from 12 to 27 square miles. There are more than 204 access sites to these lakes.

The area's extensive network of rivers and streams provides approximately 1,600 miles of canoeing waters, but periodic low flows and lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunity on the streams. Main rivers and tributaries identified as good

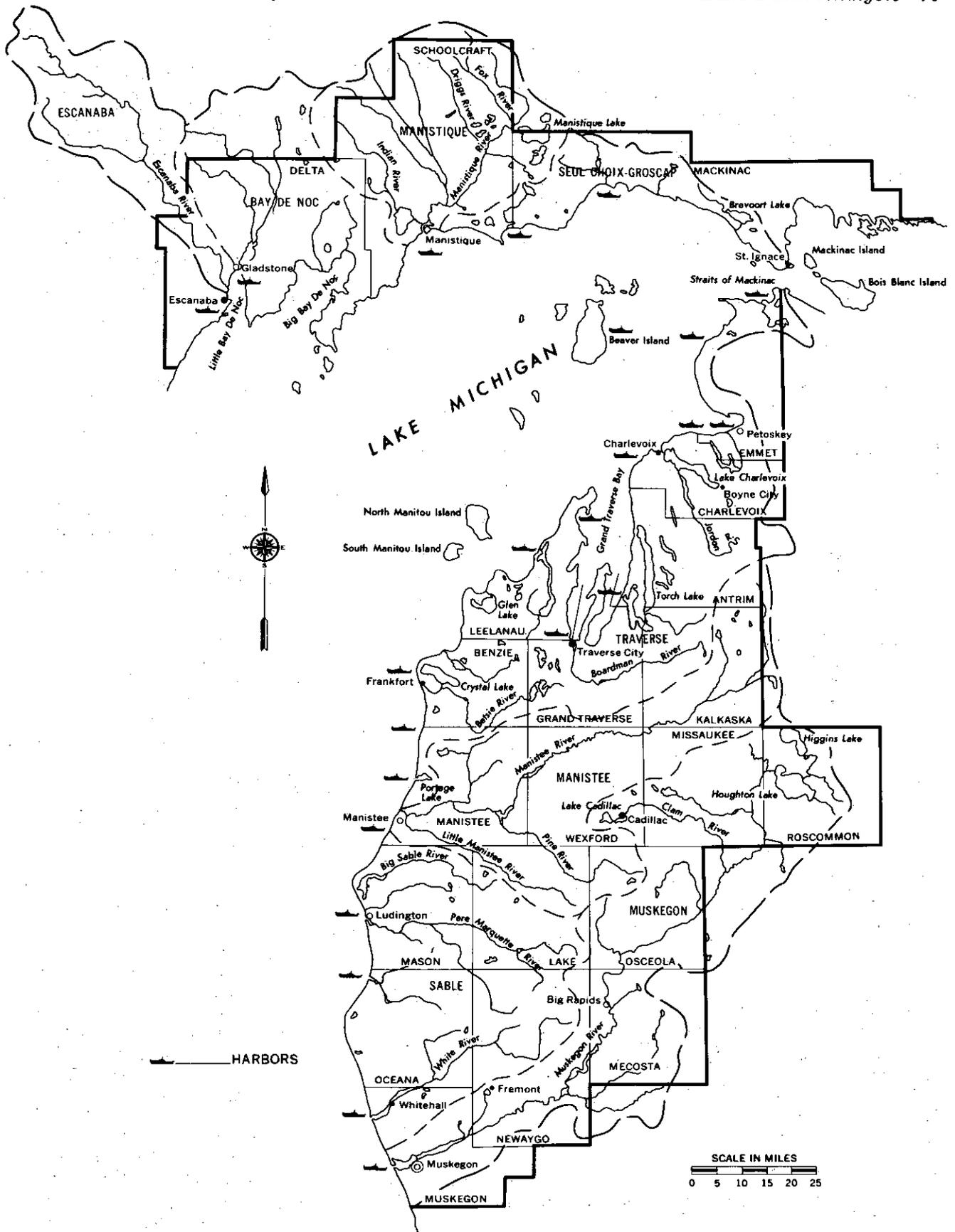


FIGURE R9-18 Harbor Facilities, RBG 2.4

TABLE R9-61 Recreational Boating Program Costs, RBG 2.3

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital	OM&R	Quantity	Capital	OM&R	Quantity	Capital	OM&R
					Costs	Costs		Costs	Costs		Costs	
				(\$1,000)	(\$1,000)		(\$1,000)	(\$1,000)		(\$1,000)	(\$1,000)	
Great Lakes												
1. Marinas	(berths)	\$ 2,800		750	2,100	1,050	1,050	2,940	7,140	600	1,680	11,760
2. Harbors	(acres)	160,000		25	4,000	400	35	5,600	2,720	20	3,200	4,480
3. Access	(each)	75,000		30	2,250	225	40	3,000	1,500	20	1,500	2,400
Inland Lakes and Streams												
1. Marinas	(berths)	2,800		0	0	0	1,500	4,200	4,200	1,500	4,200	12,600
2. Lake Access	(each)	75,000		0	0	0	25	1,875	375	25	1,875	1,125
3. Stream Access	(each)	7,500		40	300	30	30	225	165	30	225	255
4. Restoration	(acres)	5,000		0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000		0	0	0	10,000	50,000	10,000	10,000	50,000	30,000
TOTAL PROGRAM COSTS												
Federal				3,275	327		30,350	7,380		28,400	19,130	
Non-Federal Public				3,275	328		30,350	7,380		28,400	19,130	
Private				2,100	1,050		7,140	11,340		5,880	24,360	

TABLE R9-62 Recreational Boating Opportunities, RBG 2.4 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	73.4	88.1	110.4	125.7	150.9	188.9	52.3	62.8	78.5
Boat-Days of Use	2,202	2,643	3,312	3,772	4,527	5,667	1,570	1,884	2,355
SHIELDED WATERS									
Area	336	336	336	336	336	336	N/A	N/A	N/A
Boat-Days of Use	1,260	1,512	1,898	1,260	1,512	1,898	-	-	-
Number of Boats	42.0	50.4	63.3	42.0	50.4	63.3	-	-	-
OFFSHORE WATERS									
Area	377	377	377	1,005	1,005	1,005	628	628	628
Boat-Days of Use	942	1,131	1,414	2,512	3,015	3,769	1,570	1,884	2,355
Number of Boats	31.4	37.7	47.1	83.7	100.5	125.6	52.3	62.8	78.5
INLAND LAKES AND STREAMS									
Number of Boats	85.8	95.7	110.0	108.6	130.6	163.3	22.8	34.9	53.3
Boat-Days of Use	2,574	2,871	3,300	3,259	3,918	4,898	685	1,047	1,598
INLAND LAKES									
Acres	N/A	N/A	N/A	228	228	228	N/A	N/A	N/A
Boat-Days of Use	-	-	-	3,006	3,611	4,514	-	-	-
Number of Boats	-	-	-	100.2	120.4	150.5	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	1,600	1,600	1,600	N/A	N/A	N/A
Boat-Days of Use	-	-	-	253	307	384	-	-	-
Number of Boats	-	-	-	8.4	10.2	12.8	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	159.2	183.8	220.4	234.3	281.5	352.2	75.1	97.7	131.8
Boat-Days of Use	4,776	5,514	6,612	7,031	8,445	10,565	2,255	2,931	3,953

canoeing waters are the Muskegon, Manistee, Pere Marquette, Boardman, Manistique, Escanaba, Pine, Little Manistee, and Fox Rivers. A summary of boating opportunity in River Basin Group 2.4 is given in Table R9-64. Boat-day use in 1968 reached approximately 29 percent of capacity on Lake Michigan and 68 percent of capacity on the inland waters.

4.2.4.2 Boating Requirements

Recreational boating requirements for RBG

2.4 are summarized in Table R9-65. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the State of Michigan registered 47,466 boats in this area. Muskegon had the largest county count with 8,982 registered boats. The area's high participation factor, approximately 10.1 registered boats for every 100 residents, is attributed to the many inland lakes located near the population center. Michigan does not require registration of canoes, sailboats, or other nonpowered craft,

TABLE R9-63 Great Lakes Harbor Facilities, RBG 2.4

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
MICHIGAN			
Muskegon		13	Federal deep-draft harbor.
White Lake		35	Federal small-boat harbor.
Pentwater		14	Federal small-boat harbor.
Ludington		26	Federal deep-draft harbor.
Manistee		10	Federal deep-draft harbor.
Portage Lake		10	Federal small-boat harbor.
Arcadia		10	Federal small-boat harbor.
Frankfort		40	Federal deep-draft harbor.
Leland		30	Federal small-boat harbor.
Northport		20,23,27 ^a	Non-Federal harbor.
Traverse City		20	Federal small-boat harbor.
Elk Rapids		23	Non-Federal harbor.
Charlevoix		18	Federal deep-draft harbor.
Petoskey		4	Federal small-boat harbor.
Harbor Springs		25	Non-Federal harbor.
Cross Village		24,37 ^b	Federal harbor authorized.
Beaver Island		24	Federal small-boat harbor.
Mackinaw City		8 ^c	Federal small-boat harbor.
Naubinway		30	Non-Federal harbor.
Port Inland		23	Non-Federal harbor.
Manistique		66	Federal deep-draft harbor.
Escanaba	75	7-1/2	Federal deep-draft harbor.
Little Bay de Noc	53		Non-Federal harbor.

^a20 miles to Traverse City, 23 miles to Elk Rapids, 27 miles to Charlevoix.

^b24 miles to Beaver Island, 37 miles to Mackinaw City.

^cTo Mackinac Island.

TABLE R9-64 Boating Opportunities, RBG 2.4

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	285,600	257
Streams (miles)	1,600	26
Great Lakes Waters		
Open Acres	377,000	20
Sheltered Acres	336,000	6
Total	713,000	26

but comparative data indicate that the number of these unregistered boats is equal to approximately 10 percent of the registered fleet, or an additional 4,700 boats.

An analysis of boat registration data shows that 95 percent of the registered fleet is less than 20 feet in length, which is assumed to be true for unregistered boats as well.

The nonresident boating demand satisfied in this area is estimated at 74,300 boats or approximately 142 percent of the number of resident boats, according to Michigan's data. Size distribution of the nonresident fleet is assumed to be the same as that of the resident fleet. Table R9-66 shows the composition of existing and future small-boat fleets using waters in RBG 2.4 assuming that existing patterns of use do not change.

The resident fleet is expected to grow from 51,700 boats in 1968 to 93,500 by 2020. Data supplied by Michigan indicate that 91.9 percent of boating by residents is within RBG 2.4.

4.2.4.3 Recreational Boating Program

The recreational boating program for RBG 2.4 is summarized in Table R9-67. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

Federal and State water resources agencies have many ongoing studies and authorized projects that can be integrated into the plan area, including the State of Michigan's extensive grant-in-aid program, which provides public access for boating and fishing. This program involves a review of all lakes in Michigan to determine their carrying capacity so that the public boating capacity and desirability for each lake can be established.

The Michigan State Waterways Commission, Department of Natural Resources, is the State agency responsible for developing recreational boating facilities, including refuge harbors, docks, launching ramps, channels, anchorage areas, parking areas, access roads, marinas, boating island parks, and public restrooms.

Most of the inland lakes and streams are being used below capacity, but provision of additional access facilities is required to satisfy future demand. Future needs require an additional 15,000 berths and 260 launching sites by 2020. Three thousand more berths and 100 new access sites are needed on Lake Michigan as well.

TABLE R9-65 Recreational Boating Requirements, RBG 2.4 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	42.0	52.5	65.7	32.3	38.6	47.7	9.7	13.9	18.0
Boat-Days of Use	1,260	1,575	1,971	969	1,158	1,431	291	417	540
BOATS BERTHED									
Number of Boats	7.0	8.8	11.0	2.4	2.4	2.4	4.6	6.4	8.6
Boat-Days of Use	210	264	330	72	72	72	138	192	258
BOATS LAUNCHED									
Number of Boats	35.0	43.7	54.7	29.9	36.2	45.3	5.1	7.5	9.4
Number of Launchings	1,050	1,311	1,641	897	1,086	1,359	153	225	282
INLAND LAKES AND STREAMS									
Number of Boats	98.7	122.3	153.0	85.8	95.7	110.0	12.9	26.6	43.0
Boat-Days of Use	2,961	3,669	4,590	2,574	2,871	3,300	387	798	1,290
BOATS BERTHED									
Number of Boats	45.0	56.0	70.0	39.0	39.0	39.0	6.0	17.0	31.0
Boat-Days of Use	1,350	1,680	2,100	1,170	1,170	1,170	180	510	930
BOATS LAUNCHED									
Number of Boats	53.7	66.3	83.0	46.8	56.7	71.0	6.9	9.6	12.0
Number of Launchings	1,611	1,989	2,490	1,404	1,701	2,130	207	288	360
RIVER BASIN GROUP TOTAL									
Number of Boats	140.7	174.8	218.7	118.1	134.3	157.7	22.6	40.5	61.0
Boat-Days of Use	4,221	5,244	6,561	3,543	4,029	4,731	678	1,215	1,830

TABLE R9-66 Existing and Future Small-Boat Fleet, RBG 2.4 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	47.5	55.5	68.6	85.9
Nonresident ^b	74.3	85.2	106.2	132.8
Total	121.8	140.7	174.8	218.7
Composition				
< 12 feet (17.0%)	20.7 ^c	23.9	29.7	37.2
12 - 20 feet (78.0%)	95.0 ^d	109.8	136.3	170.5
20 - 30 feet (4.0%)	4.9 ^e	5.6	7.0	8.8
30 - 40 feet (0.9%)	1.1 ^f	1.3	1.6	2.0
> 40 feet (0.1%)	0.12 ^g	0.14	0.17	0.22

^aRegistered boats + 10% (unregistered boats) x 91.9% (use in area).

^bResident boats x 142%.

^cTotal includes 8.1 resident and 12.6 nonresident boats.

^dTotal includes 37.0 resident and 58.0 nonresident boats.

^eTotal includes 1.9 resident and 3.0 nonresident boats.

^fTotal includes 0.4 resident and 0.6 nonresident boats.

^gTotal includes 0.05 resident and 0.07 nonresident boats.

4.2.4.4 Program Costs

Recreational boating program costs for RBG 2.4 are shown in Table R9-68. Frame-

work program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.3 Lake Huron

Lake Huron is divided into two river basin groups, which are entirely within the State of Michigan.

4.3.1 River Basin Group 3.1 (Lake Huron Northwest)

River Basin Group 3.1 is located on the northwest side of Lake Huron (Figure R9-19). Planning Subarea 3.1 defines the area by political (county) boundaries, encompassing an 11-county area of Michigan's Lower Peninsula. PSA 3.1 contains 6,509 square miles (4,167,000 acres), of which 3.5 percent is rivers, inland lakes, and embayments. Six of the counties border on Lake Huron with a shoreline of 294 miles. River Basin Group 3.1 is defined as the hydrologic area draining into the northwest end of Lake Huron. Major watersheds include the Les Cheneaux complex, the Cheboygan River basin, the Presque Isle complex, the Thunder Bay River basin, the Alcona complex, the Au Sable River basin, and the Rifle-Au Gres complex. RBG 3.1 drains 8,135 square miles (5,208,000 acres).

TABLE R9-67 Recreational Boating Program, RBG 2.4 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	9.7	13.9	18.0	5.6	12.3	21.7	4.1	1.6	+3.7
Boat-Days of Use	291	417	540	168	369	650	123	48	+110
INLAND LAKES AND STREAMS									
Number of Boats	12.9	26.6	43.0	8.8	24.4	43.0	4.1	2.2	0
Boat-Days of Use	387	798	1,290	265	732	1,290	122	66	0
RIVER BASIN GROUP TOTAL									
Number of Boats	22.6	40.5	61.0	14.4	36.7	64.7	8.2	3.8	+3.7
Boat-Days of Use	678	1,215	1,830	433	1,101	1,940	245	114	+110
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	600	1,800	3,000	-	-
2. Harbors	acres	-	-	-	20	60	100	-	-
3. Access	each	-	-	-	40	70	100	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	4,000	10,000	15,000	-	-
2. Lake Access	each	-	-	-	30	70	110	-	-
3. Stream Access	each	-	-	-	40	100	150	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-68 Recreational Boating Program Costs, RBG 2.4

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
		Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL										
Great Lakes										
1. Marinas (berths)	\$ 2,800	600	1,680	840	1,200	3,360	6,720	1,200	3,360	13,440
2. Harbors (acres)	160,000	20	3,200	320	40	6,400	2,560	40	6,400	5,120
3. Access (each)	75,000	40	3,000	300	30	2,250	1,650	30	2,250	2,550
Inland Lakes and Streams										
1. Marinas (berths)	2,800	4,000	11,200	5,600	6,000	16,800	39,200	5,000	14,000	70,000
2. Lake Access (each)	75,000	30	2,250	225	40	3,000	1,500	40	3,000	2,700
3. Stream Access (each)	7,500	40	300	30	60	450	210	50	375	375
4. Restoration (acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment (acres)	5,000	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS										
Federal		0	4,375	437	0	6,050	2,960	0	6,012	5,372
Non-Federal Public		0	4,375	438	0	6,050	2,960	0	6,013	5,373
Private		0	12,880	6,440	0	20,160	45,920	0	17,360	83,440

4.3.1.1 Boating Opportunities

Recreational boating opportunities for RBG 3.1 are summarized in Table R9-69. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The Great Lakes shoreline comprises 263 miles of mainland shore and 31 miles of island shore. Federal and State governments have cooperated in the construction or authorization of 16 small-boat harbors (Table R9-70). Data provided by the Michigan Waterways Commission indicate that these harbors provide moorings for approximately 1,300 boats. It is estimated that launching facilities for at least 3,000 boats are provided.

This 11-county area has a total of approximately 138,800 acres of inland water surface, and approximately 111,000 acres are suitable for recreational boating. More than one-third of this surface, 51,870 acres, is in Cheboygan County where most of Michigan's three largest inland lakes are located. These lakes, connected by rivers, are part of the Inland Waterway, an improved channel and lock system constructed jointly by Federal and State governments. This system provides a 36-mile long watercourse from Conway near Lake Michigan to Cheboygan on Lake Huron. Approximately 210 craft are based along the route in RBG 3.1. There are approximately 146 access sites to the lakes and streams of this area. Most of the main rivers and tributaries in the area, including an estimated 1,400 miles of streams, are good canoeing waters. The Au

Sable River is the most popular. Table R9-71 summarizes the water resources and accessibility related to boating opportunity in River Basin Group 3.1.

Lake Huron waters are being used to approximately 24 percent of capacity while inland waters are being used to 62 percent of capacity.

4.3.1.2 Boating Requirements

Recreational boating requirements for RBG 3.1 are summarized in Table R9-72. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the State of Michigan registered 14,676 boats in this 11-county area, with the largest number (3,278) recorded in Alpena County.

The area's registered craft provide 158,500 boat-activity days annually, assuming each boat is used 30 days per season by an average of 3.6 persons per trip. Canoes and small sailboats without auxiliary power are not registered by the State. The number of resident boats is assumed to be approximately 10 percent greater than the preceding estimate, making the total approximately 16,200. There are approximately 12 registered boats for every 100 residents. This high participation factor is attributed to the proximity of many inland lakes.

The State of Michigan has indicated that the number of nonresident boats using waters in RBG 3.1 is equal to approximately 2.15 times

TABLE R9-69 Recreational Boating Opportunities, RBG 3.1 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	49.7	59.6	74.7	68.5	82.2	103.0	18.8	22.6	28.3
Boat-Days of Use	1,490	1,788	2,241	2,055	2,466	3,089	565	678	848
SHELTERED WATERS									
Area	230	230	230	230	230	230	N/A	N/A	N/A
Boat-Days of Use	863	1,035	1,300	863	1,035	1,300	-	-	-
Number of Boats	28.8	34.5	43.3	28.8	34.5	43.3	-	-	-
OFFSHORE WATERS									
Area	251	251	251	477	477	477	226	226	226
Boat-Days of Use	627	753	941	1,192	1,431	1,789	565	678	848
Number of Boats	20.9	25.1	31.4	39.7	47.7	59.7	18.8	22.6	28.3
INLAND LAKES AND STREAMS									
Number of Boats	34.9	39.6	46.4	56.3	67.6	84.5	21.4	28.0	38.1
Boat-Days of Use	1,047	1,188	1,392	1,688	2,027	2,534	641	839	1,142
INLAND LAKES									
Acres	N/A	N/A	N/A	111	111	111	N/A	N/A	N/A
Boat-Days of Use	-	-	-	1,464	1,758	2,198	-	-	-
Number of Boats	-	-	-	48.8	58.6	73.3	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	1,400	1,400	1,400	-	-	-
Boat-Days of Use	-	-	-	224	269	336	-	-	-
Number of Boats	-	-	-	7.5	9.0	11.2	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	84.6	99.2	121.1	124.8	149.8	187.5	40.2	50.6	66.4
Boat-Days of Use	2,537	2,976	3,633	3,743	4,493	5,623	1,206	1,517	1,990

the number of resident boats or 2.37 times the number of registered boats. The size distribution of the nonresident fleet is assumed to be the same as that of the resident fleet.

The resident fleet in RBG 3.1, which was 16,200 boats in 1968, is expected to grow to 33,000 boats by 2020. An estimated 92.7 percent of the boating use by the resident fleet is on waters within RBG 3.1. This use by the resident boats plus the use by nonresident boats equals the existing demand for RBG 3.1, as shown in Table R9-73.

4.3.1.3 Recreational Boating Program

The recreational boating program for RBG 3.1 is summarized in Table R9-74. The table displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

There are no active recreational boating project studies under way in this area, but there is a need for additional boating facilities, especially on the Great Lakes.

Existing berths on Lake Huron waters are not sufficient to handle the present demand and as many as 3,000 additional berths will be required by 2020. In addition, there will be a need by 2020 for 120 launching facilities, which could be included in harbors satisfying berthing needs.

Berthing for 6,000 boats and the equivalent of 130 launching sites will be needed on inland waters by 2020. It is assumed that berthing costs will be financed privately. The needs for launching facilities on inland waters in this area deserves further consideration.

4.3.1.4 Program Costs

Recreational boating program costs for RBG 3.1 are shown in Table R9-75. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.3.2 River Basin Group 3.2 (Lake Huron Southwest)

River Basin Group 3.2 is located on the southwest side of Lake Huron (Figure R9-20). Planning Subarea 3.2 defines the area by political (county) boundaries, an 11-county area of Michigan. It contains 6,969 square miles (4,461,400 acres), of which 0.8 percent is rivers, inland lakes, and embayments. Three of the counties border on Lake Huron with a shoreline of 149 miles. River Basin Group 3.2 is defined as the hydrologic area draining into the southwest end of Lake Huron. The major watersheds include the Kawkawlin complex,

TABLE R9-70 Great Lakes Harbor Facilities, RBG 3.1

Harbor	Distance to next harbor or refuge	Remarks
<u>MICHIGAN</u>		
Detour	25	Section 107 report underway.
Les Cheneaux Island	26	Authorized Federal small-boat harbor.
St. Ignace	6	Natural or non-Federal harbor-of-refuge.
Mackinac Island	7	Authorized Federal small-boat harbor.
Mackinaw City	18 ^a	Authorized Federal small-boat harbor.
Cheboygan	25	Authorized Federal deep-draft harbor.
Hammond Bay	13	Authorized Federal small-boat harbor.
Rogers City	19	Authorized Federal harbor.
Presque Isle	14	Natural or non-Federal harbor-of-refuge.
Middle Island	26	Section 107 report underway.
Alpena	18	Authorized Federal deep-draft harbor.
Black River	13	Federal harbor authorized but not constructed.
Harrisville	18	Authorized Federal small-boat harbor. Section 107 report underway.
Au Sable	20	Authorized Federal small-boat harbor.
Tawas Bay	25	Federal harbor authorized but not constructed.
Point Lookout (Au Gres River)	30	Authorized Federal small-boat harbor.

^a37 miles from Cross Village, Lake Michigan.

TABLE R9-71 Boating Opportunities, RBG 3.1

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	138,800	131
Streams (miles)	1,400	15
Great Lakes Waters		
Open Acres	251,000	5
Sheltered Acres	230,000	7
Total	481,000	12

the Saginaw River basin, and the Thumb complex. RBG 3.2 drains 8,044 square miles (5,150,000 acres).

4.3.2.1 Boating Opportunities

Recreational boating opportunities for RBG 3.2 are summarized in Table R9-76, which displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

Approximately two-thirds of the area's Great Lakes shoreline lies along Saginaw Bay. The other one-third consists of the more severe and less sheltered coast of Lake Huron. Seven recreational boat harbors have been authorized (Table R9-77). Among them is Harbor Beach, which was built for lake carrier traffic but is also used by many small craft. Approximately 2,100 berths are available.

This area has a much smaller inland water surface base than RBG 3.1 with only approxi-

TABLE R9-73 Existing and Future Small-Boat Fleet, RBG 3.1 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	15.0	19.4	24.5	30.6
Nonresident ^b	34.8	44.7	56.8	71.0
Total	49.8	64.1	81.3	101.6
Composition				
< 12 feet (32.0%)	16.0 ^c	20.6	26.2	32.7
12 - 20 feet (62.8%)	31.3 ^d	40.3	51.1	63.8
20 - 30 feet (4.5%)	2.3 ^e	2.9	3.7	4.6
30 - 40 feet (0.4%)	0.20 ^f	0.26	0.33	0.41
> 40 feet (0.1%)	0.05 ^g	0.06	0.08	0.10

^aRegistered boats + 10% (unregistered boats) x 92.7% (use in area).

^bResident boats x 215%.

^cTotal includes 4.8 resident and 11.2 nonresident boats.

^dTotal includes 9.4 resident and 21.9 nonresident boats.

^eTotal includes 0.7 resident and 1.6 nonresident boats.

^fTotal includes 0.06 resident and 0.14 nonresident boats.

^gTotal includes 0.02 resident and 0.03 nonresident boats.

mately 29,575 acres of inland lake surface, of which 24,000 acres are available for recreational boating. None of the lakes is very large. There are approximately 75 access sites on the area's lakes and rivers. Most of the area's 1,500 miles of main streams and tributary riv-

TABLE R9-72 Recreational Boating Requirements, RBG 3.1 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	25.6	32.5	40.6	12.8	15.3	18.7	12.8	17.2	21.9
Boat-Days of Use	768	975	1,218	384	459	561	384	516	657
BOATS BERTHED									
Number of Boats	4.4	5.6	7.0	1.3	1.3	1.3	3.1	4.3	5.7
Boat-Days of Use	132	168	210	39	39	39	93	129	171
BOATS LAUNCHED									
Number of Boats	21.2	26.9	33.6	11.5	14.0	17.4	9.7	12.9	16.2
Number of Launchings	636	807	1,008	345	420	522	291	387	486
INLAND LAKES AND STREAMS									
Number of Boats	38.5	48.8	61.0	34.9	39.6	46.4	3.6	9.2	14.6
Boat-Days of Use	1,155	1,464	1,830	1,047	1,188	1,392	108	276	438
BOATS BERTHED									
Number of Boats	16.2	20.5	25.7	12.6	12.6	12.6	3.6	7.9	13.1
Boat-Days of Use	486	615	771	378	378	378	108	237	393
BOATS LAUNCHED									
Number of Boats	22.3	28.3	35.3	22.3	27.0	33.8	0	1.3	1.5
Number of Launchings	669	849	1,059	669	810	1,014	0	39	45
RIVER BASIN GROUP TOTAL									
Number of Boats	64.1	81.3	101.6	47.7	54.9	65.1	16.4	26.4	36.5
Boat-Days of Use	1,923	2,439	3,048	1,431	1,647	1,953	492	792	1,095

TABLE R9-74 Recreational Boating Program, RBG 3.1 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	12.8	17.2	21.9	4.4	13.8	25.4	8.4	3.4	+3.5
Boat-Days of Use	384	516	657	132	414	762	252	102	+105
INLAND LAKES AND STREAMS									
Number of Boats	3.6	9.2	14.6	3.6	11.0	20.0	0	+1.8	+5.4
Boat-Days of Use	108	276	438	108	330	600	0	+54	+162
RIVER BASIN GROUP TOTAL									
Number of Boats	16.4	26.4	36.5	8.0	24.8	45.4	8.4	1.6	+8.9
Boat-Days of Use	492	792	1,095	240	744	1,362	252	48	+267
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	600	1,800	3,000	-	-
2. Harbors	acres	-	-	-	20	60	100	-	-
3. Access	each	-	-	-	30	80	120	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	1,500	4,000	6,000	-	-
2. Lake Access	each	-	-	-	10	30	30	-	-
3. Stream Access	each	-	-	-	30	70	100	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-75 Recreational Boating Program Costs, RBG 3.1

PROGRAM ELEMENT	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
			Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL											
Great Lakes											
1. Marinas	(berths)	\$ 2,800	600	1,680	840	1,200	3,360	6,720	1,200	3,360	13,440
2. Harbors	(acres)	160,000	20	3,200	320	40	6,400	2,560	40	6,400	5,120
3. Access	(each)	75,000	30	2,250	225	50	3,750	1,650	40	3,000	3,000
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	1,500	4,200	2,100	2,500	7,000	15,400	2,000	5,600	28,000
2. Lake Access	(each)	75,000	10	750	75	20	1,500	600	20	1,500	1,200
3. Stream Access	(each)	7,500	30	225	23	40	300	150	30	225	255
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS											
Federal				3,212	321		5,975	2,480		5,562	4,787
Non-Federal Public				3,213	322		5,975	2,480		5,563	4,788
Private				5,880	2,940		10,360	22,120		8,960	41,440

ers are suitable for canoeing. The lower 20 miles of the Saginaw River has been improved for commercial navigation, and it is also heavily used by small recreational craft. Boating opportunity in RBG 3.2 is summarized in Table R9-78.

4.3.2.2 Boating Requirements

Recreational boating requirements for RBG 3.2 are summarized in Table R9-79. The table displays demand, supply, and need for boats berthed and boats launched, in terms of number of boats and boat-days of use.

In 1968, 71 percent of the 55,079 boats registered in the 11-county area were located in the three counties with the three major urban areas. There are approximately 5.3 boats in the area for every 100 persons. Ninety-six percent of the registered boats are less than 20 feet long, and they generally do not use seasonal moorings at commercial marina facilities. Approximately 2,217 recreational craft are more than 20 feet long and normally dock in rented or boater-owned mooring facilities. Approximately 2,067 or 93 percent of these craft are moored in 10 major centers of marina development on Lake Huron and at the mouth of the Saginaw River. Canoes and

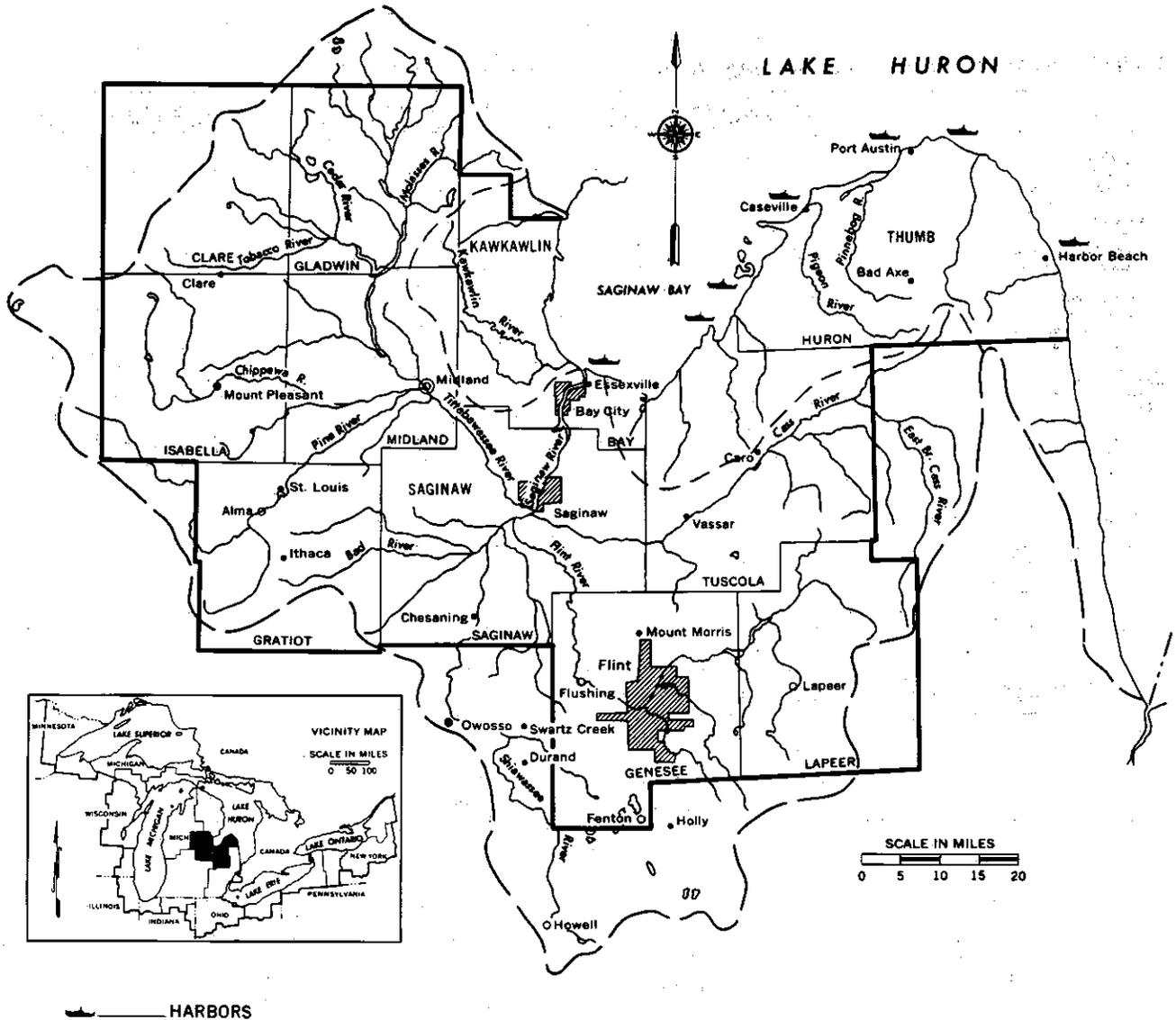


FIGURE R9-20 Harbor Facilities, RBG 3.2

sailing craft without auxiliary power are not registered in Michigan, but comparative data indicate that these small craft are approximately 10 percent of the registered small-boat fleet, or an additional 5,500 boats in River Basin Group 3.2.

Nonresident boating demand satisfied in this area is estimated by the State of Michigan at 45,000 boats or approximately 75 percent of resident boats. The size distribution of nonresident boats is assumed to be the same as that of registered resident boats.

The Michigan Waterways Commission indicates that nonresident boat use in the area is equivalent to approximately 56.8 percent of the resident fleet. Use by the resident and nonresident fleets equals the total demand for

boating facilities in RBG 3.2. Number and size composition of boats using waters in RBG 3.2 are shown in Table R9-80.

4.3.2.3 Recreational Boating Program

The recreational boating program for RBG 3.2 is summarized in Table R9-81. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

Federal studies are under way to consider the advisability of participating with the State in constructing or improving harbors. The Michigan Waterways Commission is re-

TABLE R9-76 Recreational Boating Opportunities, RBG 3.2 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	25.6	30.7	38.5	30.9	37.0	46.4	5.3	6.3	7.9
Boat-Days of Use	768	921	1,155	926	1,110	1,391	158	189	236
SHELTERED WATERS									
Area	138	138	138	138	138	138	N/A	N/A	N/A
Boat-Days of Use	518	621	780	518	621	780	-	-	-
Number of Boats	17.3	20.7	26.0	17.3	20.7	26.0	-	-	-
OFFSHORE WATERS									
Area	100	100	100	163	163	163	63	63	63
Boat-Days of Use	250	300	375	408	489	611	158	189	236
Number of Boats	8.3	10.0	12.5	13.6	16.3	20.4	5.3	6.3	7.9
INLAND LAKES AND STREAMS									
Number of Boats	55.9	62.1	71.0	18.4	22.3	27.8	-37.5	-39.8	-43.2
Boat-Days of Use	1,677	1,863	2,130	554	668	835	-1,123	-1,195	-1,295
INLAND LAKES									
ACRES	N/A	N/A	N/A	24	24	24	N/A	N/A	N/A
Boat-Days of Use	-	-	-	316	380	475	-	-	-
Number of Boats	-	-	-	10.5	12.7	15.8	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	1,500	1,500	1,500	N/A	N/A	N/A
Boat-Days of Use	-	-	-	238	288	360	-	-	-
Number of Boats	-	-	-	7.9	9.6	12.0	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	81.5	92.8	109.5	49.3	59.3	74.2	-32.2	-33.5	-35.3
Boat-Days of Use	2,345	2,784	3,285	1,480	1,778	2,226	-865	-1,006	-1,059

TABLE R9-77 Great Lakes Harbor Facilities, RBG 3.2

Harbor	Distance to next harbor or refuge	Remarks
MICHIGAN		
Saginaw River	20	Authorized Federal deep-draft harbor. Survey report underway.
Sebawaing	10	Authorized Federal small-boat harbor.
Bay Port	10	Authorized Federal small-boat harbor.
Caseville	17	Authorized Federal small-boat harbor.
Port Austin	8	Authorized Federal small-boat harbor.
Grindstone City	22	Section 107 report underway.
Harbor Beach	14	Authorized Federal deep-draft harbor. Section 107 report underway.

sponsible for the development of recreational boating facilities by the State of Michigan.

Although there is a demand for more access facilities, most lakes in this area are being used near their desirable capacity. Therefore, it is recommended that few access facilities be

constructed on inland waters. However, an additional 5,000 berths have been programmed by 2020. This will require provision of 160 acres of Great Lakes harbor area by 2020.

Many opportunities exist for reservoir de-

TABLE R9-78 Boating Opportunities, RBG 3.2

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	29,575	67
Streams (miles)	1,500	8
Great Lakes Waters		
Open Acres	100,000	5
Sheltered Acres	138,000	5
Total	238,000	10

velopment in this area. Development of reservoir sites could enhance boating opportunity. Therefore, potential reservoir sites should be acquired before these lands increase in price or are converted to subdivisions. In view of Michigan's vast road network and the high cost of reservoir water surface, only 5,000 acres of impoundments were programmed for the long-range time period.

4.3.2.4 Program Costs

Recreational boating program costs for RBG 3.2 are shown in Table R9-82. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.4 Lake Erie

Lake Erie is divided into four river basin groups covering parts of Michigan, Indiana, Ohio, Pennsylvania, and New York.

TABLE R9-80 Existing and Future Small-Boat Fleet, RBG 3.2 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	34.4	41.8	53.0	68.0
Nonresident ^b	45.4	55.3	70.1	89.9
Total	79.8	97.1	123.1	157.9
Composition				
< 12 feet (19.0%)	15.1 ^c	18.5	23.4	30.0
12 - 20 feet (77.0%)	61.5 ^d	74.8	94.8	121.4
20 - 30 feet (3.4%)	2.7 ^e	3.3	4.2	5.4
30 - 40 feet (0.5%)	0.4 ^f	0.5	0.6	0.8
> 40 feet (0.1%)	0.1 ^g	0.1	0.1	0.2

^aRegistered boats + 10% (unregistered boats) x 56.8% (use in area).

^bResident boats x 75%.

^cTotal includes 6.5 resident and 8.6 nonresident boats.

^dTotal includes 26.5 resident and 35.0 nonresident boats.

^eTotal includes 1.2 resident and 1.5 nonresident boats.

^fTotal includes 0.2 resident and 0.2 nonresident boats.

^gTotal includes 0.03 resident and 0.04 nonresident boats.

4.4.1 River Basin Group 4.1 (Western Lake Erie)

River Basin Group 4.1 is located at the west end of Lake Erie (Figure R9-21). Planning Subarea 4.1 defines the area by political (county) boundaries, encompassing a nine-

TABLE R9-79 Recreational Boating Requirements, RBG 3.2 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	38.8	49.3	63.0	22.8	27.2	33.4	16.0	22.1	29.6
Boat-Days of Use	1,164	1,479	1,890	684	816	1,002	480	663	888
BOATS BERTHED									
Number of Boats	3.9	4.9	6.4	2.1	2.1	2.1	1.8	2.8	4.3
Boat-Days of Use	117	147	192	63	63	63	54	84	129
BOATS LAUNCHED									
Number of Boats	34.9	44.4	56.6	20.7	25.1	31.3	14.2	19.3	25.3
Number of Launchings	1,047	1,332	1,698	621	753	939	426	579	759
INLAND LAKES AND STREAMS									
Number of Boats	58.3	73.8	94.9	55.9	62.1	71.0	2.4	11.7	23.9
Boat-Days of Use	1,749	2,214	2,847	1,677	1,863	2,130	72	351	717
BOATS BERTHED									
Number of Boats	27.5	34.9	44.7	26.4	26.4	26.4	1.1	8.5	18.3
Boat-Days of Use	825	1,047	1,341	792	792	792	33	255	549
BOATS LAUNCHED									
Number of Boats	30.8	38.9	50.2	29.5	35.7	44.6	1.3	3.2	5.6
Number of Launchings	924	1,167	1,506	885	1,071	1,338	39	96	168
RIVER BASIN GROUP TOTAL									
Number of Boats	97.1	123.1	157.9	78.7	89.3	104.4	18.4	33.8	53.5
Boat-Days of Use	2,913	3,693	4,737	2,361	2,679	3,132	552	1,014	1,605

TABLE R9-81 Recreational Boating Program, RBG 3.2 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	16.0	22.1	29.6	3.4	5.9	8.5	12.6	16.2	21.1
Boat-Days of Use	480	663	888	101	176	256	379	487	632
INLAND LAKES AND STREAMS									
Number of Boats	2.4	11.7	23.9	0.3	0.5	4.0	2.1	11.2	19.9
Boat-Days of Use	72	351	717	8	16	120	64	335	597
RIVER BASIN GROUP TOTAL									
Number of Boats	18.4	33.8	53.5	3.7	6.4	12.5	14.7	27.4	41.0
Boat-Days of Use	552	1,014	1,605	109	192	376	443	822	1,229
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	2,100	3,600	4,800	-	-
2. Harbors	acres	-	-	-	70	120	160	-	-
3. Access	each	-	-	-	10	15	20	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	0	0	200	-	-
2. Lake Access	each	-	-	-	0	0	15	-	-
3. Stream Access	each	-	-	-	10	20	30	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	5,000	-	-

TABLE R9-82 Recreational Boating Program Costs, RBG 3.2

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
		Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL										
Great Lakes										
1. Marinas	(berths) \$ 2,800	2,100	5,880	2,940	1,500	4,200	15,960	1,200	3,360	23,520
2. Harbors	(acres) 160,000	70	11,200	1,120	50	8,000	6,080	40	6,400	8,960
3. Access	(each) 75,000	10	750	75	5	375	375	5	375	525
Inland Lakes and Streams										
1. Marinas	(berths) 2,800	0	0	0	0	0	0	200	560	560
2. Lake Access	(each) 75,000	0	0	0	0	0	0	15	1,125	225
3. Stream Access	(each) 7,500	10	75	8	10	75	45	10	75	75
4. Restoration	(acres) 5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres) 5,000	0	0	0	0	0	0	5,000	25,000	5,000
TOTAL PROGRAM COSTS										
Federal			6,012	601		4,225	3,250		16,487	7,392
Non-Federal Public			6,013	602		4,225	3,250		16,488	7,393
Private			5,880	2,940		4,200	15,960		3,920	24,080

county area of Michigan. PSA 4.1 contains 6,345 square miles (4,062,100 acres), of which 1.9 percent is rivers, inland lakes, and embayments. One county borders on Lake Erie, one abuts Lake Huron, and three counties border on the St. Clair River or Lake St. Clair. River Basin Group 4.1 is defined as the hydrologic area draining into the west end of Lake Erie. Major watersheds include the Black River basin, the St. Clair River complex, the Clinton River basin, the Rouge complex, Huron River basin, the Swan Creek complex, and the Raisin River basin. RBG 4.1 drains 5,198 square miles (3,328,000 acres).

Major urban centers in this area are the Detroit metropolitan area, Port Huron, Mount Clemens, Pontiac, Ann Arbor, Ypsilanti, Adrian, and Monroe. The area's population, 4,291,000 persons in 1960 and 4,848,000 in 1970, is estimated to increase to 5,802,000 in 1980, 7,425,000 in 2000, and 9,568,000 in 2020.

4.4.1.1 Boating Opportunities

Recreational boating opportunities for RBG 4.1 are summarized in Table R9-83. The table displays existing capacity, the projected use of

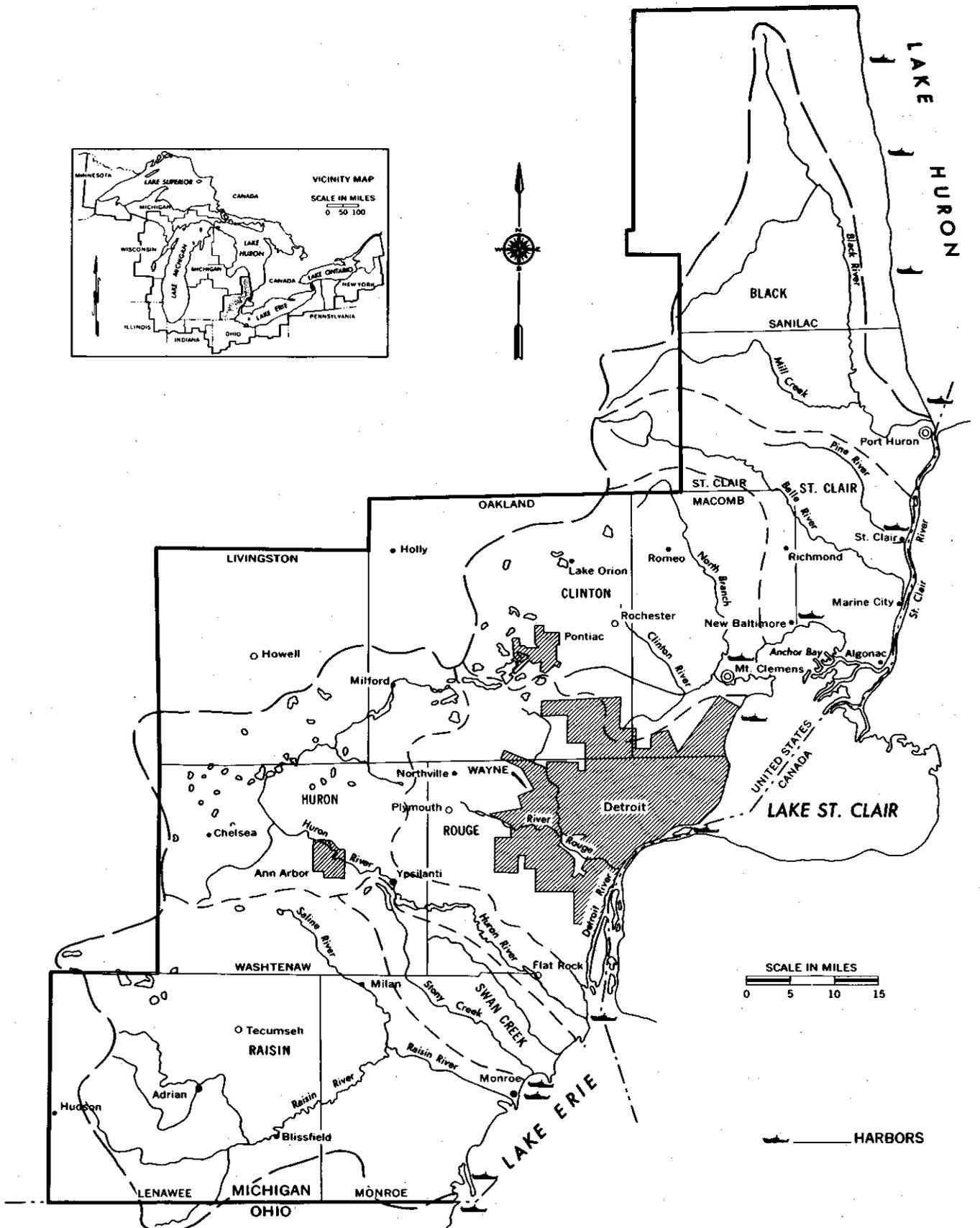


FIGURE R9-21 Harbor Facilities, RBG 4.1

TABLE R9-83 Recreational Opportunities, RBG 4.1 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	28.6	34.3	43.0	32.8	39.3	49.3	4.2	5.0	6.3
Boat-Days of Use	858	1,029	1,289	983	1,179	1,477	125	150	188
SHELTERED WATERS									
Area	128	128	128	128	128	128	N/A	N/A	N/A
Boat-Days of Use	480	576	723	480	576	723	-	-	-
Number of Boats	16.0	19.2	24.1	16.0	19.2	24.1	-	-	-
OFFSHORE WATERS									
Area	151	151	151	201	201	201	50	50	50
Boat-Days of Use	378	453	566	503	603	754	125	150	188
Number of Boats	12.6	15.1	18.9	16.8	20.1	25.2	4.2	5.0	6.3
INLAND LAKES AND STREAMS									
Number of Boats	82.6	88.5	96.9	19.1	23.1	28.8	-63.5	-65.4	-68.1
Boat-Days of Use	2,478	2,655	2,907	575	692	864	-1,903	-1,963	-2,043
INLAND LAKES									
Acres	N/A	N/A	N/A	39	39	39	N/A	N/A	N/A
Boat-Days of Use	-	-	-	514	618	772	-	-	-
Number of Boats	-	-	-	17.1	20.6	25.7	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	380	380	380	N/A	N/A	N/A
Boat-Days of Use	-	-	-	61	74	92	-	-	-
Number of Boats	-	-	-	2.0	2.5	3.1	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	111.2	122.8	139.9	51.9	62.4	78.1	-59.3	-60.4	-61.8
Boat-Days of Use	3,336	3,684	4,196	1,558	1,871	2,341	-1,778	-1,813	-1,855

TABLE R9-84 Great Lakes Harbor Facilities, RBG 4.1

Harbor	Distance to next harbor or refuge	Remarks
MICHIGAN		
Forestville	17	Authorized but not constructed.
Port Sanilac	11	Federal small-boat harbor.
Lexington	20	Authorized but not constructed.
Black River (Port Huron)		Federal small-boat harbor. Survey report underway.
St. Clair River	6	
New Baltimore	6	Survey report underway.
Clinton River	8	Federal small-boat harbor.
Harrison Township	16	No local interest.
Head of Detroit River	31	
Huron River	13	Section 107 report underway.
Sterling State Park	2	Section 107 report underway.
Monroe Harbor	3	Federal deep-draft harbor.
Bolles Harbor	3	Federal small-boat harbor.
Toledo Beach	8	

TABLE R9-85 Boating Opportunities, RBG 4.1

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	49,494	90
Streams (miles)	1,100	9
Great Lakes Waters		
Open Acres	151,000	23
Sheltered Acres ^a	128,000	11
Total	279,000	34

^aIncludes the U.S. portion of Detroit River, St. Clair River, and Lake St. Clair

existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The southeastern boundary of River Basin Group 4.1 consists of 32 miles of Lake Erie shoreline. Lake St. Clair and the St. Clair and Detroit Rivers have 108 miles of shoreline. The State of Michigan and the Federal government have cooperated in constructing recreational boat harbors at Port Sanilac, Clinton River, and Bolles Harbor. New harbors are authorized at Lexington and Forestville, Michigan. Most boating activities are limited to areas offshore from these harbors and to the Detroit River, Lake St. Clair and the St. Clair River. In 1968, 16,310 boats were moored in the area, 10,385 north of the Detroit River, and 5,925 boats in the Detroit River and Lake Erie portion of the basin. Harbors and launching sites are listed in Table R9-84.

This area has a small number of inland lakes, which are intensively used for recreational boating. The Michigan Department of Natural Resources lists the area's total water surface at 49,494 acres. Approximately 39,000 acres are considered boatable. There are 90 access sites to these lakes. Most of the lakes are crowded far beyond their desirable capacity.

A limited network of rivers and streams provides about 380 miles of canoeing waters. The lack of stream improvements and maintenance, and periodic low flows limit the amount of canoeing and small-boat opportunity on the streams. The Detroit and St. Clair Rivers have been improved for commercial navigation and are heavily used by small recreational craft. Main rivers and tributaries identified as good canoeing waters are Stony Creek, and the Raisin, Saline, Huron, Clinton, North Branch (Clinton River), Belle, Pine, and Black Rivers. Boating opportunity in River Basin Group 4.1 is summarized in Table R9-85.

4.4.1.2 Boating Requirements

Recreational boating requirements for RBG 4.1 are summarized in Table R9-86. The table displays the demand, supply, and need for boats berthed and boats launched in terms of the number of boats and the boat-days of use.

In 1968 the State of Michigan registered 157,785 boats, 3.4 registered boats for every 100 residents, in this nine-county area. Wayne County contains more registered boats (68,405) than any other county. Approximately 91 percent of the registered boats are less than 20 feet long. Canoes and small sailing boats are not registered in the State, but it is estimated that these craft are equal in number to approximately 10 percent of the registered boats, or approximately 15,800 additional boats.

It is estimated that the number of nonresident boats using waters in RBG 4.1 is equal to 6 percent of resident boats. The size distribution is assumed to be the same as that of the registered resident boats.

The resident fleet of 173,600 boats in 1968 is expected to grow to 214,500 by 1980, 277,200 by 2000, and 356,400 by 2020. An estimated 62 percent of the resident fleet use takes place within RBG 4.1. This use plus the nonresident use equals the total demand for facilities in the area. As shown in Table R9-87, the total number of boats using waters in the area is expected to increase from 118,000 in 1968 to 242,400 by 2020.

4.4.1.3 Recreational Boating Program

The recreational boating program for RBG 4.1 is summarized in Table R9-88 which displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

Federal and State water resource agencies have many ongoing studies and authorized projects that can be integrated, including the Southeastern Michigan Study for optimum development of water resources, water-related land use, and authorized recreational boat harbors. The State of Michigan has an extensive grant-in-aid program which provides public access for boating and fishing. This program involves a review of all lakes in the State of Michigan to determine their carrying capacity in order to establish a public boating capacity and desirability for each lake. Annual appropriations based on need are

TABLE R9-86 Recreational Boating Requirements, RBG 4.1 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	58.3	75.4	97.0	32.3	35.7	40.5	26.0	39.7	56.5
Boat-Days of Use	1,749	2,262	2,910	969	1,071	1,215	780	1,191	1,695
BOATS BERTHED									
Number of Boats	24.0	31.3	40.1	16.3	16.3	16.3	7.7	15.0	23.8
Boat-Days of Use	720	939	1,203	489	489	489	231	450	714
BOATS LAUNCHED									
Number of Boats	34.3	44.1	56.9	16.0	19.4	24.2	18.3	24.7	32.7
Number of Launchings	1,029	1,323	1,707	480	582	726	549	741	981
INLAND LAKES AND STREAMS									
Number of Boats	87.6	113.2	145.4	82.6	88.5	96.9	5.0	24.7	48.5
Boat-Days of Use	2,628	3,396	4,362	2,478	2,655	2,907	150	741	1,455
BOATS BERTHED									
Number of Boats	58.1	75.2	96.6	54.9	54.9	54.9	3.2	20.3	41.7
Boat-Days of Use	1,743	2,256	2,898	1,647	1,647	1,647	96	609	1,251
BOATS LAUNCHED									
Number of Boats	29.5	38.0	48.8	27.7	33.6	42.0	1.8	4.4	6.8
Number of Launchings	885	1,140	1,464	831	1,008	1,260	54	132	204
RIVER BASIN GROUP TOTAL									
Number of Boats	145.9	188.6	242.4	114.9	124.2	137.4	31.0	64.4	105.0
Boat-Days of Use	4,377	5,658	7,272	3,447	3,726	4,122	930	1,932	3,150

TABLE R9-87 Existing and Future Small-Boat Fleet, RBG 4.1 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	107.6	133.0	172.0	221.0
Nonresident ^b	10.4	12.9	16.6	21.4
Total	118.0	145.9	188.6	242.4
Composition				
< 12 feet (16.0%)	18.9 ^c	23.3	30.2	38.8
12 - 20 feet (75.0%)	88.4 ^d	109.2	141.3	181.7
20 - 30 feet (7.2%)	8.5 ^e	10.5	13.6	17.5
30 - 40 feet (1.6%)	1.9 ^f	2.3	3.2	3.9
> 40 feet (0.2%)	0.24 ^g	0.29	0.38	0.48

^aRegistered boats + 10% (unregistered boats) x 62% (use in area).

^bResident boats x 6%.

^cTotal includes 17.2 resident and 1.7 nonresident boats.

^dTotal includes 80.7 resident and 7.8 nonresident boats.

^eTotal includes 7.8 resident and 0.7 nonresident boats.

^fTotal includes 1.7 resident and 0.2 nonresident boats.

^gTotal includes 0.22 resident and 0.02 nonresident boats.

applied to each area. The center of urban development has the highest priority.

Inland lakes are being used well beyond their desirable capacity, while Great Lakes waters are being used at somewhat below ca-

capacity. Canoe streams in the area are adequate to meet demand through 2020.

In view of the present excessive use of inland waters, only 30 additional access facilities should be constructed on streams in this area. An additional 4,200 berths will be needed by 2020 on Lakes Huron, St. Clair, and Erie. Consideration should be given to large harbors incorporating several hundred berths and launching facilities.

There are 36 potential reservoir sites which could provide an additional 1.8 million boat-day use capacity, but this source has not been programmed. Even though impoundment is the most direct method of increasing opportunity, it is impracticable because of the high cost of reservoir sites and because of public opposition to flooding land for recreational purposes.

It is more economical to transfer needs by building access sites. It is possible that some reservoirs will be built in the area which would decrease transfer of needs out of the area.

4.4.1.4 Program Costs

Recreational boating program costs for RBG 4.1 are shown in Table R9-89. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

TABLE R9-88 Recreational Boating Program, RBG 4.1 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	26.0	39.7	56.5	2.5	4.7	7.6	23.5	35.0	48.9
Boat-Days of Use	780	1,191	1,695	74	140	228	706	1,051	1,467
INLAND LAKES AND STREAMS									
Number of Boats	5.0	24.7	48.5	0.3	0.6	1.2	4.7	24.1	47.3
Boat-Days of Use	150	741	1,455	8	18	36	142	723	1,419
RIVER BASIN GROUP TOTAL									
Number of Boats	31.0	64.4	105.0	2.8	5.3	8.8	28.2	59.1	96.2
Boat-Days of Use	930	1,932	3,150	82	158	264	848	1,774	2,886
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	1,200	2,400	4,200	-	-
2. Harbors	acres	-	-	-	40	80	140	-	-
3. Access	each	-	-	-	10	15	20	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	0	0	0	-	-
2. Lake Access	each	-	-	-	0	0	0	-	-
3. Stream Access	each	-	-	-	10	20	30	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-89 Recreational Boating Program Costs, RBG 4.1

PROGRAM ELEMENT	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
			Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL											
Great Lakes											
1. Marinas	(berths)	\$ 2,800	1,200	3,360	1,680	1,200	3,360	10,080	1,800	5,040	18,480
2. Harbors	(acres)	160,000	40	6,400	640	40	6,400	3,840	60	9,600	7,040
3. Access	(each)	75,000	10	750	75	5	375	375	5	375	525
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	0	0	0	0	0	0	0	0	0
2. Lake Access	(each)	75,000	0	0	0	0	0	0	0	0	0
3. Stream Access	(each)	7,500	10	75	8	10	75	45	10	75	75
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS											
Federal				3,612	361		3,425	2,130		5,025	3,820
Non-Federal Public				3,613	362		3,425	2,130		5,025	3,820
Private				3,360	1,680		3,360	10,080		5,040	18,480

4.4.2 River Basin Group 4.2 (Southwest Lake Erie)

River Basin Group 4.2 is located at the southwest end of Lake Erie (Figure R9-22). Planning Subarea 4.2 defines the area by political (county) boundaries, encompassing 20 Ohio counties and three Indiana counties. PSA 4.2 contains 9,948 square miles (6,368,700 acres), of which 0.7 percent is rivers, inland lakes, and embayments. Three of the counties border Lake Erie for 82.5 miles of mainland shoreline. An additional 74.6 miles of shoreline is found on bays, canals, and shoreline lakes.

River Basin Group 4.2 is defined as the hydrologic area draining into the southwest end of Lake Erie. Major watersheds include the Maumee River basin, the Tenmile Creek basin, the Toussaint-Portage complex, the Sandusky River basin, and the Huron-Vermilion complex. RBG 4.2 drains 10,363 square miles (6,635,000 acres).

Major urban centers in this area are Toledo, Fort Wayne, Lima, and Findlay. The area's population, which was 1,566,000 in 1960 and 1,725,000 in 1970, is expected to be 1,964,000 by 1980, 2,474,000 by 2000, and 3,116,000 by 2020.

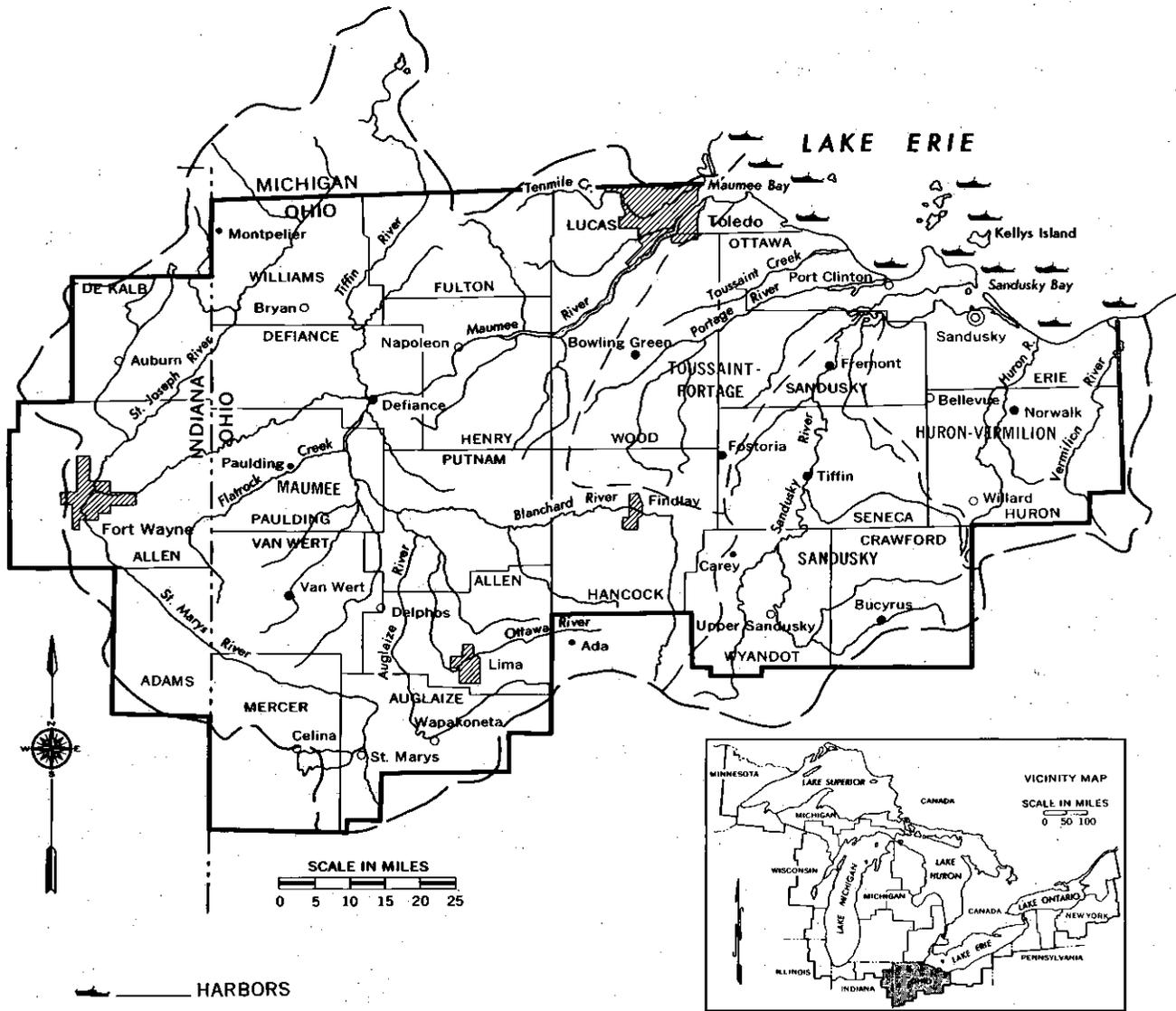


FIGURE R9-22 Harbor Facilities, RBG 4.2

4.4.2.1 Boating Opportunities

Recreational boating opportunities for RBG 4.2 are summarized in Table R9-90, which displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The Great Lakes shoreline is generally unbroken in this area except for Sandusky Bay and Maumee Bay, which provide approximately 58,000 acres of sheltered water. Great Lakes waters are suitable only for boats longer than 16 feet with motors in excess of 25 horsepower. Harbors providing 12,725 berths and numerous launching facilities are available in the area (Table R9-91).

The western boundary of River Basin Group 4.2 consists of 82.5 miles of Ohio's Lake Erie shoreline. The Federal government has improved commercial harbors along the Lake Erie shoreline, and they are also used by recreational boats. New harbors for recreational boats are authorized at Kelleys Island, West Harbor, and Ottawa.

This area has a small number of inland lakes, most of which are intensively used for recreational boating. According to the Ohio and Indiana Departments of Natural Resources, RBG 4.2 has a total water surface area of 33,000 acres, with 19 access sites. Approximately 26,000 acres are boatable.

This area has an extensive network of rivers and streams providing approximately 1,000

TABLE R9-90 Recreational Boating Opportunities, RBG 4.2 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	22.4	26.8	33.5	24.5	29.3	36.6	2.1	2.5	3.1
Boat-Days of Use	671	804	1,007	734	879	1,101	63	75	94
SHELTERED WATERS									
Area	58	58	58	58	58	58	N/A	N/A	N/A
Boat-Days of Use	218	261	328	218	261	328	-	-	-
Number of Boats	7.3	8.7	10.9	7.3	8.7	10.9	-	-	-
OFFSHORE WATERS									
Area	181	181	181	206	206	206	25	25	25
Boat-Days of Use	453	543	679	516	618	773	63	75	94
Number of Boats	15.1	18.1	22.6	17.2	20.6	25.7	2.1	2.5	3.1
INLAND LAKES AND STREAMS									
Number of Boats	26.8	29.6	33.7	16.7	20.1	25.2	-10.1	-9.5	-8.5
Boat-Days of Use	804	888	1,011	501	604	755	-303	-284	-256
INLAND LAKES									
Acres	N/A	N/A	N/A	26	26	26	N/A	N/A	N/A
Boat-Days of Use	-	-	-	343	412	515	-	-	-
Number of Boats	-	-	-	11.4	13.7	17.2	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	1,000	1,000	1,000	N/A	N/A	N/A
Boat-Days of Use	-	-	-	158	192	240	-	-	-
Number of Boats	-	-	-	5.3	6.4	8.0	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	49.2	56.4	67.2	41.2	49.4	61.8	-8.0	-7.0	-5.4
Boat-Days of Use	1,475	1,692	2,018	1,235	1,483	1,856	-240	-209	-162

TABLE R9-91 Great Lakes Harbor Facilities, RBG 4.2

Harbor	Distance to next harbor or refuge	Remarks
OHIO		
Ottawa River	7	Federal small-boat harbor authorized but not constructed.
Toledo Harbor	14	Federal commercial harbor.
Cooley Creek	11	Study underway.
Turtle Creek	15	Study underway.
Port Clinton	13	Federal small-boat harbor. Study underway.
Put-in-Bay	10	Federal small-boat harbor. Study underway.
Kelleys Island	9	Authorized but not constructed.
West Harbor	4	Authorized but not constructed.
East Harbor	10	Study underway.
Sandusky	13	Federal deep-draft harbor.
Huron	11	Federal deep-draft harbor.
Vermilion	7	Federal small-boat harbor.

miles for canoeing. Periodic low flows and the lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunity on these streams. Main rivers and tributaries identified as good canoeing waters are the Maumee, Tiffin, St. Joseph, St. Marys, Auglaize, Sandusky, Huron, and Vermilion Rivers.

TABLE R9-92 Boating Opportunities, RBG 4.2

Classification	Total Supply	Access Sites
Inland Waters		
Lakes (acres)	33,000	19
Canoe streams (mi.)	1,000	--
Great Lakes Waters		
Open Acres	181,000	
Sheltered Acres	58,000	
Total	239,000	23 ^a

^aTotal for entire Great Lakes Waters.

A summary of boating opportunity in RBG 4.2 is presented in Table R9-92.

4.4.2.2 Boating Requirements

Recreational boating requirements for RBG 4.2 are summarized in Table R9-93. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the States of Ohio and Indiana registered 43,254 boats, spread uniformly over the 23 counties with the maximum number, 9,845 boats, recorded in Lucas County, Ohio. There are 2.6 boats in the plan area for every 100 people.

Analysis of registration data shows that 95 percent of the typical boaters in the river basin group own boats less than 20 feet long

TABLE R9-93 Recreational Boating Requirements, RBG 4.2 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	20.1	25.1	32.0	16.6	17.4	18.6	3.5	7.7	13.4
Boat-Days of Use	603	753	960	498	522	558	105	231	402
BOATS BERTHED									
Number of Boats	15.8	19.6	24.9	12.7	12.7	12.7	3.1	6.9	12.2
Boat-Days of Use	474	588	747	381	381	381	93	207	366
BOATS LAUNCHED									
Number of Boats	4.3	5.5	7.1	3.9	4.7	5.9	0.4	0.8	1.2
Number of Launchings	129	165	213	117	141	177	12	24	36
I. LAND LAKES AND STREAMS									
Number of Boats	30.2	37.7	47.9	26.8	29.6	33.7	3.4	8.2	14.2
Boat-Days of Use	906	1,131	1,437	804	888	1,011	102	243	426
BOATS BERTHED									
Number of Boats	15.1	18.8	23.9	13.4	13.4	13.4	1.7	5.4	10.5
Boat-Days of Use	453	564	717	402	402	402	51	162	315
BOATS LAUNCHED									
Number of Boats	15.1	18.9	24.0	13.4	16.2	20.3	1.7	2.7	3.7
Number of Launchings	453	567	720	402	486	609	51	81	111
RIVER BASIN GROUP TOTAL									
Number of Boats	50.3	62.8	79.9	43.4	47.0	52.3	6.9	15.8	27.6
Boat-Days of Use	1,509	1,884	2,397	1,302	1,410	1,569	207	474	828

TABLE R9-94 Existing and Future Small-Boat Fleet, RBG 4.2 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	38.9	44.8	56.0	71.2
Nonresident ^b	4.8	5.5	6.8	8.7
Total	44.8	50.3	62.8	79.9
Composition				
< 12 feet (32.0%)	13.1 ^c	15.0	18.8	23.9
12 - 20 feet (63.0%)	25.7 ^d	29.6	37.0	47.1
20 - 30 feet (4.0%)	4.0 ^e	4.6	5.6	7.1
30 - 40 feet (0.7%)	0.8 ^f	0.8	1.0	1.3
> 40 feet (0.3%)	0.3 ^g	0.3	0.4	0.5

^aRegistered boats + 10% (unregistered boats) x 80% (use in area).

^bRegistered boats x 5% for boats less than 20 feet long + registered boats x 150% for boats more than 20 feet long.

^cTotal includes 12.5 resident and 0.6 nonresident boats.

^dTotal includes 24.5 resident and 1.2 nonresident boats.

^eTotal includes 1.6 resident and 2.4 nonresident boats.

^fTotal includes 0.3 resident and 0.5 nonresident boats.

^gTotal includes 0.1 resident and 0.2 nonresident boats.

that are used primarily for fishing. It is estimated that approximately 50 percent of all boats are powered by motors over 25 horsepower and are used for cruising and water

skiing. Approximately 2,075 recreational boats are longer than 20 feet and moor on Lake Erie. Comparative data indicate that canoes and small sailing boats, which must be registered in Ohio but need not be in Indiana, represent an additional 10 percent (4,325) of the boat fleet. The total resident fleet is 47,600 boats.

While the influx of small (less than 20 feet long) nonresident boats is slight (approximately the equivalent of five percent of the resident fleet), many large nonresident boats (longer than 20 feet) use the popular Great Lakes waters in this area. It is estimated that the number of nonresident boats longer than 20 feet using Great Lakes waters is equivalent to 1½ times the number of resident boats longer than 16 feet. Five percent of the resident boats are longer than 20 feet, and of the 63 percent of the resident fleet in the 12- to 20-foot category, approximately 20 percent are longer than 16 feet and desire berths on the Great Lakes (Table R9-94).

The resident fleet of 47,600 boats in 1968 is expected to grow to 56,000 boats in 1980, 70,000 in 2000, and 89,000 in 2020. Approximately 80 percent of the use by resident boats is assumed to occur on waters within RBG 4.2. This use and the use by nonresident boats comprise the total demand for boating facilities in RBG 4.2.

4.4.2.3 Recreational Boating Program

The recreational boating program for RBG

TABLE R9-95 Recreational Boating Program, RBG 4.2 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	3.5	7.7	13.4	4.3	11.3	15.0	+0.8	+3.6	+1.6
Boat-Days of Use	105	231	402	128	338	450	+23	+107	+48
INLAND LAKES AND STREAMS									
Number of Boats	3.4	8.1	14.2	0.5	4.1	8.2	2.9	4.0	6.0
Boat-Days of Use	102	243	426	16	124	246	86	119	180
RIVER BASIN GROUP TOTAL									
Number of Boats	6.9	15.8	27.6	4.8	15.4	23.2	2.1	0.4	4.4
Boat-Days of Use	207	474	828	144	462	696	63	12	132
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	3,000	7,500	12,000	-	-
2. Harbors	acres	-	-	-	100	250	400	-	-
3. Access	each	-	-	-	10	25	40	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	0	600	1,200	-	-
2. Lake Access	each	-	-	-	0	15	25	-	-
3. Stream Access	each	-	-	-	20	35	50	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	5,000	5,000	-	-

4.2 is summarized in Table R9-95, which displays the needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

Federal and State water resource agencies have many ongoing studies and authorized projects that can be integrated into the plan area, including the Northwest Ohio Water Development Plan, which is a plan for many phases of water management, and the Maumee River Basin Study. There are authorized recreational boat harbors at Ottawa, West Harbor, and Kelleys Island. The State of Ohio has an extensive grant-in-aid program that provides public access sites for boating and determines their carrying capacity. A comparison of capacity and use estimates shows that inland waters are being used at approximately three times their desirable capacity, while Great Lakes waters are being used at approximately 30 percent of their desirable capacity.

All needs for inland waters that cannot be met by developing new water areas must be shifted either to river basin groups with a surplus of inland water, to Great Lakes waters in RBGs 4.1, 4.2, and 4.3, or out of the Basin. A high priority should be placed on Great Lakes marina and harbor development.

Because of the extremely limited supply of inland water area, potential reservoir sites, such as those near the town of Defiance, should be acquired before they are converted

into subdivisions. New water areas would alleviate the overcrowding on existing waters and decrease the need to transfer use to other areas. However, if water area is available in other areas, it may be more economical to provide additional access than to construct a reservoir.

4.4.2.4 Program Costs

Recreational boating program costs for RBG 4.2 are shown in Table R9-96. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. The program costs are then summarized as Federal, non-Federal public, and private.

4.4.3 River Basin Group 4.3 (Lake Erie Central)

River Basin Group 4.3 is located on the south-central side of Lake Erie (Figure R9-23). Planning Subarea 4.3 defines the area by political (county) boundaries, encompassing eight Ohio counties. PSA 4.3 contains 3,643 square miles (2,332,200 acres), of which 1.0 percent is rivers, inland lakes, and embayments. Four of the counties border on Lake Erie and have a mainland shoreline of 108 miles. River Basin Group 4.3 is defined as the hydrologic area draining into the central part of Lake Erie. Major watersheds include the

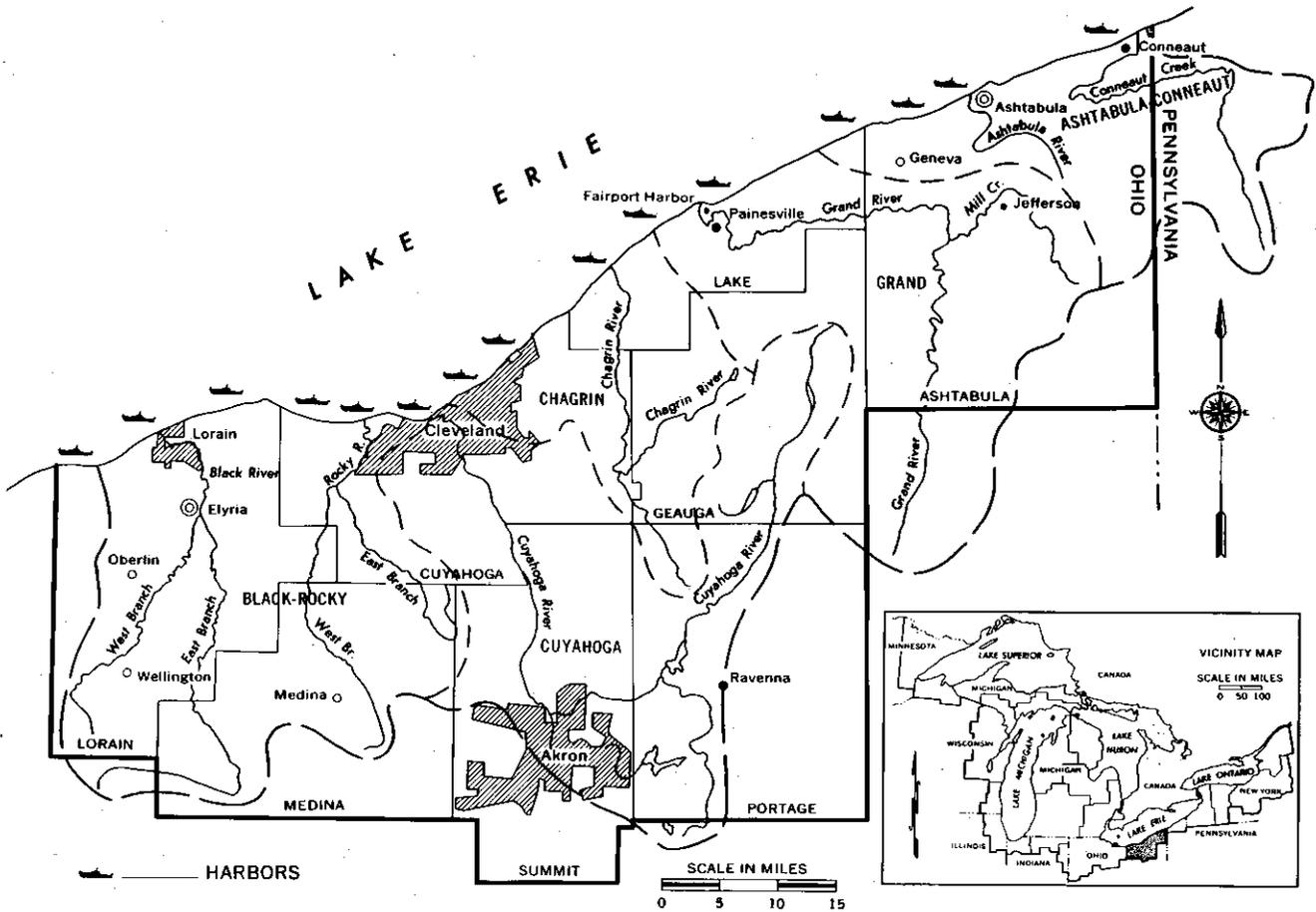


FIGURE R9-23 Harbor Facilities, RBG 4.3

Black-Rocky complex, Cuyahoga River basin, the Chagrin complex, the Grand River basin, and the Ashtabula-Conneaut complex. RBG 4.3 drains 3,252 square miles (2,082,000 acres).

Lorain-Elyria, Cleveland, and Akron. The area's population, which was 2.82 million in 1960, is projected to increase to 3.48 million by 1980, 4.40 million by 2000, and 5.53 million by 2020.

Major urban centers in this area are

TABLE R9-96 Recreational Boating Program Costs, RBG 4.2

PROGRAM ELEMENT	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
			Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL											
Great Lakes											
1. Marinas	(berths)	\$ 2,800	3,000	8,400	4,200	4,500	12,600	29,400	4,500	12,600	54,600
2. Harbors	(acres)	160,000	100	16,000	1,600	150	24,000	11,200	150	24,000	20,800
3. Access	(each)	75,000	10	750	75	15	1,125	525	15	1,125	975
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	0	0	0	600	1,680	1,680	600	1,680	5,040
2. Lake Access	(each)	75,000	0	0	0	15	1,125	225	10	750	600
3. Stream Access	(each)	7,500	20	150	15	15	113	83	15	113	128
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	0	0	0	5,000	25,000	5,000	0	0	10,000
TOTAL PROGRAM COSTS											
Federal				8,450	845		25,681	8,516		12,994	16,251
Non-Federal Public				8,450	845		25,682	8,517		12,994	16,252
Private				8,400	4,200		14,280	31,080		14,280	59,640

TABLE R9-97 Recreational Boating Opportunities, RBG 4.3 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	23.7	28.4	35.4	26.9	31.9	40.2	-3.2	3.5	4.8
Boat-Days of Use	710	852	1,065	806	957	1,209	96	105	144
SHELTERED WATERS									
Area	0	0	0	0	0	0	N/A	N/A	N/A
Boat-Days of Use	0	0	0	0	0	0	-	-	-
Number of Boats	0	0	0	0	0	0	-	-	-
OFFSHORE WATERS									
Area	284	284	284	322	322	322	38	38	38
Boat-Days of Use	710	852	1,065	806	957	1,209	96	105	144
Number of Boats	23.7	28.4	35.4	26.9	31.9	40.2	3.2	3.5	4.8
INLAND LAKES AND STREAMS									
Number of Boats	8.0	9.7	12.1	7.0	8.4	10.5	-1.0	-1.3	-1.6
Boat-Days of Use	240	291	363	208	252	315	-32	-39	-48
INLAND LAKES									
Acres	N/A	N/A	N/A	14	14	14	N/A	N/A	N/A
Boat-Days of Use	-	-	-	188	228	285	-	-	-
Number of Boats	-	-	-	6.3	7.6	9.5	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	126	126	126	N/A	N/A	N/A
Boat-Days of Use	-	-	-	20	24	30	-	-	-
Number of Boats	-	-	-	0.7	0.8	1.0	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	31.7	38.1	47.5	33.9	40.3	50.7	2.2	2.2	3.2
Boat-Days of Use	950	1,143	1,428	1,014	1,209	1,524	64	66	96

4.4.3.1 Boating Opportunities

Recreational boating opportunities for RBG 4.3 are summarized in Table R9-97. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

Major rivers are the Black, Rocky, Cuyahoga, Chagrin, Grand, Ashtabula, and Conneaut Rivers. The area contains approximately 18,000 acres of inland lakes of which approximately 14,000 acres are intensively used for recreational boating. A few potential reservoir sites exist throughout the area but only two or three large sites are available.

Beaches on Lake Erie are narrow, consisting of shingle and sand. The shoreline is relatively unbroken with no bays to furnish shelter. The commercial harbors of Lorain, Cleveland, Fairport, Ashtabula, and Conneaut are all used by recreational craft, although no improvements have been made specifically for them. The State of Ohio and the Federal government have cooperated in the improvement of Rocky River Harbor for recreational boating. Further cooperative improvements at Eastlake are in the detailed design stage, and further improvements are authorized at Conneaut Harbor. The City of Cleveland has constructed small-boat improvements at White City Park and Wildwood Park. Private interests have provided facilities at Beaver Creek, Avon Lake, Bay Village, Mentor-on-the-Lake,

and Red Creek. These harbors provided moorings for nearly 5,000 vessels in 1967 (Table R9-98).

Boating in this area generally occurs on Lake Erie, but some lakes and reservoirs in the southeastern portion help meet the demand (Table R9-99). Many of these are relatively small, with only four in excess of 1,000 acres. They are used intensively for recreation including boating.

This area has a few streams and only 126 main stream miles suitable for canoeing. Lack of stream improvements and maintenance, and periodic low flows limit the amount of canoeing and small-boat opportunity on the streams. The lower reaches of several streams have been improved for commercial navigation but they are seldom used by recreational craft due to the presence of large ships and the unattractive industrial environment. Many of the smaller streams are navigable for only a few hundred feet from the mouth. Main rivers and tributaries identified as good canoeing waters are the Cuyahoga, the Black, and the Conneaut Rivers.

4.4.3.2 Boating Requirements

Recreational boating requirements for RBG 4.3 are summarized in Table R9-100. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

TABLE R9-98 Great Lakes Harbor Facilities, RBG 4.3

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
OHIO			
Beaver Creek	145	5	Private marinas.
Lorain Harbor	115	28	Federal deep-draft harbor. Small-boat modification under study.
Avon Lake	110	17	Private development.
Bay Village	10	5	Private development.
Rocky River	810	6	Federal small-boat project completed 1968. Public landing and ramp.
Cleveland Harbor	1,250	26	Federal deep-draft harbor. Public and private boating facilities.
White City Park	205	21	Public property, leased to private club.
Wildwood Park	150	19	City development including ramp.
Chagrin River	670	9	Natural channel in river. Federal small-boat project authorized but not built.
Mentor Harbor	640	5	Private development.
Fairport Harbor	460	29	Federal deep-draft harbor. Small-boat modification under study.
Geneva-on-the-Lake State Park	0	12	Federal small-boat harbor authorized but not built.
Red Creek	100	7	Private development.
Ashtabula	100	13	Federal deep-draft harbor. Small-boat modification under study.
Conneaut Harbor	195	33	Federal deep-draft harbor. Small-boat modification authorized but not built.

TABLE R9-99 Inland Lakes, RBG 4.3

State	Number of Lakes and Reservoirs	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Ohio	94	18,200	4	10

In 1968 the State of Ohio, which requires registration of all watercraft, registered 47,186 boats throughout the eight-county area. The largest percentage was located in the Cleveland-Akron area. Overall, there are 1.6 boats to every 100 residents. Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length.

River Basin Group 4.3 experiences only a small influx of nonresident boaters because of its limited quantity of water suitable for recreational boating, and its limited public access

facilities. Nonresident boating demand satisfied in this river basin group is estimated at 36,000 boat days, based on data obtained by the State of Michigan concerning origins and destinations for boating activities in a comparable area. This figure is equivalent to approximately 1,200 boats or 2.5 percent of the resident fleet. The composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet.

Existing resident boating demand satisfied within the area is estimated to be equivalent to 50 percent of the resident fleet. This along with present nonresident demand is the total recreational boating demand satisfied in RBG 4.3. The total number of craft using the boatable waters within the area is expected to increase from 24,800 in 1968 to 45,100 by the year 2020, as shown in Table R9-101.

TABLE R9-100 Recreational Boating Requirements, RBG 4.3 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	13.9	18.4	22.5	10.9	12.1	13.9	3.0	6.3	8.6
Boat-Days of Use	417	552	675	327	363	417	90	189	258
BOATS BERTHED									
Number of Boats	7.3	9.8	11.8	5.0	5.0	5.0	2.3	4.8	6.8
Boat-Days of Use	219	294	354	150	150	150	69	144	204
BOATS LAUNCHED									
Number of Boats	6.6	8.6	10.7	5.9	7.1	8.9	0.7	1.5	1.8
Number of Launchings	198	258	321	177	213	268	21	45	54
INLAND LAKES AND STREAMS									
Number of Boats	13.9	18.4	22.6	12.4	13.8	15.6	1.5	4.6	7.0
Boat-Days of Use	417	552	678	372	414	468	45	138	210
BOATS BERTHED									
Number of Boats	6.8	9.0	11.0	6.1	6.1	6.1	0.7	2.9	4.9
Boat-Days of Use	204	270	330	183	183	183	21	87	147
BOATS LAUNCHED									
Number of Boats	7.1	9.4	11.6	6.3	7.7	9.5	0.8	1.7	2.1
Number of Launchings	213	282	348	189	231	285	24	51	63
RIVER BASIN GROUP TOTAL									
Number of Boats	27.8	36.8	45.1	23.3	25.9	29.5	4.5	10.9	15.6
Boat-Days of Use	834	1,104	1,353	699	777	885	135	327	468

TABLE R9-101 Existing and Future Small-Boat Fleet, RBG 4.3 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	23.6	26.5	35.0	43.0
Nonresident ^b	1.2	1.3	1.8	2.1
Total	24.8	27.8	36.8	45.1
Composition				
< 12 feet (32.0%)	7.9 ^c	8.9	11.8	14.4
12 - 20 feet (63.0%)	15.6 ^d	17.5	23.1	28.4
20 - 30 feet (4.0%)	1.0	1.1	1.5	1.8
30 - 40 feet (0.7%)	0.2	0.2	0.3	0.3
> 40 feet (0.3%)	0.1	0.1	0.1	0.2

^a50% of the resident boats are used in this area.

^bResident boats x 2.5%.

^cTotal includes 7.5 resident and 0.4 nonresident boats.

^dTotal includes 14.9 resident and 0.7 nonresident boats.

4.4.3.3 Recreational Boating Program

The recreational boating program for RBG 4.3 is summarized in Table R9-102. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, has studies in progress on the feasibility of constructing additional small-boat harbors along the shore

of Lake Erie. The description and status of these studies are summarized in Table R9-103.

An updated small-boat harbor program on Lake Erie is essential to the expansion of recreational boating. Present programs do not provide adequate facilities to meet projected needs within a reasonable time frame. In addition to more harbors, a better system to inform recreational boaters of weather conditions and forecasts is needed.

If resident recreational boating is to develop as projected, improved waters, in addition to the limited inland waters now available, must be provided. While a number of potential reservoir sites exist in this area, there are no Federal studies concerning their development.

Analysis of demand and supply of boating waters indicates that future needs for inland waters must be transferred to the Great Lakes, because inland waters are now utilized to capacity. This is feasible because the entire area is within a two-hour travel time of the Great Lakes and most of the population is within a one-hour travel time.

In this area most suitable marina locations on the Great Lakes have been developed. Because remaining locations lack adequate protection from lake storms, marina construction must be foregone, but there is a need for harbors-of-refuge situated to provide shelter for vessels encountering lake storms.

On Lake Erie, the desirable maximum harbor spacing interval is 15 miles, which permits boats to reach safety before dangerous storm

TABLE R9-102 Recreational Boating Program, RBG 4.3 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	3.0	6.3	8.6	2.1	5.8	9.7	0.9	0.5	+1.1
Boat-Days of Use	90	189	258	64	175	292	26	14	+34
INLAND LAKES AND STREAMS									
Number of Boats	1.5	4.6	7.0	1.5	4.4	6.6	0	0.2	0.4
Boat-Days of Use	45	138	210	45	132	198	0	6	12
RIVER BASIN GROUP TOTAL									
Number of Boats	4.5	10.9	15.6	3.6	10.2	16.3	0.9	0.7	+0.7
Boat-Days of Use	135	327	468	109	307	490			
PROGRAM ELEMENT									
STRUCTURAL	UNITS	N/A	N/A	N/A			N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	-	1,500	3,600	6,000	-	-
2. Harbors	acres	-	-	-	50	120	200	-	-
3. Access	each	-	-	-	5	15	20	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	300	900	1,200	-	-
2. Lake Access	each	-	-	-	8	20	25	-	-
3. Stream Access	each	-	-	-	5	10	10	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	3,000	8,000	10,000	-	-

TABLE R9-103 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 4.3

Locality	Purpose	Status
Coast of Lake Erie, harbors & harbors of refuge	To determine need for additional small-craft harbors along Lake Erie Coast	
Fairport Harbor, Ohio	To determine need for harbor modification for small craft	Report in final form scheduled for completion in 1972
Ashtabula Harbor, Ohio	To determine need for harbor modification for small craft	Report in final form scheduled for completion in 1973
Lorain Harbor, Ohio (Sec.107)	To determine need for harbor modification for small craft	Detailed project report underway

conditions develop. Existing harbors offer some refuge, but there are three remaining reaches of shore where the harbor spacing exceeds 15 miles. These are the 28 miles between Lorain and Rocky River, the 26 miles between Cleveland and Fairport, and the 29 miles between Fairport and Ashtabula. Harbor construction has been approved at Chagrin River, approximately 17 miles east of Cleveland, and at Geneva-on-the-Lake, approximately 17 miles east of Fairport. These distances are slightly more than those desired, but harbors there would add significantly to boating safety on Lake Erie waters. The safety pro-

gram should also include a harbor between Lorain and Rocky River, which would provide space for a marina, as would the harbor at Chagrin River, which is now used extensively for boating. All three projects would provide public launching ramps.

Another phase of harbor construction is additional breakwater protection at existing harbors. All of the commercial harbors in the area have areas that could be developed as marinas, but the existing breakwater systems, designed for commercial navigation, do not provide adequate protection for small-boat docks. An inner breakwater system, par-

tially protected by the main system, would be relatively inexpensive and would provide the needed small-boat protection.

In some areas boating demands on inland waters can be met by implementing zoning that reduces the space standard (water surface allocated to each boat) to 6 acres per boat. If demand is heavy, the standard can be reduced to 5 acres. However, in this area the actual figure is 3.9 acres per boat, assuming 18,200 available acres, 372,000 boat-days of use (1968), a turnover of two, and a 150-day season. Some areas are even more intensively used than others, according to observations by State boating officials, so the zoning alternative cannot be used effectively. There are no significant opportunities for lake restoration to increase boating waters.

Present intensive use of inland waters makes it inadvisable to add more access points. Future needs for berths and public access can best be met by providing more facilities on Great Lakes waters. Impoundments could be an addition to a framework program for recreational boating on inland waters in RBG 4.3, but there is apparently some question of political acceptability. In the interest of boaters and with a view toward the development and use of available resources, 10,000 acres of surface water area have been included in this program to be developed on a multiple-use basis when other needs and proposals are presented.

4.4.3.4 Program Costs

Recreational boating program costs for RBG 4.3 are shown in Table R9-104. Framework program elements are quantified and capital and annual costs are indicated by time period for each element. Program costs are then summarized as Federal, non-Federal public, and private.

4.4.4 River Basin Group 4.4 (Eastern Lake Erie)

River Basin Group 4.4 is located at the east end of Lake Erie (Figure R9-24). Planning Subarea 4.4 defines the area by political (county) boundaries, encompassing one county in Pennsylvania and four counties in New York. PSA 4.4 contains 4,863 square miles (3,113,000 acres), of which 1.3 percent is rivers, inland lakes, and embayments. Three of the five counties border Lake Erie, and one county borders Lake Ontario. Shoreline mileage in-

cludes 119 miles on Lake Erie, 31 miles on Lake Ontario, and 63 miles on the Niagara River. River Basin Group 4.4 is defined as the hydrologic area draining into the east end of Lake Erie. Major watersheds include the Erie-Chautauqua complex, the Cattaraugus River basin, and the Tonawanda complex. RBG 4.4 drains 2,640 square miles (1,690,000 acres).

Major urban centers in this area are Erie, Pennsylvania, and Buffalo, New York. The area's population, which was 1,783,203 in 1960, is projected to be 2.08 million by 1980, 2.51 million by 2000, and 3.07 million by 2020.

4.4.4.1 Boating Opportunities

Recreational boating opportunities for RBG 4.4 are summarized in Table R9-105. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The Lake Erie shoreline, which in this reach consists mostly of bluffs 50 to 75 feet high, is relatively straight, with only one natural bay to offer shelter. This lack of shelter and the bluffs rising almost vertically from the water's edge make the shoreline hazardous for small boats. The Lake Ontario shoreline is mostly low till bluffs behind narrow sand and ground beaches. Natural shelter is lacking, except on the lower reaches of the Niagara River. Niagara River shores above the falls are low, while below the gorge the banks are 50 to 70 feet high. The two boatable sections of the river offer a significant amount of sheltered waters for small boats.

Local political units and the Federal government have cooperated in the construction of recreational boat harbors at Barcelona, Little River at Niagara Falls, and Wilson, New York. The old commercial harbor at Olcott, New York, is now used only by recreational vessels. New recreational harbors are authorized at Elk Creek, Pennsylvania, and Cattaraugus Creek, New York. The commercial harbors of Erie, Pennsylvania, and Dunkirk and Buffalo, New York, are also used by recreational vessels. These harbors provided moorings for approximately 3,000 vessels in 1967. An additional 1,600 were moored in the Niagara River (Table R9-106).

The area has a few inland lakes, most of which are used for recreational boating (Table R9-107). The Pennsylvania portion of RBG 4.4 contains five natural lakes and one reservoir

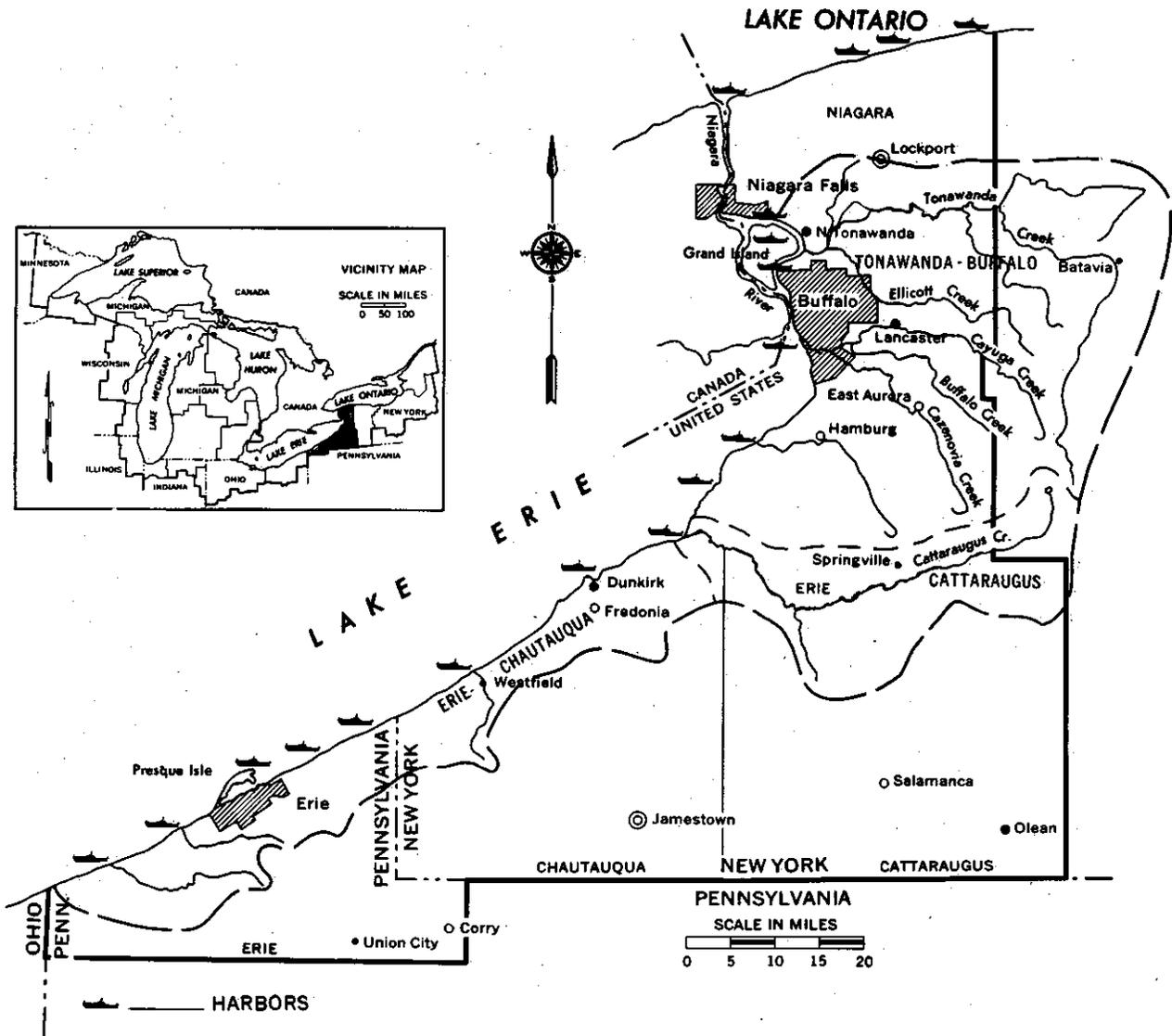


FIGURE R9-24 Harbor Facilities, RBG 4.4

with a total water surface area of approximately 500 acres. No public fishing sites have been developed by the State. The New York portion contains six natural lakes with a total water surface area of approximately 14,500 acres and 10 access sites. Approximately 12,000 acres are considered boatable. New York's Chautauqua Lake, with a surface area of 13,600 acres, provides most of the inland boating opportunities.

This area has a limited number of rivers and streams suitable for canoeing, providing approximately 48 main stream miles. Periodic low flows and the lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunity on these streams. The lower four miles of the Buffalo

River has been improved for commercial navigation, but is not used by small recreational craft. Main streams that have been identified as good canoeing waters are Cattaraugus Creek and Ischua Creek.

4.4.4.2. Boating Requirements

Recreational boating requirements for RBG 4.4 are summarized in Table R9-108. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968, New York and Pennsylvania registered 43,263 boats throughout this five-county area, with the largest percentage located in

TABLE R9-104 Recreational Boating Program Costs, RBG 4.3

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
		Quantity	Capital	OM&R	Quantity	Capital	OM&R	Quantity	Capital	OM&R
			Costs	Costs		Costs	Costs		Costs	
		(\$1,000)	(\$1,000)		(\$1,000)	(\$1,000)		(\$1,000)	(\$1,000)	
STRUCTURAL										
Great Lakes	(berths)									
1. Marinas	\$ 2,800	1,500	4,200	2,100	2,100	5,880	14,280	2,400	6,720	26,880
2. Harbors	(acres) 160,000	50	8,000	800	70	11,200	5,440	80	12,800	10,240
3. Access	(each) 75,000	5	375	38	10	750	300	5	375	525
Inland Lakes and Streams										
1. Marinas	(berths) 2,800	300	840	420	600	1,680	3,360	300	840	5,880
2. Lake Access	(each) 75,000	8	600	60	12	900	420	5	375	675
3. Stream Access	(each) 7,500	5	38	4	5	38	23	0	0	30
4. Restoration	(acres) 5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres) 5,000	3,000	15,000	1,500	5,000	25,000	11,000	2,000	10,000	18,000
TOTAL PROGRAM COSTS										
Federal			12,006	1,201		18,944	8,591		11,775	14,735
Non-Federal Public			12,007	1,201		18,944	8,592		11,775	14,735
Private			5,040	2,520		7,560	17,640		7,560	32,760

TABLE R9-105 Recreational Boating Opportunities, RBG 4.4 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	30.2	36.2	45.3	34.4	41.2	51.6	4.2	5.0	6.3
Boat-Days of Use	905	1,086	1,359	1,030	1,236	1,547	125	150	188
SHELTERED WATERS									
Area	32	32	32	32	32	32	N/A	N/A	N/A
Boat-Days of Use	120	144	181	120	144	181	-	-	-
Number of Boats	4.0	4.8	6.0	4.0	4.8	6.0	-	-	-
OFFSHORE WATERS									
Area	314	314	314	364	364	364	50	50	50
Boat-Days of Use	785	942	1,178	910	1,092	1,366	125	150	188
Number of Boats	26.2	31.4	39.3	30.4	36.4	45.6	4.2	5.0	6.3
INLAND LAKES AND STREAMS									
Number of Boats	6.6	8.0	10.0	5.5	6.6	8.3	-1.1	-1.4	-1.7
Boat-Days of Use	198	240	300	165	199	250	-33	-41	-50
INLAND LAKES									
Acres	N/A	N/A	N/A				N/A	N/A	N/A
Boat-Days of Use	-	-	-	12	12	12	-	-	-
Number of Boats	-	-	-	157	190	238	-	-	-
STREAMS									
Miles	N/A	N/A	N/A				N/A	N/A	N/A
Boat-Days of Use	-	-	-	48	48	48	-	-	-
Number of Boats	-	-	-	8	9	12	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	36.8	44.2	55.3	39.9	47.8	59.9	3.1	3.6	4.6
Boat-Days of Use	1,103	1,326	1,659	1,195	1,435	1,797	92	109	138

the Buffalo metropolitan area. Overall there is an average of 2.3 registered boats for each 100 residents.

The States do not require registration of canoes, sailboats, or other nonpowered craft, but comparative data indicate that their number is approximately equivalent to 20 percent of the registered small-boat fleet. This means an estimated 8,700 additional boats are located in this area.

Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length. This is also assumed to

be true of the unregistered portion of the small-boat fleet.

Nonresident boating demand satisfied in RBG 4.4, with its moderate quantity of suitable recreational boating waters, is estimated at 45,000 boat days. This figure is approximately equivalent to 1,500 boats or 3 percent of the resident fleet. These estimates are based on data obtained by the State of Michigan concerning origins and destinations for boating activities in a comparable area. Composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet.

TABLE R9-106 Great Lakes Harbor Facilities, RBG 4.4

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
PENNSYLVANIA			
Elk Creek	175	22	Natural channel in creek. Federal small-boat harbor authorized but not built.
Walnut Creek	0	12	Natural channel in creek. State launching site.
Erie Harbor	1,100	28	Federal deep-draft harbor.
Harbor Creek	20	21	Private development.
North East	50	13	Private development. State launching site. Federal small-boat harbor under study.
NEW YORK			
Barcelona Harbor	25	19	Federal small-boat harbor completed 1960. Public landing and launching facilities.
Dunkirk Harbor	235	36	Federal medium-draft harbor. Small-boat modification authorized but not built.
Cattaraugus Creek	250	24	Natural channel in creek. Federal small-boat harbor authorized but not built.
Sturgeon Point	150	14	Private development.
Hamburg Town Park	0	4	Launching site.
Buffalo Harbor	150		Federal deep-draft harbor.
Niagara River	1,600		Natural channel. Extensive public and private boating facilities.
Grand Island	115		Natural channel. Extensive public and private boating facilities.
Little River	25		Federal small-boat harbor completed in 1956.
Youngstown	160	12	Natural channel in lower Niagara River.
Wilson Harbor	225	6	Federal small-boat harbor completed in 1972.
Olcott Harbor	100	32	Federal small-boat harbor completed in 1918. Further modification under study.
Golden Hill State Park	10	20	State marina and launching site. Federal small-boat harbor study underway.

TABLE R9-107 Inland Lakes, RBG 4.4

State	Number of Lakes ^a	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
Pennsylvania	6	500	---	---
New York ^b	6	14,500	1	10
Total	12	15,000	1	10

^aLakes less than 40 acres are not included

^bU.S. Geological Survey published and unpublished data

Existing resident boating demand satisfied within the area is estimated to be 40 percent of the resident fleet. This along with present nonresident demand is the total recreational boating demand satisfied in River Basin Group 4.4. The total number of craft using the boatable waters within the area is expected to increase from 22,285 in 1968 to 41,400 by the year 2020. This projection and the composition of the total fleet are shown in Table R9-109.

TABLE R9-108 Recreational Boating Requirements, RBG 4.4 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	18.1	20.2	24.8	13.0	14.8	17.3	5.1	5.4	7.5
Boat-Days of Use	543	606	744	390	444	519	153	162	225
BOATS BERTHED									
Number of Boats	6.6	7.4	9.1	4.6	4.6	4.6	2.0	2.8	4.5
Boat-Days of Use	198	222	273	138	138	138	60	84	135
BOATS LAUNCHED									
Number of Boats	11.5	12.8	15.7	8.4	10.2	12.7	3.1	2.6	3.0
Number of Launchings	345	384	471	252	306	381	93	78	90
INLAND LAKES AND STREAMS									
Number of Boats	12.1	13.4	16.6	8.9	9.9	11.2	3.2	3.5	5.4
Boat-Days of Use	363	402	498	267	297	336	96	105	162
BOATS BERTHED									
Number of Boats	5.8	6.4	7.9	4.4	4.4	4.4	1.4	2.0	3.5
Boat-Days of Use	174	192	237	132	132	132	42	60	105
BOATS LAUNCHED									
Number of Boats	6.3	7.0	8.7	4.5	5.5	6.8	1.8	1.5	1.9
Number of Launchings	189	210	261	135	165	204	54	45	57
RIVER BASIN GROUP TOTAL									
Number of Boats	30.2	33.6	41.4	21.9	24.7	28.5	8.3	8.9	12.9
Boat-Days of Use	906	1,008	1,242	657	741	855	249	267	387

TABLE R9-109 Existing and Future Small-Boat Fleet, RBG 4.4 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	20.8	27.0	30.0	37.0
Nonresident ^b	1.5	3.2	3.6	4.4
Total	22.3	30.2	33.6	41.4
Composition				
< 12 feet (32.0%)	7.1	9.7	10.8	13.2
12 - 20 feet (63.0%)	14.0	19.0	21.2	26.1
20 - 30 feet (4.0%)	0.9	1.2	1.3	1.7
30 - 40 feet (0.7%)	0.2	0.2	0.2	0.3
> 40 feet (0.3%)	0.1	0.1	0.1	0.1

^a40% of resident boats.^b3% of resident boats.

4.4.4.3 Recreational Boating Program

Recreational boating program for RBG 4.4 is summarized in Table R9-110. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed and also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, is studying the feasibility of constructing additional small-boat harbors along the shore of the planning subarea. The description and status of these studies are summarized in Table R9-111.

Analysis of demand and supply of boating

waters indicates that future growth must occur on the Great Lakes, because inland waters are now used to capacity. Part of the future needs for inland waters can be transferred to Great Lakes waters because the entire area is within a two-hour travel time of the Great Lakes. Most of the population is within a one-hour travel time.

There is a need for harbors-of-refuge situated in this area to provide shelter for vessels encountering storms. The Lake Erie shoreline in this area is particularly dangerous. Much of it is vertical rock cliffs and there is only one good natural bay. Lake Ontario's shoreline is lower and has some shelter in small bays and creek mouths.

On Lake Erie the desirable maximum harbor spacing is 15 miles, which permits boats to reach safety before dangerous storm conditions develop. Commercial harbors on Lake Erie provide some shelter, but there are reaches where the spacing exceeds the desired 15 miles. There are the 33 miles between Conneaut, Ohio, and Erie, Pennsylvania, the 28 miles between Erie and Barcelona, New York, the 19 miles between Barcelona and Dunkirk, and the 36 miles between Dunkirk and Buffalo. A small-boat harbor project has been authorized at Elk Creek, Pennsylvania, 11 miles east of Conneaut, but another should be provided along the 22-mile stretch between Elk Creek and Erie. Two other harbors are needed to protect the Erie-Barcelona reach and the reach east of Barcelona to Dunkirk. A harbor project has been authorized at Cattaraugus Creek, 12 miles east of Dunkirk, and one more

TABLE R9-110 Recreational Boating Program, RBG 4.4 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	5.1	5.4	7.5	1.8	4.7	8.3	3.3	0.7	+0.8
Boat-Days of Use	153	162	225	55	140	248	98	22	+23
INLAND LAKES AND STREAMS									
Number of Boats	3.2	3.5	5.4	0.8	2.2	3.2	2.4	1.3	2.2
Boat-Days of Use	96	105	162	23	66	96	73	39	66
RIVER BASIN GROUP TOTAL									
Number of Boats	8.3	8.9	12.9	2.6	6.9	11.5	5.7	2.0	1.4
Boat-Days of Use	249	267	387	78	206	344	171	61	43

PROGRAM ELEMENT		N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL	UNITS									
Great Lakes										
1. Marinas	berths	-	-	-	1,200	2,400	3,600	-	-	-
2. Harbors	acres	-	-	-	40	80	120	-	-	-
3. Access	each	-	-	-	5	15	25	-	-	-
Inland Lakes and Streams										
1. Marinas	berths	-	-	-	300	900	1,200	-	-	-
2. Lake Access	each	-	-	-	3	7	9	-	-	-
3. Stream Access	each	-	-	-	2	5	5	-	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-	-
5. Impoundments	acres	-	-	-	1,400	3,400	4,400	-	-	-

should be provided between there and Buffalo.

These harbors, which would add significantly to the safety or recreational boating on Lake Erie, would also provide berths and launching ramps.

Additional breakwater construction is also needed to provide more space for berths. Lake Erie harbors at Erie, Barcelona, Dunkirk, and Buffalo all have space available, but the spaces lack adequate protection for berthing. Construction of additional breakwaters is already authorized at Dunkirk and the City of Buffalo is now building an additional breakwater.

Lake Ontario harbors at Wilson and Olcott could be modified to provide more berthing space without great difficulty. East of Olcott there is a distance of 32 miles to the next harbor. While the refuge problem is not as critical as on Lake Erie, this distance is excessive, and an additional refuge harbor should be provided. There is a potential site at Golden Hills State Park, near the extreme eastern limit of the area.

Inland waters are used so intensively that the zoning alternative cannot be used effectively in this area, nor are there significant opportunities to increase boating waters with lake restoration. However, there are several possible sites for inland lakes. Several multiple-purpose projects are expected to be constructed by 2020. The framework program includes 4,400 acres of surface water impoundments for recreational boating. Future

demand for berths can best be met by providing additional Great Lakes harbors and marinas.

Most boating demand for inland waters can be met if transferred to Great Lakes waters, but in order for boats to get to the water, additional access sites must be provided. Lake access sites should provide parking for 50 cars with trailers, and stream access points should accommodate 10 cars with trailers.

Additional access is also needed on the Great Lakes. Each 50-car facility could provide approximately 4,000 user days in 1980, 4,800 in 2000, and 6,000 in 2020. The number of sites programmed by the year 2020 is 25.

4.4.4.4 Program Costs

Recreational boating program costs for RBG 4.4 are shown in Table R9-112. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.5 Lake Ontario

The Lake Ontario basin is divided into three river basin groups, which include portions of New York State and the headwaters of the Genesee River in Pennsylvania.

TABLE R9-111 Studies on the Feasibility of Additional Small-Boat Harbors, RBG 4.4

Locality	Purpose	Status
Coast of Lake Erie, harbors & harbors of refuge	To determine need for additional small-craft harbors along Lake Erie coast	
Northeast Pennsylvania	To determine the need for a small-boat harbor at the locality	Report in final form to be completed after FY72
Lake Erie State Park, New York	To determine the need for a small-boat harbor at the locality	Report in final form to be completed after FY72
Dunkirk Harbor, New York	To determine need for harbor modification for small craft	Favorable report submitted to Congress in 1970, authorized in 1971
Little River, Niagara Falls, New York (Sec.107)	To determine if existing project should be modified to provide for more facilities for boats	Detailed project report underway
South shore of Lake Ontario	To determine need for additional small-boat and shore protection facilities on Lake Ontario	
Four Mile Creek, New York	To determine need for small-boat harbor and shore protection at the locality	Study underway, to be completed after FY72
Golden Hill State Park, New York	To determine need for small-boat harbor and shore protection at the locality	Study underway, to be completed in FY72
Olcott Harbor, New York	To determine need for modification of existing project to provide more facilities for small boats	Study underway, to be completed in FY74

4.5.1 River Basin Group 5.1 (West Lake Ontario)

River Basin Group 5.1 is located on the south shore of Lake Ontario (Figure R9-25). Planning Subarea 5.1 defines the area by political (county) boundaries, encompassing six counties of New York. PSA 5.1 contains 3,869 square miles (2,476,800 acres), of which 0.7 percent is rivers, inland lakes, and embayments. Two of the counties border Lake Ontario with a mainland shoreline of 59 miles. River Basin Group 5.1 is defined as the hydrologic area draining into the west end of Lake Ontario. Major watersheds include the Niagara-Orleans complex and the Genesee

River basin. RBG 5.1 drains 3,515 square miles (2,250,000 acres).

The major urban center in this area is Rochester, New York. The area's population, 797,364 in 1960, is projected to be 0.98 million by 1980, 1.22 million by 2000, and 1.54 million by 2020.

4.5.1.1 Boating Opportunities

Recreational boating opportunities for RBG 5.1 are summarized in Table R9-113. The table displays existing capacity, the projected use of existing facilities; potential capacity, the pro-

TABLE R9-112 Recreational Boating Program Costs, RBG 4.4

PROGRAM ELEMENT	UNIT	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020			
		Quantity	Capital	OM&R	Quantity	Capital	OM&R	Quantity	Capital	OM&R	
			Costs	Costs		Costs	Costs		Costs		
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)		
STRUCTURAL											
Great Lakes	(berths)										
1. Marinas	(berths)	\$ 2,800	1,200	3,360	1,680	1,200	3,360	10,080	1,200	3,360	16,800
2. Harbors	(acres)	160,000	40	6,400	640	40	6,400	3,840	40	6,400	6,400
3. Access	(each)	75,000	5	375	38	10	750	300	10	750	600
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	300	840	420	600	1,680	3,360	300	840	5,880
2. Lake Access	(each)	75,000	3	225	23	4	300	150	2	150	240
3. Stream Access	(each)	7,500	2	15	2	3	23	11	0	0	15
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	1,400	7,000	700	2,000	10,000	4,800	1,000	5,000	7,800
TOTAL PROGRAM COSTS											
Federal			7,007	701		8,736	4,550		6,150	7,527	
Non-Federal Public			7,908	702		8,737	4,551		6,150	7,528	
Private			4,200	2,100		5,040	13,440		4,200	22,680	

jected resource availability; and opportunity, the difference between the two.

Lake Ontario's shoreline in this reach consists mostly of low bluffs 5 to 10 feet high. Near the mouth of the Genesee River, the shore includes short reaches of bluffs 30 to 40 feet high interspersed with low marshy areas or ponds bordering barrier beaches. Ponds, which are generally cut off from the Lake, are used by small boats launched or permanently based there. Outlet channels are narrow and shallow, usable only by small boats familiar with the waters. Rochester's commercial harbor, which consists of the lower 3 miles of the Genesee River, is used extensively by recreational craft. Authorized recreational craft harbors of Oak Orchard, Hamlin Beach, and Irondequoit Bay are all in the detailed planning stage. Private interests have provided facilities at Johnson Creek and Sandy Creek. These public and private harbors in 1967 provided moorings for 1,565 recreational craft (Table R9-114).

There are five inland lakes and four reservoirs open to boating in the area (Table R9-115). Two moderately large lakes provide a substantial portion of the total boating water. Five public access sites have been developed by the State of New York.

A limited number of rivers and streams furnish 160 main stream miles suitable for canoeing. Principal streams identified as good canoeing water are the Genesee River and Johnson Creek. Periodic low flows and the lack of stream improvements and maintenance limit the amount of canoeing and small-boat opportunities on the inland streams in the area.

4.5.1.2 Boating Requirements

Recreational boating requirements for RBG 5.1 are summarized in Table R9-116. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the State of New York registered 33,188 boats throughout the six-county area, with the largest number in Monroe County (Rochester). Overall there is an average of 3.9 registered boats for each 100 residents.

The State of New York does not require registration of canoes, sailboats, or other non-powered craft, but comparative data indicate that the number of these unregistered craft is approximately equivalent to 20 percent of the registered small-boat fleet, or 6,600 additional boats.

Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length. This also assumed to be true of the unregistered portion of the small-boat fleet.

River Basin Group 5.1 experiences a modest influx of nonresident boaters because of its limited quantity of water suitable for recreational boating. Nonresident boating demand satisfied in this area is estimated at 78,000 boat days using data obtained by the State of Michigan concerning origins and destinations for boating activities in a comparable area. This figure is approximately equivalent to 2,600 boats or 7 percent of the resident fleet. Composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet.

LAKE ONTARIO

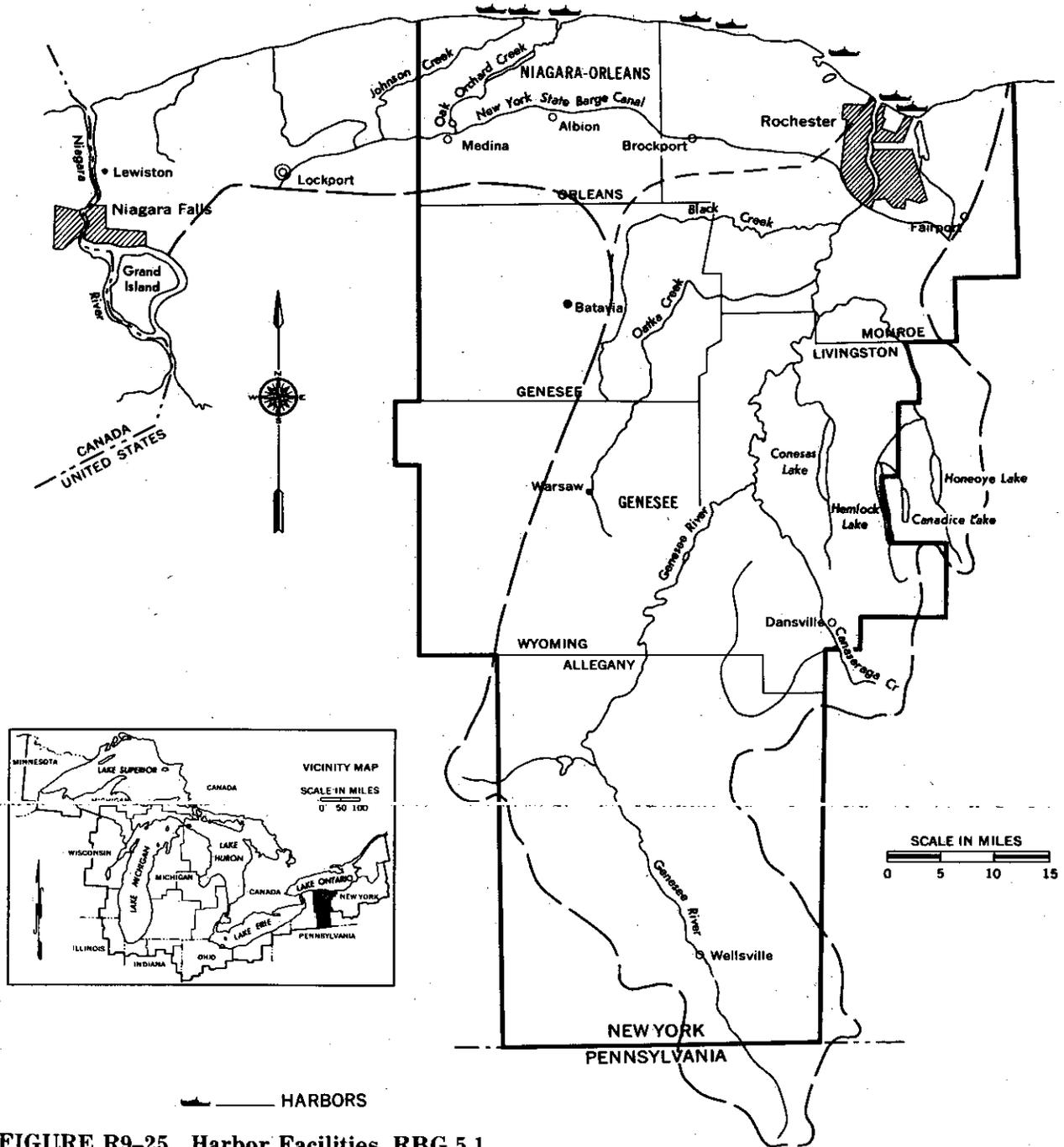


FIGURE R9-25 Harbor Facilities, RBG 5.1

Existing resident boating demand satisfied within the area is estimated to be 55 percent of the resident fleet. This, along with nonresident demand, is the total recreational boating demand satisfied in River Basin Group 5.1. The total number of craft using the boatable waters within the area is expected to increase from the 1968 figure of 24,500 to 44,600 by the

year 2020. This projection and the composition of the fleet using waters within RBG 5.1 are shown in Table R9-117.

4.5.1.3 Recreational Boating Program

The recreational boating program for RBG

TABLE R9-113 Recreational Boating Opportunities, RBG 5.1 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	12.9	15.5	19.4	15.0	18.0	22.4	2.1	2.5	3.0
Boat-Days of Use	388	465	581	451	540	675	63	75	94
SHELTERED WATERS									
Area	0	0	0	0	0	0	N/A	N/A	N/A
Boat-Days of Use	0	0	0	0	0	0	-	-	-
Number of Boats	0	0	0	0	0	0	-	-	-
OFFSHORE WATERS									
Area	155	155	155	180	180	180	25	25	25
Boat-Days of Use	388	465	581	451	540	675	63	75	94
Number of Boats	12.9	15.5	19.4	15.0	18.0	22.4	2.1	2.5	3.0
INLAND LAKES AND STREAMS									
Number of Boats	5.3	6.4	8.0	5.0	6.1	7.6	-0.3	-0.3	-0.4
Boat-Days of Use	159	192	240	150	181	228	-9	-11	-12
INLAND LAKES									
Acres	N/A	N/A	N/A	-	9.6	9.6	9.6	-	-
Boat-Days of Use	-	-	-	125	150	190	-	-	-
Number of Boats	-	-	-	4.2	5.1	6.3	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	-	160	160	160	N/A	N/A
Boat-Days of Use	-	-	-	25	31	38	-	-	-
Number of Boats	-	-	-	0.8	1.0	1.3	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	18.2	21.9	27.4	20.0	24.1	30.0	1.8	2.2	2.6
Boat-Days of Use	547	657	821	601	721	903	54	64	82

TABLE R9-114 Great Lakes Harbor Facilities, RBG 5.1

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
NEW YORK			
Green Harbor	15	38	Private development.
Johnson Creek	5	36	Private development.
Oak Orchard Harbor	180	32	Natural channel in creek. Federal small-boat harbor authorized but not built.
Hamilin Beach Harbor	0	20	State park. Federal small-boat harbor authorized but not built.
Sandy Creek	40	17	Private development.
Braddock Bay	295	6	Natural bay. Federal small-boat harbor study underway.
Rochester Harbor	640	30	Federal deep-draft harbor.
Irondequoit Bay	390	26	Natural bay. Federal small-boat harbor authorized but not built.

TABLE R9-115 Inland Lakes, RBG 5.1

State	Number of Lakes ^a	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
New York ^b	9	12,000	2	5

^aLakes less than 40 acres are not included

^bU.S. Geological Survey

5.1 is summarized in Table R9-118. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, is currently studying the feasibility of constructing

TABLE R9-116 Recreational Boating Requirements, RBG 5.1 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	14.2	17.5	22.3	9.4	11.0	13.4	4.8	6.5	8.9
Boat-Days of Use	426	525	669	282	330	402	144	195	267
BOATS BERTHED									
Number of Boats	5.2	6.4	8.1	1.6	1.6	1.6	3.6	4.8	6.5
Boat-Days of Use	156	192	243	48	48	48	108	144	195
BOATS LAUNCHED									
Number of Boats	9.0	11.1	14.2	7.8	9.4	11.8	1.2	1.7	2.4
Number of Launchings	270	333	426	234	282	354	36	51	72
INLAND LAKES AND STREAMS									
Number of Boats	14.1	17.4	22.3	12.2	13.5	15.4	1.9	3.9	6.9
Boat-Days of Use	423	522	669	366	405	462	57	117	207
BOATS BERTHED									
Number of Boats	6.8	8.4	10.6	5.9	5.9	5.9	0.9	2.5	4.7
Boat-Days of Use	204	252	318	177	177	177	27	75	141
BOATS LAUNCHED									
Number of Boats	7.3	9.0	11.7	6.3	7.6	9.5	1.0	1.4	2.2
Number of Launchings	219	270	351	189	228	285	30	42	66
RIVER BASIN GROUP TOTAL									
Number of Boats	28.3	34.9	44.6	21.6	24.5	28.8	6.7	10.4	15.8
Boat-Days of Use	849	1,047	1,338	648	735	864	201	312	474

TABLE R9-117 Existing and Future Small-Boat Fleet, RBG 5.1 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	21.90	25.10	31.00	39.60
Nonresident ^b	2.60	3.20	3.90	5.00
Total	24.50	28.30	34.90	44.60
Composition				
< 12 feet (32.0%)	7.83 ^c	9.06	11.17	14.27
12 - 20 feet (63.0%)	15.44 ^d	17.83	21.99	28.10
20 - 30 feet (4.0%)	1.00 ^e	1.13	1.40	1.78
30 - 40 feet (0.7%)	0.17 ^f	0.20	0.24	0.30
> 40 feet (0.3%)	0.06 ^g	0.08	0.10	0.15

^a55% of resident boats in area.

^b7% of resident boats in area.

^cTotal includes 7.01 resident and 0.82 nonresident boats.

^dTotal includes 13.80 resident and 1.64 nonresident boats.

^eTotal includes 0.89 resident and 0.11 nonresident boats.

^fTotal includes 0.15 resident and 0.02 nonresident boats.

^gTotal includes 0.05 resident and 0.01 nonresident boats.

additional small-boat harbors along the shore of Lake Ontario.

The Office of Parks and Recreation has principal responsibility in New York for providing recreational boating services. Other State agencies having an interest in recreational boating include the Department of Environ-

mental Conservation, which provides launching facilities and access points in State forest areas, and the Department of Transportation, which operates the New York State Barge Canal System, which is used extensively by recreational craft. The system includes public docks, which may be used by vessels transiting the canal.

An updated small-boat harbor program on Lake Ontario is essential to the expansion of recreational boating on these waters. Present programs do not provide adequate facilities to meet projected needs within a reasonable time frame. Also needed is a better system to inform recreational boaters of weather conditions and forecasts.

If recreational boating is to develop as projected on the area's inland waters, access sites and additional improved waters must be provided. A number of potential reservoir sites exist in this area, and there are studies under way at the Federal level concerning their development. The State of New York is also studying possible reservoirs.

Analysis of demand and supply of boating waters indicates that future growth must take place on the Great Lakes because inland waters are now utilized to capacity. Transfer of future needs for inland waters to Great Lakes waters is feasible because all parts of the area are within a two-hour travel time of the Great Lakes. Most of the population is within a one-hour travel time.

On Lake Ontario, the desirable spacing interval of harbors-of-refuge is 15 to 20 miles, which allows cruising boats to reach safety

TABLE R9-118 Recreational Boating Program, RBG 5.1 (thousands)

		Needs			Needs Programmed			Needs Unmet		
		To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES										
Number of Boats		4.8	6.5	8.9	2.5	5.4	9.2	2.3	1.1	+0.3
Boat-Days of Use		144	195	267	74	162	276	70	33	+9
INLAND LAKES AND STREAMS										
Number of Boats		8.8	11.0	14.3	1.0	1.3	1.4	7.8	9.7	12.9
Boat-Days of Use		264	330	429	29	38	43	235	292	386
RIVER BASIN GROUP TOTAL										
Number of Boats		13.6	17.5	23.2	3.5	6.7	10.6	10.1	10.8	12.6
Boat-Days of Use		201	312	474	103	200	319	98	112	155
PROGRAM ELEMENT		N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL										
UNITS										
Great Lakes										
1. Marinas	berths	-	-	-	1,200	2,400	3,600	-	-	-
2. Harbors	acres	-	-	-	40	80	120	-	-	-
3. Access	each	-	-	-	10	20	30	-	-	-
Inland Lakes and Streams										
1. Marinas	berths	-	-	-	300	300	300	-	-	-
2. Lake Access	each	-	-	-	3	3	3	-	-	-
3. Stream Access	each	-	-	-	5	10	10	-	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-	-
5. Impoundments	acres	-	-	-	1,300	1,300	1,300	-	-	-

before dangerous storm conditions develop. In this area of Lake Ontario the shoreline is lacking in natural shelter and Rochester Harbor provides the only refuge. Additional harbors-of-refuge are needed to the west. Harbor projects are authorized at Oak Orchard, approximately 32 miles west of Rochester, and at Hamlin Beach, approximately 20 miles west of Rochester. Construction of a harbor is also authorized at Irondequoit Bay, 4 miles east of Rochester. The next logical harbor east of there is outside the area. These three authorized harbors could provide necessary refuge on this reach of Lake Ontario shore.

The demand for berths on Great Lakes waters can be satisfied by construction of marinas at the other three harbor projects. There is a need for 3,600 berths on Great Lakes waters by 2020. Assuming an average of 200 berths per marina, as many as six new marinas would be required on the Great Lakes in each of the three time periods. It is assumed that marina construction, not including breakwaters, would be a State, local, or private responsibility.

There is little chance that more than one multipurpose impoundment will be constructed in this area. It would provide 1,300 acres of water surface area by 1980. The impoundments will need additional access sites to provide for future boating needs and more intensive use. Each site should provide parking for 50 cars with trailers so that it can provide 12,000 user days annually.

Additional access is also essential to future

boating on existing inland waters. It is suggested that each lake access site provide parking for at least 50 cars with trailers. Access sites on streams should provide parking for 10 vehicles. Forty-three sites are programmed by the year 2020.

4.5.1.4 Program Costs

Recreational boating program costs for RBG 5.1 are shown in Table R9-119. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

4.5.2 River Basin Group 5.2 (Southeast Lake Ontario)

River Basin Group 5.2 is located on the south shore of Lake Ontario (Figure R9-26). Planning Subarea 5.2 defines the area by political (county) boundaries, encompassing 12 New York counties. PSA 5.2 contains 8,876 square miles (5,682,600 acres), of which 4.5 percent is rivers, inland lakes, and embayments. Three of the counties border on Lake Ontario with a mainland shoreline of 79 miles. River Basin Group 5.2 is defined as the hydrologic area draining into Central Lake Ontario. Major watersheds include the Wayne-Cayuga complex, the Oswego River basin, and the

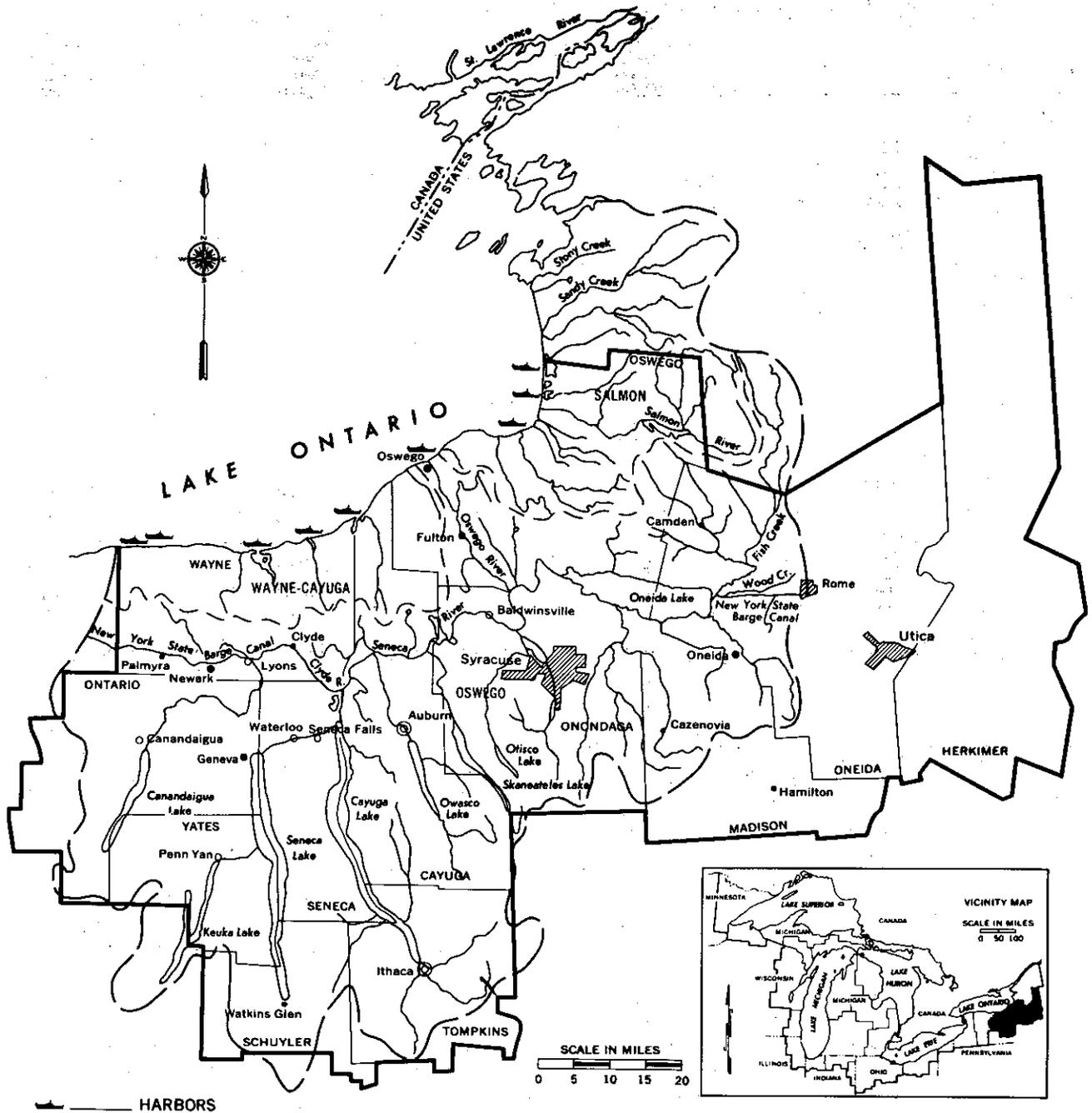


FIGURE R9-26 Harbor Facilities, RBG 5.2

Salmon-Perch complex. RBG 5.2 drains 6,815 square miles (4,363,000 acres).

Major urban centers in this area are Syracuse and Utica-Rome. The area's population, which was 1,236,359 in 1960, is expected to increase to 1.57 million by 1980, 2.02 million by 2000, and 2.56 million by 2020.

4.5.2.1 Boating Opportunities

Recreational boating opportunities for RBG 5.2 are summarized in Table R9-120. The table displays the existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and op-

TABLE R9-119 Recreational Boating Program Costs, RBG 5.1

PROGRAM ELEMENT		UNIT COST	Period 1970 to 1980		Period 1981 to 2000			Period 2001 to 2020			
			Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL											
Great Lakes											
1. Marinas	(berths)	\$ 2,800	1,200	3,360	1,680	1,200	3,360	10,080	1,200	3,360	16,800
2. Harbors	(acres)	160,000	40	6,400	640	40	6,400	3,840	40	6,400	6,400
3. Access	(each)	75,000	10	750	75	10	750	450	10	750	750
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	300	840	420	0	0	1,680	0	0	1,680
2. Lake Access	(each)	75,000	3	225	23	0	0	90	0	0	90
3. Stream Access	(each)	7,500	5	38	4	5	38	23	0	0	30
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres)	5,000	1,300	6,500	650	0	0	2,600	0	0	2,600
TOTAL PROGRAM COSTS											
Federal				6,956	696		3,594	3,501		3,575	4,935
Non-Federal Public				6,957	696		3,594	3,502		3,575	4,935
Private				4,200	2,100		3,360	11,760		3,360	18,480

portunity, the difference between the two.

The major river, the Oswego, drains most of the basin. Inland lakes in this area which are generally used for recreational boating have a total water surface area of 212,000 acres, of which 180,000 acres are boatable.

The Lake Ontario shoreline of this area has varied characteristics. The western consists of bluffs averaging 25 to 30 feet high. Beaches are narrow and mostly gravel. The next portion, extending from Sodus Bay to Oswego, consists of a unique series of parallel drumlins in their axes generally perpendicular to the Lake. Between the drumlins are low, marshy areas or open water. The lake ends of the drumlins have been eroded into almost vertical bluffs up to 150 feet high.

Narrow sand and gravel beaches have formed between and in front of the drumlins, closing the low areas off from the Lake, and making sheltered open water areas that are popular with boaters.

There are five Federal harbor projects along the lakeshore in this area, including Oswego Harbor, primarily a commercial harbor, which offers some facilities for recreational boats as well. It is also the Lake Ontario terminus of the New York State Barge Canal system, which is becoming a popular route for small boats. Projects at Great Sodus Bay and Little Sodus Bay are old commercial harbors now used for recreational boating. Projects at Port Bay and Port Ontario, which have not yet been built, are for recreational boating. Private interests have improved three other localities to provide boating facilities. These harbors provided mooring for 835 vessels in 1967 (Table R9-121).

This area is well supplied with inland lakes, most of which are suitable for recreational boating (Table R9-122). Many of the lakes are large. The largest, Oneida Lake, has an area of more than 50,000 acres. Seneca and Cayuga Lakes each have areas of more than 40,000 acres. Fifteen other lakes each have a surface area of 1,000 acres or more. Many of the larger lakes are in the famous Finger Lakes area, which occupies the western part of RBG 5.2. This scenic area, readily accessible from all parts of the northeast, attracts many visitors and constitutes a major boating area. The northeastern corner of the area has numerous small lakes. Parts of the area are nearly wilderness, and are not readily accessible to boaters.

The conditions that restrict access to most boaters in the northeast portion make that portion attractive to canoeists. Most of the area's canoeing waters are in this portion, and some of these waters connect to an extensive system of canoe waters east of the Great Lakes Region. The 76 miles of principal canoeing streams include the Salmon River, Moose River, Fish Creek, and Fall Creek.

4.5.2.2 Boating Requirements

Recreational boating requirements for RBG 5.2 are summarized in Table R9-123. The table displays demand, supply, and need for boats berthed and boats launched in terms of number of boats and boat-days of use.

In 1968 the State of New York registered 68,752 boats in this 12-county area. Boats are distributed throughout the area with the

TABLE R9-120 Recreational Boating Opportunities RBG 5.2 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	15.3	18.4	23.0	19.5	23.4	29.3	4.2	5.0	6.3
Boat-Days of Use	460	552	690	585	702	878	125	150	188
SHELTERED WATERS									
Area	0	0	0	0	0	0	N/A	N/A	N/A
Boat-Days of Use	0	0	0	0	0	0	-	-	-
Number of Boats	0	0	0	0	0	0	-	-	-
OFFSHORE WATERS									
Area	184	184	184	234	234	234	50	50	50
Boat-Days of Use	460	552	690	585	702	878	125	150	188
Number of Boats	15.3	18.4	23.0	19.5	23.4	29.3	4.2	5.0	6.3
INLAND LAKES AND STREAMS									
Number of Boats	65.6	73.2	84.2	78.8	95.5	119.4	13.2	22.3	35.2
Boat-Days of Use	1,968	2,196	2,526	2,364	2,866	3,582	396	670	1,056
INLAND LAKES									
Acres	N/A	N/A	N/A	180	180	180	N/A	N/A	N/A
Boat-Days of Use	-	-	-	2,352	2,851	3,564	-	-	-
Number of Boats	-	-	-	78.4	95.0	118.8	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	76	76	76	N/A	N/A	N/A
Boat-Days of Use	-	-	-	12	15	18	-	-	-
Number of Boats	-	-	-	0.4	0.5	0.6	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	80.9	91.6	107.2	98.3	118.9	148.7	17.4	27.3	41.5
Boat-Days of Use	2,428	2,748	3,216	2,949	3,568	4,460	521	820	1,254

TABLE R9-121 Great Lakes Harbor Facilities, RBG 5.2

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
NEW YORK			
Pultneyville	15	11	Private development.
Fairbanks Point	60	8	Private development.
Great Sodus Bay Harbor	375	14	Federal deep-draft harbor.
Port Bay	15	7	Natural bay. Federal small-boat harbor authorized but not built.
Little Sodus Bay Harbor	70	13	Federal medium-draft harbor.
Oswego Harbor	60	35	Federal deep-draft harbor.
Little Salmon River	0	25	Natural channel. State boat launching site. Federal small-boat harbor study authorized but not started.
Port Ontario Harbor	50	22	Natural channel. Federal small-boat harbor authorized but not built.
North Sandy Pond	190	20	Natural bay. Private development.

TABLE R9-122 Inland Lakes, RBG 5.2

State	Number of Lakes ^a	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
New York ^b	137	212,000	18	29

^aLakes less than 40 acres are not included

^bU.S. Geological Survey in cooperation with State Department of Environmental Conservation

largest percentage located in Onondaga County (Syracuse). Overall there is an average of 5.1 registered boats for each 100 residents.

New York does not require registration of canoes, sailboats, or other nonpowered craft, but comparative data indicate that the number of these unregistered craft is equivalent to approximately 20 percent of the registered small-boat fleet. This means an estimated 13,700 additional boats are located in this area.

Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length. This is also assumed to be true of the unregistered portion of the small-boat fleet.

Nonresident boating demand in RBG 5.2 is estimated at 619,000 boat days, the approximate equivalent of 20,300 boats or 25 percent of the resident fleet. These estimates are based on data obtained by the State of New York concerning origins and destinations for boating activities in an area comparable to

RBG 5.2. Composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet.

The resident fleet is expected to be 96,000 boats by 1980, 123,000 by 2000, and 156,000 by 2020. Existing resident boating demand satisfied within the area is estimated at 75 percent of the resident fleet. This, along with present nonresident demand, is the total recreational boating demand satisfied in RBG 5.2. The number of craft using the boatable waters within the area, which was 82,000 in 1968, is expected to increase to 156,000 by the year 2020. This projection and the composition of the total fleet are shown in Table R9-124.

4.5.2.3 Recreational Boating Program

The recreational boating program for RBG 5.2 is summarized in Table R9-125. The table displays needs, needs programmed and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of framework program.

The Federal government, in cooperation with State and local governments, has studied the feasibility of constructing additional small-boat harbors along the shore of Lake Ontario, but no studies are under way at the present time in this area.

New York's Office of Parks and Recreation is principally responsible for providing State recreational boating services. Other State agencies having an interest in recreational

TABLE R9-123 Recreational Boating Requirements, RBG 5.2 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	19.2	24.4	31.2	16.4	19.3	23.3	2.8	5.1	7.9
Boat-Days of Use	576	732	936	492	579	699	84	153	237
BOATS BERTHED									
Number of Boats	3.4	4.4	5.4	3.0	3.0	3.0	0.4	1.4	2.4
Boat-Days of Use	102	132	162	90	90	90	12	42	72
BOATS LAUNCHED									
Number of Boats	15.8	20.0	25.8	13.4	16.3	20.3	2.4	3.7	5.5
Number of Launchings	474	600	774	402	489	609	72	111	165
INLAND LAKES AND STREAMS									
Number of Boats	76.8	97.6	124.8	65.6	73.2	84.2	11.2	24.4	40.6
Boat-Days of Use	2,304	2,928	3,744	1,968	2,196	2,526	336	732	1,218
BOATS BERTHED									
Number of Boats	34.6	44.0	56.2	29.6	29.6	29.6	5.0	14.4	26.6
Boat-Days of Use	1,038	1,320	1,686	888	888	888	150	432	798
BOATS LAUNCHED									
Number of Boats	42.2	53.6	68.6	36.0	43.6	54.6	6.2	10.0	14.0
Number of Launchings	1,266	1,608	2,058	1,080	1,308	1,638	186	300	420
RIVER BASIN GROUP TOTAL									
Number of Boats	96.0	122.0	156.0	82.0	92.5	107.5	14.0	29.5	48.5
Boat-Days of Use	2,880	3,660	4,680	2,460	2,775	3,225	420	885	1,455

boating include the Department of Environmental Conservation, which studies water resources problems, including boating, and provides launching facilities and access points in State forest areas; and the Department of Transportation, which operates the New York State Barge Canal System, used extensively by recreational craft. The system includes public docks which may be used by vessels transiting the canal.

An updated small-boat harbors program on Lake Ontario and a better system to inform recreational boaters of weather conditions and forecasts are essential to expansion of recreational boating on these waters. Present programs are not adequate to meet the projected needs.

This area's large quantity of inland waters is adequate for boating needs. While a number of potential multiple-purpose reservoir sites exist in this area, there are no Federal studies concerning their development. The State of New York is making studies of water resource problems, which include boating.

While there is no need for new or improved boating waters, there is a need for additional access sites on existing Lake Ontario and inland waters.

The Lake Ontario shoreline is lacking in natural shelter. There are bays along the reach, but bars formed by littoral forces shut them off from the Lake. The bars may be breached by storm action or by private dredging efforts, but they are soon formed again.

Harbors at Great Sodus and Little Sodus Bays and at Oswego provide some refuge as well as berthing, but harbors should be spaced every 15 to 20 miles to allow cruising boats to reach safety before dangerous storm conditions develop. Where harbor spacing is excessive, at the west end near the village of Putneyville and at the other end at Port Ontario, harbors-of-refuge are needed. The refuge harbor that is authorized at Port Ontario would help link the New York State Barge Canal system, which reaches Lake Ontario at Oswego, with the popular recreational boating areas in the northeast corner of the Lake and on the St. Lawrence River.

Two other harbors will complete the harbor program. One could be at Port Bay, which is cut off from the Lake by a bar across its mouth. Port Bay is approximately halfway between Great Sodus and Little Sodus Bays. A number of boats are berthed there, even though they do not always have lake access, and additional boats could berth there as the demand increases. A project is authorized for structures

needed to maintain a permanent entrance and should be considered for construction.

Another possible site is in the southeast corner of the Lake near a popular recreational fishing spot known as Mexico Bay. Its full use is hampered by lack of boating access. Construction of Port Ontario Harbor will help, but space for expansion there is limited and eventually additional access should be provided. The Little Salmon River, between Oswego and Port Ontario, has some advantages and is worthy of consideration. Land along the lakeshore is State-owned and topography is generally suitable.

Inland waters will require 60 marinas (200 berths each) or the equivalent at individual private docks by 2020. There is little chance that multipurpose impoundments will be constructed in this area.

Additional access to inland waters is essential to meet future boating needs. Because work patterns and leisure time will increase the maximum capacity of each site with time, the number of sites programmed is 42 between 1970 and 1980, 63 between 1980 and 2000, and 55 between 2000 and 2020.

Additional access on the Great Lakes is also essential to provide for future boating needs.

TABLE R9-124 Existing and Future Small-Boat Fleet RBG 5.2 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	61.70	72.00	92.00	117.00
Nonresident ^b	20.30	24.00	30.00	39.00
Total	82.00	96.00	122.00	156.00
Composition				
< 12 feet (32.0%)	26.20 ^c	30.70	39.00	49.90
12 - 20 feet (63.0%)	51.70 ^d	60.50	76.90	98.30
20 - 30 feet (4.0%)	3.30 ^e	3.80	4.90	6.30
30 - 40 feet (0.7%)	0.50 ^f	0.70	0.80	1.10
> 40 feet (0.3%)	0.30 ^g	0.30	0.40	0.50

^a75% of resident boats.

^b25% of resident fleet.

^cTotal includes 19.70 resident and 6.50 nonresident boats.

^dTotal includes 38.90 resident and 12.80 nonresident boats.

^eTotal includes 2.50 resident and 0.80 nonresident boats.

^fTotal includes 0.40 resident and 0.10 nonresident boats.

^gTotal includes 0.20 resident and 0.10 nonresident boats.

TABLE R9-125 Recreational Boating Program, RBG 5.2 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	2.8	5.1	7.9	1.1	3.6	6.5	1.7	1.5	1.4
Boat-Days of Use	84	153	237	33	108	195	51	45	42
INLAND LAKES AND STREAMS									
Number of Boats	11.2	24.4	40.6	8.4	23.7	42.4	2.8	0.7	+1.8
Boat-Days of Use	336	732	1,218	252	710	1,272	84	22	+54
RIVER BASIN GROUP TOTAL									
Number of Boats	14.0	29.5	48.5	9.5	27.3	48.9	4.5	2.2	+0.4
Boat-Days of Use	420	885	1,455	285	818	1,467	135	67	+11
PROGRAM ELEMENT									
	N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL	UNITS								
Great Lakes									
1. Marinas	berths	-	-	-	450	1,200	1,800	-	-
2. Harbors	acres	-	-	-	15	40	60	-	-
3. Access	each	-	-	-	5	15	25	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	3,000	7,500	12,000	-	-
2. Lake Access	each	-	-	-	40	100	150	-	-
3. Stream Access	each	-	-	-	2	5	10	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

Each access site should provide parking for at least 50 cars with trailers, thus providing 6,000 user days annually. Twenty-five sites are required by 2020.

4.5.2.4 Program Costs

Recreational boating program costs for RBG 5.2 are shown in Table R9-126. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are

then summarized as Federal, non-Federal public, and private.

4.5.3 River Basin Group 5.3 (Northeast Lake Ontario)

River Basin Group 5.3 is located at the east end of Lake Ontario (Figure R9-27). Planning Subarea 5.3 defines the area by political (county) boundaries, encompassing three New York counties. It contains 5,563 square miles (3,561,600 acres), of which 8 percent is

TABLE R9-126 Recreational Boating Program Costs, RBG 5.2

PROGRAM ELEMENT	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
		Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
STRUCTURAL										
Great Lakes										
1. Marinas	(berths) \$ 2,800	450	1,260	630	750	2,100	4,620	600	1,680	8,400
2. Harbors	(acres) 160,000	15	2,400	240	25	4,000	1,760	20	3,200	3,200
3. Access	(each) 75,000	5	375	38	10	750	300	10	750	600
Inland Lakes and Streams										
1. Marinas	(berths) 2,800	3,000	8,400	4,200	4,500	12,600	29,400	4,500	12,600	54,600
2. Lake Access	(each) 75,000	40	3,000	300	60	4,500	2,100	50	3,375	3,675
3. Stream Access	(each) 7,500	2	15	2	3	23	11	5	38	23
4. Restoration	(acres) 5,000	0	0	0	0	0	0	0	0	0
5. Impoundment	(acres) 5,000	0	0	0	0	0	0	0	0	0
TOTAL PROGRAM COSTS										
Federal			2,895	290		4,636	2,085		3,681	3,749
Non-Federal Public			2,895	290		4,637	2,086		3,682	3,749
Private			9,660	4,830		14,700	34,020		14,280	63,000

ivers, inland lakes, and embayments. Two counties border on Lake Ontario with a mainland shoreline of 120 miles. River Basin Group 5.3 is defined as the hydrologic area draining into the east end of Lake Ontario. Major watersheds include the Black River basin, the St. Lawrence complex, the Oswegatchie basin, and the Grass-Raquette-St. Regis complex. RBG 5.3 drains 7,335 square miles (4,696,000 acres).

There are no major urban centers in this area. The largest city, Watertown, had a population of 33,306 in 1960. The area's population, 222,323 in 1960, is projected to increase to 230,000 by 1980, 260,000 by 2000, and 300,000 by 2020.

4.5.3.1 Boating Opportunities

Recreational boating opportunities for RBG 5.3 are summarized in Table R9-127. The table displays existing capacity, the projected use of existing facilities; potential capacity, the projected resource availability; and opportunity, the difference between the two.

The Lake Ontario shoreline in this area consists of two separate parts. The 10 miles adjacent to River Basin Group 5.2 consists of a sandy barrier beach in front of marsh areas and small ponds. At the north end of this area the character changes abruptly into cliffs 10 to 20 feet high, and in places, 75 feet high. The

shoreline is relatively irregular with several large bays offering shelter and boatable waters when the open lake is hazardous.

This area includes the upper 114 miles of the St. Lawrence River, including its head at Lake Ontario. The river is essentially an arm of the Lake in this area and the drop in water surface elevation from Lake Ontario is small. The current is slow and in many cases imperceptible. There is an abundance of sheltered waters for boating including areas suitable for construction of marinas and launching ramps. The upper 40 miles of the river is the famous Thousand Islands section, noted for its beautiful scenery. This combination of sheltered water and attractive environment draws boaters from well outside the area, including many from outside the State.

There are 164,000 acres of sheltered Great Lakes waters in RBG 5.3, accommodating 2,040 boats moored in public and private marinas. There are Federal harbor projects at Sackets Harbor, Cape Vincent, Morristown, and Ogdensburg, which provide some facilities for recreational craft. The major navigation improvement in the area is the St. Lawrence Seaway, which consists of channels and locks. It was designed for commercial navigation but is also used by recreational craft cruising along the St. Lawrence. Harbor facilities in RBG 5.3 are shown in Table R9-128.

Some of the inland lakes (Table R9-129) in the more rugged portions of the area that

TABLE R9-127 Recreational Boating Opportunities, RBG 5.3 (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	22.5	27.2	34.0	22.5	27.2	34.0	0	0	0
Boat-Days of Use	674	816	1,021	674	816	1,021	0	0	0
SHELTERED WATERS									
Area	164	164	164	164	164	164	N/A	N/A	N/A
Boat-Days of Use	612	741	927	612	741	927	-	-	-
Number of Boats	20.4	24.7	30.9	20.4	24.7	30.9	-	-	-
OFFSHORE WATERS									
Area	25	25	25	25	25	25	0	0	0
Boat-Days of Use	62	75	94	62	75	94	0	0	0
Number of Boats	2.1	2.5	3.1	2.1	2.5	3.1	0	0	0
INLAND LAKES AND STREAMS									
Number of Boats	12.3	13.8	15.9	17.4	20.9	26.1	5.1	7.1	10.2
Boat-Days of Use	369	414	477	520	626	783	151	212	306
INLAND LAKES									
Acres	N/A	N/A	N/A	32	32	32	N/A	N/A	N/A
Boat-Days of Use	-	-	-	422	507	634	-	-	-
Number of Boats	-	-	-	14.1	16.9	21.1	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	621	621	621	N/A	N/A	N/A
Boat-Days of Use	-	-	-	98	119	149	-	-	-
Number of Boats	-	-	-	3.3	4.0	5.0	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	34.8	41.0	49.9	39.9	48.1	60.1	5.1	7.1	10.2
Boat-Days of Use	1,043	1,230	1,498	1,194	1,442	1,804	151	212	306

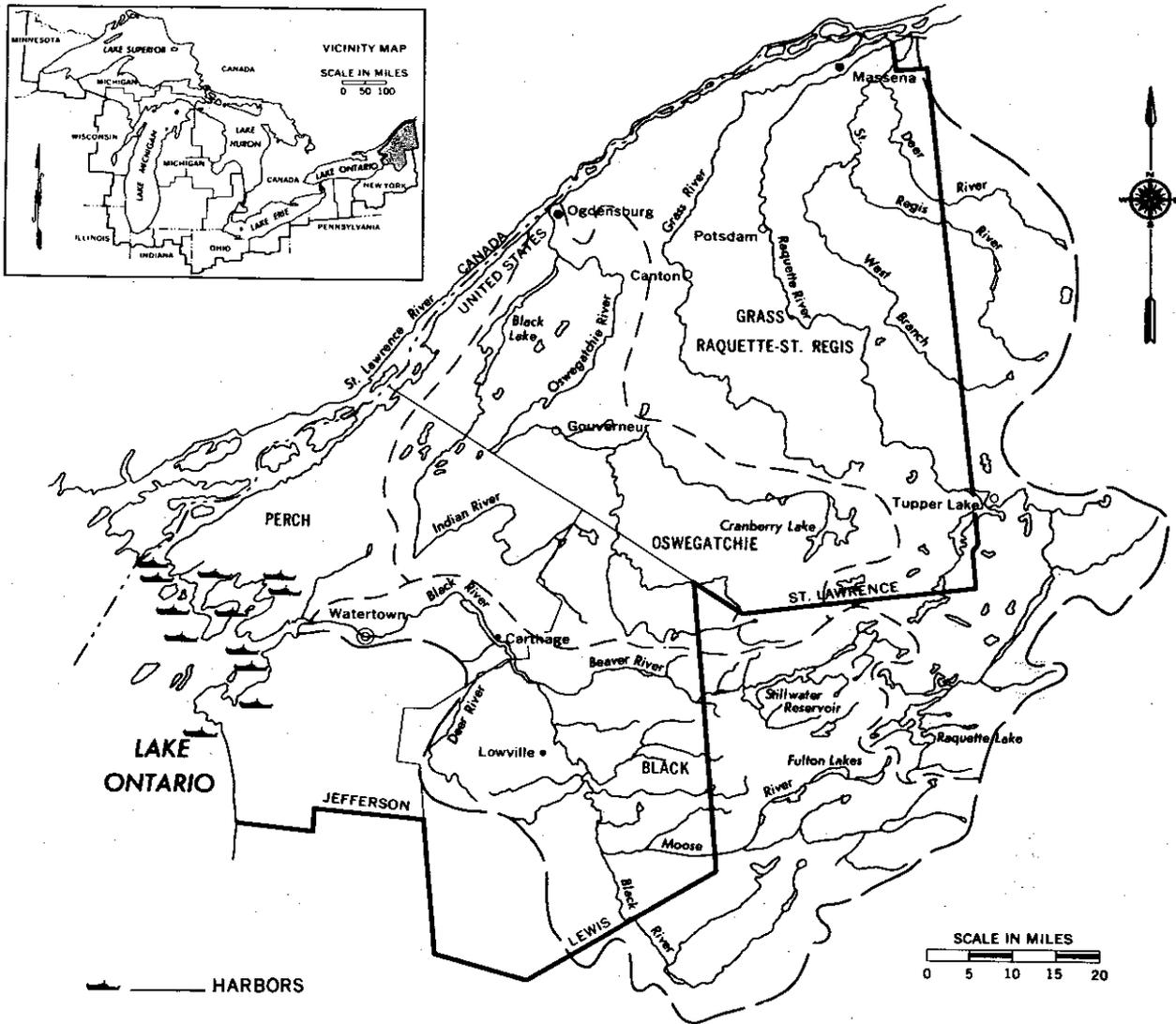


FIGURE R9-27 Harbor Facilities, RBG 5.3

TABLE R9-128 Inland Lakes, RBG 5.3

State	Number of Lakes ^a	Total Water area (acres)	Number of Lakes over 1,000 acres	Public Access Sites
New York ^b	129	40,000	3	8

^aLakes less than 40 acres are not included

^bU.S. Geological Survey in cooperation with State Department of Environmental Conservation

the State maintains as wilderness are inaccessible to vehicles other than jeeps. For this reason, effective boating water is 75 percent of the total. New York has developed eight public access sites on these inland waters.

This area has approximately 535 miles of main streams and approximately 86 miles of small tributary rivers suitable for canoeing. Principal rivers and tributaries identified as good canoeing waters are the St. Lawrence, Black, Oswegatchie, Indian, Grass, and Raquette Rivers.

TABLE R9-129 Great Lakes Harbor Facilities, RBG 5.3

Harbor	Boats Moored	Distance to next harbor or refuge	Remarks
<u>NEW YORK</u>			
Stony Creek	15	5	Natural channel. Private development.
Henderson Bay	305		Natural bay. Public launching ramp. Private development.
Sackets Harbor	115		Federal small-boat harbor, active portion completed.
Chaumont Bay	230		Natural bay. Public launching ramp. Private development.
<u>St. Lawrence River</u>			
Cape Vincent to Clayton	205	19	Natural channels and bays. Public launching ramps. Private development.
Clayton to Alexandria Bay	605	10	Natural channels and bays. Public launching ramps. Private development.
Alexandria Bay to Chippewa Point	465	13	Natural channels and bays. Public launching ramps. Private development.
Chippewa Point to Morristown	45	11	Natural channels. Public launching ramp.
Morristown to Ogdensburg	60	10	Federal small-boat harbor at Morristown completed 1928. Natural channel elsewhere.
Ogdensburg to Coles Creek	110	24	Federal deep-draft harbor at Ogdensburg. Natural channels and bays elsewhere. Public launching ramps. Private development.
Coles Creek to Barnhart Island	110	16	Natural channels and bays. Public launching ramps. Private development.

4.5.3.2 Boating Requirements

Recreational boating requirements for RBG 5.3 are summarized in Table R9-130. The table displays demand, supply, and need for boats berthed and boats launched in terms of the number of boats and the boat-days of use.

In 1968 the State of New York registered 18,865 boats in this three-county area. Registered boats are distributed throughout the area with a larger percentage located on the St. Lawrence River. Overall there is an average 6.8 registered boats for each 100 residents.

The State of New York does not require registration of canoes, sailboats, or other non-powered craft, but comparative data indicate that their number is equivalent to approximately 20 percent of the registered small-boat fleet. This means an estimated 3,800 additional boats are located in this area.

Analysis of boat registration data shows that the vast majority of recreational craft are 20 feet or less in length. This is also assumed to be true for the unregistered portion of the small-boat fleet.

Many nonresident boaters come to RBG 5.3 because of its large quantity of water suitable for recreational boating, its beautiful scenery, and its freedom from urban environment. Non-resident boating demand satisfied in this river basin group is estimated to be 306,000 boat days, the equivalent of approximately 10,200 boats or approximately 45 percent of the resident fleet. These estimates are based on data obtained by the State of New York concerning origins and destinations for boating activities in an area comparable to RBG 5.3. Boaters come primarily from River Basin Groups 5.1 and 5.2, but significant numbers also come from more distant areas, including areas out-

TABLE R9-130 Recreational Boating Requirements, RBG 5.3 (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	18.7	21.1	24.3	18.3	20.8	24.3	0.4	0.3	0
Boat-Days of Use	561	633	729	549	624	729	12	9	0
BOATS BERTHED									
Number of Boats	6.8	7.8	9.0	6.7	6.7	6.7	0.1	1.1	2.3
Boat-Days of Use	204	234	270	201	201	201	3	33	69
BOATS LAUNCHED									
Number of Boats	11.9	13.3	15.3	11.6	14.1	17.6	0.3	+0.8	+2.3
Number of Launchings	357	399	459	348	423	528	9	+24	+69
INLAND LAKES AND STREAMS									
Number of Boats	12.4	14.0	16.2	12.3	13.8	15.9	0.1	0.2	0.3
Boat-Days of Use	372	420	486	369	414	477	3	6	9
BOATS BERTHED									
Number of Boats	5.4	6.1	7.0	5.3	5.3	5.3	0.1	0.8	1.7
Boat-Days of Use	162	183	210	159	159	159	3	24	51
BOATS LAUNCHED									
Number of Boats	7.0	7.9	9.2	7.0	8.5	10.6	0	+0.6	+1.4
Number of Launchings	210	237	276	210	255	318	0	+18	+42
RIVER BASIN GROUP TOTAL									
Number of Boats	31.1	35.1	40.5	30.6	34.6	40.2	0.5	0.5	0.3
Boat-Days of Use	933	1,053	1,215	918	1,038	1,206	15	15	9

side the Great Lakes Basin. Composition of the estimated nonresident fleet is determined by applying the same percentages used for the resident fleet.

Existing boating waters satisfy 90 percent of the demand of the resident fleet. The resident and present nonresident demand is the total recreational boating demand that is being satisfied in River Basin Group 5.3. The total number of craft using the boatable waters within the area is expected to increase from 30,600 in 1968 to 40,500 by the year 2020. This projection and composition of the total fleet are shown in Table R9-131.

4.5.3.3 Recreational Boating Program

The recreational boating program for RBG 5.3 is summarized in Table R9-132. The table displays needs, needs programmed, and needs unmet for Great Lakes waters, inland lakes, and streams. Needs programmed are also shown as elements of a framework program.

The Federal government, in cooperation with State and local governments, has studied the feasibility of constructing additional small-boat harbors along the shore of Lake Ontario, but no studies are under way currently.

The Office of Parks and Recreation has the principal responsibility in the State of New York for providing recreational boating services.

An updated program concerning small-boat facilities on Lake Ontario and the St. Law-

rence River is essential to the expansion of recreational boating on these waters. Present programs do not provide for adequate facilities to meet the projected needs within a reasonable time. A better system to inform

TABLE R9-131 Existing and Future Small-Boat Fleet, RBG 5.3 (thousands)

	1968	1980	2000	2020
Number of Boats				
Resident ^a	20.4	20.7	23.4	27.0
Nonresident ^b	<u>10.2</u>	<u>10.4</u>	<u>11.7</u>	<u>13.5</u>
Total	30.6	31.1	35.1	40.5
Composition				
< 12 feet (32.0%)	9.9 ^c	9.9	11.3	13.0
12 - 20 feet (63.0%)	19.2 ^d	19.6	22.1	26.0
20 - 30 feet (4.0%)	1.2 ^e	1.3	1.4	1.6
30 - 40 feet (0.7%)	0.25 ^f	0.25	0.25	0.30
> 40 feet (0.3%)	0.50 ^g	0.50	0.10	0.15

^a90% of resident boats.

^b45% of resident boats.

^cTotal includes 6.6 resident and 3.3 nonresident boats.

^dTotal includes 12.8 resident and 6.4 nonresident boats.

^eTotal includes 0.8 resident and 0.4 nonresident boats.

^fTotal includes 0.15 resident and 0.10 nonresident boats.

^gResident boats only.

TABLE R9-132 Recreational Boating Program, RBG 5.3 (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	0.4	0.3	0	0.3	0.3	0.4	0.1	0	+0.4
Boat-Days of Use	12	9	0	8	9	11	4	0	+11
INLAND LAKES AND STREAMS									
Number of Boats	0.1	0.2	0.3	0.2	0.3	0.5	+0.1	+0.1	+0.2
Boat-Days of Use	3	6	9	5	10	16	+2	+4	+7
RIVER BASIN GROUP TOTAL									
Number of Boats	0.5	0.5	0.3	0.5	0.6	0.9	0	+0.1	+0.6
Boat-Days of Use	15	15	9	13	19	27	2	+4	+18
PROGRAM ELEMENT		N/A	N/A	N/A			N/A	N/A	N/A
STRUCTURAL	UNITS								
Great Lakes									
1. Marinas	berths	-	-	-	0	0	0	-	-
2. Harbors	acres	-	-	-	0	0	0	-	-
3. Access	each	-	-	-	2	2	2	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	100	200	300	-	-
2. Lake Access	each	-	-	-	0	0	0	-	-
3. Stream Access	each	-	-	-	2	4	6	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

recreational boaters of weather conditions and forecasts is also needed.

If recreational boating is to develop in this area as projected, additional improved access must be provided. There are no Federal studies concerning development of the potential reservoir sites in this area, but the State of New York is studying multiple-purpose reservoirs in the area that would include facilities for recreational boating.

No Great Lakes harbor or marina construction is programmed in this area. The Lake Ontario shoreline in RBG 5.3 has ample natural shelter.

Inland waters will require marinas with 300 berths by 2020. Based on criteria used in this appendix, RBG 5.3 has enough surplus capacity to absorb transfer of demand from river

basin groups with shortages of boating waters. Data on resident and nonresident boats indicate that some transfer now occurs. There are no significant opportunities for lake restoration in this area, nor is there much chance that multipurpose impoundments will be constructed.

4.5.3.4 Program Costs

Recreational boating program costs for RBG 5.3 are shown in Table R9-133. Framework program elements are quantified and capital and annual costs are indicated for each element by time period. Program costs are then summarized as Federal, non-Federal public, and private.

TABLE R9-133 Recreational Boating Program Costs, RBG 5.3

PROGRAM ELEMENT	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
			Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
Great Lakes											
1. Marinas	(berths)	\$ 2,800	0	0	0	0	0	0	0	0	
2. Harbors	(acres)	160,000	0	0	0	0	0	0	0	0	
3. Access	(each)	75,000	2	150	15	0	0	60	0	60	
Inland Lakes and Streams											
1. Marinas	(berths)	2,800	100	280	140	100	280	840	100	280	
2. Lake Access	(each)	75,000	0	0	0	0	0	0	0	0	
3. Stream Access	(each)	7,500	2	15	2	2	15	9	2	15	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	
TOTAL PROGRAM COSTS											
Federal				82	8		7	34		7	37
Non-Federal Public				83	9		8	35		8	38
Private				280	140		280	840		280	1,400

SUMMARY

The conclusions of this appendix are related to six subsections: Opportunities, Requirements, Programs, Program Costs, Program Effectiveness, and Areas for Future Study.

Recreational Boating Opportunities

Opportunities for recreational boating on the Great Lakes and on inland lakes and streams in the Basin are summarized in Table R9-134. Subtotals for the five Lake basins are shown in Tables R9-135, R9-136, R9-137, R9-138, and R9-139.

On the Great Lakes existing capacity is the 5,808,000 acres of water surface area available for boating in sheltered areas and within 5 miles of harbors. Existing carrying capacity is slightly more than one million boats or 24 million boat-days of use. Potential capacity includes provision of additional harbors, principally on Lake Michigan, Lake Superior, and Lake Huron, that will increase the carrying capacity by almost one-half million boats or 8 million boat days.

On inland lakes and streams existing capacity, the estimated use of these waters, is equivalent to supply. Potential capacity was determined using criteria set forth in this appendix. The difference between potential capacity and existing capacity is the amount of additional use that these waters can support, based on standards derived in this appendix. Negative numbers indicate that water areas are being used beyond standard capacity. There is no opportunity for increased inland lake and stream capacity within the Lakes Michigan, Huron, and Erie basins. The Lake Superior basin has significant opportunity. In the total Great Lakes Basin the 1980 opportunity is negative, and the 2020 opportunity is less than one hundred thousand boats or approximately 2.5 million boat days.

Recreational Boating Requirements

Requirements for recreational boating on the Great Lakes and on the inland lakes and

streams in the Basin are summarized in Table R9-140. Subtotals for the five Lake basins are shown in Tables R9-141, R9-142, R9-143, R9-144, and R9-145.

Supply will increase in time if the efficiency of boating facilities increases as assumed. Need is the difference between demand and supply.

The Great Lakes Basin need is estimated to increase from approximately 200 thousand boats in 1980 to nearly 700 thousand boats in 2020 or from approximately 7 million boat days in 1980 to nearly 20 million boat days in 2020. Short-range need exists on the Great Lakes, but most long-range need pertains to inland lakes and streams. The greatest needs are in the Lake Michigan basin.

Recreational Boating Program

The program to satisfy recreational boating needs is summarized in Table R9-146. Subtotals for the five Lake basins are shown in Tables R9-147, R9-148, R9-149, R9-150, and R9-151.

The program is described in two parts, need satisfaction and program elements. The lower portion of the tables shows the number and type of facilities programmed to meet needs. These program elements were not projected beyond the stated capacity of the potential water resource base. Program elements were then converted to needs programmed in terms of number of boats and boat-days of use. This conversion permits analysis of unmet needs. A plus sign preceding a number under the unmet needs column indicates that programs proposed will satisfy more needs than were calculated for the specific Lake basin. For example, Lake Superior was overprogrammed, while Lake Michigan and Lake Erie have many unmet needs.

Recreational Boating Program Costs

Costs related to the recreational boating program are summarized in Table R9-152.

Subtotals for the five Lake basins are shown in Tables R9-153, R9-154, R9-155, R9-156, and R9-157.

Capital and OM&R costs are shown for each program element. Costs are allocated to Federal, non-Federal public, and private interests. Data are provided incrementally for the three planning periods.

Capital costs range from more than \$272 million for the first period to nearly \$408 million for the second period and \$368 million for the third period. OM&R costs increase from \$63 million in 1980, to \$432 million by 2000, and to \$772 million by 2020. Private interests will be obligated to provide 70 percent of the OM&R costs and 33 percent of the capital costs for the 50-year planning period.

Program Effectiveness

Program effectiveness is first measured by comparing the amount of need satisfied and the amount of need left unmet. It has been noted that 58 percent of the total boat-day needs have been met by the program as presented. The primary factor limiting complete need satisfaction is the capacity of the resource. If the criteria were less stringent, more needs could have been met. As analyses for some river basin groups indicate, boatable waters are already used beyond the standard capacity presented in this appendix. If boaters are willing to accept a more congested boating experience, the standard could be lowered in order to satisfy more needs. This standard is normally lowered in heavily urbanized areas. Because the Framework Study covers all recreational boating in the entire Great Lakes Basin, the criteria were not adjusted for localized preferences.

Program effectiveness is also measured by comparing the alternatives or program elements that were selected with each other. The strategies, alternatives, criteria, and impacts were compared and given a priority ranking as a part of the study methodology. The framework program was developed with these priority rankings in mind, so it is nearly optimal.

Some river basin groups have a surplus of good boating water while others have very little. Because all needs cannot be met by either existing waters or additional impounded waters, some needs must be transferred to areas of surplus inland water or to the Great Lakes. Another alternative is for boaters to select some other form of recreation. As use

and the distance to more desirable waters increase, more boaters will make this decision. Full development and management of the existing and future impounded waters will be a very costly program. If such a program is not undertaken, conditions at existing facilities will become extremely congested or other forms of recreation will be chosen.

Areas for Future Study

The great lack of data concerning boat use and movement limits development of a harbor system that is truly responsive to boaters' desires. Although this Framework Study is a major step toward providing a plan for such a harbor system, its usefulness is limited by the fact that much of the methodology is primarily based on data collected by the Michigan State Waterways Commission and then applied to other States as well as Michigan. Future studies oriented toward recommending construction of facilities must collect and analyze additional data on boat use.

Studies of boating activities are being made by Federal, State, and private interests, but the data collected are not always comparable, and they normally cover only a portion of the Basin. The questions on transfers, nonresident demand, and tourism are left unanswered. Data collection and analysis for the entire Great Lakes Basin are absolutely necessary if future facilities are to fulfill the desires of recreational boaters.

Congressional authorization is needed for a Basinwide study to further develop data concerning boaters' desires and boat-use patterns and to recommend construction of new facilities or modification of existing facilities. New facilities or modifications could be recommended in interim reports, with a final report scheduled for completion within 10 years after the first year of funding.

The Basin provides a good quality of life. It offers beautiful scenery, excellent opportunities for fishing, swimming, power boating, and sailing, and a sound economy based on manufacturing, agriculture, and mining. These are all dependent on the Basin's water resources. Some uses are complementary, others are competitive. Prime consideration must be given to effects of any action on the environment and to restoring, preserving, and improving the Great Lakes for the benefit of all users.

TABLE R9-134 Recreational Boating Opportunities, Great Lakes Basin Summary (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	674.9	810.9	1,014.6	901.8	1,082.7	1,354.9	226.9	271.8	340.3
Boat-Days of Use	15,950	19,171	24,003	21,177	25,433	31,836	5,227	6,262	7,833
SHELTERED WATERS									
Area	1,820	1,820	1,820	1,820	1,820	1,820	N/A	N/A	N/A
Boat-Days of Use	6,441	7,740	9,707	6,441	7,740	9,707	-	-	-
Number of Boats	281.5	337.8	423.2	281.5	337.8	423.2	-	-	-
OFFSHORE WATERS									
Area	3,988	3,988	3,988	6,199	6,199	6,199	2,211	2,211	2,211
Boat-Days of Use	9,509	11,431	14,296	14,736	17,693	22,139	5,227	6,262	7,843
Number of Boats	393.4	473.1	591.4	620.3	744.9	931.7	226.9	271.8	340.3
INLAND LAKES AND STREAMS									
Number of Boats	694.2	778.2	897.0	650.6	785.7	982.3	-43.6	7.5	85.3
Boat-Days of Use	20,825	23,347	26,909	19,509	23,591	29,462	-1,316	244	2,553
INLAND LAKES									
Acres	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A
Boat-Days of Use	-	-	-	1,456	1,456	1,456	-	-	-
Number of Boats	-	-	-	18,018	21,786	27,208	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A
Boat-Days of Use	-	-	-	9,581	9,581	9,581	-	-	-
Number of Boats	-	-	-	1,491	1,805	2,254	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	1,369.1	1,589.1	1,911.6	1,552.4	1,868.4	2,337.2	183.3	279.3	425.6
Boat-Days of Use	36,775	42,518	50,912	40,686	49,024	61,298	3,911	6,506	10,386

TABLE R9-135 Recreational Boating Opportunities, Lake Superior Basin (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	252.3	303.4	379.3	345.1	414.7	518.0	92.8	111.3	139.2
Boat-Days of Use	3,278	3,946	4,932	4,484	5,393	6,741	1,206	1,447	1,809
SHELTERED WATERS									
Area	510	510	510	510	510	510	N/A	N/A	N/A
Boat-Days of Use	1,530	1,836	2,305	1,530	1,836	2,305	-	-	-
Number of Boats	117.7	141.2	176.5	117.7	141.2	176.0	-	-	-
OFFSHORE WATERS									
Area	879	879	879	1,482	1,482	1,482	603	603	603
Boat-Days of Use	1,748	2,110	2,627	2,954	3,557	4,436	1,206	1,447	1,809
Number of Boats	134.6	162.2	202.8	227.4	273.5	342.0	92.8	111.3	132.9
INLAND LAKES AND STREAMS									
Number of Boats	71.7	79.7	91.2	146.8	177.1	221.6	75.1	97.4	130.4
Boat-Days of Use	2,152	2,391	2,736	4,396	5,326	6,643	2,244	2,925	3,907
INLAND LAKES									
Acres	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A
Boat-Days of Use	-	-	-	408	408	408	-	-	-
Number of Boats	-	-	-	4,276	5,171	6,462	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	-	-	-	N/A	N/A	N/A
Boat-Days of Use	-	-	-	945	945	945	-	-	-
Number of Boats	-	-	-	120	145	181	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	324.0	383.1	470.5	491.9	591.8	740.1	167.9	208.7	269.6
Boat-Days of Use	5,430	6,337	7,668	8,880	10,709	13,384	3,450	4,372	5,716

TABLE R9-136 Recreational Boating Opportunities, Lake Michigan Basin (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	191.7	230.4	288.5	281.7	338.5	423.6	90.0	108.1	135.1
Boat-Days of Use	5,748	6,912	8,653	8,449	10,155	12,707	2,701	3,243	4,054
SHELTERED WATERS									
Area	560	560	560	560	560	560	N/A	N/A	N/A
Boat-Days of Use	2,100	2,520	3,163	2,100	2,520	3,163	-	-	-
Number of Boats	70.0	84.0	105.5	70.0	84.0	105.5	-	-	-
OFFSHORE WATERS									
Area	1,464	1,464	1,464	2,545	2,545	2,545	1,081	1,081	1,081
Boat-Days of Use	3,648	4,392	5,490	6,349	7,635	9,544	2,701	3,243	4,054
Number of Boats	121.7	146.4	183.0	211.7	254.5	318.1	90.0	108.1	135.1
INLAND LAKES AND STREAMS									
Number of Boats	324.5	367.6	427.6	279.6	338.0	422.5	-44.9	-29.6	-5.1
Boat-Days of Use	9,733	11,029	12,827	8,388	10,150	12,673	-1,345	-879	-154
INLAND LAKES									
Acres	N/A	N/A	N/A	600	600	600	N/A	N/A	N/A
Boat-Days of Use	-	-	-	7,861	9,511	11,875	-	-	-
Number of Boats	-	-	-	262.1	316.7	395.9	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	3,325	3,325	3,325	N/A	N/A	N/A
Boat-Days of Use	-	-	-	527	639	798	-	-	-
Number of Boats	-	-	-	17.5	21.3	26.6	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	516.2	598.0	716.1	561.3	676.5	846.1	45.1	78.5	130.0
Boat-Days of Use	15,481	17,941	21,480	16,837	20,305	25,380	1,356	2,364	3,900

TABLE R9-137 Recreational Boating Opportunities, Lake Huron Basin (thousands)

	Existing Capacity			Potential Capacity			Opportunity		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	75.3	90.3	113.2	99.4	119.2	149.4	24.1	28.9	36.2
Boat-Days of Use	2,258	2,709	3,396	2,981	3,576	4,480	723	867	1,084
SHELTERED WATERS									
Area	368	368	368	368	368	368	N/A	N/A	N/A
Boat-Days of Use	1,381	1,656	2,080	1,381	1,656	2,080	-	-	-
Number of Boats	46.1	55.2	69.3	46.1	55.2	69.3	-	-	-
OFFSHORE WATERS									
Area	351	351	351	640	640	640	289	289	289
Boat-Days of Use	877	1,053	1,316	1,600	1,920	2,400	723	867	1,084
Number of Boats	29.2	35.1	43.9	53.3	64.0	80.1	24.1	28.9	36.2
INLAND LAKES AND STREAMS									
Number of Boats	90.8	101.7	117.4	74.7	89.9	112.3	-16.1	-11.8	-5.1
Boat-Days of Use	2,724	3,051	3,522	2,242	2,695	3,369	-482	-356	-153
INLAND LAKES									
Acres	N/A	N/A	N/A	135	135	135	N/A	N/A	N/A
Boat-Days of Use	-	-	-	1,780	2,138	2,673	-	-	-
Number of Boats	-	-	-	59.3	71.3	89.1	-	-	-
STREAMS									
Miles	N/A	N/A	N/A	2,900	2,900	2,900	N/A	N/A	N/A
Boat-Days of Use	-	-	-	462	557	696	-	-	-
Number of Boats	-	-	-	15.4	18.6	23.2	-	-	-
RIVER BASIN GROUP TOTAL									
Number of Boats	166.1	192.0	230.6	174.1	209.1	261.7	8.0	17.1	31.1
Boat-Days of Use	4,882	5,760	6,918	5,223	6,271	7,849	241	511	931

TABLE R9-140 Recreational Boating Requirements, Great Lakes Basin Summary (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	416.6	523.2	660.7	263.2	305.3	363.3	153.4	217.9	297.4
Boat-Days of Use	12,163	15,309	19,362	7,739	8,975	10,679	4,424	6,334	8,683
BOATS BERTHED									
Number of Boats	110.9	139.8	175.3	67.8	67.8	67.8	43.1	72.0	107.5
Boat-Days of Use	3,251	4,104	5,152	1,992	1,992	1,992	1,259	2,112	3,160
BOATS LAUNCHED									
Number of Boats	305.7	383.4	485.4	195.4	237.5	295.5	110.3	145.9	189.9
Number of Launchings	8,912	11,205	14,210	5,747	6,983	8,687	3,165	4,222	5,523
INLAND LAKES AND STREAMS									
Number of Boats	787.7	985.2	1,244.4	707.8	780.0	882.7	79.9	205.2	361.7
Boat-Days of Use	23,632	29,556	37,332	21,234	23,400	26,481	2,397	6,156	10,851
BOATS BERTHED									
Number of Boats	396.1	497.8	628.0	356.2	356.2	356.2	39.9	141.6	271.8
Boat-Days of Use	11,883	14,933	18,841	10,685	10,685	10,685	1,198	4,248	8,156
BOATS LAUNCHED									
Number of Boats	391.6	487.4	616.4	351.6	423.8	526.5	40.0	63.6	89.9
Number of Launchings	11,749	14,623	18,491	10,549	12,715	15,796	1,200	1,850	2,695
RIVER BASIN GROUP TOTAL									
Number of Boats	1,204.3	1,508.4	1,905.1	971.0	1,085.3	1,246.0	233.3	423.1	659.1
Boat-Days of Use	35,795	44,865	56,694	28,973	32,375	37,160	6,821	12,490	19,534

TABLE R9-141 Recreational Boating Requirements, Lake Superior Basin (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	19.7	22.8	27.0	9.2	10.8	12.9	10.5	12.0	14.1
Boat-Days of Use	256	297	351	119	140	167	137	157	184
BOATS BERTHED									
Number of Boats	4.5	5.3	6.3	2.5	2.6	2.7	2.0	2.7	3.6
Boat-Days of Use	59	69	82	33	34	35	26	35	47
BOATS LAUNCHED									
Number of Boats	15.2	17.5	20.7	6.7	8.2	10.2	8.5	9.3	10.5
Number of Launchings	197	218	269	86	106	132	111	112	137
INLAND LAKES AND STREAMS									
Number of Boats	76.6	87.9	104.4	71.7	79.7	91.2	4.9	8.2	13.2
Boat-Days of Use	2,299	2,637	3,132	2,152	2,391	2,736	147	246	396
BOATS BERTHED									
Number of Boats	35.3	40.0	46.8	33.7	33.7	33.7	1.6	6.3	13.1
Boat-Days of Use	1,059	1,200	1,404	1,011	1,011	1,011	48	189	393
BOATS LAUNCHED									
Number of Boats	41.3	47.9	57.6	38.0	46.0	57.5	3.3	1.9	0.1
Number of Launchings	1,239	1,437	1,728	1,140	1,380	1,725	99	57	3
RIVER BASIN GROUP TOTAL									
Number of Boats	96.3	110.7	131.4	80.9	90.5	104.1	15.4	20.2	27.3
Boat-Days of Use	2,555	2,934	3,483	2,271	2,531	2,903	284	403	580

TABLE R9-142 Recreational Boating Requirements, Lake Michigan Basin (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	170.0	216.5	276.0	101.5	120.9	147.0	68.5	95.6	129.0
Boat-Days of Use	5,100	6,495	8,280	3,045	3,627	4,410	2,055	2,868	3,870
BOATS BERTHED									
Number of Boats	29.0	37.3	47.2	12.0	12.0	12.0	17.0	25.3	35.2
Boat-Days of Use	870	1,119	1,416	360	360	360	510	759	1,056
BOATS LAUNCHED									
Number of Boats	141.0	179.2	228.8	89.5	108.9	135.0	51.5	70.3	93.8
Number of Launchings	4,230	5,376	6,864	2,685	3,267	4,050	1,545	2,109	2,814
INLAND LAKES AND STREAMS									
Number of Boats	367.2	463.0	588.3	324.5	356.3	401.2	42.7	106.7	187.1
Boat-Days of Use	11,016	13,890	17,649	9,735	10,689	12,036	1,281	3,201	5,613
BOATS BERTHED									
Number of Boats	184.5	234.5	297.6	163.9	163.9	163.9	20.6	70.6	133.7
Boat-Days of Use	5,535	7,034	8,929	4,916	4,916	4,916	619	2,118	4,013
BOATS LAUNCHED									
Number of Boats	182.7	228.5	290.7	160.6	194.4	237.3	22.1	34.1	53.7
Number of Launchings	5,481	6,856	8,720	4,818	5,831	7,120	662	1,025	1,600
RIVER BASIN GROUP TOTAL									
Number of Boats	537.2	679.5	864.3	426.0	477.2	548.2	111.2	202.3	316.1
Boat-Days of Use	16,116	20,385	25,929	12,780	14,314	16,446	3,336	6,071	9,483

TABLE R9-143 Recreational Boating Requirements, Lake Huron Basin (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	64.4	81.8	103.6	35.6	42.5	52.1	28.8	39.3	51.5
Boat-Days of Use	1,932	2,454	3,108	1,068	1,275	1,563	864	1,179	1,545
BOATS BERTHED									
Number of Boats	8.3	10.5	13.4	3.4	3.4	3.4	4.9	7.1	10.0
Boat-Days of Use	249	315	402	102	102	102	147	213	300
BOATS LAUNCHED									
Number of Boats	56.1	71.3	90.2	32.2	39.1	48.7	23.9	32.2	41.5
Number of Launchings	1,683	2,139	2,706	966	1,173	1,461	717	966	1,245
INLAND LAKES AND STREAMS									
Number of Boats	96.8	122.6	155.9	90.8	101.7	117.4	6.0	20.9	38.5
Boat-Days of Use	2,904	3,678	4,677	2,724	3,251	3,522	180	627	1,155
BOATS BERTHED									
Number of Boats	43.7	55.4	70.4	39.0	39.0	39.0	4.7	16.4	31.4
Boat-Days of Use	1,311	1,662	2,112	1,170	1,170	1,170	141	492	942
BOATS LAUNCHED									
Number of Boats	53.1	67.2	85.5	51.8	62.7	78.4	1.3	4.5	7.1
Number of Launchings	1,593	2,016	2,565	1,554	1,881	2,352	39	135	213
RIVER BASIN GROUP TOTAL									
Number of Boats	161.2	204.4	259.5	126.4	144.2	169.5	34.8	60.2	90.0
Boat-Days of Use	4,836	6,132	7,785	3,792	4,326	5,085	1,044	1,806	2,700

TABLE R9-144 Recreational Boating Requirements, Lake Erie Basin (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	110.4	139.1	176.3	72.8	80.0	90.3	37.6	59.1	86.0
Boat-Days of Use	3,312	4,173	5,289	2,184	2,400	2,709	1,128	1,773	2,580
BOATS BERTHED									
Number of Boats	53.7	68.1	85.9	38.6	38.6	38.6	15.1	29.5	47.3
Boat-Days of Use	1,611	2,043	2,577	1,158	1,158	1,158	453	885	1,419
BOATS LAUNCHED									
Number of Boats	56.7	71.0	90.4	34.2	41.4	51.7	22.5	29.6	38.7
Number of Launchings	1,701	2,130	2,712	1,026	1,242	1,551	675	888	1,161
INLAND LAKES AND STREAMS									
Number of Boats	143.8	182.7	232.5	130.7	141.8	157.4	13.1	40.9	75.1
Boat-Days of Use	4,314	5,481	6,975	3,921	4,254	4,722	393	1,227	2,253
BOATS BERTHED									
Number of Boats	85.8	109.4	139.4	78.8	78.8	78.8	7.0	30.6	60.6
Boat-Days of Use	2,574	3,282	4,182	2,364	2,364	2,364	210	918	1,818
BOATS LAUNCHED									
Number of Boats	58.0	73.3	93.1	51.9	63.0	78.6	6.1	10.3	14.5
Number of Launchings	1,740	2,199	2,793	1,557	1,890	2,358	183	309	435
RIVER BASIN GROUP TOTAL									
Number of Boats	254.2	321.8	408.8	203.5	221.8	247.7	50.7	100.0	161.1
Boat-Days of Use	7,626	9,654	12,264	6,105	6,654	7,431	1,521	3,000	4,833

TABLE R9-145 Recreational Boating Requirements, Lake Ontario Basin (thousands)

	Demand			Supply			Need		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	52.1	63.0	77.8	44.1	51.1	61.0	8.0	11.9	16.8
Boat-Days of Use	1,563	1,890	2,334	1,323	1,533	1,830	240	357	504
BOATS BERTHED									
Number of Boats	15.2	18.6	22.5	11.3	11.3	11.3	4.1	7.3	11.2
Boat-Days of Use	462	558	675	339	339	339	123	219	336
BOATS LAUNCHED									
Number of Boats	36.7	44.4	55.3	32.8	39.8	49.7	3.9	4.6	5.6
Number of Launchings	1,101	1,338	1,659	984	1,194	1,491	117	138	168
INLAND LAKES AND STREAMS									
Number of Boats	103.3	129.0	163.3	90.1	100.5	115.5	13.2	28.5	47.8
Boat-Days of Use	3,099	3,870	4,899	2,703	3,015	3,465	396	855	1,434
BOATS BERTHED									
Number of Boats	46.8	58.5	73.8	40.8	40.8	40.8	6.0	17.7	33.0
Boat-Days of Use	1,404	1,755	2,214	1,224	1,224	1,224	180	531	990
BOATS LAUNCHED									
Number of Boats	56.5	70.5	89.5	49.3	59.7	74.7	7.2	10.8	14.8
Number of Launchings	1,695	2,115	2,685	1,479	1,791	2,241	216	324	444
RIVER BASIN GROUP TOTAL									
Number of Boats	155.4	192.0	241.1	134.2	151.6	176.5	21.2	40.4	64.6
Boat-Days of Use	4,662	5,760	7,233	4,026	4,548	5,295	636	1,212	1,938

TABLE R9-146 Recreational Boating Program, Great Lakes Basin Summary (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	153.4	217.9	297.4	53.5	120.7	198.1	99.9	97.2	99.3
Boat-Days of Use	4,424	6,334	8,683	1,443	3,282	5,608	2,981	3,052	3,075
INLAND LAKES AND STREAMS									
Number of Boats	79.9	193.8	335.3	34.3	98.3	174.8	45.6	95.5	160.5
Boat-Days of Use	2,397	5,816	10,059	1,026	2,951	5,246	1,371	2,865	4,813
RIVER BASIN GROUP TOTAL									
Number of Boats	233.3	411.7	632.7	87.8	219.0	372.9	145.5	192.7	259.8
Boat-Days of Use	6,821	12,150	18,742	2,469	6,233	10,854	4,352	5,917	7,888
PROGRAM ELEMENT									
STRUCTURAL	N/A	N/A	N/A				N/A	N/A	N/A
UNITS									
Great Lakes									
1. Marinas	berths	-	-	-	19,500	42,000	63,450	-	-
2. Harbors	acres	-	-	-	650	1,400	2,115	-	-
3. Access	each	-	-	-	257	507	727	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	12,500	33,900	52,900	-	-
2. Lake Access	each	-	-	-	125	315	482	-	-
3. Stream Access	each	-	-	-	221	484	691	-	-
4. Restoration	acres	-	-	-	4,000	8,000	8,000	-	-
5. Impoundments	acres	-	-	-	5,700	27,700	45,700	-	-

TABLE R9-147 Recreational Boating Program, Lake Superior Basin (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	10.5	12.0	14.1	9.4	13.9	20.2	1.1	+1.9	+5.9
Boat-Days of Use	137	157	184	122	181	263	15	+24	+79
INLAND LAKES AND STREAMS									
Number of Boats	4.9	8.2	13.2	4.9	10.7	16.4	0	+2.5	+3.2
Boat-Days of Use	147	246	396	149	320	492	+2	+74	+96
RIVER BASIN GROUP TOTAL									
Number of Boats	15.4	20.2	27.3	14.3	24.6	36.6	1.1	+4.4	+9.3
Boat-Days of Use	284	403	580	271	501	755	13	+98	+175
PROGRAM ELEMENT									
STRUCTURAL	N/A	N/A	N/A				N/A	N/A	N/A
UNITS									
Great Lakes									
1. Marinas	berths	-	-	-	2,100	3,000	4,050	-	-
2. Harbors	acres	-	-	-	70	110	135	-	-
3. Access	each	-	-	-	45	55	70	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	-	2,000	6,000	10,000	-	-
2. Lake Access	each	-	-	-	25	30	30	-	-
3. Stream Access	each	-	-	-	15	35	50	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-
5. Impoundments	acres	-	-	-	0	0	0	-	-

TABLE R9-148 Recreational Boating Program, Lake Michigan Basin (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	68.5	95.6	129.0	21.7	51.3	87.3	46.8	44.3	41.7
Boat-Days of Use	2,055	2,868	3,870	652	1,439	2,617	1,403	1,429	1,253
INLAND LAKES AND STREAMS									
Number of Boats	42.7	95.3	160.7	12.8	39.5	70.9	29.9	55.8	89.8
Boat-Days of Use	1,281	2,861	4,821	383	1,187	2,127	898	1,674	2,694
RIVER BASIN GROUP TOTAL									
Number of Boats	111.2	190.9	289.7	34.5	90.8	158.2	76.7	100.1	131.5
Boat-Days of Use	3,336	5,729	8,691	1,035	2,626	4,744	2,301	3,103	3,947
PROGRAM ELEMENT									
STRUCTURAL	N/A	N/A	N/A				N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	6,150	13,800	20,400	-	-	-
2. Harbors	acres	-	-	205	460	680	-	-	-
3. Access	each	-	-	125	250	355	-	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	5,000	13,500	20,500	-	-	-
2. Lake Access	each	-	-	36	110	175	-	-	-
3. Stream Access	each	-	-	120	270	390	-	-	-
4. Restoration	acres	-	-	4,000	8,000	8,000	-	-	-
5. Impoundments	acres	-	-	0	10,000	20,000	-	-	-

TABLE R9-149 Recreational Boating Program, Lake Huron Basin (thousands)

	Needs			Needs Programmed			Needs Unmet		
	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES									
Number of Boats	28.8	39.3	51.5	7.8	19.7	33.9	21.0	19.6	17.6
Boat-Days of Use	864	1,179	1,545	233	590	1,018	631	589	527
INLAND LAKES AND STREAMS									
Number of Boats	6.0	20.9	38.5	3.9	11.5	24.0	2.1	9.4	14.5
Boat-Days of Use	180	627	1,155	116	346	720	64	281	435
RIVER BASIN GROUP TOTAL									
Number of Boats	34.8	60.2	90.0	11.7	31.2	57.9	23.1	29.0	32.1
Boat-Days of Use	1,044	1,806	2,700	349	936	1,738	695	870	962
PROGRAM ELEMENT									
STRUCTURAL	N/A	N/A	N/A				N/A	N/A	N/A
Great Lakes									
1. Marinas	berths	-	-	2,700	5,400	7,900	-	-	-
2. Harbors	acres	-	-	90	180	260	-	-	-
3. Access	each	-	-	40	95	140	-	-	-
Inland Lakes and Streams									
1. Marinas	berths	-	-	1,500	4,000	6,200	-	-	-
2. Lake Access	each	-	-	10	30	65	-	-	-
3. Stream Access	each	-	-	40	90	130	-	-	-
4. Restoration	acres	-	-	0	0	0	-	-	-
5. Impoundments	acres	-	-	0	0	5,000	-	-	-

TABLE R9-150 Recreational Boating Program, Lake Erie Basin (thousands)

		Needs			Needs Programmed			Needs Unmet		
		To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES										
Number of Boats		37.6	59.1	86.0	10.7	26.5	40.6	26.9	32.6	45.4
Boat-Days of Use		1,128	1,773	2,580	321	793	1,228	807	980	1,352
INLAND LAKES AND STREAMS										
Number of Boats		13.1	40.9	75.1	3.1	11.3	19.2	10.0	29.6	55.9
Boat-Days of Use		393	1,227	2,253	92	340	576	301	887	1,677
RIVER BASIN GROUP TOTAL										
Number of Boats		50.7	100.0	161.1	13.8	37.8	59.8	36.9	62.2	101.3
Boat-Days of Use		1,521	3,000	4,833	413	1,133	1,804	1,108	1,867	3,029
PROGRAM ELEMENT		N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL										
UNITS										
Great Lakes										
1. Marinas	barths	-	-	-	6,900	15,900	25,800	-	-	-
2. Harbors	acres	-	-	-	230	530	860	-	-	-
3. Access	each	-	-	-	30	70	105	-	-	-
Inland Lakes and Streams										
1. Marinas	barths	-	-	-	600	2,400	3,600	-	-	-
2. Lake Access	each	-	-	-	11	42	59	-	-	-
3. Stream Access	each	-	-	-	37	70	95	-	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-	-
5. Impoundments	acres	-	-	-	4,400	16,400	19,400	-	-	-

TABLE R9-151 Recreational Boating Program, Lake Ontario Basin (thousands)

		Needs			Needs Programmed			Needs Unmet		
		To 1980	To 2000	To 2020	To 1980	To 2000	To 2020	To 1980	To 2000	To 2020
GREAT LAKES										
Number of Boats		8.0	11.9	16.8	3.9	9.3	16.1	4.1	2.6	0.7
Boat-Days of Use		240	357	504	115	279	482	125	78	22
INLAND LAKES AND STREAMS										
Number of Boats		20.1	35.6	55.2	9.6	25.3	44.3	10.5	10.3	10.9
Boat-Days of Use		603	1,068	1,656	286	758	1,331	317	310	325
RIVER BASIN GROUP TOTAL										
Number of Boats		28.1	47.5	72.0	13.5	34.6	60.4	14.6	12.9	11.6
Boat-Days of Use		843	1,425	2,160	401	1,037	1,813	442	388	347
PROGRAM ELEMENT		N/A	N/A	N/A				N/A	N/A	N/A
STRUCTURAL										
UNITS										
Great Lakes										
1. Marinas	barths	-	-	-	1,650	3,600	5,400	-	-	-
2. Harbors	acres	-	-	-	55	120	180	-	-	-
3. Access	each	-	-	-	17	37	57	-	-	-
Inland Lakes and Streams										
1. Marinas	barths	-	-	-	3,400	8,000	12,600	-	-	-
2. Lake Access	each	-	-	-	43	103	153	-	-	-
3. Stream Access	each	-	-	-	9	19	26	-	-	-
4. Restoration	acres	-	-	-	0	0	0	-	-	-
5. Impoundments	acres	-	-	-	1,300	1,300	1,300	-	-	-

TABLE R9-152 Recreational Boating Program Costs, Great Lakes Basin Summary

PROGRAM ELEMENT	STRUCTURAL	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
				Great Lakes								
1. Marinas	(berths)	\$ 2,800	19,500	54,600	27,300	22,500	63,000	172,200	21,450	60,060	295,260	
2. Harbors	(acres)	160,000	650	104,000	10,400	750	120,000	65,600	715	114,400	112,480	
3. Access	(each)	75,000	257	19,275	1,928	250	18,750	11,460	220	16,500	18,510	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	12,500	35,000	17,500	21,400	59,920	129,920	19,000	53,200	243,040	
2. Lake Access	(each)	75,000	125	9,375	938	190	14,250	6,600	167	12,525	11,880	
3. Stream Access	(each)	7,500	221	1,659	166	263	1,974	1,058	207	1,554	1,764	
4. Restoration	(acres)	5,000	4,000	20,000	2,000	4,000	20,000	12,000	0	0	16,000	
5. Impoundment	(acres)	5,000	5,700	28,500	2,850	22,000	110,000	33,400	18,000	90,000	73,400	
TOTAL PROGRAM COSTS												
Federal				91,404	9,141		142,487	65,059		117,302	117,017	
Non-Federal Public				91,405	9,141		142,487	65,059		117,302	117,017	
Private				89,600	44,800		122,920	302,120		113,260	538,300	

TABLE R9-153 Recreational Boating Program Costs, Lake Superior Basin

PROGRAM ELEMENT	STRUCTURAL	UNITS	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
				Great Lakes								
1. Marinas	(berths)	\$ 2,800	2,100	5,880	2,940	1,200	3,360	15,120	750	2,100	20,580	
2. Harbors	(acres)	160,000	70	11,200	1,120	40	6,400	5,760	25	4,000	7,840	
3. Access	(each)	75,000	45	3,375	338	10	750	1,500	15	1,125	1,875	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	2,000	5,600	2,800	4,000	11,200	22,400	4,000	11,200	44,800	
2. Lake Access	(each)	75,000	25	1,875	188	5	375	825	0	0	900	
3. Stream Access	(each)	7,500	15	113	11	20	150	75	15	113	128	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	0	0	0	
TOTAL PROGRAM COSTS												
Federal				8,281	828		3,837	4,080		2,619	5,371	
Non-Federal Public				8,282	829		3,838	4,080		2,619	5,372	
Private				11,480	5,740		14,560	37,520		13,300	65,380	

TABLE R9-154 Recreational Boating Program Costs, Lake Michigan Basin

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
				Great Lakes								
1. Marinas	(berths)	\$ 2,800	6,150	17,220	8,610	7,650	21,420	55,860	6,600	18,480	95,760	
2. Harbors	(acres)	160,000	205	32,800	3,280	255	40,880	21,280	220	35,200	36,480	
3. Access	(each)	75,000	125	9,375	938	125	9,375	5,625	105	7,875	9,075	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	5,000	14,000	7,000	8,500	23,800	51,800	7,000	19,600	95,200	
2. Lake Access	(each)	75,000	36	2,700	270	74	5,550	2,190	65	4,875	4,275	
3. Stream Access	(each)	7,500	120	900	90	150	1,125	585	120	900	990	
4. Restoration	(acres)	5,000	4,000	20,000	2,000	4,000	20,000	12,000	0	0	16,000	
5. Impoundment	(acres)	5,000	0	0	0	10,000	50,000	10,000	10,000	50,000	30,000	
TOTAL PROGRAM COSTS												
Federal				32,887	3,289		63,425	25,840		49,425	48,410	
Non-Federal Public				32,888	3,289		63,425	25,840		49,425	48,410	
Private				31,220	15,610		45,220	107,660		38,080	190,960	

TABLE R9-155 Recreational Boating Program Costs, Lake Huron Basin

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
				Great Lakes								
1. Marinas	(berths)	\$ 2,800	2,700	7,560	3,780	2,700	7,560	22,680	2,400	6,720	36,960	
2. Harbors	(acres)	160,000	90	14,400	1,440	90	14,400	8,640	80	12,800	14,080	
3. Access	(each)	75,000	40	3,000	300	55	4,125	2,025	45	3,375	3,525	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	1,500	4,200	2,100	2,500	7,000	15,400	2,200	6,160	28,560	
2. Lake Access	(each)	75,000	10	750	75	20	1,500	600	35	2,625	1,425	
3. Stream Access	(each)	7,500	40	300	30	50	375	195	40	300	330	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	0	0	0	0	0	0	5,000	25,000	5,000	
TOTAL PROGRAM COSTS												
Federal				9,225	922		10,200	5,730		22,050	12,180	
Non-Federal Public				9,225	923		10,200	5,730		22,050	12,180	
Private				11,760	5,880		14,560	38,080		12,880	65,520	

TABLE R9-156 Recreational Boating Program Costs, Lake Erie Basin

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
Great Lakes												
1. Marinas	(berths)	\$ 2,800	6,900	19,320	9,660	9,000	25,200	63,840	9,900	27,720	116,760	
2. Harbors	(acres)	160,000	230	36,800	3,680	300	48,000	24,320	330	52,800	44,480	
3. Access	(each)	75,000	30	2,250	225	40	3,000	1,500	35	2,625	2,625	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	600	1,680	840	1,800	5,040	8,400	1,200	3,360	16,800	
2. Lake Access	(each)	75,000	11	825	83	31	2,325	795	17	1,275	1,515	
3. Stream Access	(each)	7,500	37	278	28	33	249	161	25	188	248	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	4,400	22,000	2,200	12,000	60,000	20,800	3,000	15,000	35,800	
TOTAL PROGRAM COSTS												
Federal				31,076	3,108		56,787	23,788		35,944	42,334	
Non-Federal Public				31,077	3,108		56,787	23,788		35,944	42,334	
Private				21,000	10,500		30,240	72,240		31,080	133,560	

TABLE R9-157 Recreational Boating Program Costs, Lake Ontario Basin

PROGRAM ELEMENT	STRUCTURAL	(UNITS)	UNIT COST	Period 1970 to 1980			Period 1981 to 2000			Period 2001 to 2020		
				Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)	Quantity	Capital Costs (\$1,000)	OM&R Costs (\$1,000)
Great Lakes												
1. Marinas	(berths)	\$ 2,800	1,650	4,620	2,310	1,950	5,460	14,700	1,800	5,040	25,200	
2. Harbors	(acres)	160,000	55	8,800	880	65	10,400	5,600	60	9,600	9,600	
3. Access	(each)	75,000	17	1,275	128	20	1,500	810	20	1,500	1,410	
Inland Lakes and Streams												
1. Marinas	(berths)	2,800	3,400	9,520	4,760	4,600	12,880	31,920	4,600	12,880	57,680	
2. Lake Access	(each)	75,000	43	3,225	323	60	4,500	2,190	50	3,750	3,765	
3. Stream Access	(each)	7,500	9	68	7	10	75	42	7	53	68	
4. Restoration	(acres)	5,000	0	0	0	0	0	0	0	0	0	
5. Impoundment	(acres)	5,000	1,300	6,500	650	0	0	2,600	0	0	2,600	
TOTAL PROGRAM COSTS												
Federal				9,934	994		8,237	5,621		7,264	8,721	
Non-Federal Public				9,934	994		8,238	5,621		7,264	8,722	
Private				14,140	7,070		18,340	46,620		17,920	82,880	

GLOSSARY

anchored—held in place in the water by an anchor; includes moored to a buoy or anchored vessel, and dragging anchor.

bank—(1) the rising ground bordering a lake, river, or sea; on a river designated right or left as it would appear facing downstream; (2) an elevation of the sea floor of large area, surrounded by deeper water, but safe for surface navigation; (3) a submerged plateau or shelf, a shoal, or shallow.

bar—an offshore ridge or mound of sand, gravel, or other unconsolidated material submerged at least at high tide, especially at the mouth of a river or estuary, or lying a short distance from and usually parallel to the beach.

barrier beach—a bar essentially parallel to the shore, the crest of which is above high water.

breakwater—a structure protecting a shore area, harbor, anchorage, or basin from waves.

bulkhead—a structure separating land and water areas, primarily designed to resist earth pressures.

bulking—in materials handling, the increase in volume in fine material such as sand, resulting from the presence of moisture.

canal—an artificial watercourse cut through a land area for use in navigation, irrigation, etc.

capacity—the total number of slips and moorings at a given marina.

channel—(1) a natural or artificial waterway of perceptible extent which either periodically or continuously contains moving water, or which forms a connecting link between two bodies of water; (2) part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation; (3) a large strait, like the Eng-

lish Channel; (4) the deepest portion of a stream, bay, or strait through which the main volume or current of water flows.

conditions or causes not otherwise classified—the majority of these accidents will be freak accidents which cannot be classified under any of the other causes.

controlling depth—the least depth of water in the navigable parts of a waterway, which limits the allowable draft of vessels.

crest length wave—the length of a wave along its crest. Sometimes called crest width.

crest of wave—the highest part of a wave; that part of the wave above still water level.

cruising—proceeding normally, unrestricted; an absence of drastic rudder or engine changes.

datum—(leveling) any level surface taken as a surface of reference, from which to measure elevations; for example, mean sea level.

datum plane—the horizontal plane to which soundings, ground elevations, or water surface elevations are referred.

decay of waves—the change that waves undergo after they leave a generating area (fetch) and pass through a calm, or region of lighter winds. In the process of decay, the significant wave height decreases and the significant wave length increases.

deep water—water of depth such that surface waves are little affected by conditions on the ocean bottom. It is customary to consider water deeper than one-half the surface wave length as deep water.

depth—vertical distance from the still water level (or datum as specified) to the bottom.

diffraction of water waves—lateral transmission of energy along a wave crest. When a

- portion of a train of waves is interrupted by a barrier such as a breakwater, the effect of diffusion is manifested by propagation of waves into the sheltered region with the barrier's geometric shadow.
- dock**—natural or artificial inlet or basin used by boats, including both the water and the protecting sides; a wharf or platform for loading or unloading boats.
- documented yacht**—a vessel five net tons or more, owned by a citizen of the United States and used exclusively for pleasure with a valid marine document issued by the Coast Guard. Documented vessels cannot be numbered.
- draft**—the number of feet below the surface of the water.
- dredge**—a machine for excavating material at the bottom of a body of water, raising it to the top and discharging it on the bank through pipe line or by conveyors, or into a scow for removal to a distant point.
- embayment**—an indentation in a shore line forming an open bay.
- estuary**—that portion of a stream influenced by the tide of the body of water into which it flows; a bay, as the mouth of a river, where the tide meets the river current.
- fetch**—in wave forecasting, the continuous area of water over which wind blows in essentially a constant direction. Sometimes used synonymously with fetch length and generating area. In wind up phenomena, for enclosed bodies of water, the distance between two points of maximum and minimum water surface elevations. This would usually coincide with the longest axis in general wind direction.
- fetch length**—in wave forecasting, the horizontal distance (in direction of the wind) over which the wind blows.
- following wind**—in wave forecasting, wind blowing in the same direction that waves are travelling.
- freeboard**—additional height of a structure above design high water level to prevent overflow. Also, at a given time the vertical distance between the water level and the top of the structure. On a ship, the distance from the water line to main deck or gunwale.
- fueling**—any stage of the fueling operation; primarily concerned with introduction of explosive or combustible vapors or liquids on board.
- generation of waves**—creation of waves by natural or mechanical means. In wave forecasting, the creation and growth of waves caused by a wind blowing over a water surface for a certain period of time. The area involved is called the generating area or fetch.
- harbor**—a protected body of water used by vessels as a place of safety or for the transfer of passengers and cargo between water and land carriers.
- harbor line (inner and outer)**—lines defining the limits of a port or haven with regard to inner or best protected area and outer or less protected area. Often referred to in port regulations.
- height of wave**—vertical distance between a crest and the preceding trough.
- hindcasting wave**—the calculation from historical synoptic wind charts of the wave characteristics that probably occurred at some past time.
- inboard/outboard**—also referred to as inboard/outdrive. Regarded as inboard because the power unit is located inside the boat.
- inlet**—a short, narrow waterway connecting a bay, lagoon, or similar body of water with a large parent body of water. An arm of the sea (or other body of water) that is long compared to its width and that may extend a considerable distance inland.
- inshore (zone)**—in beach terminology the zone of variable width extending from the shore face through the breaker zone.
- jetty**—(U.S. usage) on open seacoasts, a structure extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel. In British

usage jetty is synonymous with wharf or pier.

kinetic energy (of waves)—in a progressive oscillatory wave, a summation of the energy of motion of the particles within the wave. This energy does not advance with the wave form.

lagoon—a shallow body of water, like a pond or lake, which usually has a shallow, restricted outlet.

motorboat—any vessel equipped with propulsion machinery, not more than 65 feet in length.

motor vessel—any vessel equipped with propulsion machinery (other than steam), more than 65 feet long.

nautical mile—length of a minute of arc, 1/21,600 of an average great circle of the earth. Generally one minute of latitude is considered equal to one nautical mile. The accepted United States value since 1959 is 6,076.115 feet, approximately 1.151 times as long as the statute mile of 5,280 feet.

numbered vessel—any undocumented vessel numbered by a State with an approved numbering system or by the Coast Guard, under the Federal Boating Act of 1958.

offshore (n. or adj.)—in beach terminology, the comparatively flat zone of variable width, extending from the breaker zone to the seaward edge of the continental shelf; a direction seaward from the shore.

opposing wind—in wave forecasting, a wind blowing in the opposite direction to that in which the waves are travelling.

onshore wind—a wind blowing landward from the sea in the coastal area.

oscillatory wave—a wave in which each individual particle oscillates about a point with little or no permanent change in position. The term is commonly applied to progressive oscillatory waves in which only the form advances, the individual particles moving in closed or nearly closed orbits. Distinguished from a wave of translation.

outboard—includes portable engines. Some are so large as to preclude portability in its

true sense but they are considered outboard because they are not permanently affixed to the structure of the craft. Also includes all outboard motors regardless of the method or location used to mount the engine, i.e., motor wells, "kicker pits", motor pockets.

pass—in hydrographic usage a navigable channel, through a bar, reef, or shoal, or between closely adjacent islands.

pier—a structure, extending out into the water from the shore, to serve as a landing place, a recreational facility, etc., rather than to afford coastal protection.

population density—ratio of a county population to the county net area, where net area is the area of usable land excluding water and parks, in population per square mile.

progressive wave—a wave which is manifested by the progressive movement of the wave form.

profile, beach—the intersection of the ground surface with a vertical plane; may extend from the top of the dune line to the seaward limit of sand movement.

refraction of water waves—process by which the direction of a wave moving in shallow water at an angle to the contours is changed. The part of the wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours.

revetment—a facing of stone, concrete, etc., built to protect a scarp embankment or shore structure against erosion by the wave action or currents.

roller—an indefinite term, sometimes considered to be one of a series of long-crested, large waves which roll in upon a coast, as after a storm.

rules of the road—statutory and regulatory rules governing navigation of vessels. There are four different sets of these marine traffic laws: Great Lakes, Western Rivers, Inland, and International.

set-up, wind—(1) vertical rise in the still water level on the leeward side of a body of water

- caused by wind stresses on the surface of the water; (2) difference in elevation of still water caused by wind stresses on the surface of the water; (3) synonymous with wind tide although wind tide is usually reserved for use on the ocean and large bodies of water.
- seawall**—a structure separating land and water areas primarily designed to prevent erosion and other damage due to wave action.
- shoal (noun)**—an elevated portion of the sea bottom composed of any material, except rock or coral, that may endanger surface navigation.
- shoreline**—intersection of a specified plane of water with the shore or beach (e.g. the high water shoreline would be the intersection of the plane of mean high water with the shore or beach). The line delineating the shoreline on U.S. Coast Guard and Geodetic Survey nautical charts and surveys that approximates the mean high water line.
- significant wave**—a statistical term denoting waves with the average height and period of the one-third highest wave of a given wave group. The composition of the higher wave depends upon the extent to which the lower waves are considered. Experience so far indicates that a careful observer who attempts to establish the character of the higher waves will record values which approximately fit the definition. A wave of significant wave period and significant wave height.
- slip**—a space between two piers, wharves, etc., for the berthing of vessels.
- sound (noun)**—a wide waterway between the mainland and an island, or a wide waterway connecting two sea areas. A relatively long arm of the sea or ocean forming a channel between an island and a mainland or connecting two larger bodies, like a sea and the ocean, or two parts of the same body; usually wider and more extensive than a strait.
- still water level**—the elevation of the surface of the water if all wave action were to cease.
- topography**—configuration of a surface including its relief, the position of its streams, roads and buildings.
- training wall**—a wall or jetty to direct current flow.
- trough of wave**—lowest part of a wave formed between successive crests; also that part of a wave below still water level.
- wave**—a ridge, deformation, or undulation of the surface of a water body.
- wave age**—the ratio of wave velocity to wind velocity.
- wave decay**—change that waves undergo after they leave a generating area (fetch) and pass through a calm, or region of lighter or opposing winds. In the process of decay, the significant wave height decreases and the significant wave length increases.
- wave direction**—direction from which a wave approaches.
- wave, gravity**—a wave whose velocity of propagation is controlled primarily by gravity. Water waves of a length greater than 2 inches are considered gravity waves.
- wave group**—a series of waves in which the wave direction, wave length, and wave height vary only slightly.
- wave forecasting**—theoretical determination of future wave characteristics, usually from observed or predicted meteorological phenomena.
- wave height**—the vertical distance between a crest and the preceding trough.
- wave height coefficient**—ratio of the wave height at a selected point to the deep water wave height. The refraction coefficient multiplied by the shoaling factor.
- wave hindcasting**—calculation from historical synoptic wind charts of the wave characteristics that probably occurred at some past time.

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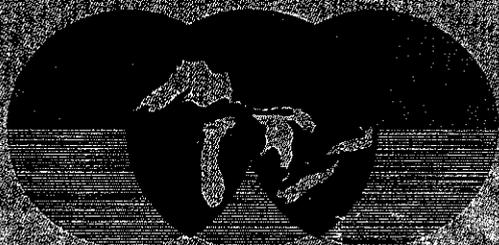
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