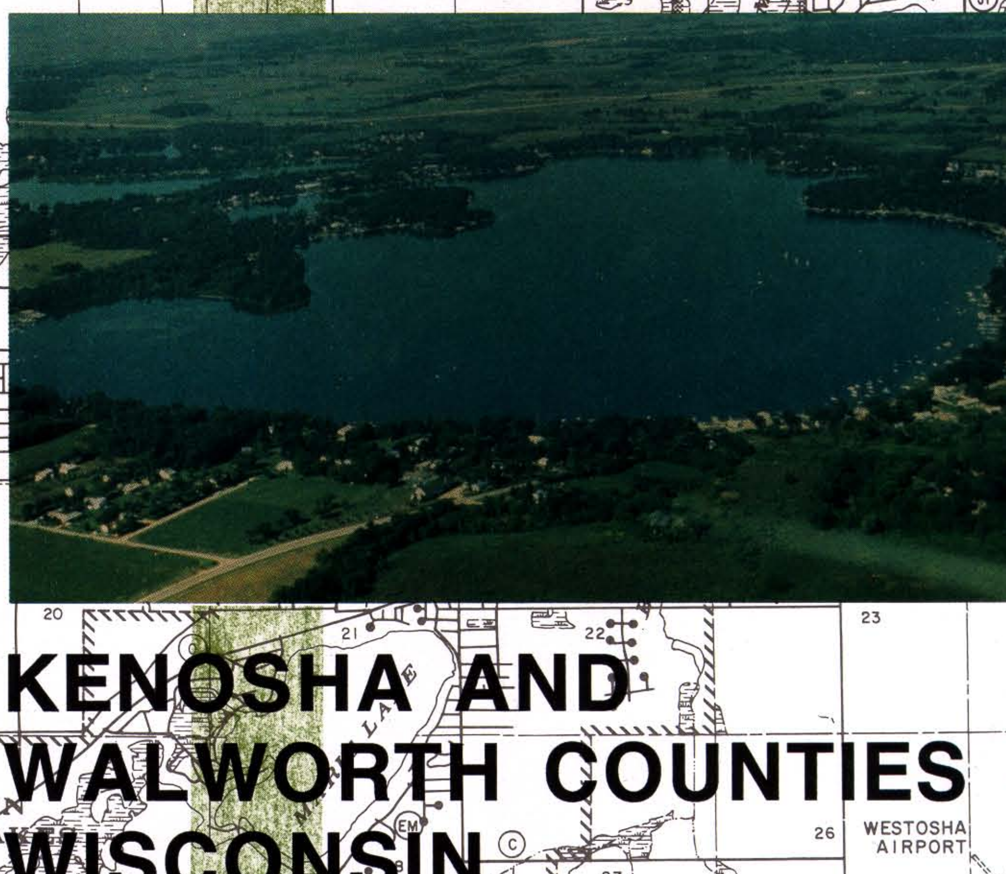
COMMUNITY ASSISTANCE
PLANNING REPORT NO. 196

A MANAGEMENT PLAN FOR POWERS LAKE



KENOSHA AND WALWORTH COUNTIES WISCONSIN

THE DISTRICT OF POWERS LAKE
SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Special acknowledgement is due Ms. Nancy R. Zolidis, SEWRPC Principal Specialist, Mr. David B. Kendziorski, former SEWRPC Principal Planner, and Ms. Tami J. Dake, Ms. Mary Jo Schabel, and Ms. Donna J. Sheridan, SEWRPC Planning Analysts, for their contribution to the conduct of this study and the preparation of this report.

COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 196

A MANAGEMENT PLAN FOR POWERS LAKE, KENOSHA AND WALWORTH COUNTIES, WISCONSIN

Prepared by the

Southeastern Wisconsin Regional Planning Commission
for
The Powers Lake
Management District

November 1991

Inside Region $5.00
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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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November 11, 1991

TO: All Units and Agencies of Government and Citizens Groups Involved in Water Quality and Water Use Management for Powers Lake

In 1989, the Regional Planning Commission, at the request of the Powers Lake Management District, undertook a study to address water quality, recreational use, and natural resource problems of Powers Lake. The study was a cooperative effort by the Southeastern Wisconsin Regional Planning Commission, The Powers Lake Management District, the U. S. Geological Survey, Kenosha and Walworth Counties, and private consultants. The purpose of the study was to describe, evaluate, and recommend measures to protect and enhance water quality; to provide opportunities for safe water-based recreational activities; to preserve and protect the natural resource base, including the fishery and other aquatic resources and the woodland and wetland areas; and to reduce the erosion of the shoreline.

This report documents the findings and recommendations of the study. The report describes the physical and biological properties of Powers Lake and its watershed; the quality of its waters and the conditions affecting that quality, including existing land use, and watershed management practices; the recreational use; and the shoreline conditions, and sets forth the recommended management measures.

A preliminary draft of this report was reviewed and commented on by the Powers Lake Management District Board, and presented by the Commission to the Powers Lake Management District at its annual meeting held on August 2, 1991. Upon due consideration of the comments made on the preliminary plan, the preliminary plan was revised and presented at the Powers Lake Management District Board Meeting held on October 3, 1991. This final report reflects the comments and suggestions made as a result of this review.

The plan presented in this report should provide a sound guide to the making of development decisions concerning the wise management of Powers Lake as an aesthetic and recreational asset of immeasurable value. Accordingly, adoption of the plan presented herein by all of the concerned water use management agencies is urged. The Regional Planning Commission stands ready to assist the various units and agencies of government concerned in carrying out the plan recommendations.

Respectfully submitted,

Kurt W. Bauer
Executive Director

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Chapter I

INTRODUCTION

Approximately 100 major inland lakes in southeastern Wisconsin constitute one of the most valuable natural resources of the Region. Concern over the deteriorating condition and increasing recreational use of these lakes led the State Legislature, in 1974, to enact legislation enabling lake residents and others to form inland lake protection and rehabilitation districts. The purpose of these special units of local government is to develop programs that will protect and rehabilitate the valuable natural resources represented by the lakes.

Powers Lake is a 459-acre lake located in U. S. Public Land Survey Section 18, Township 1 North, Range 19 East, Town of Randall, Kenosha County and in U. S. Public Land Survey Section 13, Township 1 North, Range 18 East, Town of Bloomfield, Walworth County. Because of its good quality, Powers Lake represents a particularly valuable resource within the Southeastern Wisconsin Region. Located in close proximity to the large metropolitan areas of Chicago and Milwaukee, Powers Lake is subject to accelerated urbanization and to a heightened demand for water-based recreational use. Realization that increased development and demands on lake use could cause problems of deteriorating water quality and degradation of the overall lake ecosystem led to the formation of a Powers Lake Management District in 1985.

In response to the growing concerns of the lake residents, the Powers Lake Management District undertook the preparation of a comprehensive management plan for the lake. This program involved a cooperative effort of the U. S. Geological Survey, Kenosha County, private consultants, the Southeastern Wisconsin Regional Planning Commission, and the Lake District. Data were available from a concurrent study of alternative sewerage systems for the Powers, Benedict, and Tombeau Lakes area being conducted by consultants to the Towns of Randall, Wheatland, and Bloomfield. The results of a hydrologic and water quality monitoring program conducted by the U. S. Geological Survey between October 1986 and October 1987 to determine the existing water budget and water quality of the lake and to quantify pollutant loadings to the lake were also available for use in the plan preparation, as were additional water quality data obtained in 1988, 1989, and 1990. A macrophyte survey was conducted by a private consultant under contract to the Lake District. The Regional Planning Commission provided inventories and analyses of land use, zoning, sediment characteristics, existing water uses, and shoreline and biological conditions. A mail survey of the residents of the District conducted by the Powers Lake Management District and the Commission identified local concerns, recreational use problems and conflicts, and possible solutions. The Kenosha County Land Conservation Committee provided the Commission with an evaluation of nonpoint sources of water pollution. Kenosha County also provided data on onsite sewerage systems. The Wisconsin Department of Industry, Labor and Human Relations also conducted a survey of the onsite systems.

This report summarizes the results of the inventories and provides an evaluation and interpretation of the data collected and collated. The report presents feasible alternative and recommended measures for achieving four important long-range objectives for Powers Lake: 1) the protection and enhancement of water quality conditions; 2) the management of recreational opportunities; 3) the protection and enhancement of fishery and other aquatic resources, wildlife habitat, and wetland areas; and 4) the control of excessive water level fluctuations and reduction in shore erosion.

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Chapter II

PHYSICAL DESCRIPTION

INTRODUCTION

In order to permit evaluation of the relationship between the physical and biological resources of Powers Lake, the physical characteristics of its basin and its watershed must be defined, with particularly careful attention to the hydrology of the Lake. Accordingly, this chapter describes such physical characteristics of the lacustrine basin as depth, volume, bottom sediment conditions, and shoreline conditions, and of the Lake watershed, including drainage areas and soil characteristics. This chapter also addresses the general climate of the area and the hydrologic, or water, budget of the Lake.

Table 1

HYDROGRAPHY AND MORPHOMETRY OF POWERS LAKE: 1990

Parameter	Measurement
Size	
Area of Lake	459 acres
Drainage Area	2,368 acres
Lake Volume	7,453 acre-feet[c]
Hydraulic Residence Time[a]	3.8 years
Shape	
Length of Lake	1.3 miles
Length of Shoreline	5.3 miles
Width of Lake	0.8 mile
Shoreline Development Factor[b]	1.77
Depth	
Portion of Lake Less than Five Feet	17 percent
Portion of Lake More than 20 Feet	37 percent
Mean Depth	16 feet
Maximum Depth	33 feet

[a] *The "hydraulic residence time" is estimated as the time period required for the full volume of the lake to be replaced by inflowing waters during a year of normal precipitation.*

[b] *The shoreline development factor is the ratio of the shoreline length to that of a circular lake of the same area.*

[c] *Volume calculated for a water surface elevation of 833.0 feet above NGVD.*

Source: Wisconsin Department of Natural Resources, U. S. Geological Survey, and SEWRPC.

LAKE BASIN

Powers Lake is a natural body with several large bays and two deep basins. The origin of Powers Lake is similar to that of many other lake basins in the Region: it was formed from the melting of ice blocks that were separated from the Michigan Lobe of the continental glacier as it retreated from southeastern Wisconsin approximately 15,000 years ago and from the subsequent subsidence of sand and gravel within and covering these blocks. The Lake lies in an area of unconsolidated glacial sediments. These glacial sediments, primarily ice-contact and outwash deposits about 150 feet thick, are underlain by bedrock formations of Precambrian, Cambrian, Ordovician, and Silurian ages, and are overlaid in part of the basin by organic deposits formed both before and after glaciation.

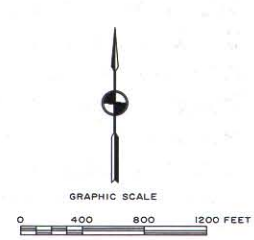
The Lake receives intermittent inflow from an unnamed tributary, referred to in this report as the Powers Lake inlet, which enters the Lake from the wetland complex northeast of the Lake. Powers Lake is in the headwaters of the East Branch of the Nippersink River, which flows from the Lake southerly through Tombeau Lake, then southwesterly to where it joins the North Branch of the Nippersink River and eventually flows to the Fox River (Illinois). Of the approximately 100 major lakes in the seven-county Southeastern Wisconsin Region, Powers Lake ranks 22nd in size, with a surface area of about 459 acres. Basic hydrographic and morphometric data for Powers Lake are presented in Table 1, and are illustrated on Map 1. Powers Lake has a volume of approximately 7,453 acre-feet based on a water surface elevation of 833.0 feet above National Geodetic Vertical Datum (NGVD). Approximately 17 percent of the lake area has a water depth of less than five feet; 46 percent of the lake area has a water depth between five and 20 feet; and 37 percent has a water depth greater than 20 feet. The mean depth of Powers Lake is 16 feet, and the maximum depth is 33 feet. Powers Lake is about 1.3 miles long and about 0.8 mile wide.

Map 1

HYDROGRAPHY AND MORPHOMETRY OF POWERS LAKE

LEGEND

- DEPTH LESS THAN 5 FEET
- DEPTH 5-10 FEET
- DEPTH 10-20 FEET
- DEPTH 20-30 FEET
- DEPTH GREATER THAN 30 FEET
- 30 WATER DEPTH CONTOUR (DEPTH IN FEET)



Source: Wisconsin Department of Natural Resources and SEWRPC.

LAKE BOTTOM SUBSTRATE

Lake bottom sediment types and locations are shown on Map 2. Marl is the dominant sediment type, found throughout the Lake in water deeper than five feet, covering about 88 percent of the lake bottom. Sand and gravel occur in shallower areas and predominate around the shoreline. Sand covers approximately 3 percent of the lake bottom, gravel covers about 5 percent, and a combination of sand and gravel covers about 4 percent. Muck covers the bottom of a small bay on the western shore and covers less than 1 percent of the lake bottom. A combination of muck, sand, clay, and gravel are found in the Jefferson Island channel.

SHORELINE CONDITIONS

Erosion of the Powers Lake shoreline results in the loss of land, damage to lakeside facilities, and interference with access to, and use of, the shoreline. Such erosion is primarily caused by waves generated by wind, by motorboating activities, and by ice action. A survey of Powers Lake shoreline conditions was conducted in June of 1990 to identify the type and condition of existing shore protection structures and to evaluate the stability of unprotected shoreline areas.

A total of 133 shore protection structures were found to be located on the Powers Lake shoreline: 71 bulkheads, or 53 percent of the total structures; 33 revetments, or 25 percent of the total structures; and 29 beaches, or 22 percent of the total structures. A bulkhead is a vertical retaining wall usually constructed of concrete, steel sheet piling, or timber. A revetment is a layer or layers of armor stone underlain by filter cloth or gravel bedding. Beaches may contain natural sand or gravel deposits or may be artificially nourished. These structures protect about 13,070 feet of shoreline, or about 47 percent of the total shoreline length of Powers Lake.

The length of each structure was measured and any apparent failures noted. Types of failures include overtopping, where the height of waves, or spray from breaking waves, exceeds the top of a structure and erodes material above and behind it; flanking, or erosion at the sides of a structure; toe scouring, or erosion at the base of a structure; collapsing; and material failure. Collapsing and material failure were the most common types of failure noted, affecting about 16 percent, and about 10 percent of the structures surveyed, respectively. Overall, 43 of the 133 structures, or about 32 percent, exhibited one or more types of failure and were in need of repair. Map 3 shows the location of shore protection structures in Powers Lake and identifies those structures in need of repair.

Of the 53 percent of the Powers Lake shoreline that was not protected by structures, 89 percent was found to be stable and well vegetated. About 1,750 feet of shoreline, or about 12 percent of the unprotected shoreline of the Lake, was found to be actively eroding in June of 1990. These eroding stretches are also shown on Map 3.

WATERSHED CHARACTERISTICS

The watershed area tributary to Powers Lake includes areas in Kenosha and Walworth Counties and encompasses about 2,177 acres, or about 3.4 square miles, as shown on Map 4. The total watershed-to-Lake ratio is about 4.7 to 1, indicating that Powers Lake receives drainage water from a land and water surface 4.7 times larger than the Lake itself.

Map 5 shows the original 1836 plat of the U. S. Public Land Survey for the Powers Lake area. A comparison of the present watershed tributary to Powers Lake, Map 4, with the 1836 map, Map 5, indicates that the drainage pattern in the Powers Lake area, especially north of the Lake, has been altered since 1836. Not shown on the 1836 map but shown on the present watershed map is an unnamed channelized stream presently draining land to the north/northwest and discharging to Powers Lake. On the 1836 map wetlands northeast of Powers Lake were drained by a stream which, on the present map, has been reduced to drainage ditches. Much of this stream may have disappeared since 1836 as the wetlands were ditched and drained. Presently, wetlands in the northern part of U. S. Public Land Survey Section 8, Township 1 North, Range 19 East, are drained to the northeast by a ditch system discharging to New Munster Creek. Because these wetlands are not drained to Powers Lake, they are not currently included in the watershed tributary to the Lake.

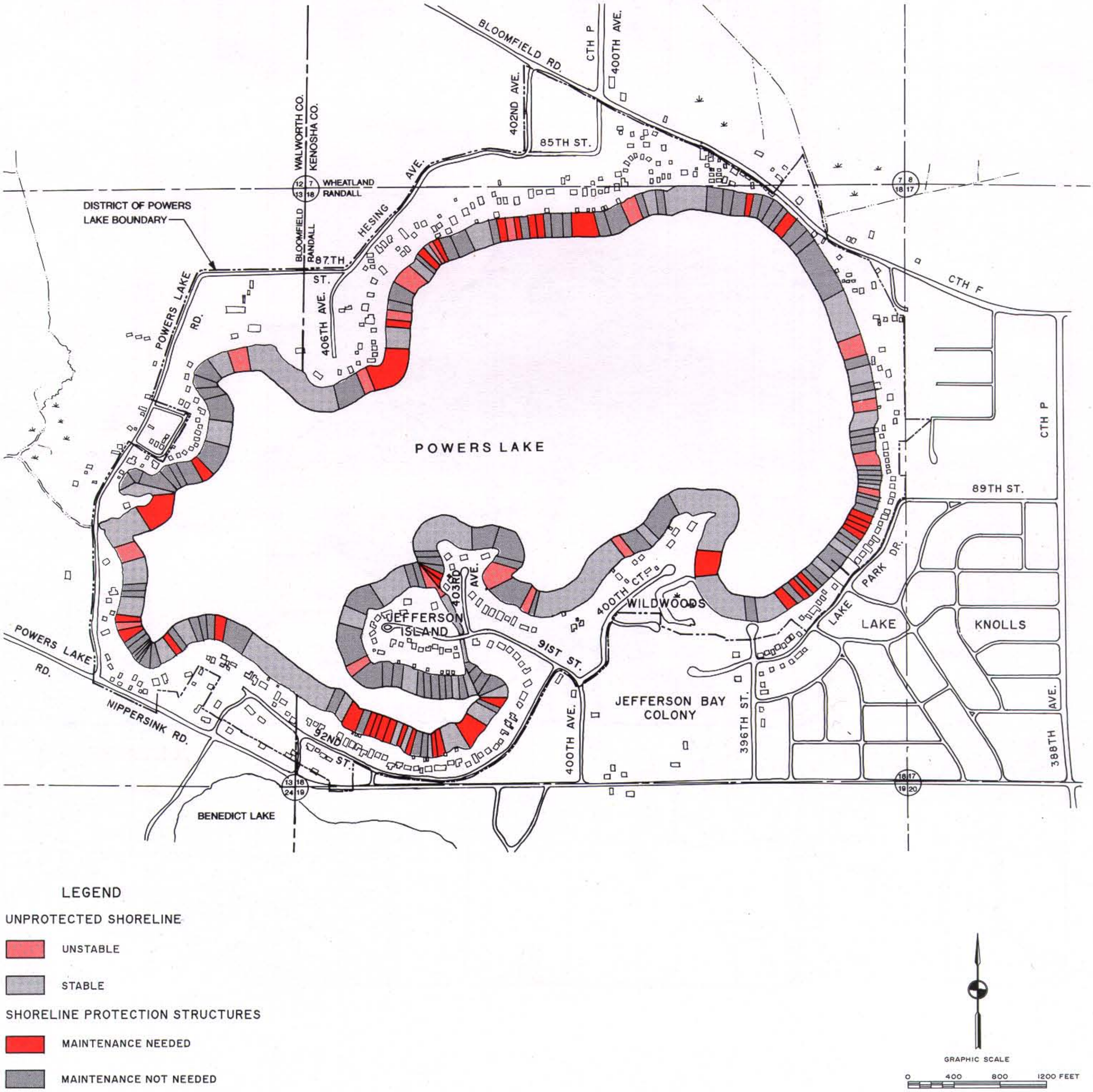
Map 2

BOTTOM SEDIMENT TYPES IN POWERS LAKE

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map 3

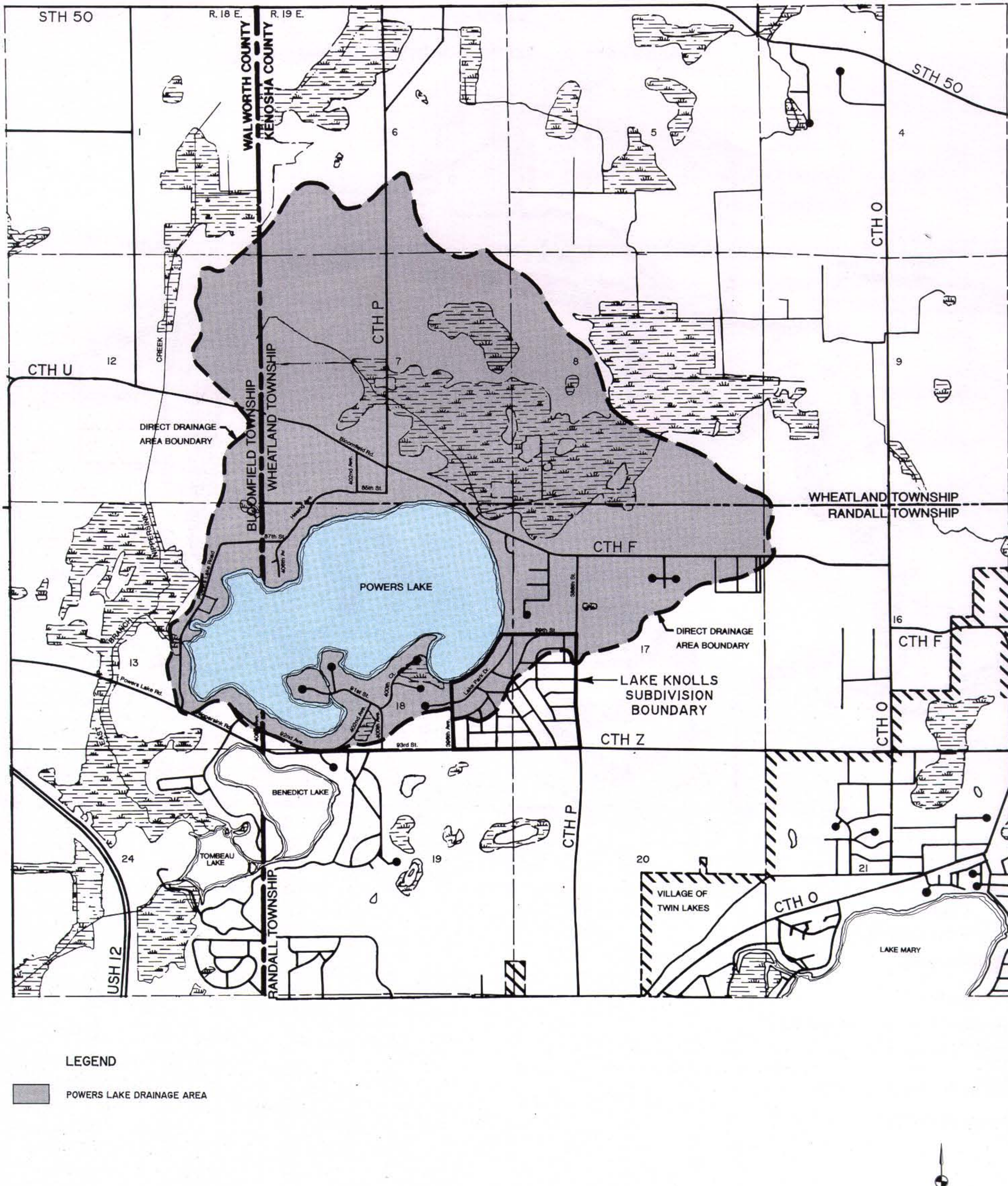
POWERS LAKE SHORELINE CONDITIONS: 1990



Source: SEWRPC.

Map 4

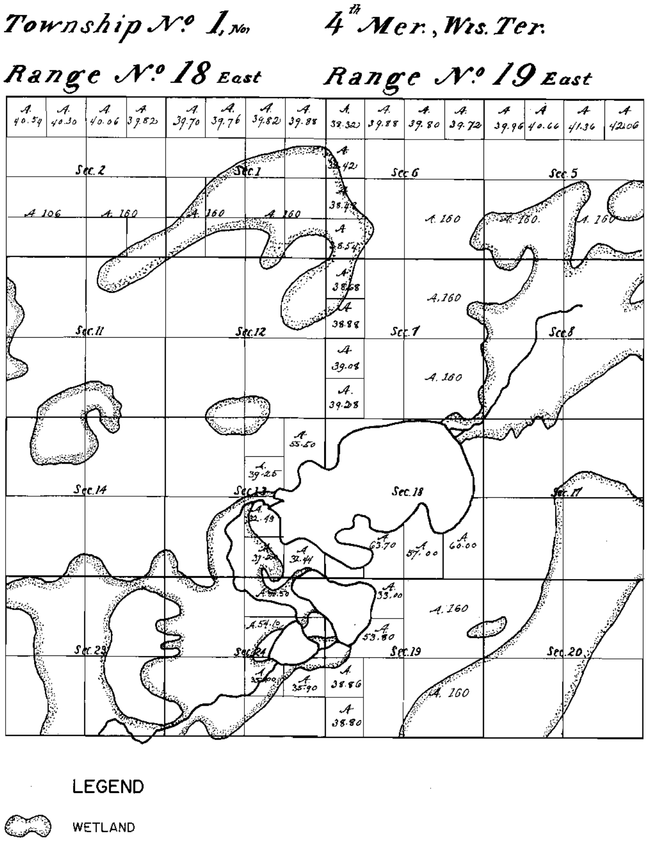
POWERS LAKE DRAINAGE AREA



Source: SEWRPC.

Map 5

ORIGINAL UNITED STATES PUBLIC LAND SURVEY PLAT OF THE POWERS LAKE AREA: 1836



LEGEND

WETLAND

Source: U. S. Public Land Survey.

SOIL TYPE AND CONDITIONS

Soil type, land slope, and land use and management practices are among the more important factors determining lake water quality conditions. The U. S. Soil Conservation Service under contract to the Southeastern Wisconsin Regional Planning Commission completed a detailed soil survey of the Powers Lake area in 1966.[1] The soil survey for the first time anywhere in the United States contained interpretations for planning and engineering application as well as for agriculture application. Using the regional soil survey an assessment was made of hydrologic characteristics of the soils in the drainage area tributary to Powers Lake and of the suitability of the soils for urban residential development utilizing conventional onsite sewage disposal systems (septic tank systems); utilizing alternative onsite sewage disposal systems; and utilizing public sanitary sewers.

Soil type, land slope, and vegetative cover are important factors affecting the rate, amount, and quality of stormwater runoff. The soil texture and the shape and stability of aggregates of soil particles, expressed as soil structure, influence the permeability, infiltration rate, and erodibility of soils. The land slope is also an important determination of stormwater runoff rates and of susceptibility to erosion.

Soils within the Powers Lake drainage area were categorized into four main hydrologic soil groups, as well as an "other" category, as indicated in Table 2. The areal extent of these soils and their locations within the watershed are shown on Map 6. The relative proportions of the Powers Lake drainage area covered by each of the hydrologic soils groups are: Group A, excessively drained soils, 0 percent; Group B, well drained soils, about 59 percent; Group C, poorly drained soils, 0 percent; Group D, very poorly drained soils, about 19 percent; and "other," which includes areas such as man-made fill areas and quarries, about 1 percent. Powers Lake accounts for the remaining 21 percent of the drainage area.

Soils within the Powers Lake drainage area were examined for suitability for urban residential development. With respect to residential development utilizing conventional onsite sewage disposal systems, as shown on Map 7, about 62 percent of the drainage area tributary to Powers Lake is covered by soils suitable for such development and about 28 percent by soils unsuitable for such development. The soil suitability could not be determined for the remaining 10 percent of the land in the drainage area.

With respect to residential development utilizing alternative onsite sewage disposal systems, such as mound systems, as shown on Map 8, about 56 percent of the drainage area tributary to Powers Lake is covered by soils suitable for such development and about 28 percent by soils unsuitable for such development. Soil suitability could not be determined for the remaining 16 percent of the land in the drainage area.

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[1]*See SEWRPC Planning Report No. 8, The Soils of Southeastern Wisconsin, June 1966.*

Table 2

GENERAL HYDROLOGICAL SOIL TYPES IN THE DRAINAGE AREA TO POWERS LAKE

Group	Soil Characteristics	Drainage Area Extent (acres)	Percent of Total
A	Excessively drained-somewhat excessively drained Very rapid to rapid permeability Low shrink-swell potential	0	0
B	Well drained-moderately well drained Texture intermediate between coarse and fine Moderately rapid to moderate permeability Low to moderate shrink-swell potential	1,292	59.3
C	Somewhat poorly drained-poorly drained High water table for part or most of year Mottling, suggesting poor aeration and lack of drainage, generally present in A-C horizons Slowly permeable layer in or immediately below A/B horizons	0	0
D	Very poorly drained High water table for most of year Organic/clay soils Clay soils have high shrink-swell potential	402	18.5
Made Land	Open pit mining areas, man-made fill areas containing widely varying soils and other materials	24	1.1
Water	--	459	21.1
Total	--	2,177	100.0

Source: SEWRPC.

Soil limitations for residential development utilizing sanitary sewer service are shown on Map 9. About 66 percent of the drainage area tributary to Powers Lake is covered by soils suitable such development, and about 33 percent by soils unsuitable for such development. Soil suitability could not be determined for the remaining 1 percent of the land in the drainage area.

CLIMATE AND HYDROLOGY

Table 3 reports the long-term average monthly air temperatures taken from official National Oceanic and Atmospheric Administration (NOAA) records for the weather recording stations at Lake Geneva, Wisconsin, located approximately six miles northwest of Powers Lake, and at Burlington, Wisconsin, located approximately 10 miles north of Powers Lake. Table 3 also lists the mean monthly temperatures for these stations during the 1987 water year. From October 1986 through October 1987, the air temperature averaged 4.0 degrees above the normal temperature of 46.6°F at Lake Geneva, and 2.9 degrees above the normal temperature of 48.6°F at Burlington.

The U. S. Geological Survey conducted a hydrologic study of Powers Lake from October 16, 1986 through October 15, 1987.[2] Hydrologic data were collected at 12 monitoring sites, as shown on Map 10.

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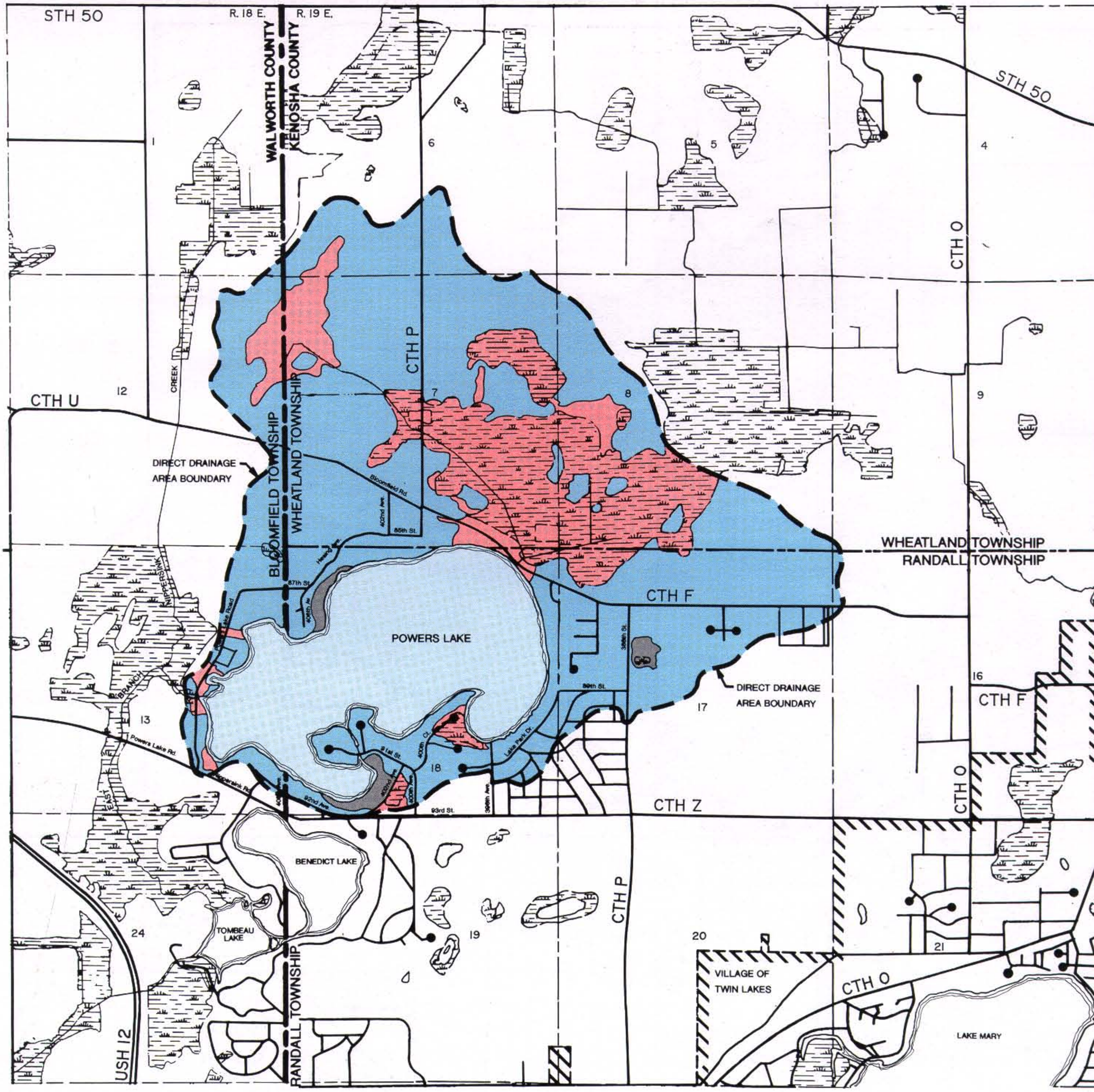
[2]*U. S. Geological Survey, Hydrology and Water Quality of Powers Lake, Southeastern Wisconsin, Water Resources Investigations Draft Report, 1990.*

Map 6

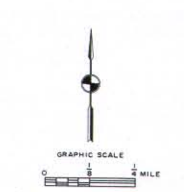
HYDROLOGIC SOIL GROUPS: POWERS LAKE DRAINAGE AREA



LEGEND

HYDROLOGIC GROUPS

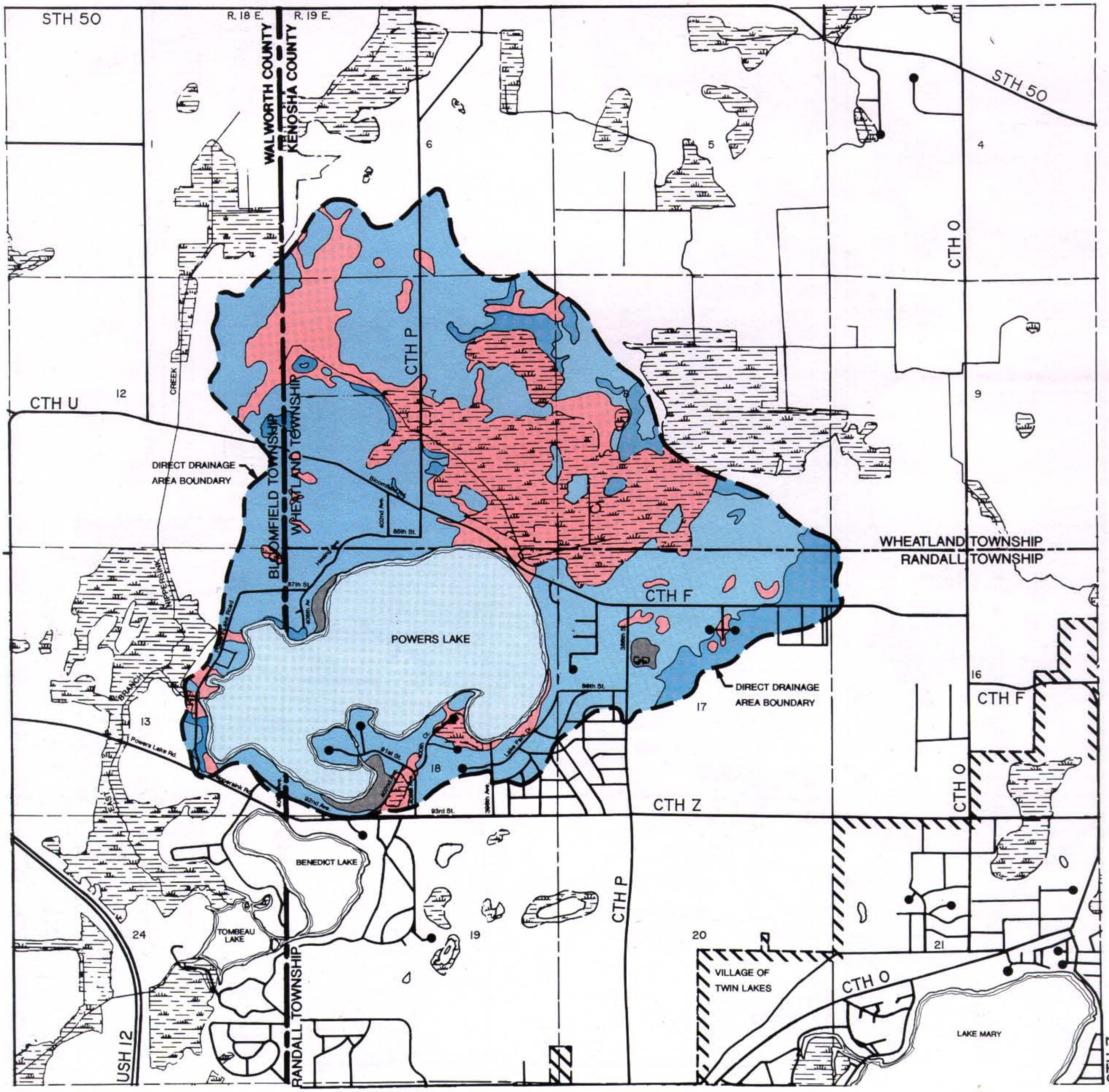
- GROUP B: MODERATELY DRAINED SOILS
- GROUP D: VERY POORLY DRAINED SOILS
- HYDROLOGIC SOIL GROUP NOT DETERMINED
- SURFACE WATER



Source: U. S. Soil Conservation Service and SEWRPC.

Map 7

SUITABILITY OF SOILS IN THE POWERS LAKE DRAINAGE AREA FOR CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS UNDER CURRENT ADMINISTRATIVE RULES: FEBRUARY 1991



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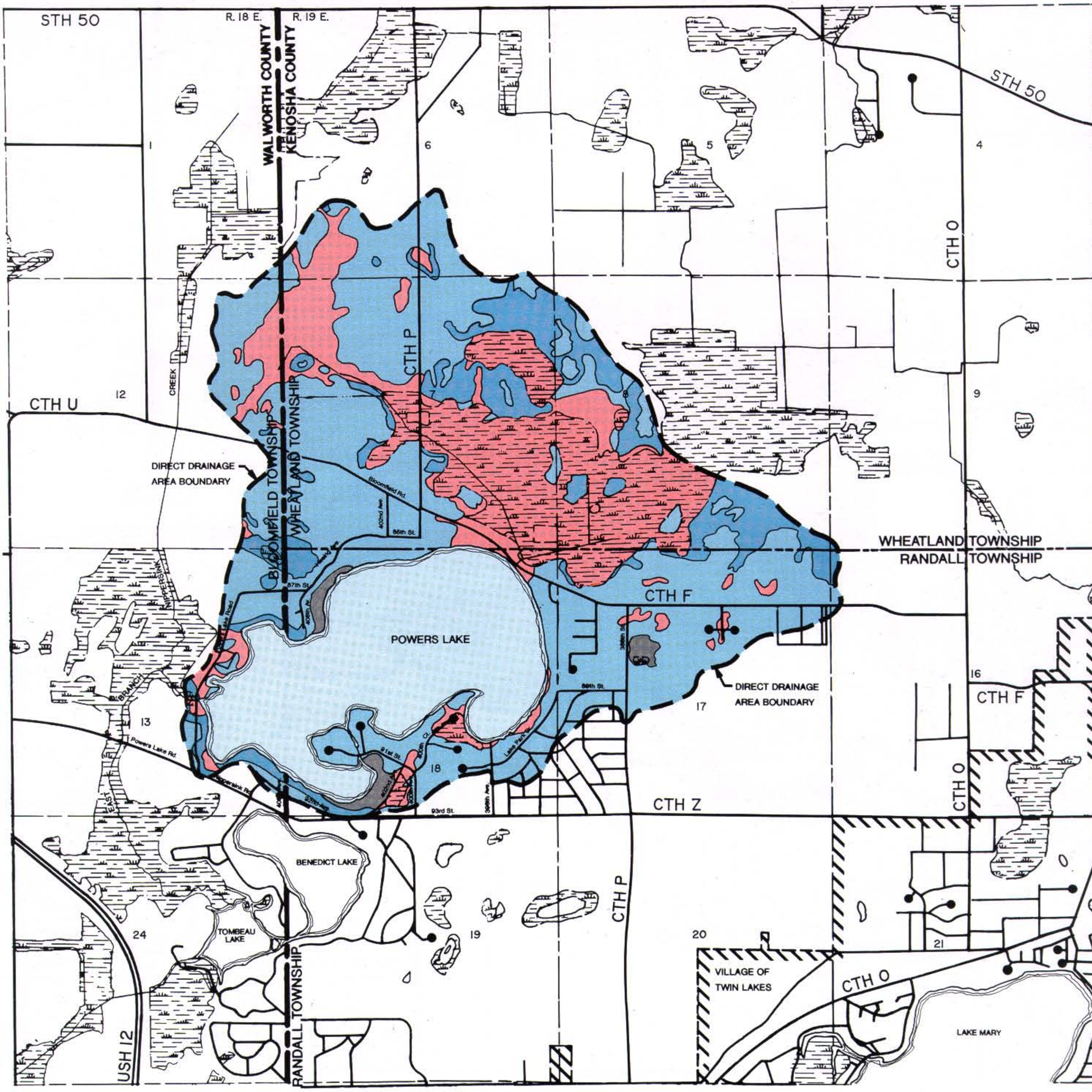
- UNSUITABLE: AREAS COVERED BY SOILS HAVING A HIGH PROBABILITY OF NOT MEETING THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS
- UNDETERMINED: AREAS COVERED BY SOILS HAVING A RANGE OF CHARACTERISTICS AND/OR SLOPES WHICH SPAN THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS SO THAT NO CLASSIFICATION CAN BE ASSIGNED
- SUITABLE: AREAS COVERED BY SOILS HAVING A HIGH PROBABILITY OF MEETING THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS
- OTHER: AREAS CONSISTING FOR THE MOST PART OF DISTURBED LAND FOR WHICH NO INTERPRETIVE DATA ARE AVAILABLE
- SURFACE WATER

NOTE: ONSITE INVESTIGATIONS ARE ESSENTIAL TO THE DETERMINATION OF WHETHER ANY SPECIFIC TRACT OF LAND IS SUITABLE FOR DEVELOPMENT SERVED BY A MOUND SEWAGE DISPOSAL SYSTEM

Source: U. S. Soil Conservation Service and SEWRPC.

Map 8

SUITABILITY OF SOILS IN THE POWERS LAKE DRAINAGE AREA FOR MOUND SEWAGE DISPOSAL SYSTEMS UNDER CURRENT ADMINISTRATIVE RULES: FEBRUARY 1991



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UNSUITABLE: AREAS COVERED BY SOILS WHICH HAVE A HIGH PROBABILITY OF NOT MEETING THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING MOUND SEWAGE DISPOSAL SYSTEMS

UNDETERMINED: AREAS COVERED BY SOILS HAVING A RANGE OF CHARACTERISTICS AND/OR SLOPES WHICH SPAN THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING MOUND SEWAGE DISPOSAL SYSTEMS SO THAT NO CLASSIFICATION CAN BE ASSIGNED

SUITABLE: AREAS COVERED BY SOILS HAVING A HIGH PROBABILITY OF MEETING THE CRITERIA OF CHAPTER ILHR 83 OF THE WISCONSIN ADMINISTRATIVE CODE GOVERNING MOUND SEWAGE DISPOSAL SYSTEMS

OTHER: AREAS CONSISTING FOR THE MOST PART OF DISTURBED LAND FOR WHICH NO INTERPRETIVE DATA ARE AVAILABLE

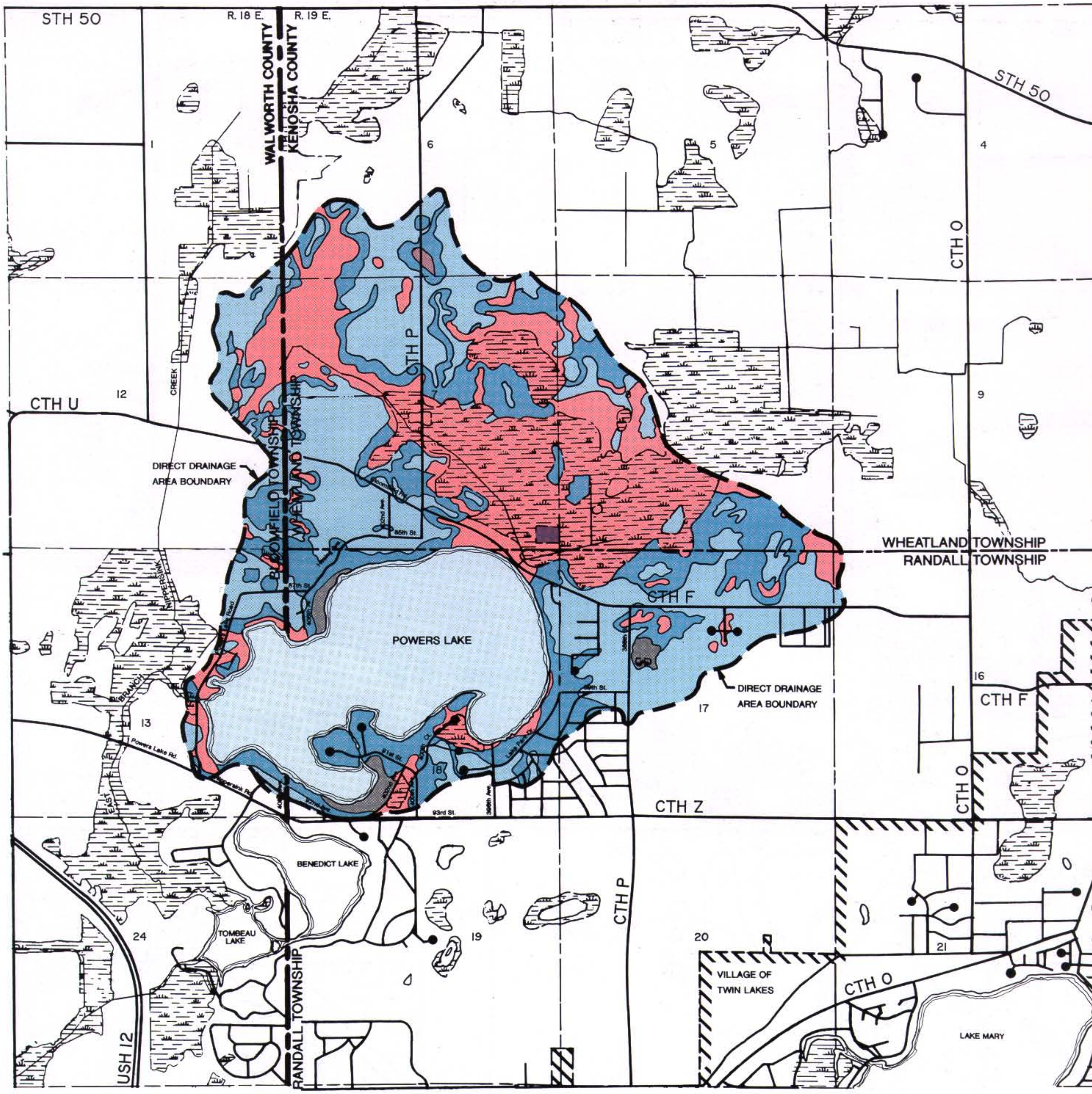
SURFACE WATER

NOTE: ONSITE INVESTIGATIONS ARE ESSENTIAL TO THE DETERMINATION OF WHETHER ANY SPECIFIC TRACT OF LAND IS SUITABLE FOR DEVELOPMENT SERVED BY A MOUND SEWAGE DISPOSAL SYSTEM

Source: U. S. Soil Conservation Service and SEWRPC.

Map 9

SUITABILITY OF SOILS IN THE POWERS LAKE DRAINAGE AREA FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE



LEGEND

- AREAS COVERED BY SOILS HAVING SEVERE LIMITATIONS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE
- AREAS COVERED BY SOILS HAVING MODERATE LIMITATIONS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE
- AREAS COVERED BY SOILS HAVING SLIGHT LIMITATIONS FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE
- UNCLASSIFIED SOILS
- SURFACE WATER

Source: U. S. Soil Conservation Service and SEWRPC.

Table 3

CLIMATOLOGICAL DATA FOR THE POWERS LAKE AREA

Mean Monthly Temperature (°F)	October	November	December	January	February	March	April	May	June	July	August	September	Annual
Lake Geneva: 1945-1988	51.5	37.0	24.7	18.7	23.2	32.1	45.6	56.5	66.7	71.8	70.1	62.2	46.7
Lake Geneva: 1986-1987	51.3	34.4	27.5	24.3	31.8	38.3	51.3	63.1	73.3	76.3	70.9	64.3	50.6
Departure from Normal	-0.2	-2.6	2.8	5.6	8.6	6.2	5.7	6.6	6.6	4.5	0.8	2.1	4.0
Burlington: 1950-1980	50.4	36.9	22.2	17.4	21.6	32.0	45.8	56.7	66.3	71.1	69.2	57.0	45.6
Burlington: 1986-1987	50.4	34.0	27.4	23.6	30.7	37.5	48.1	- -[a]	71.6	- -[a]	69.7	61.7	48.5
Departure from Normal	0	-2.9	5.2	6.2	9.1	5.5	2.3	- -[a]	5.3	- -[a]	0.5	0.1	2.9

Mean Monthly Precipitation (inches)	October (16-31)	November	December	January	February	March	April	May	June	July	August	September	October (1-15)	Annual
Lake Geneva: 1945-1988	1.28	2.40	2.20	1.89	1.39	2.67	3.63	3.35	4.16	4.26	3.81	3.42	1.28	35.74
Burlington: 1951-1986	1.22	2.21	1.70	1.44	1.08	2.44	3.46	2.96	4.52	4.41	3.76	3.06	1.22	33.48
Powers Lake: 1986-1987	0.34	0.75	0.81	0.93[b]	0.0[b]	1.17[b]	5.49	4.94	0.63	3.06	6.86	1.89	0.29	27.16
Departure from Normal (Lake Geneva)	-0.94	-1.65	-1.39	-0.96	-1.39	-1.50	1.86	1.59	-3.53	-1.20	3.05	-1.58	0.99	-8.58
Departure from Normal (Burlington)	-0.88	-1.46	-0.89	-0.51	-1.08	-1.27	2.03	1.98	-3.89	-0.35	3.10	-1.15	0.93	-6.32

Mean Monthly Evaporation (inches)	October (16-31)	November	December	January	February	March	April	May	June	July	August	September	October (1-15)	Annual
Powers Lake: Average 1986-1987	0.77[c]	0.76[d]	0.30[d]	0.06[d]	0.12[d]	1.82[d]	5.48	5.52	7.44	6.71	5.97	3.81	1.63	31.80

[a]*Data not reported, average long-term Burlington data used to calculate annual temperature.*

[b]*Value measured at Burlington, Wisconsin.*

[c]*Estimate based on a 13 percent reduction comparing Powers Lake evaporation data to Arlington, Wisconsin, when both month's data were available.*

[d]*Estimated using linear regression of Powers Lake monthly evaporation pan data based on method by Dunne and Leopold (1978).*

Source: National Oceanic and Atmospheric Administration and U. S. Geological Survey.

Precipitation was measured at three stations on Powers Lake during nonfreezing weather and at Burlington when the Powers Lake stations were not in operation. The measured values for the 1987 water year are listed in Table 3 along with the long-term average monthly precipitation values for the Lake Geneva and Burlington stations. As shown in Figure 1, precipitation at Powers Lake in 1987 was 21.17 inches, or 8.6 inches below normal when compared to the long-term record at the Lake Geneva station, and about 6.3 inches below normal when compared to the long-term record at the Burlington station.

Evaporation from Powers Lake's surface was estimated using daily readings during nonfreezing periods from an evaporation pan located in the southeastern part of the lake basin. During freezing periods or when no Powers Lake data were available, estimates were made using a linear regression of Powers Lake monthly evaporation pan data; evaporation pan data from Arlington, Wisconsin, 65 miles northwest of Powers Lake;[3] or by a mass-transfer method for ice cover.[4] Evaporation from the lake surface during the study period of October 16, 1986 through October 15, 1987 was calculated as 31.80 inches.

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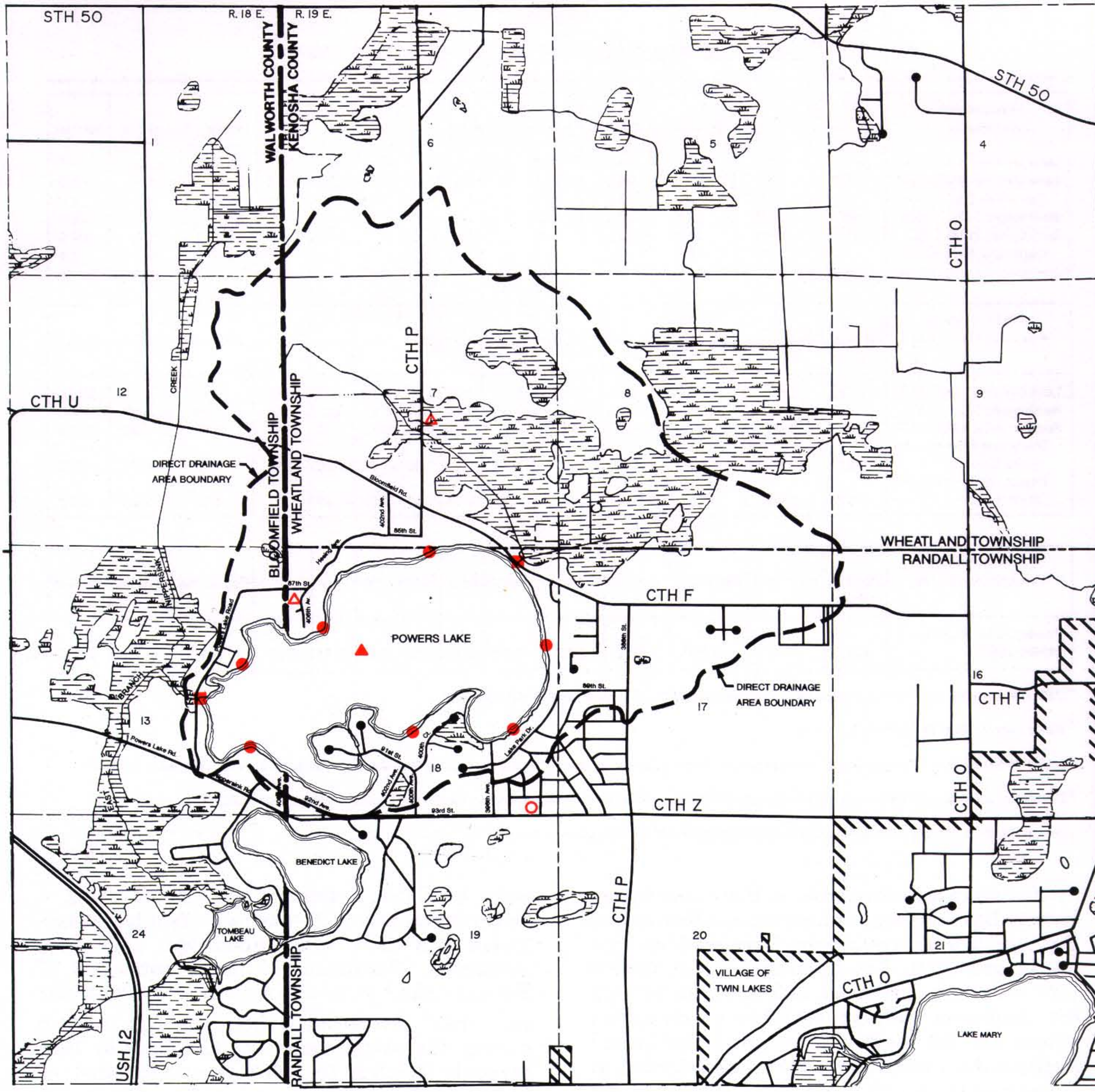
[3]*U. S. Department of Commerce, Climatological Data, Annual Summary: National Oceanic and Atmospheric Administration, Vol. 91, No. 13; 1986.*

[4]*T. Dunne and L. B. Leopold, Water in Environmental Planning, W. H. Freeman and Company, San Francisco; 1978.*

Map 10

MONITORING STATIONS IN THE POWERS LAKE DRAINAGE AREA



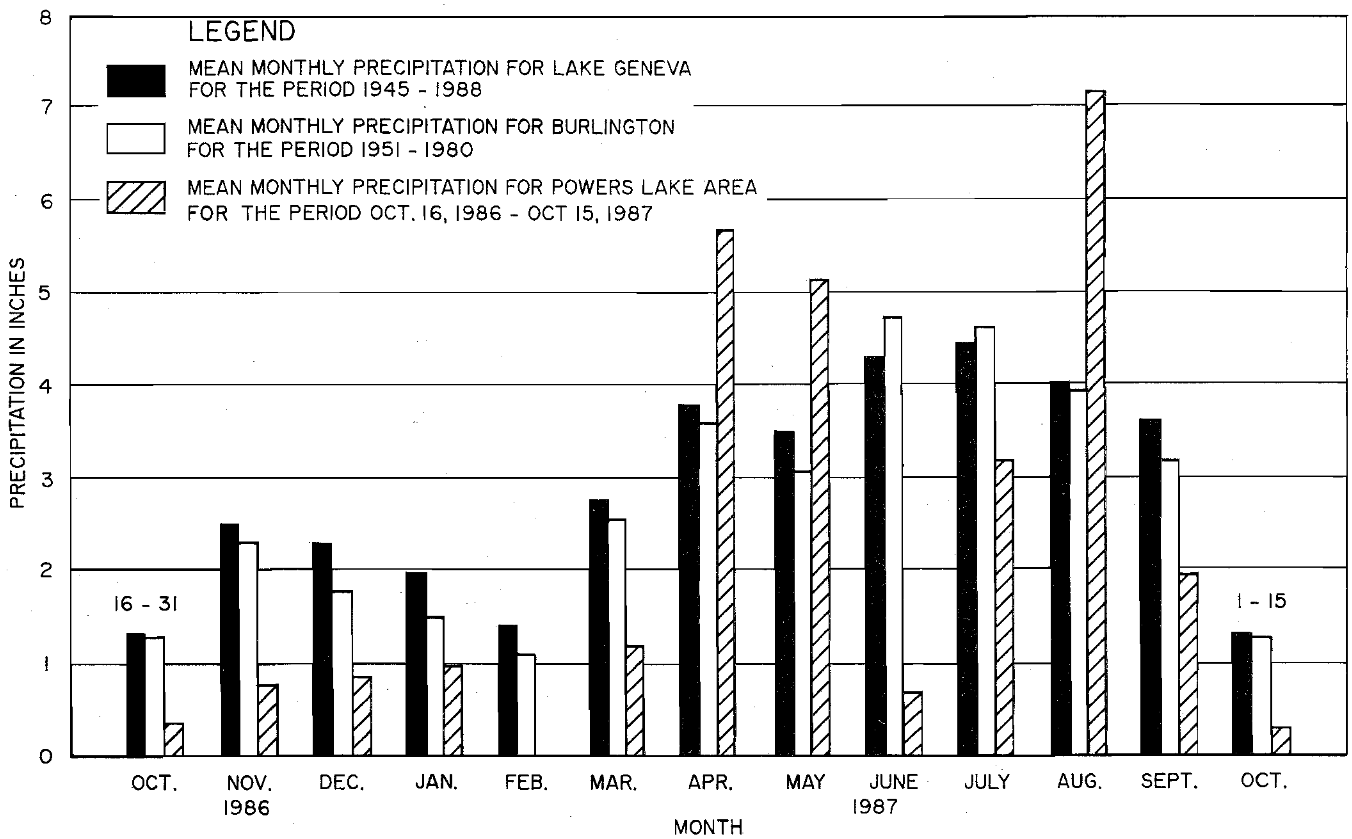
LEGEND

- ▲ LAKE MONITORING SITE
- ■ STREAM FLOW-GAGING STATION, AND WATER QUALITY SAMPLING SITE
- ● GROUNDWATER OBSERVATION WELL AND WATER QUALITY SAMPLING SITE
- △ NONRECORDING RAIN GAGE
- ○ EVAPORATION PAN AND MANUALLY READ RAIN GAGE

Source: U. S. Geological Survey.

Figure 1

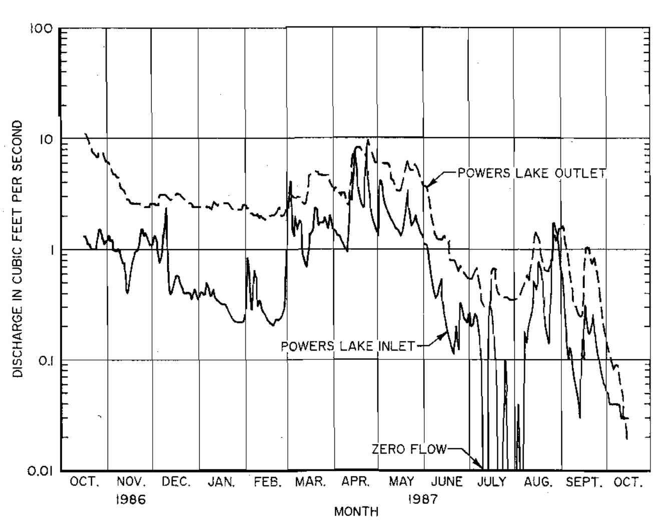
LONG-TERM AND 1986-1987 STUDY YEAR PRECIPITATION FOR THE POWERS LAKE AREA



Source: U. S. Geological Survey, National Oceanic and Atmospheric Administration, and SEWRPC.

Figure 2

POWERS LAKE INLET AND OUTLET STREAMFLOW: 1986-1987



Source: U. S. Geological Survey and SEWRPC.

Water inflow to and outflow from Powers Lake were estimated from stage and discharge measurements taken at the Powers Lake inlet and the Powers Lake outlet. Stages at the inlet were recorded continuously, and stages at the outlet, which served as a lake-stage record for the lake, were read daily by a local observer. Discharge data from the Powers Lake inlet and outlet for the 1987 water year are shown in Figure 2. In general, the discharge of surface water inflow was less than the discharge of surface water outflow. Discharge of inlet water was highest in April 1987 and declined to a low of zero in July 1987. Surface water discharge at the outlet was highest in October 1986 and in April 1987 and was lowest at the end of the study in October 1987.

Seven shallow groundwater monitoring wells, also shown on Map 10, were installed in the nearshore lakebed and water levels were recorded in October 1986 and in April, May, July, and

October 1987 to determine whether or not groundwater was discharging into the Lake. Observed lake level and well water level data indicated that throughout the study period Powers Lake was receiving groundwater. It may, therefore, be assumed that no significant groundwater outflow occurred during the study period.

Water level fluctuations for Powers Lake are shown in Figure 3. Powers Lake water levels during the 1987 water year fluctuated less than one foot, ranging from an elevation of 833.5 feet above NGVD of 1929 on October 16, 1986, to 832.7 feet above NGVD on October 15, 1987.

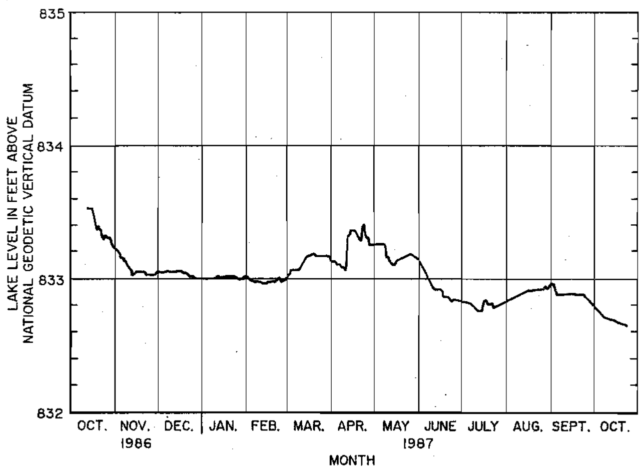
A hydrologic budget for Powers Lake was calculated for the 1987 water year from measured or estimated precipitation, inflow from Powers Lake inlet, groundwater inflow and outflow, Powers Lake outflow, and lake level data. The hydrologic budgets for Powers Lake for a normal year and for water year 1987 are shown in Figure 4. During the 1987 water year, it was estimated that 2,780 acre-feet of water entered the Lake, based on a water surface elevation of 833.0 feet above NGVD. Of this total, about 1,030 acre-feet, or 37 percent, was contributed by precipitation falling directly onto Powers Lake; about 989 acre-feet, or 36 percent, was contributed by groundwater; approximately 635 acre-feet, or 23 percent, was contributed by inflow from Powers Lake inlet; and about 129 acre-feet, or 4 percent, was contributed by shoreline drainage.

Of the total water output from Powers Lake of approximately 3,170 acre-feet, about 1,970 acre-feet, or 62 percent, was discharged via the Powers Lake outlet, while about 1,200 acre-feet, or 38 percent, evaporated from the surface of the Lake.

The hydrologic budget for the 1987 water year does not represent a normal year. Streamflow averaged 10 percent greater than normal, precipitation was 13 percent less than normal, and groundwater inflows were above normal. Therefore, a second hydrologic budget was calculated for Powers Lake utilizing rainfall data adjusted to reflect the normal rainfall expected during an average year based upon long-term data. As shown in Figure 4, in an "average year," precipitation may be expected to dominate the inflow (about 42 percent), followed by groundwater (about 32 percent), Powers Lake inlet (about 21 percent), and shoreline drainage (about 5 percent). Streamflow would account for about 61 percent of the outflow and evaporation would comprise the remaining about 39 percent.

Figure 3

POWERS LAKE WATER LEVEL: 1986-1987



Source: U. S. Geological Survey and SEWRPC.

The hydraulic residence time, or the time required for the full volume of a lake to be completely replaced, is important in determining the expected response of the lake in question to increased or reduced nutrient and other pollutant loadings. If a lake basin volume is small and/or the rate of water inflow is high, the hydraulic residence time may be as short as 10 days or less. Pollutants that enter the lake may be quickly washed out and algal cells do not usually have time to grow and accumulate. As residence time increases, interactions between the water column and bottom sediments have greater influences on the water quality.[5] If a lake basin volume is very large and/or the rate of inflow is low, the hydraulic residence time may range from 100 days to several years, which allows time for pollutants to accumulate and for algae to assimilate nutrients and grow. Lake restoration techniques may have delayed results in lakes with long hydraulic residence times.[6]

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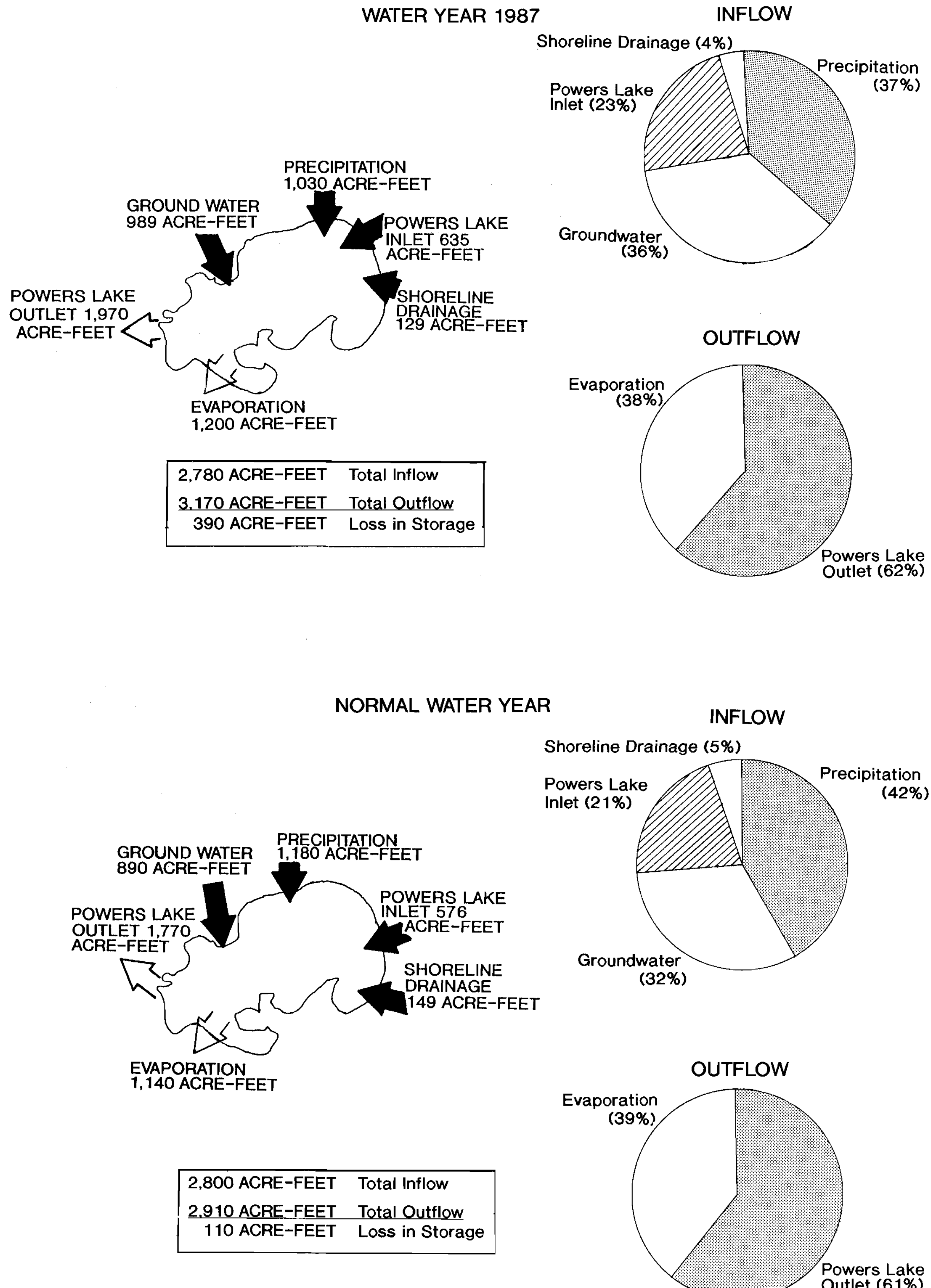
[5] *The Lake and Reservoir Restoration Guidance Manual, 1st Edition, L. Moore and K. Thornton, eds., U. S. Environmental Protection Agency, 1988.*

[6] *Ibid.*

Figure 4

HYDROLOGIC BUDGET FOR POWERS LAKE



Source: U. S. Geological Survey and SEWRPC.

Based on the hydrologic budget, the hydraulic residence time for Powers Lake during the 1987 water year was calculated as about 3.8 years. During a normal year, the estimated hydraulic residence time would be 4.2 years. Other lakes in the area with similar hydraulic residence times include the Lauderdale chain of lakes (Green, Middle, and Mill Lakes), Walworth County, and Delavan Lake, Walworth County. By contrast, Benedict and George Lakes, Kenosha County, have shorter residence times of less than one year, and Geneva Lake has a longer residence time, 20 years.

SUMMARY

This chapter presents an inventory of the physical characteristics of Powers Lake and its drainage area. Proper consideration of alternative measures which affect the hydrology or water quality of Powers Lake require characterization of lake basin morphometry and bottom substrate conditions, lake shoreline conditions, the surface water drainage pattern, the soil conditions, and the climate and hydrology of the drainage area.

Powers Lake is a 459-acre lake with a mean depth of 16 feet and a maximum depth of 33 feet. Marl covers about 88 percent of the lake bottom. About 48 percent of the 5.3-mile shoreline was protected in 1990 by 133 shore protection structures, including 71 bulkheads, 33 revetments, and 29 beaches. About 32 percent of the structures were in need of repair in 1990. Of the 52 percent of the shoreline that was not protected by structures, 89 percent was stable and well vegetated.

Most of the soils within the approximate 2,177-acre Powers Lake drainage area are moderately well drained. Approximately 62 percent of the land draining to Powers Lake is covered by soils suitable for residential development with conventional onsite sewage disposal systems, about 56 percent is covered by soils suitable for alternative onsite sewage disposal systems, and about 66 percent is covered by soils suitable for sanitary sewered residential development. The soil types also affect the severity of soil erosion and the feasibility of certain nonpoint source pollution control measures such as infiltration systems.

The climate and hydrology of Powers Lake were observed by the U. S. Geological Survey from October 16, 1986, through October 15, 1987. Of the total water input to Powers Lake over this period, precipitation contributed about 37 percent, groundwater about 36 percent, the Powers Lake inlet about 23 percent, and shoreline drainage about 4 percent. Of the total water output from Powers Lake, about 62 percent was discharged from the Powers Lake outlet and about 38 percent evaporated from the lake surface.

During the study period, the annual precipitation was 27.16 inches, or 6.3 inches below long-term (1951-1980) annual average for the Burlington weather station and 8.6 inches below long-term (1948-1988) annual average for the Lake Geneva weather station. In an average year, it was estimated that precipitation accounts for 42 percent of the inflow; groundwater, 32 percent; Powers Lake inlet, 21 percent; and shoreline drainage, 5 percent. Streamflow contributes an estimated 61 percent of an average year's outflow budget and evaporation accounts for the remaining estimated 39 percent.

Chapter III

LAND USE, POPULATION, AND ZONING

INTRODUCTION

Water pollution problems, recreational use conflicts, and the risk of damage to environmentally valuable areas, as well as the ultimate solutions to those problems, are primarily a function of the human activities within the drainage area of a lake and of the ability of the underlying natural resource base to sustain those activities. Accordingly, the land uses and population levels in the direct drainage area of a lake are important considerations in lake water quality management.

The geographic, as well as functional, jurisdictions of minor civil divisions and special-purpose units of government are also important factors which must be considered in a lake management plan, since these local units of government provide the basic structure of the decision-making framework within which environmental problems must be addressed.

CIVIL DIVISIONS

Superimposed on the 3.4-square-mile drainage area to Powers Lake are the local civil division boundaries shown on Map 11. Civil divisions which include land within the drainage area include the Towns of Randall and Wheatland, Kenosha County, and the Town of Bloomfield, Walworth County. Approximately 3.0 square miles, or about 87 percent of the drainage area, lie within Kenosha County; and about 0.4 square mile, or 13 percent of the drainage area, lies within Walworth County. The areal extents of each of the civil divisions in the drainage area are set forth in Table 4.

POPULATION

As indicated in Table 5, the resident population of the area draining to Powers Lake remained relatively stable between 1960 and 1985.

Table 4

AREAL EXTENT OF CIVIL DIVISION IN THE POWERS LAKE DRAINAGE AREA

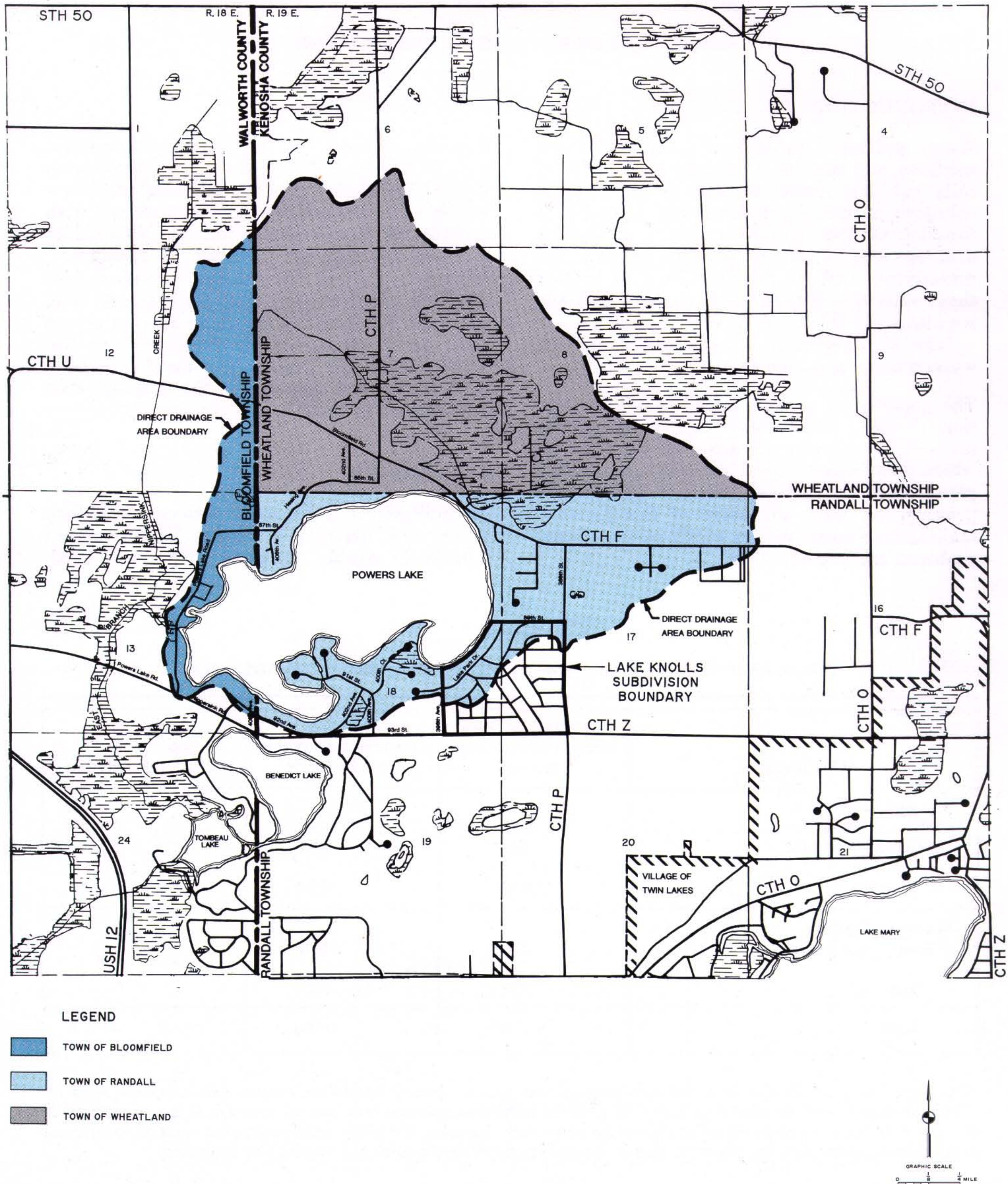
Civil Division	Civil Division Area Within Drainage Area (acres)	Percent of Drainage Area Within Civil Divisions	Percent of Civil Division Within Drainage Area
Kenosha County			
Town of Randall	903[a]	41.5	7.9
Town of Wheatland	1,000	45.9	6.5
Subtotal	1,903	87.4	- -
Walworth County			
Town of Bloomfield	274	12.6	1.2
Subtotal	274	12.6	- -
Total	2,177[a]	100.0	- -

[a]*The Lake Knolls subdivision is a 135-acre development located partially within the Powers Lake Drainage Area as shown on Map 11. Of the total area, about 50 acres lie within the drainage area and are included in the quantification in Table 4. In addition, about 85 acres lie outside of the drainage area. The entire subdivision area must be considered in lake management planning since the area is considered part of the Powers Lake "community of interest."*

Source: SEWRPC.

Map 11

CIVIL DIVISION BOUNDARIES IN THE POWERS LAKE DRAINAGE AREA: 1990



Source: SEWRPC.

Increases in the number of households was offset by the smaller family sizes, except between 1970 and 1980, when the population increased by about 5 percent, from 860 to 900 persons.

It is estimated that there are 300 additional housing units with a seasonal population of about 700 persons in the Powers Lake drainage area. Nearly 50 percent of the homes in the drainage area were, in 1990, seasonal. These homes represent a potential for conversion to year-round residences over the planning period. Population forecasts prepared by the Regional Planning Commission indicate, as shown in Table 5, that the population of the drainage area tributary to Powers Lake may be expected to remain essentially stable, or to rise slightly, through the year 2010.

Table 5

HISTORICAL AND FORECAST RESIDENT POPULATION LEVELS OF THE POWERS LAKE DRAINAGE AREA: 1960-2010

Year	Number of Residents[a]	Number of Households
1960	860	240
1970	860	250
1980	900	320
1985	880[b,c]	330[b]
2010	880[d]-1,010[e]	330[d]-370[e]

[a]*Includes permanent residents only.*

[b]*In addition to the permanent residents, there were about 700 seasonal residents in the Powers Lake drainage area.*

[c]*The Lake Knolls subdivision is located partially within the Powers Lake Drainage Area. That subdivision includes a total of 185 residences with a resident population of about 500 persons. Of that total, about 95 residences with a population of about 260 persons lie within the drainage area, and about 90 residences with a population of about 240 persons lie outside of the drainage area.*

[d]*Intermediate growth-centralized land use future scenario under the regional land use planning program.*

[e]*High growth-centralized land use future scenario under the regional land use planning program.*

Source: SEWRPC.

LAND USE

The pattern of land use in the drainage area to Powers Lake, that is, the intensity and spatial distribution of the various land uses, is an important determinant of lake water quality. The existing land use pattern can perhaps best be understood within the context of its historical development. The movement of European settlers into the Southeastern Wisconsin Region began in about 1830. Completion of the U. S. Public Land Survey in southeastern Wisconsin in 1836 and the subsequent sale of the public lands brought a rapid influx of settlers into the area. Map 5 in Chapter II shows the original plat of the U. S. Public Land Survey for the Powers Lake area.

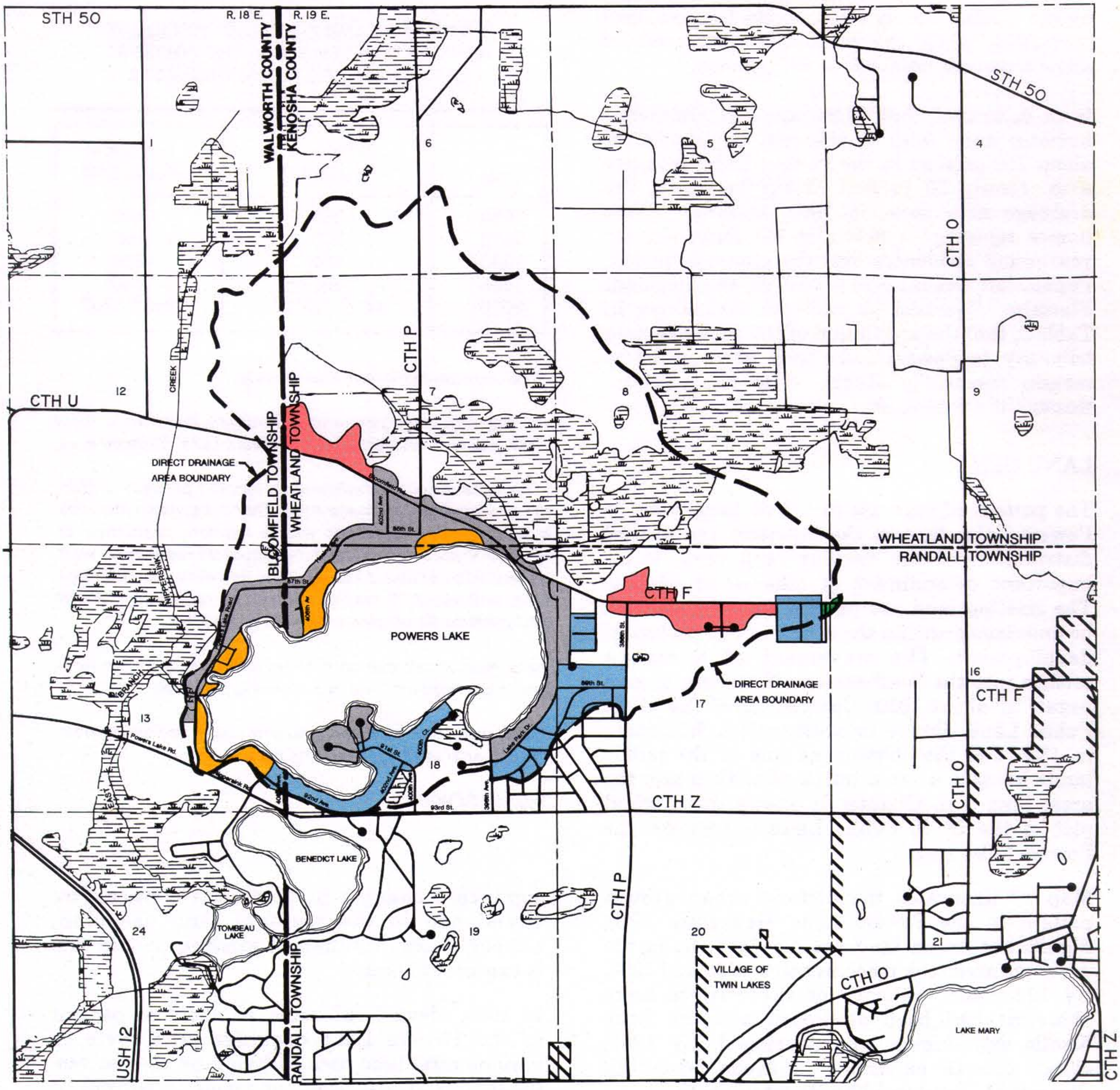
Map 12 illustrates the historic urban growth pattern in the Powers Lake area since 1920. Significant urban land use development in the drainage area took place between 1920 and 1950. By 1963, the majority of the Powers Lake shoreline had been developed and the Lake Knolls subdivision was developed. By 1980, urban growth expanded in areas bordering Bloomfield Drive and 87th Street (CTH F).

Probable future, as well as existing, land use is an important consideration in any sound lake management planning program. Land use data are accordingly presented for the drainage area to Powers Lake. The existing land use pattern in the area is shown on Map 13 and is quantified in Table 6. Under year 2010 conditions, no significant changes in land use conditions are envisioned in the regional land use plan, although some infilling of existing platted lots is expected to occur.

In 1985, about 1,767 acres, or about 81 percent of the Powers Lake drainage area, were in various rural land uses. Urban land uses encompassed about 410 acres, or about 19 percent of the drainage area, with residential being the dominant urban land use. The 459 acres of surface water of Powers Lake account for 21 percent of the drainage area. Woodlands and wetlands are important land uses comprising about 424 acres, or about 19 percent of the drainage area. Transportation and utility land uses comprise about 84 acres of land, or about

Map 12

HISTORIC URBAN GROWTH IN THE POWERS LAKE DRAINAGE AREA: 1920-1980



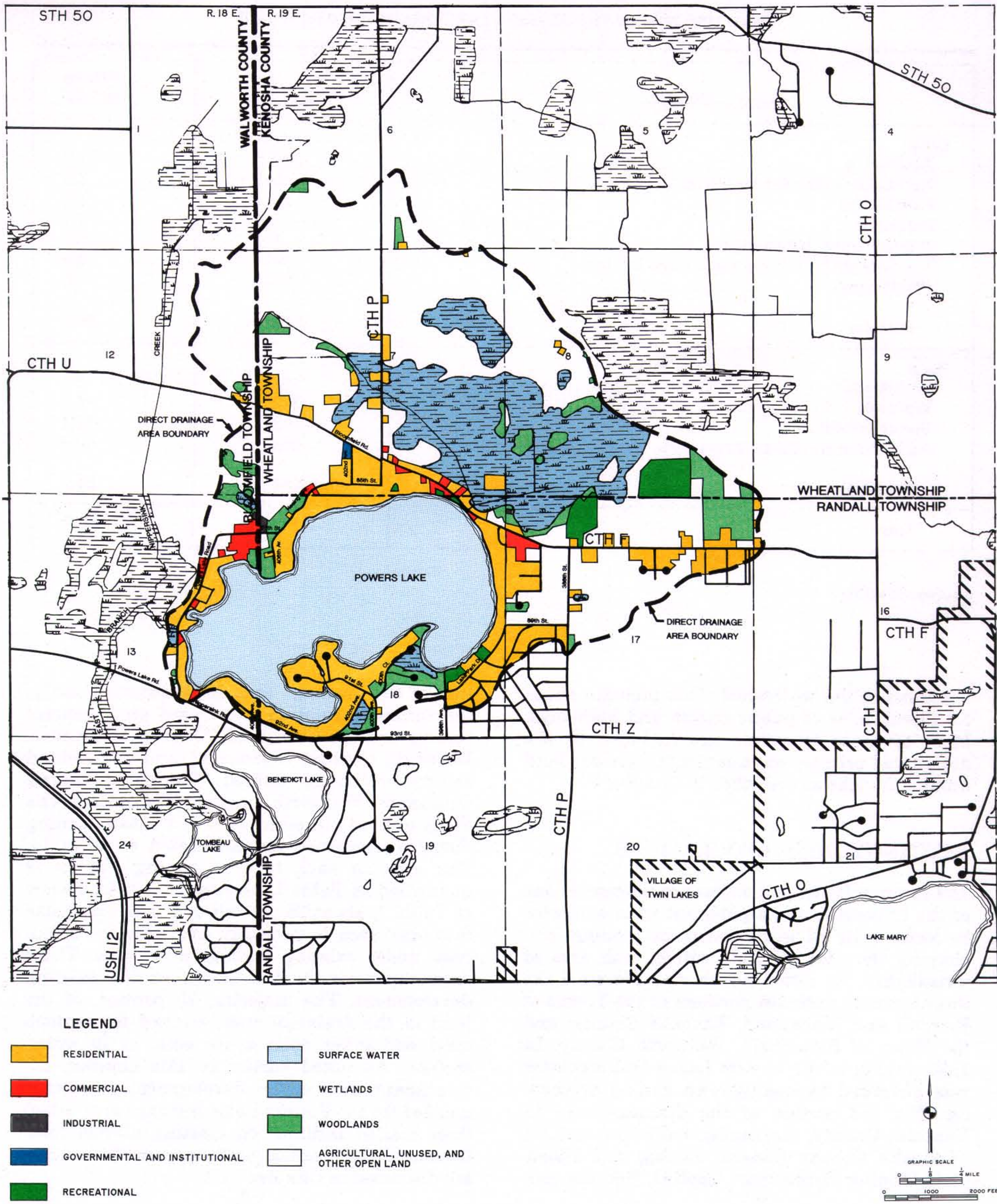
LEGEND

- 1920
- 1950
- 1963
- 1970
- 1980

Source: SEWRPC.

Map 13

GENERALIZED LAND USE IN THE POWERS LAKE DRAINAGE AREA: 1985



Source: SEWRPC.

Table 6

LAND USE WITHIN THE POWERS LAKE DRAINAGE AREA: 1985

Land Use Category	Acres	Percent of Total
Urban		
Residential	250	11.5
Residential Under Development	18	0.8
Commercial	22	1.0
Industrial	1	<0.1
Government and Institutional	1	<0.1
Transportation, Communication, and Utilities	84	3.9
Recreational	34	1.6
Subtotal	410	18.8
Rural		
Woodlands	112	5.2
Wetlands	312	14.3
Surface Water	459	21.1
Agricultural and Other Open Lands	884	40.6
Subtotal	1,767	81.2
Total	2,177	100.0

Source: SEWRPC.

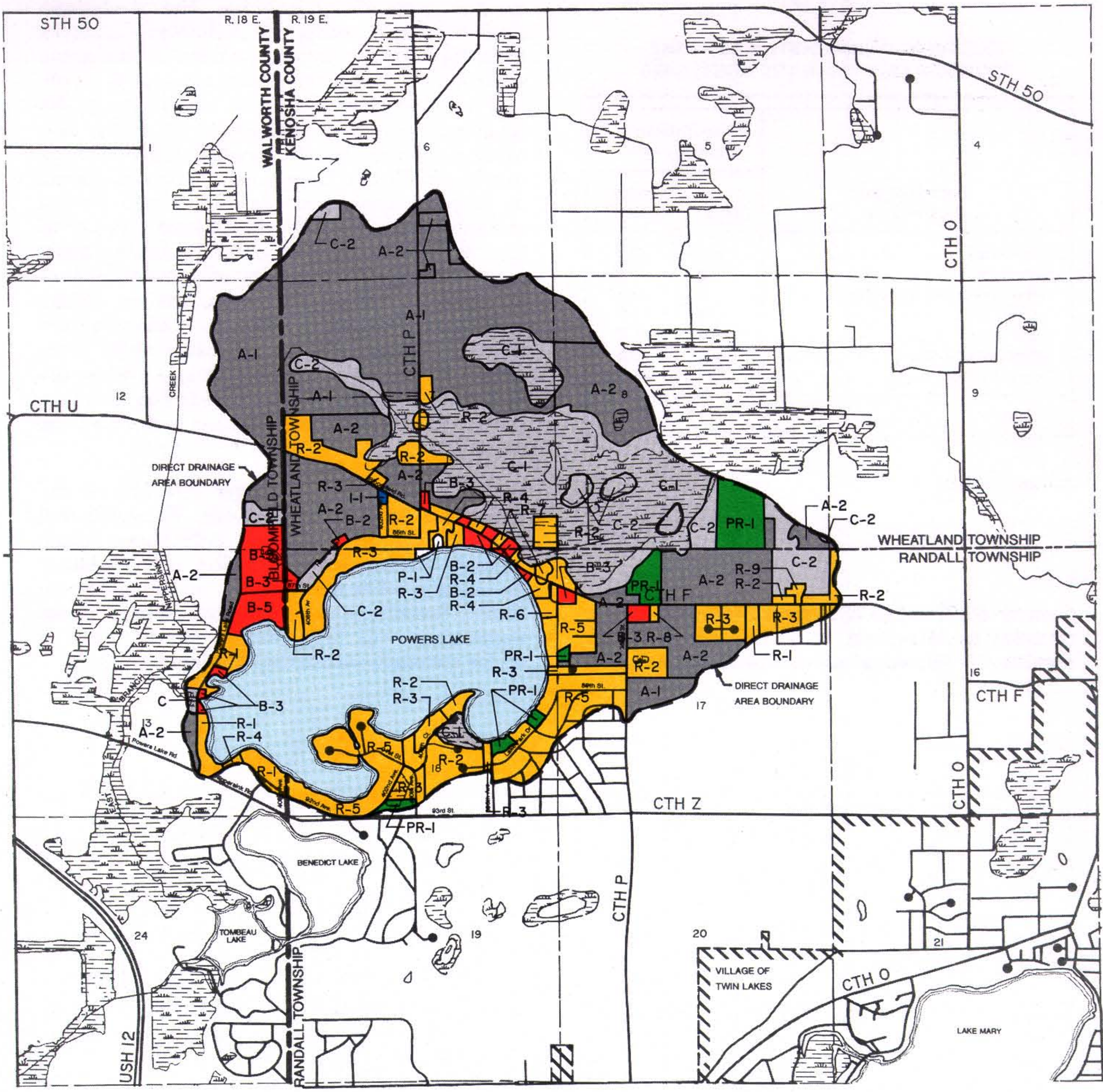
4 percent of the watershed. This includes about 5.5 lineal miles of public streets and highways. Most of these resources are included in the designated primary environmental corridor land around the lake as described in Chapter V.

EXISTING ZONING REGULATIONS

The community zoning ordinance represents one of the important and significant tools available to local units of government in guiding and shaping the uses of lands within their area of jurisdiction. As noted above, the Powers Lake drainage area includes portions of the Towns of Randall and Wheatland, Kenosha County; and the Town of Bloomfield, Walworth County. In 1990, zoning in the Powers Lakes drainage area was governed by county-town zoning ordinances. For the portion of the drainage area in Kenosha County, the zoning ordinance entitled "Kenosha County General Zoning and Floodplain/Zoning Ordinance" applied. For the portion of the drainage area in Walworth County, the zoning regulation was based on a general zoning ordinance entitled "Zoning Ordinance, Walworth County, Wisconsin," and a shoreland zoning ordinance entitled "Shoreland Zoning Ordinance, Walworth County, Wisconsin." The areas of land placed in each of the local zoning districts concerned are delineated on Map 14. The area in each type of zoning district is quantified in Table 7. As can be seen by review of Table 7, about 25 percent of the Powers Lake drainage area is currently available for urban uses under existing zoning ordinances. These areas approximate the extent of the existing development. The majority, 75 percent, of the land in the drainage area is zoned for agricultural and other open space uses, or is water surface. As noted earlier in this chapter, no significant new urban development is recommended for the Powers Lake drainage area other than limited infilling on existing platted lots. Recommended zoning ordinance modifications are discussed in Chapter VIII.

Map 14

EXISTING ZONING DISTRICTS IN THE POWERS LAKE DRAINAGE AREA



LEGEND

- RESIDENTIAL
- COMMERCIAL
- GOVERNMENTAL AND INSTITUTIONAL
- RECREATIONAL
- AGRICULTURAL
- OTHER RURAL LAND

TOWN OF WHEATLAND

- A-1 AGRICULTURAL PRESERVATION DISTRICT
- A-2 GENERAL AGRICULTURAL DISTRICT
- R-2 SUBURBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-3 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-4 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- B-2 COMMUNITY BUSINESS DISTRICT
- B-3 HIGHWAY BUSINESS DISTRICT
- I-1 INSTITUTIONAL DISTRICT
- PR-1 PARK-RECREATIONAL DISTRICT
- C-1 LOWLAND RESOURCE CONSERVANCY DISTRICT
- C-2 UPLAND RESOURCE CONSERVANCY DISTRICT

TOWN OF RANDALL

- A-1 AGRICULTURAL PRESERVATION DISTRICT
- A-2 GENERAL AGRICULTURAL DISTRICT
- R-1 RURAL RESIDENTIAL DISTRICT
- R-2 SUBURBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-3 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-4 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-5 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-6 URBAN SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-7 SUBURBAN 2 AND 3 FAMILY RESIDENTIAL DISTRICT
- R-8 URBAN TWO-FAMILY RESIDENTIAL DISTRICT
- R-9 MULTIPLE-FAMILY RESIDENTIAL DISTRICT
- B-2 COMMUNITY BUSINESS DISTRICT
- B-3 HIGHWAY BUSINESS DISTRICT
- PR-1 PARK-RECREATIONAL DISTRICT
- C-1 LOWLAND RESOURCE CONSERVANCY DISTRICT
- C-2 UPLAND RESOURCE CONSERVANCY DISTRICT

TOWN OF BLOOMFIELD

- A-1 PRIME AGRICULTURAL LAND DISTRICT
- R-1 SINGLE-FAMILY RESIDENTIAL DISTRICT
- R-4 MULTIPLE-FAMILY RESIDENTIAL DISTRICT
- B-3 WATERFRONT BUSINESS DISTRICT
- B-5 PLANNED COMMERCIAL-RECREATION BUSINESS DISTRICT
- C CONSERVATION DISTRICT
- C-2 UPLAND RESOURCE CONSERVATION DISTRICT

GRAPHIC SCALE

Source: SEWRPC.

Table 7

EXISTING ZONING DISTRICTS IN THE POWERS LAKE DRAINAGE AREA: 1990

Current Zoning District Type	Total Tributary Drainage Area	
	Acreage	Percent of Total
Residential	446	20.5
Commercial	65	3.0
Government and Institutional	2	0.1
Recreational	39	1.8
Agricultural	785	36.0
Other Rural Lands	381	17.5
Surface Water	459	21.1
Total	2,177	100.0

Source: SEWRPC.

Section 59.971 of the Wisconsin Statutes requires counties in Wisconsin to enact ordinances to regulate all shoreland areas within the unincorporated areas of the counties. The regulations apply to lands within the following distances from the ordinary high-water mark of navigable waters: 1,000 feet from a lake, pond, or flowage, and 300 feet from a river or stream, or to the landward side of a floodplain, whichever distance is greater. The designated shoreland area within the Powers Lake drainage area is shown on Map 14. The standards and criteria for the ordinances are set forth in Chapter NR 115 of the Wisconsin Administrative Code. They include sanitary regulations, and restrictions on lot sizes, on building setbacks, and on filling, grading, and dredging. Moreover, under Chapter NR 115, all counties in the State must place wetlands five acres or more in size within the statutory shoreland zoning jurisdiction area in a shoreland-wetland zoning district to ensure their preservation.

In accordance with Chapter NR 115 of the Wisconsin Administrative Code, Walworth and Kenosha Counties adopted ordinances which regulate the use of wetlands five acres or larger and certain other wetlands within the aforementioned jurisdictional shoreland areas. These regulations will help prevent further loss of major wetlands within the shoreland areas.

Chapter IV

WATER QUALITY

HISTORICAL BACKGROUND

Some water quality information was recorded for Powers Lake in 1966 and 1977 by the Wisconsin Department of Natural Resources.[1] These data indicated that Powers Lake had good water quality and that there was little evidence of pollution or excessive fertilization. Residents of Powers Lake have expressed concerns about future water quality, and in 1985 the Powers Lake District Board of Commissioners decided a water quality study was necessary to provide background information to manage the lake. A long-range comprehensive water quality monitoring program was developed which was designed to provide data for the development of a comprehensive lake management plan.

In 1986, an initial study of Powers Lake was conducted by the U. S. Geological Survey, in cooperation with the Powers Lake Management District. This initial study consisted of sampling the lake in March, April, June, July, and August of 1986 for depth profiles of dissolved oxygen, water temperature, pH, and specific conductance. During the period of open water, water transparency, phosphorus, and chlorophyll-a concentrations were also determined.

A more intensive monitoring program of Powers Lake was conducted from October 16, 1986 through October 15, 1987, by the U. S. Geological Survey. This study involved the determination of the physical and chemical characteristics of the lake water quality described above, the identification of the summer phytoplankton and zooplankton present, and the determination of the phosphorus discharges to the lake from surface and ground water. In-lake water quality monitoring was continued from February of 1988 through 1990.

[1]*Southeastern Wisconsin Regional Planning Commission and Wisconsin Department of Natural Resources, Powers Lake, Kenosha County, Wisconsin, Lake Use Report No. FX-13. 1969.*

EXISTING WATER QUALITY CONDITIONS

Water quality conditions may be assessed by examining the physical and chemical characteristics of the water, such as water temperature, dissolved oxygen, specific conductance, alkalinity, pH, water clarity, chlorophyll-a, and nutrients. These characteristics were measured by the U. S. Geological Survey. Sampling site locations are shown on Map 10 in Chapter II. The findings are summarized in Tables 8 and 9 and are discussed below. More detailed information on these water quality data, including locations and procedures, can be found in reports published by the U. S. Geological Survey.[2]

Thermal Stratification

Water temperatures in Powers Lake vary with water depth and season. Water temperatures ranged from about 34 to 83 degrees Fahrenheit during the study period, as shown in Table 8. Water is unique in that it reaches its maximum density at about 39 degrees Fahrenheit and it is lighter at both warmer and colder temperatures. Density variances at different temperatures within a lake can be sufficient to prevent mixing of warm and cold water. This effect, known as thermal stratification, shown in Figure 5, occurs during the summer and winter months in Powers Lake, and has a significant impact on both chemical and biological conditions in Powers Lake.

As summer approaches, the surface waters of Powers Lake warm rapidly, expand and become lighter than the lower water. A barrier begins to form between the lighter, warmer surface water and the heavier, colder, bottom water. Summer stratification is then evident as depicted under "Summer Stratification" in Figure 5. The barrier is marked by a zone of rapid drop in temperature with depth, known as the thermocline.

[2]*U. S. Geological Survey, Hydrology and Water Quality of Powers Lake, Southeastern Wisconsin, Water Resources Investigation Draft Report, 1990.*

Table 8

SEASONAL WATER QUALITY CONDITIONS IN POWERS LAKE: 1986-1989

Parameter[a]	Fall (mid-September to mid-December) Shallow[c]	Fall Deep[d]	Winter (mid-December to mid-March) Shallow[c]	Winter Deep[d]	Spring (mid-March to mid-June) Shallow[c]	Spring Deep[d]	Summer (mid-June to mid-September) Shallow[c]	Summer Deep[d]
Temperature (°F)								
Range	52.7-66.2	51.8-64.4	33.6-41.0	37.4-41.5	42.8-69.8	42.8-57.2	70.7-83.3	56.3-68.0
Mean[b]	59.5(2)	58.1(2)	36.1(5)	39.7(5)	54.3(6)	49.7(6)	76.8(11)	62.2(11)
Dissolved Oxygen								
Range	6.8-9.1	5.3-7.6	12.9-18.2	3.3-7.7	9.4-12.0	0.5-11.9	7.7-9.3	0.0-1.7
Mean[b]	7.95(2)	6.45(2)	15.14(5)	4.88(5)	10.65(6)	7.66(6)	8.45(11)	0.22(11)
Conductivity (μS/cm)								
Range	390-451	390-456	382-478	475-558	454-476	450-491	421-454	441-524
Mean[b]	420.5(2)	423.0(2)	425.4(5)	505.0(5)	463.7(6)	469.3(6)	437.6(11)	481.4(11)
pH (standard units)								
Range	8.2-8.4	8.2-8.3	7.2-8.7	7.7-8.2	8.0-8.8	7.6-8.7	8.3-8.7	7.2-7.9
Mean[b]	8.30(2)	8.25(2)	8.20(5)	7.90(5)	8.40(6)	8.20(6)	8.52(11)	7.49(11)
Secchi Disk (feet)								
Range	7.9-8.5	- -	10.5	- -	8.9-19.7	- -	6.6-11.5	- -
Mean[b]	8.2(2)	- -	10.5(1)	- -	15.7(6)	- -	8.7(11)	- -
Chlorophyll-a (μg/l)								
Range	6.0	- -	13.0	- -	1.0-5.0	- -	2.0-6.0	- -
Mean[b]	6.0(1)	- -	13.0(1)	- -	2.80(5)	- -	3.59(11)	- -
Total Phosphorus								
Range	0.015-0.018	0.015-0.025	<0.005-0.007	<0.005-0.013	0.007-0.029	0.008-0.020	0.005-0.052	0.010-0.052
Mean[b]	0.0165(2)	0.0200(2)	0.0048(2)	0.0078(2)	0.0138(6)	0.0118(6)	0.0134(11)	0.0246(11)
Orthophosphorus								
Range	<0.001-<0.004	<0.004-0.014	<0.001	<0.001-0.002	0.003-0.010	0.001-0.004	0.003-0.006	0.002-0.008
Mean[b]	0.002(2)	0.009(2)	<0.001(2)	0.001(2)	0.004(5)	0.003(6)	0.003(3)	0.003(11)

[a]*Milligrams per liter unless othewise indicated.*

[b]*Number of samples in parentheses.*

[c]*Depth of sample approximately 1.5 feet.*

[d]*Depth of sample greater than 30 feet.*

Source U. S. Geological Survey and SEWRPC.

The zone of transition between warm and cold water, on either side of the thermocline, is known as the metalimnion. It separates the warmer, lighter surface water, known as the epilimnion, from the colder, heavier bottom layer of water, known as the hypolimnion. The barrier is easily crossed by fish, but essentially prohibits the exchange of water between the epilimnion and the hypolimnion. The development of the thermocline begins in early summer and reaches its maximum in late summer. This stratification period lasts until autumn, when air temperatures cool the surface water and wind action results in the disappearance of the thermocline. As the surface water cools, it becomes more dense, sinking and mixing under wind action to erode the thermocline until the entire volume of the lake water is of uniform temperature. This phenomenon, which follows summer stratification, is illustrated in Figure 5 as "Fall Turnover."

As the water temperature cools to below 39 degrees Fahrenheit, it becomes less dense and floats on the denser warmer water. Eventually the water near the surface cools to 32 degrees Fahrenheit, at which temperature ice begins to form and cover the surface of the lake, sealing it off from the atmosphere for about four months. Figure 5 depicts "Winter Stratification," which occurs as the colder, lighter water and ice remain close to the surface, again separated from the warmer, heavier water near the bottom of the lake.

The arrival of spring brings warmer weather and the reversal of the stratification process which is known as "Spring Turnover," shown in Figure 5. As the surface waters warm, they become more dense and begin to approach the temperature of the warmer, lower water until the entire volume of water reaches the same tem-

Table 9

POWERS LAKE WATER QUALITY DATA: APRIL 1986-1990

Parameter[a]	April 17, 1986		April 6, 1987		April 13, 1988		April 10, 1989		April 4, 1990	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	31.5	1.5	32.5	1.5	32.5	1.5	32.0	- -	- -
Water Temperature (°F)	48.7	48.0	42.8	42.8	50.9	50.0	43.7	43.7	- -	- -
Dissolved Oxygen	10.5	10.7	11.7	11.7	10.7	9.9	12.0	11.9	- -	- -
Specific Conductance (µS/cm)	476	450	454	463	464	463	463	462	- -	- -
Dissolved Solids	255	250	260	259	258	258	256	254	- -	- -
Alkalinity, as CaCO3	179	152	187	187	174	174	177	176	- -	- -
Hardness, as CaCO3	220	220	- -	- -	200	200	220	220	- -	- -
pH (standard units)	8.4	8.5	8.8	8.7	8.3	8.5	8.0	8.2	- -	- -
Secchi Disk (feet)[b]	16.4		19.7		14.5		17.1		19.0	
Color (Pt-Co. scale)	5	5	4	1	10	5	10	10	- -	- -
Turbidity (NTU)	2.1	10.0	0.9	0.6	0.8	0.7	<0.5	<0.5	- -	- -
Chlorophyll-a (µg/l)	5	- -	<5	- -	<5	- -	E1.0	- -	2	- -
Nitrate Nitrogen	<0.01	<0.01	0.1	0.1	- -	- -	- -	- -	- -	- -
Nitrite Nitrogen	0.995	0.045	<0.01	<0.01	- -	- -	- -	- -	- -	- -
Nitrate/Nitrite	- -	- -	- -	- -	0.05	0.03	0.04	0.04	- -	- -
Ammonia Nitrogen	0.020	0.020	0.03	0.02	<0.02	0.02	<0.02	<0.02	- -	- -
Organic Nitrogen	0.38	0.58	0.47	0.48	0.40	0.40	0.40	0.40	- -	- -
Total Nitrogen	- -	- -	0.6	0.6	- -	- -	- -	- -	- -	- -
Total Phosphorus	0.007	0.011	0.029	0.010	0.008	0.012	<0.02	<0.02	0.009	- -
Orthophosphorus	0.003	0.004	0.010	0.001	0.004	0.004	0.003	0.003	- -	- -
Calcium (Ca)	37	37	41	41	35	35	34	33	- -	- -
Magnesium (Mg)	30	30	30	30	28	28	33	33	- -	- -
Sodium (Na)	10	10	11	11	11	11	14	14	- -	- -
Potassium (K)	2.3	2.3	2.5	2.5	2.7	2.6	2.5	2.6	- -	- -
Sulfate (SO4)	27	32	30	30	30	31	33	33	- -	- -
Chloride (Cl)	22	22	21	22	24	24	28	28	- -	- -
Fluoride (F)	- -	- -	0.1	0.1	0.1	0.1	0.1	0.1	- -	- -
Silica (SiO2)	9.5	9.4	9.1	9.1	5.7	5.9	5.4	5.4	- -	- -
Iron (µg/l)	10	6	13	5	<100	<100	<50	<50	- -	- -
Manganese (µg/l)	<1	<1	2	3	<40	<40	<40	<40	- -	- -

NOTE: E = estimated.

[a]*Milligrams per liter unless otherwise indicated.*

[b]*Depth at which the Secchi disk can no longer be seen.*

Source: U. S. Geological Survey and SEWRPC.

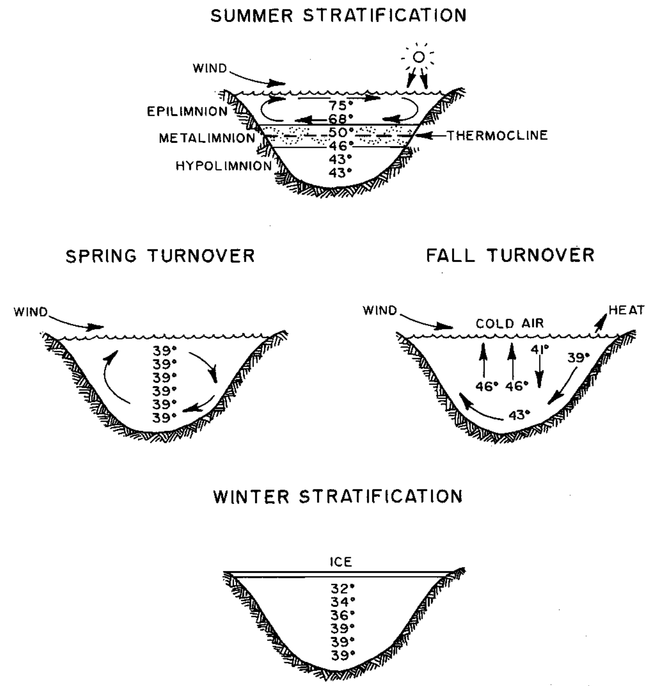
perature. Wind action serves to mix the lake water throughout until it is uniformly at 39 degrees Fahrenheit. Beyond this point, the surface water continues to warm, becomes lighter, and floats on top of the colder water. This begins the formation of the thermocline and another summer of thermal stratification. As already noted, this phenomenon of thermal stratification is an important factor in water quality conditions within Powers Lake, as is discussed further in the following sections.

Dissolved Oxygen

Dissolved oxygen levels are one of the most critical factors affecting water quality conditions in Powers Lake. As shown in Table 8, concentrations of dissolved oxygen are generally higher at the surface of Powers Lake where there is an interchange between the water and the atmosphere and some stirring by wind; aquatic macrophytes and algae also release oxygen into the lake as they photosynthesize. Dissolved oxygen concentrations are lowest on the bottom of the lake, where decomposer organisms utilize oxygen in the decay process. When the lake is thermally stratified, the unmixed hypolimnion, the lower, colder layer of water, may become depleted of dissolved oxygen, a condition known as anoxia.

Figure 5

THERMAL STRATIFICATION OF LAKES



Source: University of Wisconsin-Extension.

The hypolimnion of Powers Lake becomes anoxic during summer stratification. During the 1986 to 1989 study period the anoxic zone reached a maximum during July, when dissolved oxygen levels were at or near zero at water depths greater than 24 feet. This zone of anoxic conditions covered about 27 percent of the lake bottom. The depleted oxygen level in the hypolimnion causes many fish species to move upward nearer to the surface of the lake, where higher dissolved oxygen concentrations exist. Fall turnover restores the supply of oxygen to the bottom waters.

Hypolimnetic anoxia is common in many of the lakes in southeastern Wisconsin during summer stratification. In some lakes in the Region, anoxia also occurs during winter stratification; thick ice and deep snow cover may prevent adequate aeration of the epilimnion. This condition may result in fish winterkill if the lake's supply of dissolved oxygen is not sufficient to meet the total winter demand. However, in Powers Lake, oxygen was present throughout the entire water column during winter stratification of 1986 through 1989 and winterkill was not a problem.

Specific Conductance

Specific conductance is an indicator of the concentration of dissolved solids in the water; as the amount of dissolved solids increases, the specific conductance increases. During winter and summer thermal stratification, specific conductance increases at the lake bottom due to an accumulation of dissolved materials in the hypolimnion. As shown in Table 9 the specific conductance of Powers Lake during spring turnover of 1986 to 1989 ranged from 450 to 476 μS/cm (microsiemens per centimeter at 25 degrees Centigrade). These values are within the normal range for lakes in southeastern Wisconsin.

Alkalinity and Hardness

Alkalinity is an index of the buffering capacity of the lake, or the capacity to absorb and neutralize acidic loadings. The alkalinity of a lake depends on the level of bicarbonate, carbonate, and hydroxide ions present in the water. Lakes in southeastern Wisconsin typically have a high alkalinity due to the types of soil coverings and the bedrock underlying the watersheds. Water hardness is a measure of the polyvalent metallic ions, such as calcium and magnesium. Hardness is usually reported as an equivalent concentration of calcium carbonate ($CaCO_3$). Powers Lake is a hardwater alkaline lake. During spring turnover of 1986 to 1989, alkalinity ranged from 152 to 187 milligrams per liter (mg/l), while hardness ranged from 200 to 220 mg/l, as listed in Table 9. These values are within the normal range of lakes in southeastern Wisconsin.[3]

Hydrogen Ion Concentration (pH)

The pH is a measure of the hydrogen ion concentration on a scale from 0 to 14 standard units, where 7 indicates neutrality. A pH above

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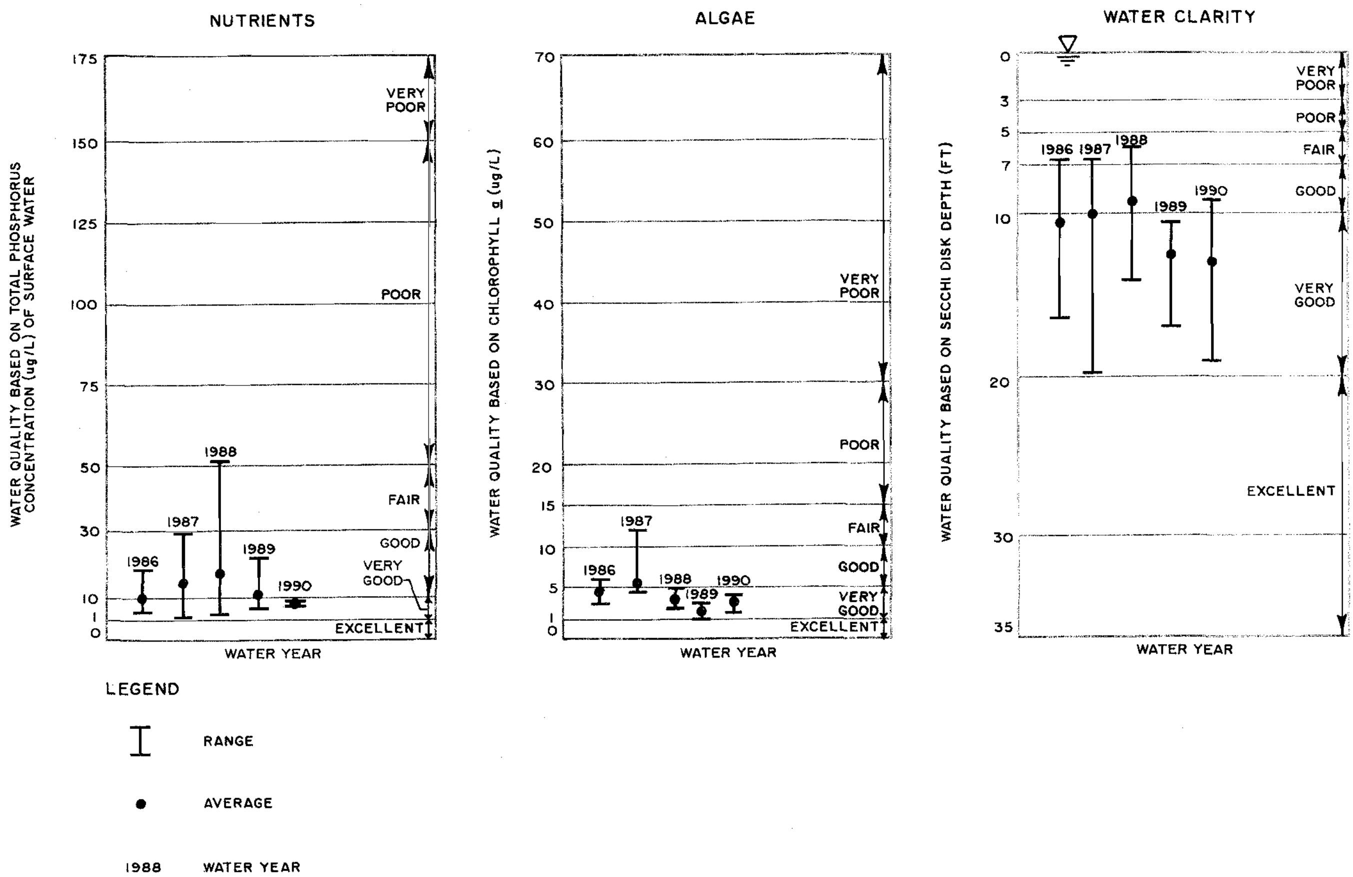
[3] *R. A. Lillie and J. W. Mason, Limnological Characteristics of Wisconsin Lakes, Technical Bulletin No. 138, Wisconsin Department of Natural Resources, Madison, Wisconsin, 1983.*

Figure 6

POWERS LAKE PRIMARY WATER QUALITY INDICATORS: 1986-1990



Source: U. S. Geological Survey and SEWRPC.

7 indicates basic water, and a pH below 7 indicates acidic water. In Powers Lake, the pH was found to range between 7.2 and 8.8 standard units, as shown in Table 8. Since Powers Lake has a high alkalinity, or buffering capacity, the pH does not fluctuate below 7, and the Lake is not susceptible to the harmful effects of acid rain.

Water Clarity

Water clarity, or transparency, gives an indication of the overall water quality; clarity may decrease due to high concentrations of suspended materials such as algae and zooplankton, water color, and turbidity. Water clarity is measured with a Secchi disk, a black and white, eight-inch-diameter disk which is lowered into the water until a depth is reached at which the disk is no longer visible. This depth is known as the Secchi disk reading.

Water clarity is generally variable throughout the year as algal populations increase and decrease. Secchi disk readings may fluctuate daily and annually because of changes in weather and nutrient loadings. Secchi disk readings for Powers Lake ranged from 6.6 feet in August of 1986 and July of 1987 to 19.7 feet in April of 1987. The average Secchi disk reading for the 1986 through 1989 study period was 10.9 feet. As shown in Figure 6, these values indicate good to very good water quality compared to other lakes in southeastern Wisconsin.[4]

Chlorophyll-a

Chlorophyll-a is the major photosynthetic pigment in algae. The amount of chlorophyll-a

[4] *Ibid.*

present in a water sample is an indicator of the biomass of live algae in the water. Chlorophyll-a concentrations are usually lowest in winter and reach a peak in the summer as algal populations reach a maximum. Winter chlorophyll-a levels were measured only once during the study period; a maximum chlorophyll-a concentration of 13 micrograms per liter (μg/l) was recorded in January of 1987. This value indicates an algal bloom under ice cover.

Open water chlorophyll-a concentrations in Powers Lake ranged from a low of 1.0 μg/l in April 1989 to a high of 6.0 μg/l in August 1986, October 1986, and August 1987. These values are within the range of other lakes in the Region[5] and indicate good water quality, as illustrated in Figure 6.

Nutrient Characteristics

Aquatic plants and algae require nutrients such as phosphorus, nitrogen, carbon, calcium, chloride, iron, magnesium, sulfur and silica for growth. In hardwater alkaline lakes, most of the nutrients are generally found in concentrations which exceed the need of growing plants. However, in lakes where the supply of one or more of these nutrients is limiting, plant growth is limited. Two of the most important nutrients, in this respect, are phosphorus and nitrogen.

The ratio of total nitrogen to total phosphorus in lake water can indicate which nutrient is likely limiting plant growth. Where the nitrogen to phosphorus ratio is greater than 15:1, the lake is generally phosphorus limited, while a ratio of less than 10:1 indicates that nitrogen is the limiting nutrient.[6] In Powers Lake, the nitrogen to phosphorus ratios in samples collected following spring turnover for April 1986 through 1989, were greater than 15:1. This indicates that phosphorus is the limiting factor for plant production at spring turnover.

Both total phosphorus and soluble phosphorus concentrations were measured for Powers Lake. Soluble phosphorus, being dissolved in water, is readily available for plant growth. However, its concentration varies widely over short periods of time, as plants take up and release this nutrient. Therefore total phosphorus is a better indicator of nutrient status. Total phosphorus includes the phosphorus contained in plant and animal fragments suspended in the lake water.

The Southeastern Wisconsin Regional Planning Commission recommends that total phosphorus concentrations in lakes not exceed 0.020 mg/l during spring turnover. This is the level considered necessary to prevent nuisance algae and macrophyte growth. During spring turnover of the study years, the total phosphorus concentrations in Powers Lake ranged from 0.007 to 0.029 mg/l. Total phosphorus in the surface water of Powers Lake averaged 0.012 mg/l throughout the 1986 to 1989 study period, indicating good water quality, as shown in Figure 6.

When organisms die, they sink to the bottom of the lake, where they are decomposed. Phosphorus from these organisms is stored in the bottom sediments. Phosphorus is not highly soluble in water and readily forms insoluble precipitates with calcium, iron, and aluminum. However, when lakes become depleted of oxygen during stratification, the phosphorus becomes soluble and is readily released from the sediments. As the water begins to mix again, during spring and fall turnover, this phosphorus is mixed throughout the lake and is available for algal growth. However, the 1986 through 1989 data indicate that there is little, if any, internal release of dissolved phosphorus from the bottom sediments of Powers Lake. Dissolved orthophosphorus concentrations in the bottom waters ranged from 0.002 to 0.008 mg/l for samples collected during summer anoxic periods, as shown in Table 8.

POLLUTION SOURCES AND LOADINGS

Currently there are no known point source discharges of pollutants to Powers Lake or to the surface waters tributary to Powers Lake. Nonpoint sources of water pollution include urban sources, such as runoff from residential, commercial, industrial, transportation, and recreational land uses; construction activities; failing septic tank systems; rural sources, such as runoff from cropland, pasture, woodland, from livestock wastes; and also from general atmospheric conditions.

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[5] *Ibid.*

[6] *M. O. Alum, R. E. Gessner, and J. H. Gokstatter, An Evaluation of the National Eutrophication Data, U. S. Environmental Protection Agency Working Paper No. 900, 1977.*

Sediment Yields

Agricultural croplands within the drainage area to Powers Lake were surveyed in 1990 by the Kenosha County Land Conservation staff. For each of the 54 agricultural fields the soil types, the slope conditions, the crop type, the farm practices used, and the drainage system were identified. The universal soil loss equation was used to estimate the average soil loss from sheet and rill erosion from each field.

Sheet erosion is characterized by the removal of a relatively uniform, thin layer of soil from the land surface, resulting from runoff in the form of shallow sheets of water flowing over the ground. Such shallow surface flow typically does not move more than a few feet before collecting in surface depressions. Rill erosion occurs when sheet runoff begins to concentrate in surface depressions and, gaining in velocity, cuts small but well defined channels, called "rills."

A detailed description of the universal soil loss equation can be found in Agricultural Handbook Number 537 issued by the U. S. Department of Agriculture.[7] It should be recognized that the soil "loss" estimated by the equation refers to soil dislodged and moved from place to place. The equation does not indicate the distance moved, nor does it indicate whether the movement is to a waterway, a neighboring farm field, or a difference location on the field of origin. Soil which is dislodged and moved from place to place could potentially be transported to Powers Lake. The estimated sediment yield was used to assess the relative pollution potential of each field.

Soil loss rates from surveyed fields, using the universal soil loss equation, averaged about 10.8 tons per acre per year. The rate of sediment loss depends in part on the type of cropping and management practices in a watershed. In general, dairy fields have a lower soil erosion rate than cash crop fields. The estimated sediment yields from the Powers Lake area, as shown on Map 15 and Table 10, were generally higher than the Kenosha County average of 4.5 tons per acre per year.[8] Some 29 fields, covering 59 percent of the lands surveyed, had sediment yields of five to 15 tons per acre per year; 19 fields, covering 24 percent of the lands surveyed, had sediment yields of 15 to 25 tons per acre per year; and four fields, covering 5 percent of the lands surveyed, had sediment yields exceeding 25 tons per acre per year.

Unit-Area Loadings

To estimate loadings of sediment, phosphorus, and lead from both urban and rural nonpoint sources, unit area loading rates were applied to 1985 land use conditions. The unit area loading rates used are presented in Table 11, and were derived for use in the Powers Lake drainage area from the Wisconsin Department of Natural Resources' Source Loading and Management Model (SLAMM) results and from literature sources. The unit area loading analysis was conducted to help quantify the relative contribution of nonpoint source pollutant loadings to surface waters in the watershed to Powers Lake. The relative contributions of sediment, phosphorus, and lead to surface waters in the Powers Lake watershed under 1985 land use conditions are shown in Table 12 and Figure 7. Maps 16 and 17 show the percentage of pollutant loadings contributed by specific land uses.

Agricultural land was the largest source of sediment and phosphorus to surface waters in the Powers Lake watershed, contributing about 43 percent and 65 percent of the respective loads. Residential land, particularly residential land under development, was also a significant source of sediment and phosphorus, contributing about 41 percent of the sediment load and about 22 percent of the phosphorus load to surface waters. The lowest sediment and phosphorus loads were generated from wetlands and woodlands. Although these areas account for nearly 20 percent of the land in the drainage area, they contributed less than 2 percent of the loads.

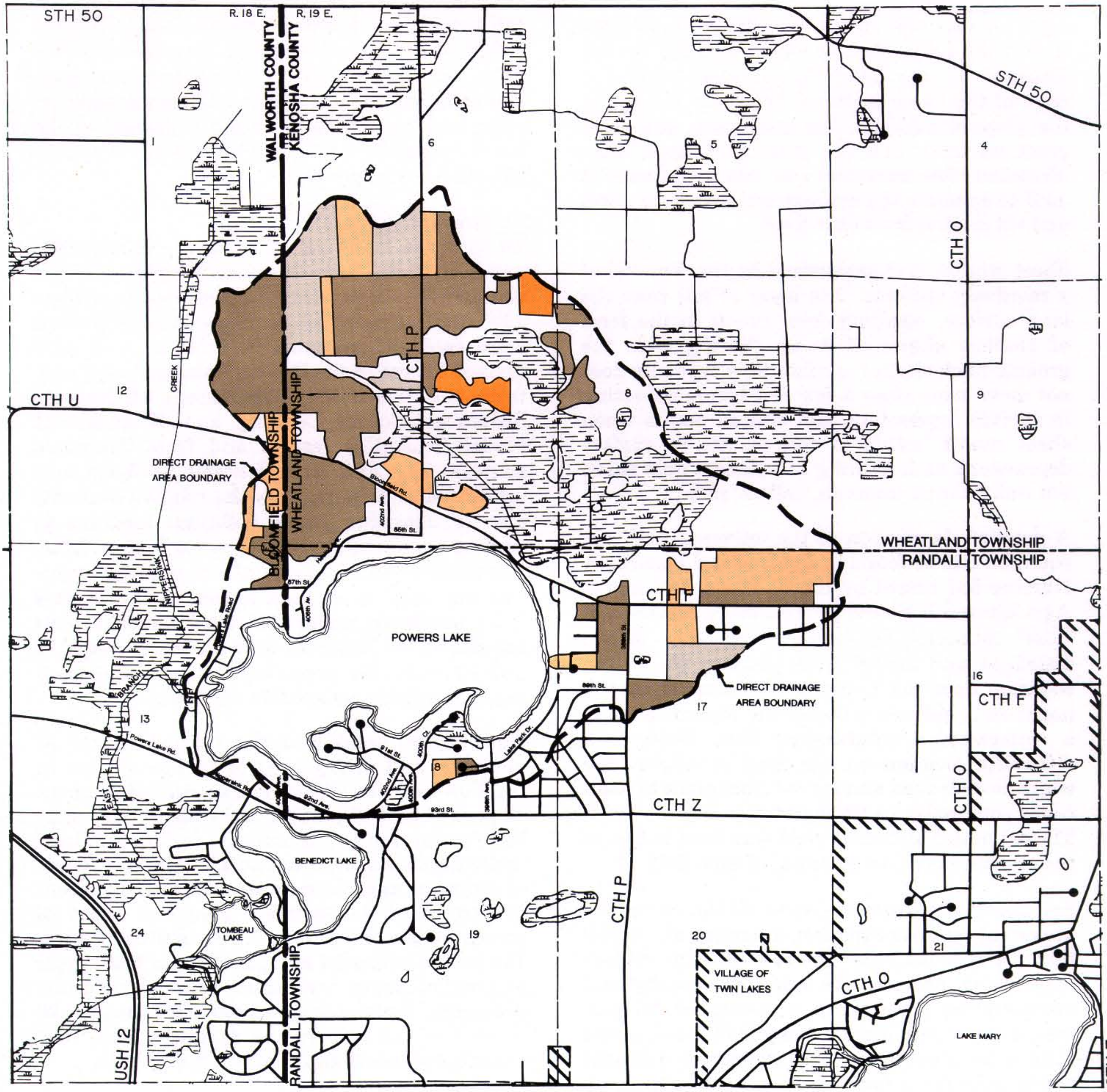
Lead was used in this analysis as an indicator of metals and other pollutants that are contributed primarily by urban sources. The largest

[7]*U. S. Department of Agriculture, Agricultural Handbook Number 537, Predicting Rainfall Erosion Losses, A Guide to Conservation Planning, 1978.*

[8]*SEWRPC Community Assistance Planning Report No. 164, Kenosha County Agricultural Soil Loss Erosion Control Plan, 1989.*

Map 15

ESTIMATED SEDIMENT YIELDS FROM AGRICULTURAL CROPLAND IN THE DRAINAGE AREA TO POWERS LAKE: 1990



LEGEND

SEDIMENT YIELD IN TONS PER ACRE PER YEAR

- LESS THAN 5.0
- 5.0 - 15.0
- 15.1 - 25.0
- GREATER THAN 25.0

GRAPHIC SCALE 0 1/8 1/4 MILE; 0 1000 2000 FEET

Source: SEWRPC.

Table 10

ESTIMATED SEDIMENT YIELDS FROM AGRICULTURAL FIELDS WITHIN THE DRAINAGE AREA TO POWERS LAKE: 1990

Sediment Yield (tons/acre/year)	Number of Agricultural Fields	Area (acres)	Percent of Total
<5.0	6	115	17
5.0-15.0	29	402	59
15.1-25.0	15	129	19
>25.0	4	34	5
Total	54	680	100

Source: Kenosha County Land Conservation Department.

sources of lead, or urban runoff metals, were transportation and commercial land runoff, which accounted for 67 percent of the total load. It should be noted that lead loadings have been found to be declining and will probably decline in the future as the use of leaded gasoline continues to decline and is discontinued. However, loadings of other metals contributed by urban sources will not be affected by this change in motor fuel.

Septic Tank Systems Surveys

Septic tank onsite sewage disposal systems are designed to remove phosphorus by adsorption to soil in the drainfield. Removal capacity decreases with increasing soil particle size and all soils have a fixed adsorptive capacity that could eventually become exhausted.

In 1987, there were over 200 septic tank systems present around the Powers Lake shoreline. During the summer of 1987, the Kenosha County Department of Planning and Development conducted an analysis and evaluation of the performance of these systems. In July and August of 1987, a septic leachate survey was conducted by Kenosha County from a boat equipped with a septic leachate detector.

Malfunctioning septic tank systems may discharge septic leachate to the lake through surface runoff and in some cases and for some pollutants through groundwater flow into the lake. This effluent contains organic residuals that will fluoresce when correctly stimulated and inorganics (primarily chloride and sodium ions) that provide a relative change in conductivity of water when compared to nearby unaffected water. A septic leachate detector monitors both of these characteristics to detect leachate plumes along a shoreline.

During July and August of 1987, 20 plumes interpreted to be of wastewater origin were detected along the shoreline of Powers Lake.[9] The locations of these plumes are shown on Map 18. All plumes were close to developed properties where groundwater was close to the land surface, with the greatest frequency of plumes on the northwest and northeast shoreline. Plumes were generally not found in areas of higher elevation compared to lake level. The hydrologic data collected by the U. S. Geological Survey indicate that areas of the greatest groundwater discharge into the lake coincided with some of the septic system plumes.[10]

Bacteriological sampling conducted as part of this Kenosha County study indicated no significant hazard to swimmers except near the public boat landing on the south side of the lake, where three high bacterial levels were measured. This contamination may be attributed to an onsite sewage disposal system bordering the park, underground tile lines draining adjacent land, and potential dumping of boat holding tank waste or other material. The Powers Lake inlet had occasional high bacterial levels, which may be due to malfunctioning septic systems during high flows or to discharge from a duck and goose farm located upstream of the lake. Since completion of the County study, there have been follow-up activities resulting in replacement or abandonment of several onsite sewage disposal systems.

A facility planning program specifically designed to evaluate the conditions of the onsite sewage disposal systems around Powers Lake, as well as around Benedict and Tombeau Lakes, was initiated in the Fall of 1990 by the Towns

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[9] *T. Perkins, Powers Lake Septage Leachate Survey, Summer of 1987, Kenosha County Planning and Development, Informational Paper; 1988.*

[10] *U. S. Geological Survey, Hydrology and Water Quality of Powers Lake, Southeastern Wisconsin, Water Resources Investigation Draft Report, 1990.*

Table 11

UNIT-AREA POLLUTANT LOADING RATES USED FOR THE POWERS LAKE WATERSHED

Land Use	Unit-Area Loadings (pounds/acre/year)					
	Existing Conditions			Planned No Action		
	Total Suspended Solids	Phosphorus	Lead[a]	Total Suspended Solids	Phosphorus	Lead[a]
Industrial and Commercial	940	1.46	2.64	957	1.48	2.69
Government and Institutional	214	0.57	0.23	216	0.58	0.24
Suburban and Low-Density Residential-Planned Sewers	11	0.04	0.01	11	0.04	0.01
Construction Sites	20,000	13.0	0.07	20,000	13.0	0.07
Parks and Recreation	3	0.03	0.001	3	0.03	0.001
Woodland and Other Open Urban Land	3	0.03	0.004	3	0.03	0.004
Agricultural Land	450	0.86	0.01	450	0.86	0.01
Wetland	3	0.03	0.004	3	0.03	0.004
Water	188	0.13	0.13	188	0.13	0.13

[a]*Lead is used as an indication of metal loadings contributed primarily from urban land uses.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Table 12

ANNUAL NONPOINT SOURCE POLLUTANT LOADINGS IN THE TOTAL TRIBUTARY DRAINAGE AREA TO POWERS LAKE: 1985

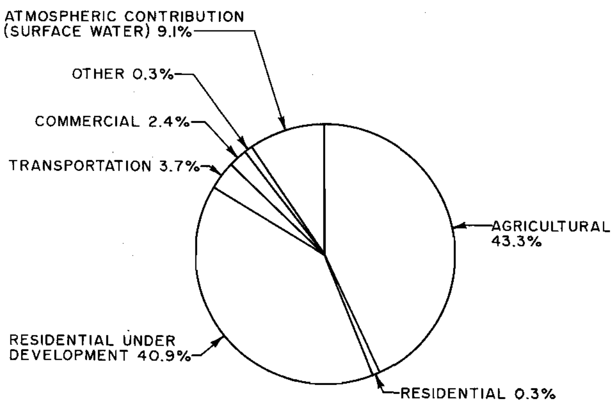
Direct Drainage Area	Sediment		Phosphorus		Lead	
	Pounds	Percent	Pounds	Percent	Pounds	Percent
Agricultural and Other Open Land	404,300	43.3	773	64.6	9	3.8
Residential	3,000	0.3	11	0.9	3	1.1
Residential Under Development	382,000	40.9	248	20.7	1	0.6
Transportation[a]	34,500	3.7	54	4.5	97	40.8
Commercial	22,300	2.4	35	2.9	63	26.4
Industrial	1,500	0.2	3	0.3	4	1.7
Government and Institutional	200	<0.1	1	<0.1	<1	<0.1
Recreational	100	<0.1	1	<0.1	<1	<0.1
Wetland	1,000	0.1	10	0.8	1	0.4
Woodland	300	<0.1	4	0.3	1	0.4
Surface Water	85,000	9.1	59	4.9	59	24.7
Total	934,200	100.0	1,196	100.0	238	100.0

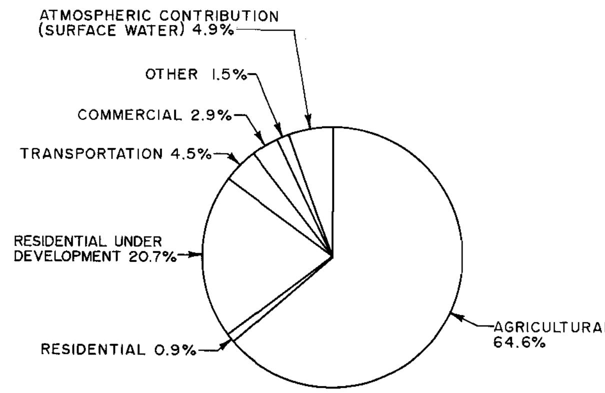
[a]*Includes local and collector streets, standard arterial streets, and expressways.*

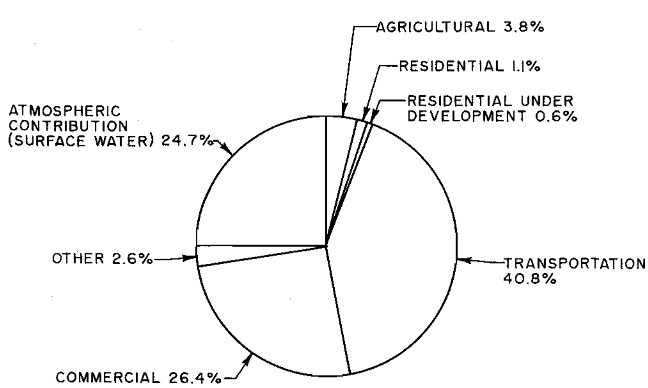
Source: SEWRPC.

Figure 7

EXTERNAL SOURCES OF POLLUTANTS TO POWERS LAKE: 1985







Source: SEWRPC.

of Randall, Wheatland, and Bloomfield. This planning program will also consider alternative means of resolving any identified problem with the onsite systems including the installation of sanitary sewers. The facility plan is being conducted by a consultant, Crispell-Snyder, Inc. By Spring 1991, an initial evaluation of the onsite systems had been completed, expanding the data previously collected by Kenosha County. Data collected included the distribution of a questionnaire; onsite inspections of 98 selected systems, well water samples at 24 selected residences, additional lake water quality sampling at 30 sites; an evaluation of all available soils and groundwater data; and consideration of lot configuration and suitability for replacement systems.

Phosphorus Loadings

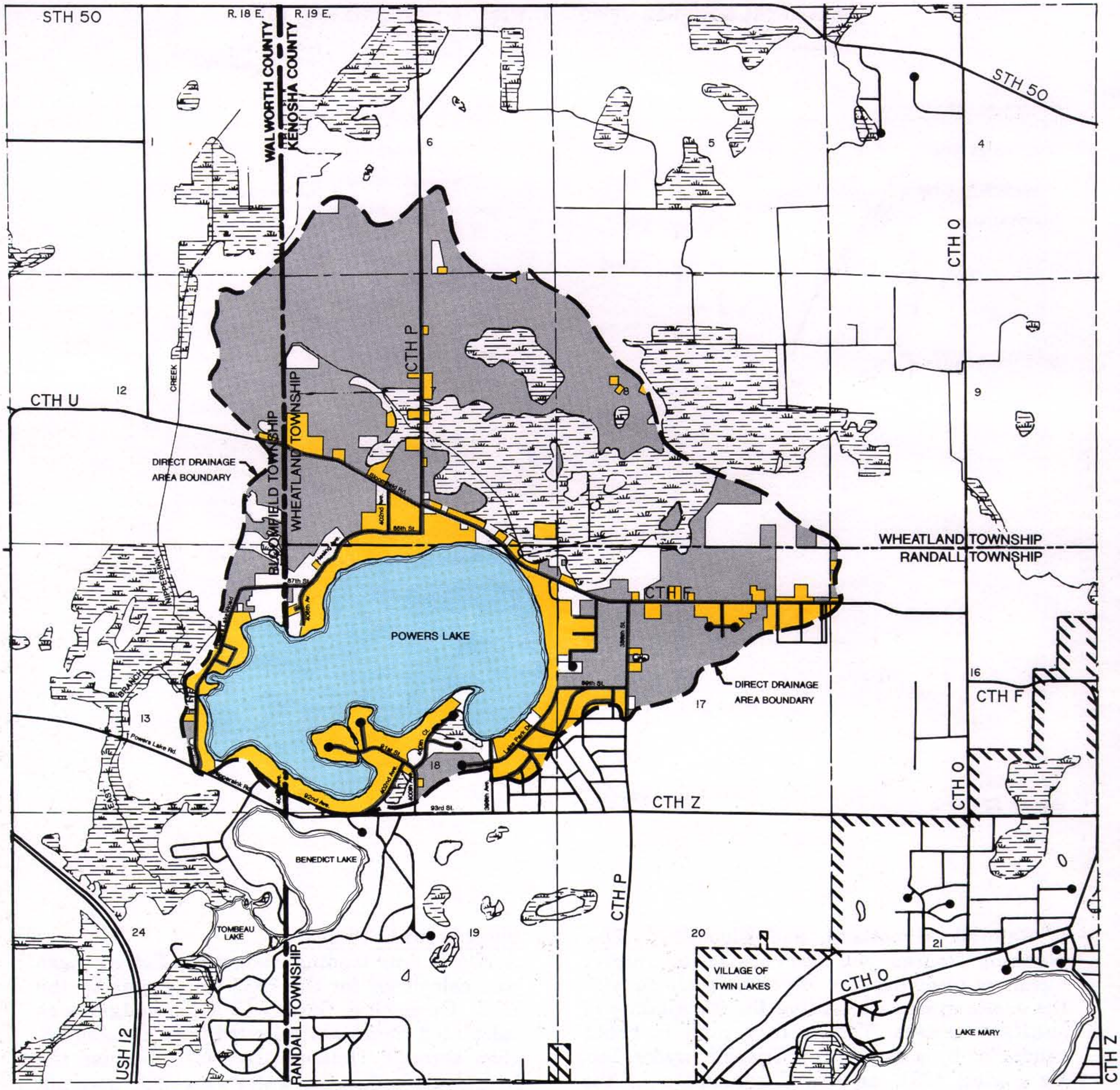
A phosphorus loading budget for Powers Lake was calculated for the 1987 water year by the U. S. Geological Survey.[11] This budget was calculated from data collected from October 16, 1986 through October 15, 1987. Because the hydrologic budget for water year 1987 does not represent a normal year, a phosphorus budget was also estimated for Powers Lake during a normal year. Both budgets are presented in Table 13.

In water year 1987, the total phosphorus load to Powers Lake from external sources was 516 pounds. Shoreline drainage contributed the

[11] *Ibid.*

Map 16

UNIT-AREA POLLUTANT LOADINGS: SEDIMENT AND PHOSPHORUS



LEGEND

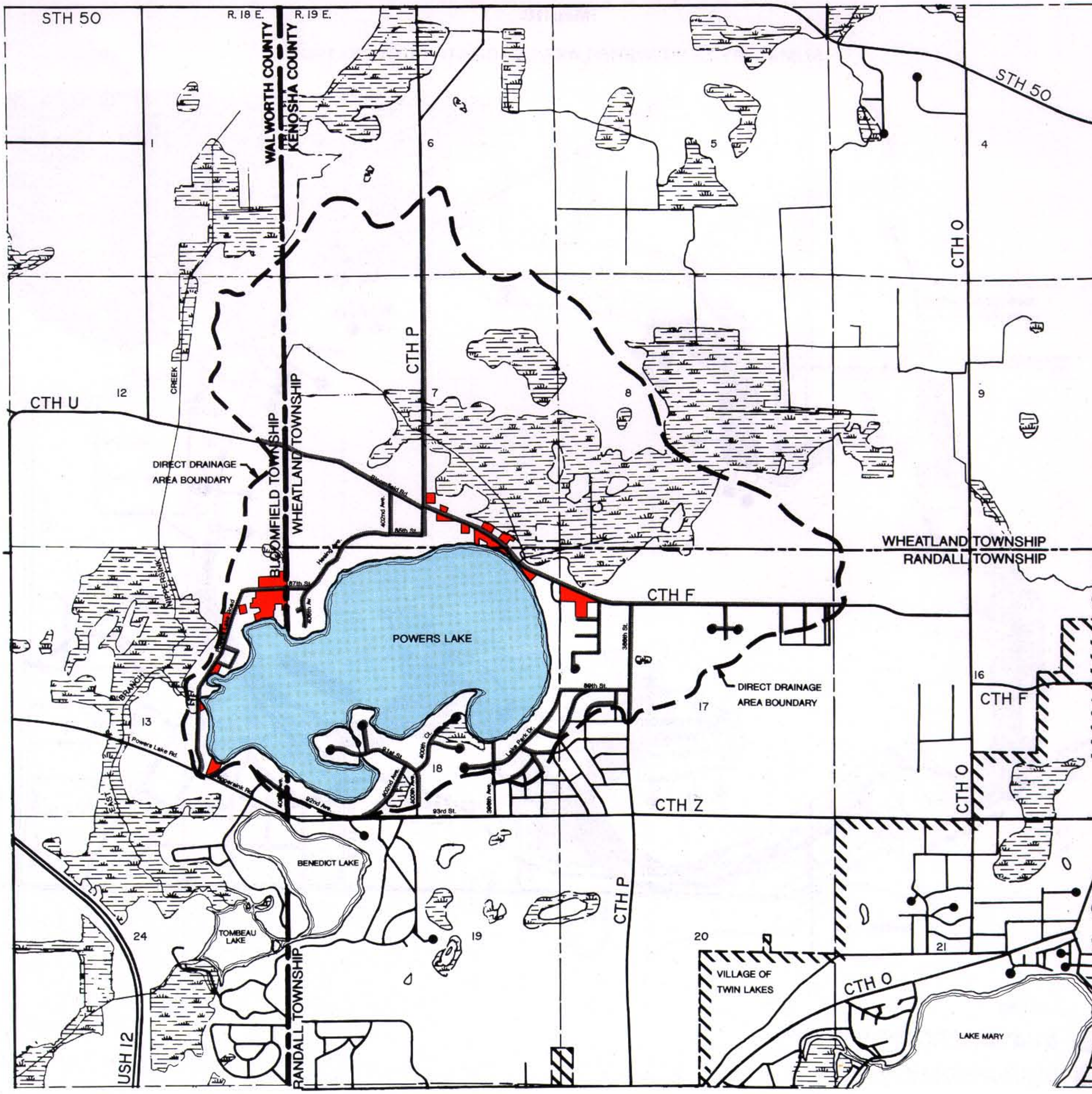
PERCENT OF LOAD CONTRIBUTED BY AREA

	SEDIMENT	PHOSPHORUS
AGRICULTURAL	43.3%	64.5%
RESIDENTIAL	41.2%	21.6%
TRANSPORTATION	3.7%	4.5%
ATMOSPHERIC CONTRIBUTION (SURFACE WATER)	9.1%	4.9%
OTHER LANDS	2.7%	4.5%

Source: SEWRPC.

Map 17

UNIT-AREA POLLUTANT LOADINGS: LEAD



LEGEND

PERCENT OF LOAD CONTRIBUTED BY AREA

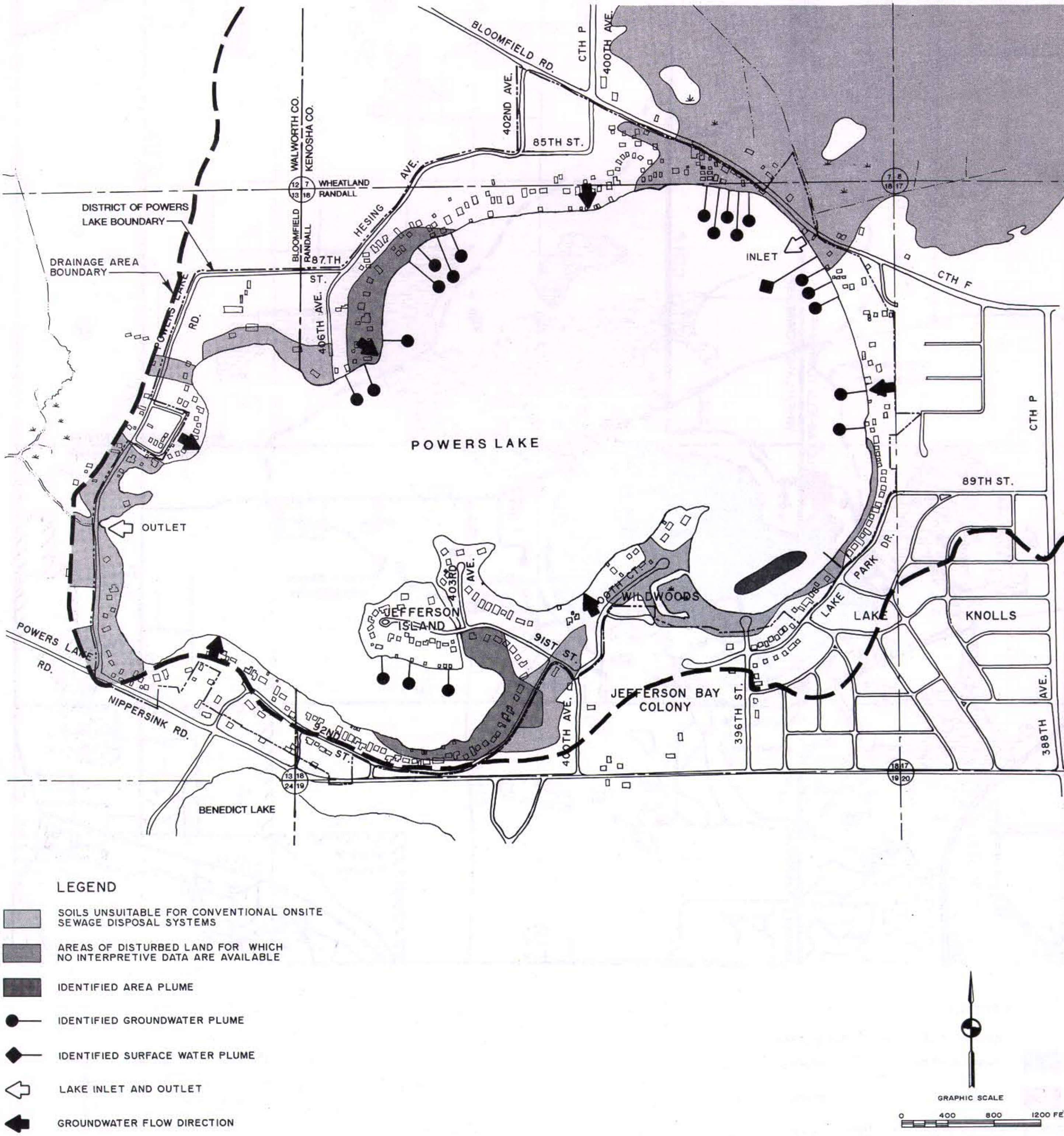
	TRANSPORTATION	40.8%
	COMMERCIAL	26.4%
	ATMOSPHERIC CONTRIBUTION (SURFACE WATER)	24.7%
	OTHER LANDS	8.1%

GRAPHIC SCALE 0 1/8 1/4 MILE; 0 1000 2000 FEET

Source: SEWRPC.

Map 18

SUMMARY OF POWERS LAKE LEACHATE SURVEY: 1987



Source: U. S. Geological Survey and SEWRPC.

Table 13

PHOSPHORUS LOADING BUDGETS FOR POWERS LAKE: 1987 AND NORMALIZED WATER YEARS

Phosphorus Inputs	Water Year 1987		Estimated for a Normal Year	
	Loading (pounds)	Percent of Total	Loading (pounds)	Percent of Total
Powers Lake Inlet	186	36	337	45
Shoreline Drainage	229	44	263	35
Precipitation	56	11	64	9
Septic Systems	34	7	70	10
Ground Water	11	2	10	1
Total	516	100	744	100

Source: U. S. Geological Survey.

largest amount, 44 percent; followed by Powers Lake inlet, 36 percent; direct precipitation, 11 percent; septic systems, 7 percent; and groundwater, 2 percent.

For a normal year, it was estimated that 744 pounds of phosphorus would be contributed to Powers Lake from external sources. Powers Lake inlet would contribute the largest amount, 45 percent; followed by shoreline drainage, 35 percent; septic systems, 10 percent; direct precipitation, 9 percent; and groundwater, 1 percent.

Internal recycling of phosphorus from bottom sediments is not included in the table. As stated earlier, the water quality data indicate that there is not a significant amount of phosphorus released from the sediments during periods of anoxia.

The total phosphorus loads calculated by the U. S. Geological Survey for 1987 and for a normal year are lower than that estimated by the unit area loading analysis presented in Table 12. The large wetland areas to the northeast of Powers Lake likely act as a nutrient and sediment trap. Thus, the high loadings from agricultural lands in the drainage area are reduced before they are delivered to Powers Lake.

TROPHIC CONDITION RATING

Lakes are commonly classified according to the degree of nutrient enrichment, or trophic status. The ability of lakes to support a variety of recreational activities and healthy fish and aquatic life communities is often associated with the degree of enrichment which has occurred. There are three terms used to describe the trophic status of a lake: oligotrophic, mesotrophic, and eutrophic.

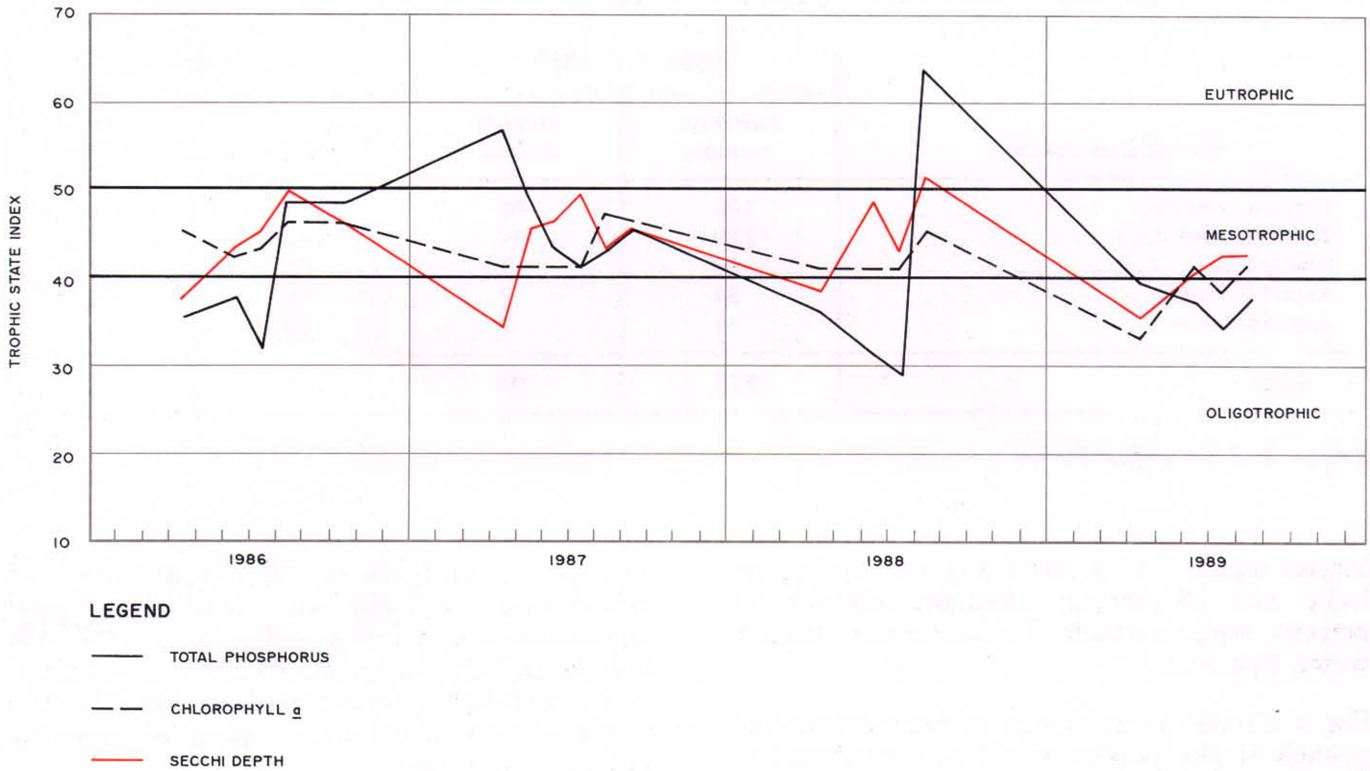
Oligotrophic lakes are defined as nutrient-poor lakes. These lakes characteristically support relatively few aquatic plants and algae and often do not contain very productive fisheries. Because of the naturally fertile soils and the intensive land use practices employed, there are relatively few oligotrophic lakes in southeastern Wisconsin.

Mesotrophic lakes are defined as moderately fertile lakes which support abundant aquatic plant and algae growths and may support productive fisheries. Mesotrophic lakes usually do not exhibit nuisance weed and algae growths. Many of the cleaner lakes in southeastern Wisconsin are classified as mesotrophic.

Eutrophic lakes are defined as nutrient-rich lakes. These lakes are often characterized by excessive growths of aquatic plants and/or experience frequent blooms of algae. Many eutrophic lakes support very productive fisheries. In shallow eutrophic lakes, fish winterkills may be common. Many of the more polluted lakes in southeastern Wisconsin are classified as eutrophic.

Figure 8

TROPHIC STATE OF POWERS LAKE



Source: U. S. Geological Survey and SEWRPC.

Several numerical "scales," based on one or more water quality parameters, have been developed to define the trophic condition of a lake. Because the trophic state is a continuum from very nutrient poor to nutrient rich water, a numerical scale is useful for comparing lakes and for evaluating trends in water quality conditions.

Trophic State Index
The Trophic State Index (TSI) assigns a trophic condition rating based on Secchi disk, total phosphorus, and chlorophyll-a levels. The original Trophic State Index developed by Carlson (1977) has been modified for Wisconsin lakes using data compiled by the Wisconsin Department of Natural Resources on 184 lakes.

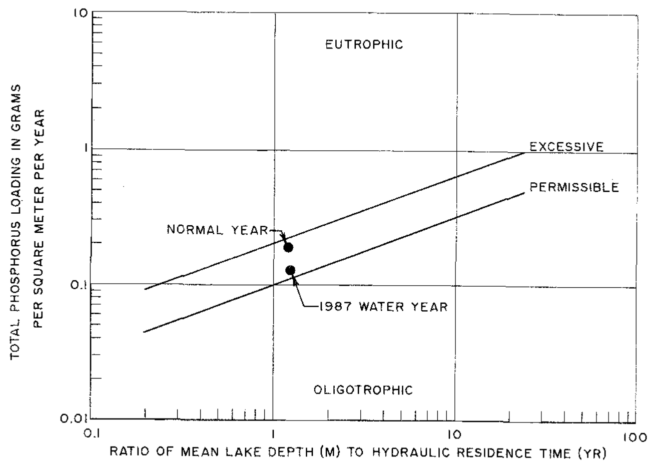
The Trophic State Index for Powers Lake calculated from Secchi disk, total phosphorus, and chlorophyll-a levels are shown in Figure 8. Based on the Trophic State Index ratings, Powers Lake is classified as mesotrophic.

Vollenweider's Model
The Vollenweider Model assigns a trophic condition rating based on the ratio of mean lake depth to hydraulic residence time and phosphorus loadings per unit of lake-surface. The "permissible" rate of phosphorus loading is the amount that a lake could tolerate and still remain oligotrophic. The "excessive" loading rate is defined as the level of phosphorus loading above which a lake would be classified as eutrophic. The zone separating the oligotrophic and eutrophic categories represents the mesotrophic category, as shown on Figure 9.

A phosphorus loading rate of 0.127 grams per square meter (g/m^2) per year was calculated for the 1987 study period, based on the total phosphorus external load of 516 pounds. For a normal water year, a phosphorus loading rate of 0.184 g/m^2 per year was calculated, based on the total phosphorus external load of 744 pounds. In both cases, the calculated phosphorus loading

Figure 9

TROPHIC STATE CLASSIFICATION OF POWERS LAKE BASED ON THE VOLLENWEIDER MODEL



Source: U. S. Geological Survey.

rate was below the excessive rate defined by the model, and thus Powers Lake is classified as mesotrophic.

SUMMARY

Powers Lake represents a typical hardwater alkaline lake that has not been subjected to high levels of pollution. Physical and chemical parameters measured during the study period indicate that the water quality is within the good to very good range, compared to other regional lakes. Total phosphorus levels were below the level considered necessary to cause nuisance algae and macrophyte growths. During summer stratification, the water below 24 feet becomes devoid of oxygen but the upper waters remain well oxygenated to support a fish population. Winterkill is not a problem in Powers Lake because the entire water column remains oxygenated. Internal release of phosphorus from bottom sediments is not a problem in Powers Lake.

There are no known point sources of pollutants in the Powers Lake watershed. Nonpoint sources of pollution include runoff from agricultural and urban areas. Sediment yields from agricultural fields in the watershed were estimated using the universal soil loss equation and were found to be generally high. Unit area loadings showed that agricultural and residential runoff were the largest external sources of sediment and phosphorus; commercial and transportation land runoff were the largest external sources of lead.

In 1987, there were over 200 onsite sewage disposal septic systems present around the Powers Lake shoreline. During the summer of that year, 20 plumes interpreted to be of wastewater origin were found during a septic leachate survey of Powers Lake. Hydrologic data indicate that areas of greatest groundwater discharge into the lake coincide with some of the septic plumes, while the lowest occurrence of plumes were in areas of low groundwater discharge. Bacteriological sampling in Powers Lake indicates no potential health hazards, except in isolated locations. Some samples indicated high bacterial levels near the lake inlet and near the public boat landing on the south side of the Lake. The coliform bacteria data were variable, with some samples at the same location indicating levels below standards.

In 1987, the total phosphorus load to Powers Lake was 516 pounds; shoreline drainage was the largest external source of phosphorus. For an average year, it was estimated that the total phosphorus load would be 744 pounds, and Powers Lake inlet would contribute the largest amount. Based on phosphorus loading rates calculated from the Vollenweider Model, and Trophic State Index ratings calculated from Secchi disk, total phosphorus, and chlorophyll-a levels, Powers Lake is classified as a mesotrophic lake. Mesotrophic lakes are defined as moderately fertile lakes which support abundant, but not nuisance, macrophyte and algae growths.

In general, water quality data and the classification systems used indicate Powers Lake to have a relatively high water quality. Based on five years of data, there are no clear trends indicating changes in water quality conditions. Important water quality considerations to be considered further in subsequent sections of this report are potential impact of onsite sewage disposal systems and the lake inlet on water quality conditions, and alternatives to resolving problems resulting from these sources. In addition, it is important to develop lake management action which will result in maintenance or modest reduction in other pollution sources.

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Chapter V

AQUATIC BIOTA, ENVIRONMENTALLY VALUABLE AREAS, AND RECREATIONAL ACTIVITIES

INTRODUCTION

Within a lake, nutrients are transferred through a network of organisms known as a "food pyramid." At the base of this pyramid are the aquatic plants, the primary food producers. Aquatic plants convert the inorganic compounds from the lake water and sediment into organic compounds, which are directly available as food for aquatic animals. In this process, known as photosynthesis, plants utilize energy from sunlight and release the oxygen required by other aquatic organisms.

The primary consumers in the food pyramid are small animals referred to as zooplankton, which feed on microscopic aquatic plants and, in turn, are eaten by secondary consumers, such as small fish. Secondary consumers are preyed upon by the top predators, including larger fish, waterfowl, and humans. At each level of the food pyramid, waste products are broken down by decomposer organisms in the lake sediments. In this process many of the nutrients are recycled through the food pyramid.

Each group or level of organisms is an important link in the food pyramid. For example, the amount of algae available for consumption may determine the abundance of zooplankton, which in turn may influence the abundance of fish. Human actions often disrupt the balance of the aquatic system. Overfishing may cause an imbalance in the fish community, which may result in unbalanced zooplankton and phytoplankton communities. Pollution in the watershed may increase the nutrient levels available to the phytoplankton and macrophyte communities, allowing them to increase to nuisance levels that are not controlled by zooplankton and fish predation. Because of the complexities of the food pyramid and of the network of living organisms involved, the long-term effects of any perturbations are difficult to predict.

AQUATIC PLANTS

Aquatic plants include larger plants, or macrophytes, and microscopic algae, or phytoplankton. These are the primary producers in the aquatic food pyramid. Macrophytes and phytoplankton compete for the same nutrients in a lake, and therefore lakes with an abundant macrophyte community may not experience frequent algae blooms. Similarly, heavy growths of algae may prevent macrophytes from becoming established in a lake.

Aquatic Macrophytes

Aquatic macrophytes include aquatic flowering plants, ferns, mosses, liverworts, and macroscopic algae. They may be emergent, submergent, floating-leaved, or free-floating. Aquatic macrophytes release oxygen into the lake, incorporate nutrients, and, if rooted, help stabilize sediment and reduce shoreline erosion. When present in moderate densities, aquatic macrophytes provide a valuable source of food and habitat for fish, waterfowl, and other aquatic organisms. However, the abundance of some species may increase to nuisance proportions and interfere with fish production and navigational and recreational lake use.

Aquatic macrophytes are useful environmental indicators of the overall water quality of a lake. Productive lakes with good water quality generally support a diverse population of vegetation, while eutrophic lakes with poor water quality generally support nuisance populations of only a few species.

Aquatic macrophyte surveys of Powers Lake were conducted on July 19, 1967, by the Wisconsin Department of Natural Resources[1] and on July 28 and 29, 1986, by Applied Research and Technology.[2] The Regional Planning Commission staff surveyed the shoreline vegetation of

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[1] *Wisconsin Department of Natural Resources, Powers Lake, Kenosha County, Wisconsin, SEWRPC Lake Use Report No. FX-13; Madison, Wisconsin, 1969, 18 pp.*

[2] *Applied Research and Technology, Aquatic Macrophyte Survey of Powers Lake, 1986.*

Table 14

AQUATIC MACROPHYTES IN POWERS LAKE: 1967-1990

Species Name	Common Name	1967[a]	1986[b]	1990[c]
Chara sp.	Muskgrass	A	A	1,3,4,5
Ceratophyllum sp.	Coontail	S	- -	- -
Elodea canadensis	Waterweed	- -	- -	1
Lemna minor	Duckweed	- -	- -	5,6
Myriophyllum sp.	Water milfoil	C	- -	- -
M. spicatum	Spiked water milfoil	- -	A	1,3,4,5,6
Najas marina	Spiny naiad	- -	C	- -
N. flexilus	Slender naiad	- -	C	- -
Nitella sp.	Stonewort	C	C	- -
Nymphaea odorata	White waterlily	S	S	1,2,4,5
Nuphar variegatum	Yellow waterlily	S	- -	2
Potamogeton sp.	Pondweed	- -	- -	2,3
P. amplifolius	Large leaf pondweed	- -	- -	4,5
P. berchtoldii	Berchtold's pondweed	- -	S	- -
P. crispus	Curly-leaf pondweed	- -	- -	1,3,6
P. freisii	Freis' pondweed	- -	- -	1,4,5
P. gramineus	Variable pondweed	- -	S	2,4
P. natans	Floating-leaf pondweed	S	S	1,2,3
P. pectinatus	Sago pondweed	S	S	1,2,3,5,6
P. praelongus	White-stemmed pondweed	S	S	- -
Ranunculus sp.	Aquatic buttercup	- -	- -	5
Utricularia vulgaris	Bladderwort	- -	C	2,3
Vallisneria americanus	Water celery	S	C	1,3,5

NOTE: A = abundant, C = common, S = scattered, sparse, 1 to 6 = present in areas designated on Map 21.

[a]*Abundance categories estimated from written description from Wisconsin Department of Natrual Resources.*

[b]*Abundance categories from Applied Research and Technology.*

[c]*Abundance categories from survey of lakeshore only, not entire lake.*

Source: Wisconsin Department of Natural Resources, Applied Research and Technology, and SEWRPC.

Powers Lake on July 5, 1990. A combined population of 23 submerged, floating-leaved, and free-floating species has been identified in the Lake, as shown in Table 14. Species that were not classified as common were not found in all years.

Map 19 presents in graphic summary form the 1986 distribution of common macrophyte species in Powers Lake. Chara, macroscopic algae, was the most abundant species and occurred throughout the Lake. Water milfoil (Myriophyllum) formed dense beds in several scattered locations. Other common species included naiads (Najas), stonewort (Nitella), water celery (Vallisneria), and bladderwort (Utricularia).

Several species of pondweeds (Potamogeton) were scattered throughout the Lake. Beds of white- and yellow-flowered waterlilies (Nymphaea and Nuphar) occurred on the western end of the Lake, near the outlet.

Powers Lake supports a healthy and diverse submerged and floating aquatic macrophyte community that provides a valuable habitat for fish and other aquatic organisms in the Lake. Comparison of the 1967 and 1986 lakewide surveys indicates that the community has remained similar in abundance and composition. The maximum rooting depth in 1967 and 1986 was about 27 feet, indicating excellent water clarity.

Map 19

MACROPHYTE DISTRIBUTION IN POWERS LAKE, WISCONSIN: JULY 1986

Source: Applied Research and Technology and SEWRPC.

Table 15

MACROPHYTES OF THE POWERS LAKE SHORELINE: 1990

Species Name	Common Name	Location Designated on Map 21
Asclepias incarnata	Marsh milkweed	2
Alisma plantago-aquatica	Water plantain	6
Bromus inermis	Smooth brome grass	2,6
Carduus nutans[a]	Nodding thistle	3
Carex vulpinoidea	Fox sedge	6
Cicuta bulbifera	Water hemlock	6
Cirsium arvense[a]	Canada thistle	6
Decodon verticillatus	Swamp loosestrife	1
Eleocharis sp.	Spike rush	3,5,6
E. erythropoda	Spike rush	6
Impatiens biflora	Jewelweed	6
Ipomoea purpurea	Common morning glory	6
Lycopus sp.	Bugleweed	6
Melilotus officinalis	Yellow sweet clover	6
Mentha arvensis	Wild mint	6
Phalaris arundinaceae[a]	Reed canary grass	2,3,5,6
Poa pratensis	Kentucky bluegrass	3
Polygonum sp.	Smartweed	3,6
Scirpus acutus	Hard-stemmed bulrush	2,5
S. americanus	Chairmaker's rush	1,3
S. validus	Soft-stemmed bulrush	6
Scutellaria galericulata	Marsh skullcap	6
Solanum dulcamara	Deadly nightshade	6
Solidago gigantea	Giant goldenrod	2
Sonchus arvensis[a]	Sow thistle	6
Typha angustifolia	Narrow-leaved cattail	5
T. latifolia	Broad-leaved cattail	5

[a]*Nonnative species.*

Source: SEWRPC.

Water milfoil (Myriophyllum sp.) is present in the Lake; its abundant growth has caused navigational and recreational problems in many Wisconsin lakes. However, in Powers Lake it does not dominate the plant community. Like many aquatics, milfoil can spread by fragments. The presence of Chara is beneficial to Powers Lake because it forms submerged mats on the bottom of the Lake, which may prevent further establishment of milfoil fragments.

Twenty-seven emergent species were identified during the 1990 survey of Powers Lake and are listed in Table 15. The shoreline of Powers Lake is highly developed and emergent macrophytes were sparse in distribution. Swamp loosestrife (Decodon verticillatus) was found on the southeast shore of the Lake, as shown on Map 19. Cattails (Typha) were found along the western shore and bulrushes (Scirpus), spikerushes (Eleocharis), and reed canary grass (Phalaris arundinaceae) were found at scattered locations around the Lake. The greatest diversity of emergent species was found near the mouth of the inlet stream, where 25 species were identified.

Phytoplankton

Phytoplankton are small, generally microscopic, free-floating algae which occur as single cells, colonies of cells, or as filaments. Generally, phytoplankton are classified according to their dominant pigmentation, i.e., blue-green or golden-brown.

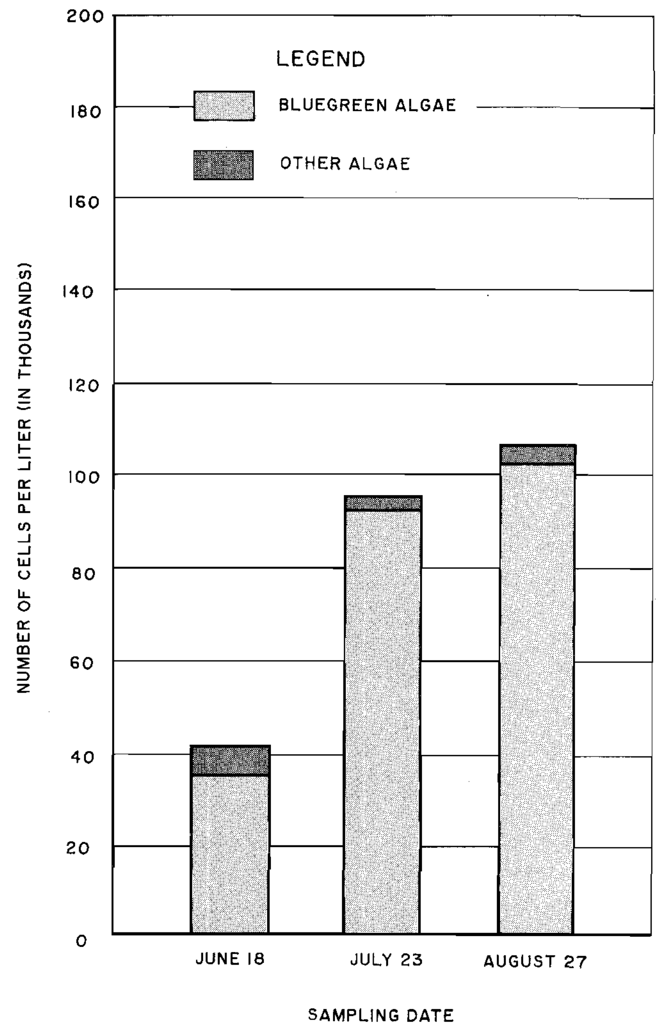
Phytoplankton abundance and diversity vary seasonally with fluctuations in solar irradiance and nutrient availability. In temperate lakes there is a typical seasonal succession as different species reach their maximum growth at different times of the year. Data on the phytoplankton community of Powers Lake are only available for the summer months,[3] when phytoplankton are normally most abundant.

Figure 10 indicates that blue-green algae dominated the phytoplankton community during June, July, and August of 1987. Blue-green algae often persist through the summer because they have slow growth rates and low loss rates to sedimentation. Several species have air cells, or "pseudovacuoles," which allow them to regulate their buoyancy and minimize the loss of cells by sedimentation. They can maximize their growth by moving vertically in the water column to obtain optimal levels of light and nutrients.

Blue-green algae are not normally used as food by zooplankton because of their large size and/or toxicity. Heavy concentrations of blue-green algae, or algal blooms, may accumulate on shorelines, where they produce noxious odors and unsightly conditions as they die and decompose. A common description of an algal bloom is a situation in which the population of a particular algal species exceeds 500,000 cells per liter (cells/l).[4] In Powers Lake the blue-green population reached a maximum on August 27, 1987, of 112,000 cells/l, which is well below this concentration. Phytoplankton populations normally decline as fall approaches due to colder water temperatures and less available light.

Figure 10

POWERS LAKE PHYTOPLANKTON COMMUNITY: SUMMER 1987



Source: U. S. Geological Survey and SEWRPC.

Aquatic Plant Management

Compared to other southeastern Wisconsin lakes, Powers Lake has relatively few aquatic plant problems. Aquatic plant management has been limited to a few spot applications of algicides and herbicides, as shown in Table 16. Four types of chemicals have been used in the past: Cutrine Plus, Aquathol Plus, Aquathol-K, and 2,4-D. Cutrine Plus is an algicide used to control Chara, filamentous, and planktonic algae. Aquathol Plus, Aquathol-K, and 2,4-D are herbicides that control macrophytes. The chemical treatments of Powers Lake were confined to shoreline areas and did not extend farther than 200 feet from shore. Currently, there is no known use of chemicals or mechanical harvesting to control aquatic plants on Powers Lake.

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[3] *U. S. Geological Survey, Hydrology and Water Quality of Powers Lake, Southeastern Wisconsin, Water Resources investigations Draft Report, 1990.*

[4] *L. J. Britton, R. C. Averett, and R. F. Ferreira, An Introduction to the Processes, Problems and Management of Urban Lakes, U. S. Geological Survey Circular 601-K, 1975.*

Table 16

HISTORY OF AQUATIC PLANT CONTROL IN POWERS LAKE: 1973-1990

Treatment Date	Chemical				Total Area Treated
	Cutrine Plus	Aquathol Plus	Aquathol-K	2,4-D	
Summer 1973	- -	6 gallons	- -	- -	- -
June 15, 1981	1.5 gallons	- -	- -	7 gallons	2.3 acres
July 29, 1981	2.5 gallons	- -	2 gallons	5 gallons	1.5 acres

Source: Wisconsin Department of Natural Resources.

AQUATIC ANIMALS

Aquatic animals include the microscopic zooplankton, benthic or bottom dwelling invertebrates, fish, reptiles, amphibians, mammals, and waterfowl that inhabit the shore area. These make up the primary and secondary consumers of the food pyramid.

Zooplankton

Zooplankton are minute, free-floating animals inhabiting the same environment as phytoplankton. Zooplankton are primary consumers in the aquatic food web, feeding to a large extent on such phytoplankton as green algae and diatoms. The zooplankton, in turn, are preyed upon by fish, particularly larvae or fry of bluegills, pumpkinseeds, sunfish, and largemouth bass.

Zooplankton in Powers Lake were sampled in June, July, and August 1987.[5] Twelve species were identified and the diversity of zooplankton species was found to be typical of a mesotrophic Wisconsin lake. Major groups included protozoans, rotifers, copepods, and cladocerans, as shown in Table 17. Protozoans and rotifers are non-predatory and feed on bacteria, small algae, and particulate matter; copepods and cladocerans feed on both algae and other zooplankton.

Table 17

ZOOPLANKTON SPECIES LIST FOR POWERS LAKE: SUMMER 1987

Protozoans Ceratium hirundinella
Rotifers Asplanchna sp. Kellicottia longispina Trichocera sp.
Cladocerans Bosmina longirostris Daphnia dubia Daphnia pulex Daphnia rosea Chydoridae (immature)
Codepods Diacyclops bicuspidatus thomasi Diaptomus ashlandi nauplii

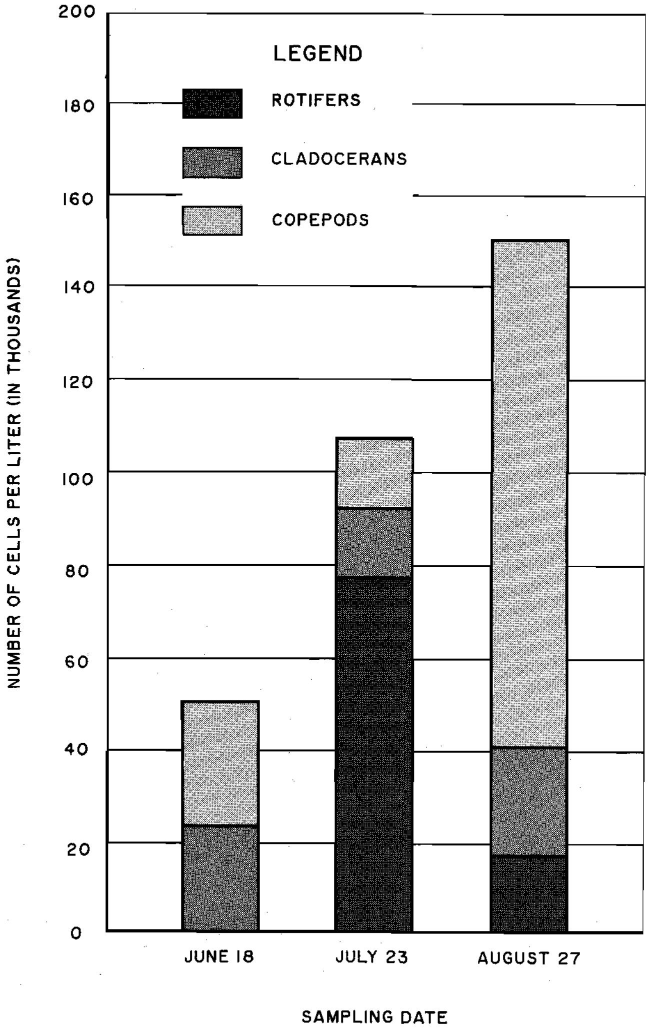
Source: U. S. Geological Survey.

The zooplankton populations in southeastern Wisconsin lakes normally reach a peak in April and May, as temperatures increase and small phytoplankton become available as a food resource. The different species shift in abundance as food resources and predators fluctuate through the summer. Figure 11 presents the abundance of zooplankton in Powers Lake during the Summer of 1987. Rotifers dominated in July and copepods dominated in June and August. As fall approaches, zooplankton populations typically decline, because of colder water temperatures and decreased food.

[5] *U. S. Geological Survey, Hydrology and Water Quality of Powers Lake, Southeastern Wisconsin, Water Resources Investigations, Draft Report, 1990.*

Figure 11

POWERS LAKE ZOOPLANKTON COMMUNITY: SUMMER 1987



Source: U. S. Geological Survey and SEWRPC.

Table 18

POWERS LAKE FISH POPULATION

Common Name	Scientific Name
Predator Fish	
Northern Pike	Esox lucius
Walleyed Pike	Stizostedion vitreum vitreum
Largemouth Bass	Micropterus salmoides
Smallmouth Bass	Micropterus dolomieiu
Panfish	
Bluegill	Lepomis macrochirus
Pumpkinseed	Lepomis gibbosus
Green Sunfish	Lepomis cyanellus
Warmouth Bass	Lepomis gulosis
Rock Bass	Ambloplites rupestris
Black Crappie	Pomoxis nigromaculatus
White Crappie	Pomoxis annularis
Yellow Perch	Perca flavescens
Bullhead	Ictalurus sp.
Rough Fish	
Carp	Cyprinus carpio
White Sucker	Catostomus commersoni
Longnose Gar	Lepisosteus osseus
Bowfin	Amia calva
Redhorse	Moxostoma sp.
Lake Chubsucker	Erimyzon sucetta
Small Forage Fish	
Bluntnose Minnow	Pimephales notatus
Topminnow	Fundulus sp.
Johnny Darter	Etheostoma nigrum
Blackchin Shiner	Notropis heterodon

Source: Wisconsin Department of Natural Resources.

Fish

The Wisconsin Department of Natural Resources surveyed the fish population of Powers Lake in 1969 and the species observed are listed in Table 18. General habit and habitat characteristics of species are summarized in Table 34, Chapter VII. Specific areas of Powers Lake that provide valuable fish habitat sites are discussed later in this chapter.

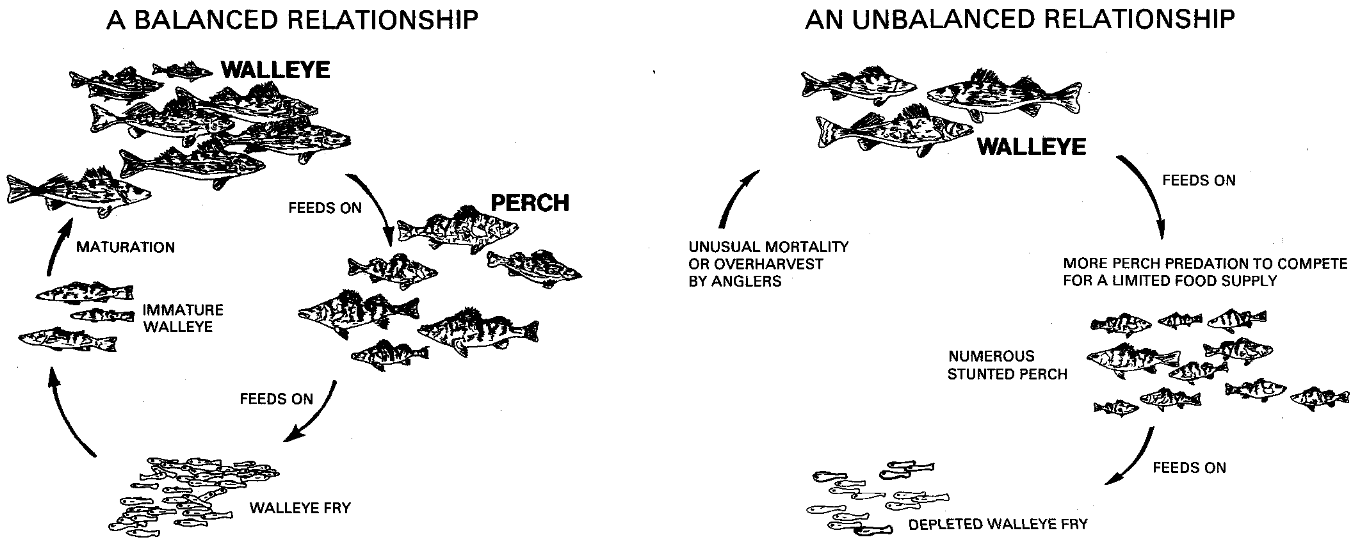
The top predator fish species of Powers Lake include northern pike, walleyed pike, largemouth bass, and smallmouth bass. These species are carnivorous, primarily feeding on other fish, crayfish, and frogs. These species are among the largest and most prized gamefish for Powers Lake anglers. The Powers Lake Fishing Club currently stocks the Lake to supplement this resource base.

"Panfish" is a common term applied to a broad group of smaller fish; their short and usually broad shape makes them perfectly pan-sized. Panfish species present in Powers Lake include the bluegill, pumpkinseed, green sunfish, warmouth bass, rock bass, black crappie, white crappie, yellow perch, and bullhead. The habitat of panfish varies widely among the different species, but their diet of plentiful insects and plants, coupled with prolific breeding, leads to large populations with rapid turnover.[6] Many

[6] *Wisconsin Department of Natural Resources, Fish and Wildlife Comprehensive Plan, 1979.*

Figure 12

THE PREDATOR-PREY RELATIONSHIP



Source: Wisconsin Department of Natural Resources, Bureau of Fisheries Management.

regional lakes have stunted, or slow-growing panfish populations because the numbers are not controlled by the predator fish. Panfish frequently feed on the fry of predator fish and if the panfish population is overabundant, they may quickly deplete the predator fry population. Figure 12 illustrates the importance of a balanced predator-prey relationship, using walleyed pike and perch as an example.

The results of the 1969 Powers Lake fish survey indicated that the Lake provided a good walleye-bass-panfish fishery and that the predator fish were present in sufficient numbers to control the panfish population, thereby avoiding the problem of stunting.[7] However, the report indicated that the future of spawning habitat for the large predators was questionable. Northern pike may spawn successfully in the woody marsh northeast of the Lake, but passage to and from this area is extremely difficult and past channeling of the wetland has severely limited the size of the area usable by spawning fish. Walleyes require rocky shores, sandbars, and gravelly shoals for spawning. The lack of habitat, coupled with poor natural reproduction in southern Wisconsin lakes, may lead to a decrease in this species. Twenty-five adult smallmouth bass were stocked in Powers Lake in 1937; however, reproduction and survival of this species may be limited because their optimal habitat of gravelly bottom, though found along the shoreline, is a relatively small part of the inhabitable area. Similarly, largemouth bass habitat may be threatened by lakeshore development and disturbance to the aquatic plant communities. Along with habitat destruction, overharvest of predator fish by anglers can deplete the population, leading to an unbalanced fishery.

The good water quality, sand and gravel shores, and healthy aquatic plant community have probably prevented the increase of rough fish species in Powers Lake. "Rough fish" is a broad term applied to species that do not readily bite on hook and line, feed on game fish, destroy habitat needed by more desirable species, or have a poor eating quality because of numerous bones or off flavor.[8] Rough fish species occurring in Powers Lake include carp, white sucker, longnose gar, bowfin, redhorse, and lake chubsucker. These species are generally bottom-

[7] *Wisconsin Department of Natural Resources, Powers Lake, Kenosha County, Wisconsin, SEWRPC Lake Use Report No. FX-13; Madison, Wisconsin, 1969, 18 pp.*

[8] *Wisconsin Department of Natural Resources, Fish and Wildlife Comprehensive Plan, 1979.*

dwelling and tolerate low dissolved oxygen levels and high turbidity. The lack of optimal habitat has limited the rough fish population of Powers Lake, but continued water quality protection is essential to prevent future rough fish problems. Current information on the fish population of Powers Lake is lacking. The 1990 recreational use survey conducted by Commission staff indicated that the majority of the anglers have perceived a decrease in predator fish numbers and an increase in some rough fish species. A more thorough analysis of the fish population is required to examine the current trends and potential problems.

Other Aquatic Wildlife

Although a field inventory of amphibians, reptiles, birds, and mammals was not conducted as a part of the Powers Lake study, it is possible by polling naturalists and wildlife managers familiar with the area to complete a list of amphibians, reptiles, birds, and mammals which should be found in the area under existing conditions. The technique used in collating the wildlife data involved obtaining lists of those amphibians, reptiles, birds, and mammals known to have existed and known to exist in the two counties in which the Powers Lake drainage area lies; associating these lists with the historic and remaining habitat areas, as inventoried; and then projecting the appropriate amphibian, reptile, bird, and mammal species into the Powers Lake area. The net result of the application of this technique is a better understanding of which species were once present in the drainage area, which species are normally present under existing conditions, and which species could be expected to be lost as urbanization proceeds within the area.

Amphibians and Reptiles: Although often unseen and unheard, amphibians and reptiles are vital components of the ecologic system of an environmental unit like the Powers Lake drainage area. Examples of amphibians native to the area include frogs, toads, and salamanders. Turtles and snakes are examples of reptiles common to the Powers Lake area. Table 19 presents a summary of the 14 amphibian and 16 reptile species normally present in the Powers Lake area under present conditions and identifies those species most sensitive to urbanization.

Most amphibians and reptiles have definite habitat requirements which are adversely affected by certain agricultural land management practices as well as by advancing urban development. One of the major detriments to the maintenance of amphibians in a changing environment is the destruction of breeding ponds. Frogs and salamanders often return to the same breeding site year after year, even if the pond is not there, in which case they cannot breed. When an area is being filled and developed some ponds must be selected and saved if amphibians are to be maintained. Toads are somewhat of an exception among amphibians in this respect, in that they can better adapt to the changes in environment which normally accompanies urbanization.

Another major consideration in the preservation of both amphibians and reptiles is the maintenance of migration routes. Many species annually transverse distances of a mile or more from wintering sites to breeding sites to summer foraging grounds. The same pathways are used each year, and if species are to be maintained in the area, these pathways must be preserved. Protection of the environmental corridors can assist materially in this respect.

Certain amphibians and reptiles are particularly susceptible to the changes in food sources brought about by urbanization. The Western fox snake and Eastern milk snake, for example, are very likely to be lost over time to the area because of the reduction of rodents, their potential prey.

Birds: A large number of birds, ranging in size from large game birds to small songbirds, are found in the Powers Lake area. Table 20 lists those birds that normally occur in the drainage area. Each bird is classified as to whether it breeds within the area, merely visits the area during the annual migration periods, or visits the area only on rare occasions.

Game birds found in the drainage area include pheasants, partridges, woodcocks, snipe, rails, dabbling ducks, diving ducks, coots, and geese. Pheasants and partridges are upland game bird species and provide some opportunities for hunting. Although the Powers Lake drainage area lies within the Mississippi flyway, opportunities for waterfowl hunting are now limited because of habitat deterioration and urbanization. The fall pheasant population within the drainage area is irregularly distributed but fair populations live in the larger existing habitats. In actively hunted areas adjacent to the drain-

Table 19

AMPHIBIANS AND REPTILES OF THE POWERS LAKE AREA

Scientific (family) and Common Name	Species Reduced or Dispersed with Full Area Urbanization	Species Lost with Full Area Urbanization
Amphibians		
Necturides		
Mudpuppy	X	- -
Ambystomatidae		
Blue-Spotted Salamander	- -	X
Spotted Salamander[a]	- -	X
Eastern Tiger Salamander	X	- -
Salamandridae		
Central Newt	X	- -
Bufonidae		
American Toad	X	- -
Hylidae		
Blanchard's Cricket Frog	X	- -
Northern Spring Peeper	- -	X
Eastern Gray Tree Frog	- -	X
Western Chorus Frog	X	- -
Ranidae		
Bull Frog	- -	X
Green Frog	X	- -
Wood Frog	- -	X
Northern Leopard Frog	- -	X
Reptiles		
Chelydridae		
Common Snapping Turtle	X	- -
Kinosternidae		
Musk Turtle (stinkpot)	X	- -
Emydidae		
True Map Turtle	- -	X
Midland Painted Turtle	X	- -
Blanding's Turtle[a]	- -	X
Colubridae		
Northern Water Snake	X	- -
Northern Brown Snake	X	- -
Red-Bellied Snake	X	- -
Eastern Garter Snake	X	- -
Chicago Garter Snake	X	- -
Prairie (plains) Garter Snake	X	- -
Butler's Garter Snake	X	- -
Eastern Hognose Snake	- -	X
Eastern Smooth Green Snake	- -	X
Western Fox Snake	- -	X
Eastern Milk Snake	- -	X

[a]*Identified as threatened in Wisconsin.*

Source: SEWRPC.

Table 20

BIRDS LIKELY TO OCCUR IN THE POWERS LAKE AREA

Scientific (family) and Common Name	Breeding	Wintering	Migrant
Podicipedidae			
Pied-Billed Grebe	--	--	X
Ardeidae			
American Bittern	--	--	X
Least Bittern	--	--	X
Great Blue Heron	--	--	X
Green-Backed Heron[a]	X	--	X
Black-Crowned Night-Heron	--	--	X
Yellow-Crowned Night-Heron	R?	--	R
Anatidae			
Tundra Swan	--	--	X
Canada Goose	--	--	X
Wood Duck[a]	X	--	X
Green-Winged Teal	--	--	X
American Black Duck	--	X	X
Gadwall	X	--	X
Mallard[b]	X	X	X
Northern Pintail	--	--	X
Blue-Winged Teal[a]	X	--	X
Northern Shoveler	--	--	X
American Wigeon	--	--	X
Redhead	--	--	X
Ring-Necked Duck	--	--	X
Canvasback	X	X	X
Greater Scaup	--	--	X
Lesser Scaup	--	--	X
Oldsquaw	--	--	X
Common Goldeneye	--	R	X
Bufflehead	--	R	X
Hooded Merganser	X	X	X
Common Merganser	R	--	X
Cathartidae			
Turkey Vulture	--	--	X
Accipitridae			
Osprey	--	--	X(E)
Bald Eagle	--	--	R(E)
Golden Eagle	--	--	r
Northern Harrier	--	R	X
Sharp-Shinned Hawk	--	X	X
Cooper's Hawk	--	R(T)	X(T)
Northern Goshawk	--	R	X
Red-Shouldered Hawk	--	R(T)	X(T)
Broad-Winged Hawk	--	--	X
Red-Tailed Hawk[a]	R	X	X
Rough-Legged Hawk	--	X	X
Falconidae			
American Kestrel[b]	X	X	X
Merlin	--	--	X
Peregrine Falcon	--	--	R(E)
Phasianidae			
Ring-Necked Pheasant[b] (introduced)	X	X	NA
Rallidae			
Virginia Rail[a]	R	--	X
Sora[a]	R	--	X
Common Moorhen	--	--	R
American Coot	--	--	X

Table 20 (continued)

Scientific (family) and Common Name	Breeding	Wintering	Migrant
Gruidae			
Sandhill Crane	--	--	R
Charadriidae			
Black-Bellied Plover	--	--	X
Lesser Golden-Plover	--	--	X
Semipalmated Plover	--	--	X
Killdeer[b]	X	--	X
Scolopacidae			
Greater Yellowlegs	--	--	X
Lesser Yellowlegs	--	--	X
Solitary Sandpiper	--	--	X
Spotted Sandpiper[b]	X	--	X
Upland Sandpiper	--	--	X
Ruddy Turnstone	--	--	X
Red Knot	--	--	R
Sanderling	--	--	X
Semipalmated Sandpiper	--	--	X
Pectoral Sandpiper	--	--	X
Dunlin	--	--	X
Common Snipe	R	R	X
American Woodcock[a]	X	--	X
Wilson's Phalarope	--	--	X
Laridae			
Ring-Billed Gull	--	X	X
Herring Gull	--	X	X
Caspian Tern	--	--	X
Common Tern	--	--	X(E)
Forster's Tern	--	--	X(E)
Black Tern	--	--	X
Columbidae			
Rock Dove	X	X	NA
Mourning Dove	X	X	X
Cuculidae			
Black-Billed Cuckoo[a]	X	--	X
Yellow-Billed Cuckoo[a]	X	--	X
Stirigidae			
Eastern Screech-Owl[b]	X	X	NA
Great Horned Owl[a]	X	X	NA
Snowy Owl	--	R	R
Barred Owl[a]	R?	R	NA
Long-Eared Owl	--	R	R
Short-Eared Owl	--	X	X
Northern Saw-Whet Owl	--	--	X
Common Barn Owl	X	--	X
Caprimulgidae			
Common Nighthawk	X	--	X
Whippoorwill	--	--	X
Apodidae			
Chimney Swift	X	--	X
Trochilidae			
Ruby-Throated Hummingbird	X	--	X
Alcedinidae			
Belted Kingfisher[b]	X	--	X
Picidae			
Red-Headed Woodpecker[b]	X	R	X
Red-Bellied Woodpecker[b]	R	X	NA
Yellow-Bellied Sapsucker	--	R	X

Table 20 (continued)

Scientific (family) and Common Name	Breeding	Wintering	Migrant
Picidae (continued)			
Downy Woodpecker[b]	X	X	NA
Hairy Woodpecker[b]	X	X	NA
Northern Flicker[b]	X	R	X
Tyrannidae			
Olive-Sided Flycatcher	--	--	X
Eastern Wood-Pewee[b]	X	--	X
Yellow-Bellied Flycatcher	--	--	X
Acadian Flycatcher	--	--	X
Alder Flycatcher	--	--	X
Willow Flycatcher[a]	X	--	X
Least Flycatcher	--	--	X
Eastern Phoebe[a]	X	--	X
Great Crested Flycatcher[b]	X	--	X
Eastern Kingbird[b]	X	--	X
Alaudidae			
Horned Lark[a]	X	X	X
Hirundinidae			
Purple Martin[b]	X	--	X
Tree Swallow[b]	X	--	X
Northern Rough-Winged Swallow	X	--	X
Bank Swallow[a]	X	--	X
Cliff Swallow[a]	X	--	X
Barn Swallow[a]	X	--	X
Corvidae			
Blue Jay	X	X	X
American Crow	X	X	X
Paridae			
Black-Capped Chickadee[b]	X	X	X
Tufted Titmouse	R?	R	NA
Sittidae			
Red-Breasted Nuthatch	--	X	X
White-Breasted Nuthatch	X	X	NA
Certhiidae			
Brown Creeper	--	X	X
Troglodytidae			
Carolina Wren	--	--	R
House Wren	X	--	X
Winter Wren	--	--	X
Sedge Wren[a]	R	--	X
Marsh Wren[a]	R	--	X
Musicapidae			
Golden-Crowned Kinglet	--	X	X
Ruby-Crowned Kinglet	--	--	X
Blue-Gray Gnatcatcher[a]	R	--	X
Eastern Bluebird[a]	R	--	X
Veery[a]	R?	--	X
Gray-Cheeked Thrush	--	--	X
Swainson's Thrush	--	--	X
Hermit Thrush	--	--	X
Wood Thrush[b]	X	--	X
American Robin	X	X	X
Mimidae			
Gray Catbird	X	--	X
Northern Mockingbird	--	R	R
Brown Thrasher[b]	X	--	X

Table 20 (continued)

Scientific (family) and Common Name	Breeding	Wintering	Migrant
Motacillidae			
Water Pipit	--	--	X
Bombycillidae			
Bohemian Waxwing	--	R	--
Cedar Waxwing	X	X	X
Laniidae			
Northern Shrike	--	R	X
Sturnidae			
European Starling	X	X	X
Vireonidae			
White-Eyed Vireo	--	--	R
Solitary Vireo	--	--	X
Yellow-Throated Vireo[a]	--	X	--
Warbling Vireo	X	--	X
Philadelphia Vireo	--	--	X
Red-Eyed Vireo[b]	X	--	X
Emberizidae			
Blue-Winged Warbler[a]	R	--	X
Golden-Winged Warbler	--	--	X
Tennessee Warbler	--	--	X
Orange-Crowned Warbler	--	--	X
Nashville Warbler	--	--	X
Northern Parula	--	--	X
Yellow Warbler[b]	X	--	X
Chestnut-Sided Warbler[a]	R?	--	X
Magnolia Warbler	--	--	X
Cape May Warbler	--	--	X
Black-Throated Blue Warbler	--	--	X
Yellow-Rumped Warbler	--	--	X
Black-Throated Green Warbler	--	--	X
Blackburnian Warbler	--	--	X
Pine Warbler	--	--	X
Palm Warbler	--	--	X
Bay-Breasted Warbler	--	--	X
Blackpoll Warbler	--	--	X
Cerulean Warbler	--	--	X
Black-and-White Warbler[a]	R?	--	X
American Redstart[a]	R?	--	X
Prothonotary Warbler	--	--	R
Ovenbird[a]	R	--	X
Northern Waterthrush	--	--	X
Louisiana Waterthrush	--	--	R
Kentucky Warbler	--	--	R
Connecticut Warbler	--	--	X
Mourning Warbler[a]	R	--	X
Common Yellowthroat[b]	X	--	X
Hooded Warbler	--	--	X
Wilson's Warbler	--	--	X
Canada Warbler[a]	R?	--	X
Yellow-Breasted Chat	--	--	R
Scarlet Tanager[a]	X	--	X
Northern Cardinal	X	X	NA
Rose-Breasted Grosbeak[b]	X	--	X
Indigo Bunting[b]	X	--	X
Dickcissel	--	--	R
Rufous-Sided Towhee[a]	X	--	X

Table 20 (continued)

Scientific (family) and Common Name	Breeding	Wintering	Migrant
Emberizidae (continued)			
American Tree Sparrow	--	X	X
Chipping Sparrow	X	--	X
Clay-Colored Sparrow	--	--	X
Field Sparrow[a]	X	--	X
Vesper Sparrow[a]	--	--	X
Savannah Sparrow[a]	X	--	X
Grasshopper Sparrow	--	--	X
Henslow's Sparrow[a]	X	--	X
LeConte's Sparrow	--	--	R
Fox Sparrow	--	R	X
Song Sparrow[b]	X	X	X
Lincoln's Sparrow	--	--	X
Swamp Sparrow[a]	X	R	X
White-Throated Sparrow	--	R	X
White-Crowned Sparrow	--	--	X
Harris' Sparrow	--	--	R
Dark-Eyed Junco	--	X	X
Lapland Longspur	--	R	X
Snow Bunting	--	R	X
Bobolink[a]	X	--	X
Red-Winged Blackbird[b]	X	X	X
Eastern Meadowlark[a]	X	R	X
Western Meadowlark[a]	R	--	X
Yellow-Headed Blackbird	--	--	X
Rusty Blackbird	--	R	X
Brewer's Blackbird	--	--	X
Common Grackle	X	X	X
Brown-Headed Cowbird[b]	X	X	X
Orchard Oriole	R	--	R
Northern Oriole	X	--	X
Fringillidae			
Pine Grosbeak	--	R	--
Purple Finch	--	X	X
Red Crossbill	--	R	R
White-Winged Crossbill	--	R	R
Common Redpoll	--	X	X
Pine Siskin	--	X	X
American Goldfinch	X	X	X
Evening Grosbeak	--	R	X
Ploceidae			
House Sparrow	X	X	NA

NOTE: Breeding—Nesting species (nonnesting species present in summer are not included)
Wintering—Present January-February
Migrant—Spring and/or fall transient

X - present, not rare
R - rare
V - vagrant (not regularly occurring in southeastern Wisconsin)
NA - not applicable
(T) - threatened species in Wisconsin
(E) - endangered species in Wisconsin (bald eagle also U. S. threatened, peregrine falcon also U. S. endangered)
? - seasonal status uncertain

[a]*Species lost as breeding birds with full watershed urbanization.*

[b]*Species reduced in numbers as breeding birds with full watershed urbanization.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Table 21

MAMMALS OF THE POWERS LAKE AREA

Didelphidae
Common Opossum
Soricidae
Cinereous Shrew
Short-Tailed Shrew
Vespertilionidae
Little Brown Bat
Eastern Long-Earred Bat
Silver-Haired Bat
Georgian Bat
Big Brown Bat
Red Bat
Hoary Bat
Leporidae
Mearns's Cottontail Rabbit
Sciuridae
Woodchuck
Striped Ground Squirrel
Eastern Chipmunk
Gray Squirrel
Fox Squirrel
Southern Flying Squirrel
Castoridae
Beaver
Cricetidae
Woodland Deer Mouse
Prairie Deer Mouse
Northern White-Footed Mouse
Meadow Vole
Prairie Vole
Muskrat
Muridae
Norway Rat
House Mouse
Zapodidae
Hudsonian Meadow Jumping Mouse
Canidae
Coyote
Red Fox
Gray Fox
Procyonidae
Raccoon
Mustelidae
Least Weasel
Long-Tailed Weasel
Mink
Badger
Northern Plains Skunk
Otter (occasional visitor)
Cervidae
White-Tailed Deer

Source: H. T. Jackson, Mammals of Wisconsin, 1961, and SEWRPC.

age area, harvests may reach 20 or more cocks per square mile. Wintering flocks may reach 50 to 100 birds. Flocks of that size require good cover interspersed with fields containing waste grain, such as corn from farming operations. Supplemental feeding of such flocks will greatly aid in their survival during severe winters.

The Powers Lake drainage area supports a significant population of waterfowl, especially of mallards and teals. Larger numbers move through during migration periods, when most of the regional species may be present. Other species of waterfowl within the area include herons, sandpipers, gulls, plovers, and terns. Most of the waterfowl, shorebirds, and wading birds may be expected to be present in and adjacent to Powers Lake.

Because of the mixture of lowland and upland woodlots, wetlands, and agricultural lands still present in the area, along with the favorable summer climate, the area supports many other species of birds. Hawks and owls function as major rodent predators within the ecosystem. Swallows, whippoorwills, woodpeckers, nuthatches, and flycatchers, as well as several other species, serve as major insect predators. In addition to their ecological roles, birds such as robins, redwing blackbirds, orioles, cardinals, kingfishers, and mourning doves serve as subjects for bird watchers and photographers.

Not all birds are viewed as an asset from an ecological, economic, or social point of view. With the advance of urbanization and, therefore, the loss of natural habitat, conditions have become less compatible for the more desirable bird species. English sparrows, starlings, grackles, and pigeons have replaced the more desirable birds in certain areas because of their great tolerance for urban conditions. The redwing blackbird particularly is beginning to feel the urban impact as wetland areas, particularly cattail marshes, are drained or filled.

Mammals: A variety of mammals, ranging in size from large animals like the Northern white-tailed deer to small animals like the pygmy shrew, is found in the Powers Lake area. Table 21 lists 38 mammals whose range is known to extend into the area.

Larger mammals still fairly common in the less densely populated areas include white-tailed deer, cottontail rabbits, gray squirrels, fox squirrels, muskrats, minks, weasels, raccoons, red foxed, skunks, and opossums. The first four are often considered game mammals, the rest are classified as fur-bearing mammals.

White-tailed deer are generally restricted to the larger wooded areas. The open meadows and croplands adjacent to the woodlots, as well as the shrub swamps, are also utilized by deer. Human and deer populations living in proximity are incompatible. When deer wander or are forced into residential, commercial, or industrial areas, they typically exhibit extreme panic, running wildly and presenting a threat to people, property, and themselves. Foraging deer sometimes cause damage to gardens, ornamental trees, croplands, and orchards. Deer-automobile collisions often occur on the fringes of urban areas, another example of the stress conditions that exist when deer inhabit urban fringe areas.

The cottontail rabbit is abundant throughout the drainage area even in urbanized areas. Rabbit hunting is possible in some areas, while many people enjoy observing the activities of this mammal. There is also an abundance of grey squirrels and fox squirrels in the area. The grey squirrel is found primarily in woodlots and wooded residential sections, while the fox squirrel is found in some of the more open woods and countryside. Both require trees of some maturity because natural cavities in such trees are needed both for the rearing of young and for winter protection.

Muskrats and cottontails are probably the most abundant and widely distributed furbearing mammals in and near the area and may bring an economic return to some trappers. Muskrats may be attracted to any significant water area, including Powers Lake, to wetlands, small ponds, creeks, and drainage ditches, all of which may provide suitable habitat. The familiar muskrat house contributes a certain amount of interest to the landscape and is often used by other wildlife. Waterfowl may make use of the houses for nesting, and minks and raccoons occasionally use muskrat houses as denning areas. Preservation and improvement of muskrat habitat would, therefore, benefit waterfowl, mink, and raccoons. The Powers Lake area may still provide an income supplement to part-time trappers, since a 40-acre marsh can yield over 100 muskrats a year.

The raccoon is associated with the woodland areas. Much of the raccoon's food, however, is water-based, so it makes considerable transient use of wetland areas. Scavenging raccoons can become pests in wooded environments that contain urban fringe development.

The red fox is more characteristic of mixed habitat and farmland areas. Most people are tolerant of the fox because of its aesthetic appeal, while others not so well informed consider it a threat to other wildlife.

Skunks and opossums are common area furbearers. Both of these mammals inhabit woodland areas bordering farmlands and urban fringe development and venture into wetlands in search of food. Skunks and opossums tend to become inactive in cold weather, although neither is a true hibernator.

Small mammals fairly common in the area include the short-tailed shrew, striped ground squirrel or gopher, meadow vole, white-footed mouse, and little brown bat. These small mammals, with the exception of bats, are commonly associated with meadows, fencerows, and utility and transportation rights-of-way. They vary in their importance from insect predators and food sources for larger mammals and raptors, hawks and owls, to pests in croplands, gardens, and lawns.

Bats, despite their appearance and nocturnal habits, generally have a positive impact on the urban environmental in that they are major insect predators, often consuming one-third their weight in insects each night. With the destruction of woodland and wetland habitats through urban development, the more adaptable species of these flying mammals may relocate within the areas of urban development.

The complete spectrum of wildlife species originally native to Kenosha and Walworth Counties has, along with its habitat, undergone significant change in terms of diversity and population since settlement of the area. This change is a direct result of conversion of the land by the European settlers from natural to agricultural and urban uses, beginning with clearing the forest and prairies and draining wetlands and ending with the development of extensive urban land uses. Successive cultural uses and attendant management practices, both rural and urban, have been superimposed on the overall land use changes and have also affected the wildlife and wildlife habitat. In agricultural areas, these cultural management practices include land drainage by ditching and tiling and the expanding use of fertilizers, herbicides, and pesticides. In urban areas, cultural management practices that affect wildlife and their habitat include the use of fertilizers, herbicides, and pesticides, road salting, heavy motor vehicle traffic producing disruptive noise levels and damaging air pollution, and the introduction of domestic animals.

Existing high value wildlife areas, which include areas within woodlands and wetlands of the Powers Lake drainage area, are shown on Map 20. These high-value wildlife areas cover approximately 557 acres, or about 26 percent of the drainage area. In addition to these high-value wildlife areas, many wildlife species, particularly small game mammals, depend on private lands where open agricultural land is the main component of habitat. In addition to wetland preservation and forest and woodlot management, the proper use of these private lands is an important component of wildlife habitat management.

WETLANDS

Wetlands are defined by the Wisconsin Department of Natural Resources as areas where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which have soils indicative of wet conditions. Wetlands in southeastern Wisconsin are classified predominantly as deep marsh, shallow marsh, southern sedge meadow, fresh (wet) meadow, shrub carr, alder thicket, low prairie, fen, bog, southern wet and wet-mesic hardwood forest, and conifer swamp.

Wetlands form an important part of the landscape in and adjacent to Powers Lake, important in that they perform an important set of natural functions that make them invaluable ecological and environmental resources. These functions may be summarized as follows:

1. Wetlands affect the quality of water. The aquatic plants which grow in wetlands change inorganic nutrients, such as phosphorus and nitrogen, into organic material, storing it in their leaves and in peat (the plant remains). In addition, the stems, leaves, and roots of these plants retard the flow of water through the wetlands, allowing silt and other sediment, with the attached nutrients and other water pollutants to settle out. Thereby, wetlands help protect the downstream or offshore resources from siltation and pollution.

2. Wetlands influence the quantity of available water. Wetlands act to provide water during periods of drought and hold it back during periods of wet weather, thereby stabilizing streamflows and controlling downstream flooding. At a depth of 12 inches, one acre of marsh is capable of holding more than 300,000 gallons of water and thus helps protect downstream areas from flooding.

3. Wetlands located along the shoreline of lakes and streams help protect the shoreline from erosion.

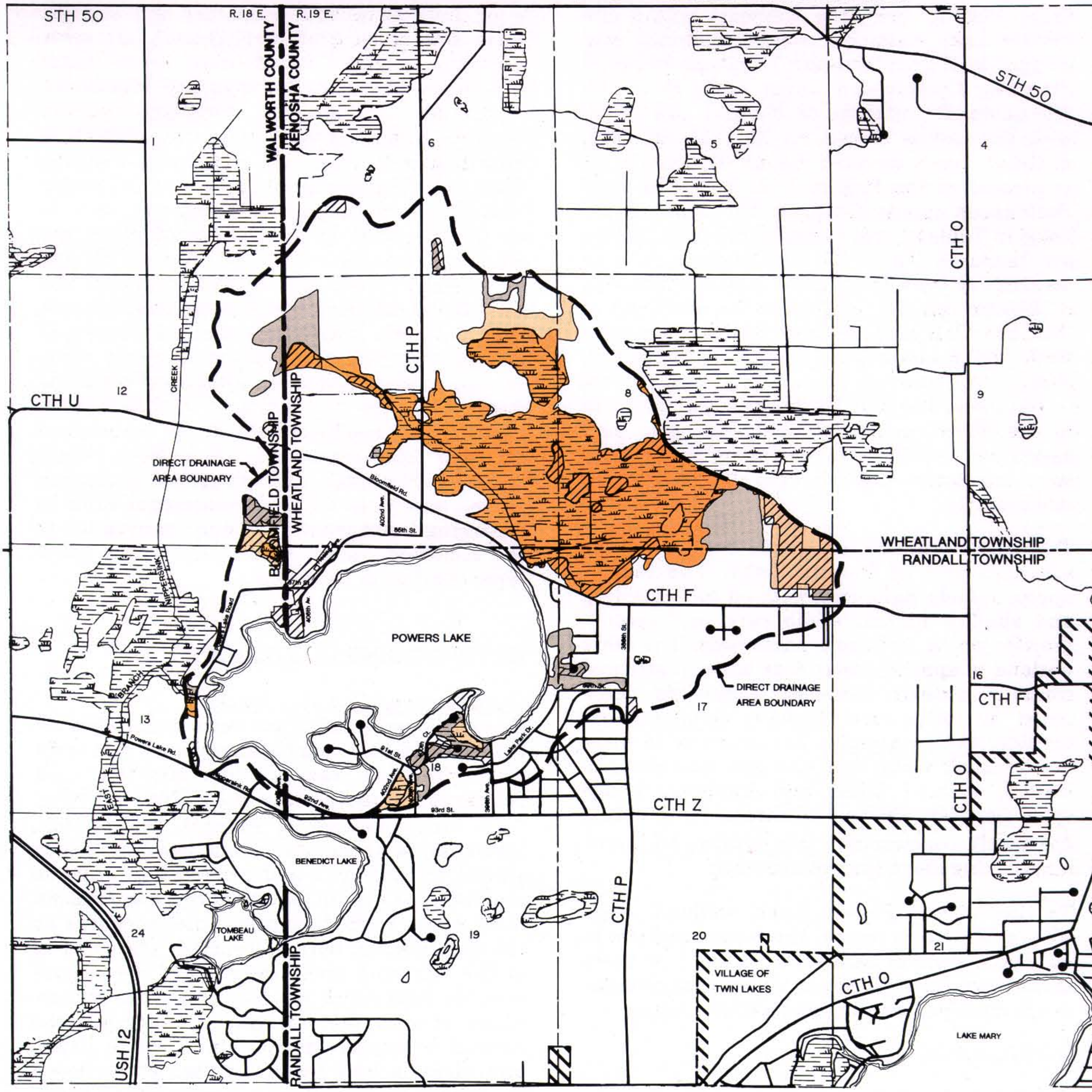
4. Wetlands may serve as groundwater discharge and recharge areas.

5. Wetlands are important resources for overall ecological health and diversity. They provide essential breeding and feeding grounds and shelter and escape cover for many forms of fish and wildlife. The water present in a wetland is attractive to upland birds and other animals. These functions give wetlands recreational, research, and educational values; support activities such as hunting, trapping, and fishing; and add aesthetic value to the community.

Wetlands have severe limitations for residential, commercial, and industrial development. Generally, these limitations are due to the erosive character, high compressibility and instability, high water table, low bearing capacity, and high shrink-swell potential of wetland soils. In addition, the use of metal conduits in some wetland soil types is constrained because of high corrosion potential. These limitations may result in flooding, wet basements, unstable foundations, failing pavements, and broken sewer and water lines. In addition, there are significant onsite preparation and maintenance costs associated with the development of wetland soils, particularly as they relate to roads, foundations, and public utilities.

Map 20

WILDLIFE HABITAT AREAS WITHIN THE POWERS LAKE DRAINAGE AREA



LEGEND

CLASS I WILDLIFE HABITAT (HIGH VALUE)

CLASS II WILDLIFE HABITAT (MEDIUM VALUE)

CLASS III WILDLIFE HABITAT (GOOD VALUE)

WETLANDS

WOODLANDS

GRAPHIC SCALE 0 1/8 1/4 MILE; 0 1000 2000 FEET

Source: SEWRPC.

From 1985 to 1990, the wetlands within the Powers Lake watershed were inventoried and mapped by the Southeastern Wisconsin Regional Planning Commission under contract to the Wisconsin Department of Natural Resources, with the results shown on Map 21. In 1990, wetland areas covered about 312 acres, or 14 percent of the Powers Lake drainage area. Herbaceous species found in the wetlands are listed in Table 22, while shrubs and trees present are listed in Table 23. The largest area of wetlands in the Powers Lake drainage area was a 294-acre complex located to the northeast of the Lake. This area consisted of shallow marsh, fresh (wet) meadow, good quality calcareous fen, shrub carr, tamarack swamp, and southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community included some past agricultural activities in and along the wetland edge and water level changes due to ditching and draining.

Two small wetland areas are located at the southern end of Powers Lake. The larger, approximately eight-acre, wetland contains deep and shallow marsh, shrub carr, and second-growth wet to wet-mesic hardwoods. The other wetland is approximately four acres in size and contains southern wet-mesic hardwoods, dominated by cottonwood (Populus deltoides) and boxelder (Acer negunda). Disturbances to these areas include water level changes, past channelization, wetland filling and dumping, dredge spoil disposal, clearing of shrubs for pier and boardwalk construction, tree cutting, and yard landscaping along the wetland edge.

To the west of Powers Lake, wetland areas consist of shallow marsh, shrub carr, and wet to wet-mesic lowland hardwoods. In the past these areas have been subject to water level changes due to ditching, draining and wetland filling.

WOODLANDS

Woodlands are defined as those areas one acre or more in size having 17 or more deciduous trees per acre, each measuring at least four inches in diameter at breast height, and having 50 percent or more tree canopy coverage. In addition, coniferous tree plantations and reforestation projects are identified as woodlands by the Commission. Approximately 112 acres, or about 5 percent of the Powers Lake drainage area, are covered by woodlands. This woodland cover is classified as consisting of xeric hardwood to wet-mesic lowland hardwood forests.

Woodlands have both economic and ecologic value and, under good management, can serve a variety of uses. Located primarily on ridges and slopes and along streams and lakeshores, woodlands provide an attractive natural resource of immeasurable value. In addition to contributing to clean air and water, reducing stormwater runoff and flooding, and promoting groundwater recharge, woodlands contribute to the maintenance of a diversity of plant and animal life in association with human life and can thereby provide important recreational and educational opportunities. It is important to note that valuable woodlands can be destroyed through mismanagement in a short time, thereby contributing to the siltation of lakes and streams and the destruction of wildlife habitat areas. Thus, woodlands should be maintained for their total scenic, wildlife habitat, educational, recreational, and watershed protection values, as well as for their commercial value in producing forest products and in contributing to the increased values of residential and other types of urban development.

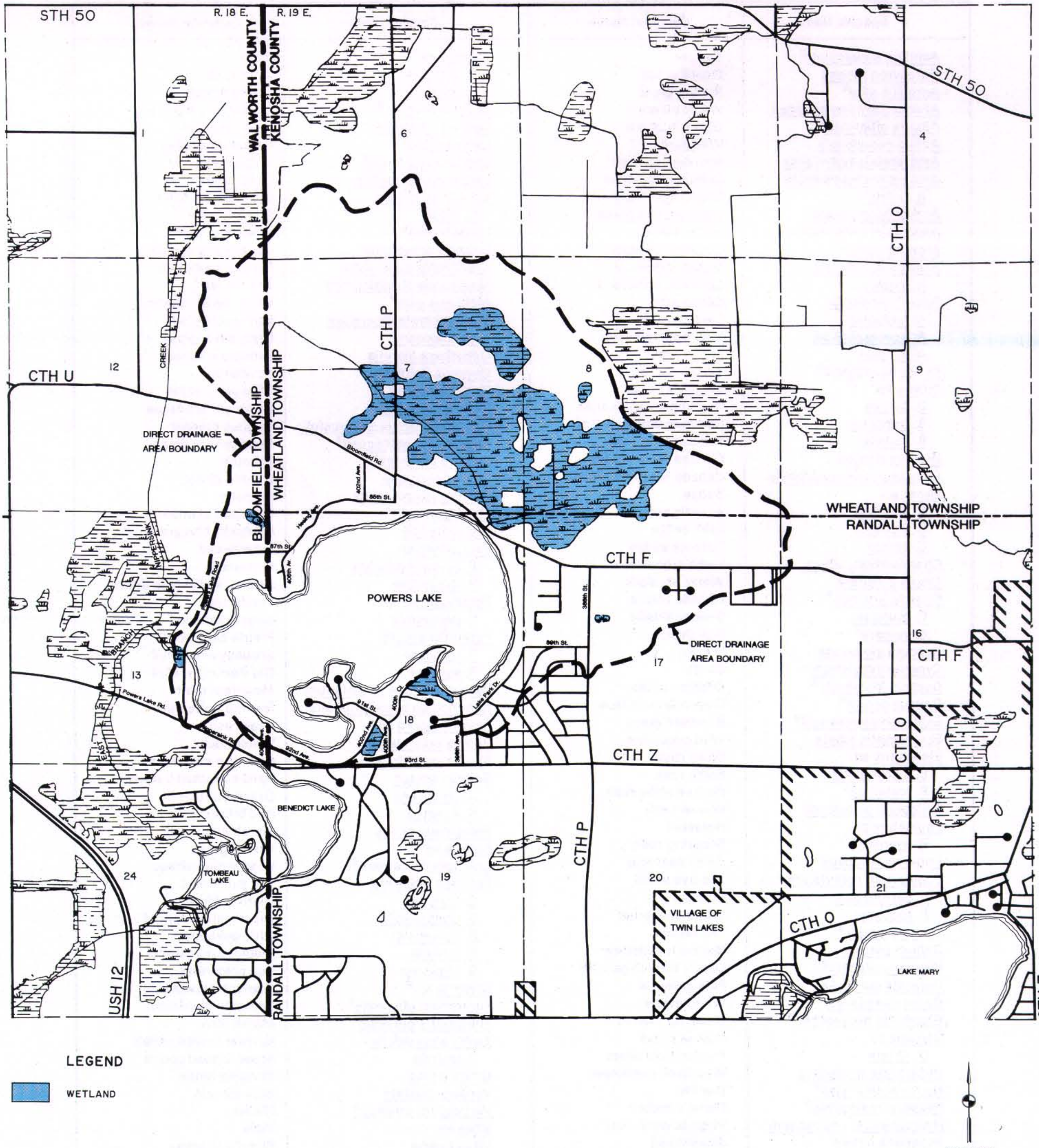
ENVIRONMENTAL CORRIDORS

Environmental Corridor Concept

One of the most important tasks undertaken by the Regional Planning Commission as part of its work program was the identification and delineation of those areas of the Region having high concentrations of natural, recreational, historical, aesthetic, and scenic resources which should be preserved and protected in order to maintain the overall quality of the environment. Such areas, termed environmental corridors by the Commission, normally include one or more of the following seven elements of the natural resource base which are essential to the maintenance of both the ecological balance and the natural beauty of the Region: 1) lakes, rivers, and streams and the associated undeveloped shorelands and floodlands; 2) wetlands; 3) woodlands; 4) prairies; 5) wildlife habitat areas; 6) wet, poorly drained, and organic soils; and 7) rugged terrain and high-relief topography. While the foregoing seven elements constitute integral parts of the natural resource base, there are five additional elements which, although not a part of the natural resource base per se, are closely related to, or centered on, that base, and therefore are important in identifying and delineating areas with scenic, recreational, and educational value. These additional elements

Map 21

EXISTING WETLANDS IN THE POWERS LAKE DRAINAGE AREA



Source: Wisconsin Department of Natural Resources and SEWRPC.

Table 22

HERBACEOUS PLANT SPECIES OBSERVED IN WETLANDS OF POWERS LAKE AREA: 1985-1990

Species Name	Common Name	Species Name	Common Name
Achillea millefolium[a]	Yarrow	Juncus sp.	Rush
Agropyron repens	Quack grass	J. nodosus	Joint rush
Agrositis alba[a]	Redtop grass	J. torreyi	Torrey's rush
Alisma plantago-aquatica	Water plantain	Lactuca serriola[a]	Prickly wild lettuce
Alliaria officinalis[a]	Garlic mustard	Leersia oryzoides	Rice cut grass
Allium canadensis	Wild garlic	Lemna minor	Lesser duckweed
Amaranthus retroflexus	Redroot pigweed	Leonurus cardiaca[a]	Motherwort
Ambrosia artemisiifolia	Common ragweed	Liatris pycnostachya	Gayfeather
A. trifida	Giant ragweed	Lobelia siphilitica	Great blue lobelia
Andropogon gerardi	Big bluestem grass	L. kalmii	Brook lobelia
Apocynum cannabium	Indian hemp	Lychnis alba[a]	White campion
Arctium minus[a]	Common burdock	Lycopus americana	Cutleaf bugleweed
Asclepias incarnata	Marsh milkweed	Lysimachia quadriflora	Prairie loosestrife
A. syriaca	Common milkweed	Matteuccia struthiopteris	Ostrich fern
Aster lateriflorus	Calico aster	Melilotus alba[a]	White sweet clover
A. lucidulus	Swamp aster	Muhlenbergia glomerata	Fen muhly grass
A. novae-angliae	New England aster	M. mexicana	Leafy satin grass
A. simplex	Marsh aster	Oenethera biennis	Evening primrose
Barbarea vulgaris[a]	Yellow rocket	Oxypolis rigidior	Cowbane
Bidens sp.	Beggar's ticks	Panicum flexile	Wiry panic grass
B. cernua	Nodding beggar's ticks	Parnassia glauca	Grass of Parnassus
B. frondosa	Common beggar's ticks	Parnthenocissus quinquefolia	Virginia creeper
B. vulgata	Tall beggar's ticks	Phalaris arundinaceae[a]	Reed canary grass
Bromus ciliatus	Ciliated brome grass	Phleum pratense[a]	Timothy
Calamagrostis canadensis	Canada bluejoint grass	Phlox paniculata	Garden phlox
Carex sp.	Sedge	Phryma leptostachya	Lopseed
C. aquatilis	Aquatic sedge	Plantago major[a]	Common plantain
C. lacustris	Lake sedge	Poa pratensis	Kentucky bluegrass
C. stricta	Tussock sedge	Polygonum sp.	Smartweed
Chenopodium album	Lamb's-quarter	P. pennsylvanicum	Pinkweed
Cicuta bulbifera	Water hemlock	P. sagittatum	Arrow-leaved tear-thumb
Cirsium arvense[a]	Canada thistle	Potamogeton sp.	Pondweed
C. muticum	Swamp thistle	P. pectinatus	Sago pondweed
C. vulgare[a]	Bull thistle	Potentilla arguta	Prairie cinquefoil
Cuscuta glomerata	Dodder	P. fruticosa	Shrubby cinquefoil
Cyperus esculentus	Chufa	P. simplex	Old field cinquefoil
Dactylis glomerata[a]	Orchard grass	Pycnanthemum virginianum	Mountain mint
Daucus carota[a]	Queen Anne's lace	Ranunculus septentrionalis	Swamp buttercup
Echinochloa crusgalli[a]	Barnyard grass	Rhynchospora sp.	Beak rush
Echinocystis lobata	Wild cucumber	Rumex orbiculatus	Water dock
Eleocharis sp.	Spike rush	Sagittaria latifolia	Common arrowhead
E. erythropoda	Spike rush	Scirpus acutus	Hard-stemmed bulrush
E. rostellata[b]	Beaked spike rush	S. atrovirens	Green bulrush
Epilobium coloratum	Willow herb	S. lineatus	Red bulrush
Equisetum sp.	Horsetail	Selaginella apoda	Marsh clubmoss
E. hyemale	Scouring rush	Setaria sp.[a]	Foxtail grass
Erigeron strigosus	Daisy fleabane	Solanum dulcamara[a]	Deadly nightshade
Eupatorium maculatum	Joe-pye weed	Solidago altissima	Tall goldenrod
E. perfoliatum	Boneset	S. gigantea	Giant goldenrod
E. rugosum	White snakeroot	S. graminifolia	Grassleaf goldenrod
Festuca elatior[a]	Tall fescue	S. ohioensis[c]	Ohio goldenrod
Galium boreale	Northern bedstraw	S. riddellii	Riddell's goldenrod
Gentiana procera[c]	Lesser fringed gentian	S. uliginosa	Bog goldenrod
Gerardia purpurea	Pink gerardia	Stellaria sp.[a]	Giant chickweed
Geum canadense	White avens	Tarazacum officinale[a]	Common dandelion
Glechoma hederaceae[a]	Creeping Charlie	Thelypteris palustris	Marsh fern
Glyceria sp.	Manna grass	Typha angustifolia	Narrow-leaved cattail
G. striata	Fowl manna grass	T. latifolia	Broad-leaved cattail
Helianthus strumosus	Woodland sunflower	Urtica dioica	Stinging nettle
Hemerocallis fulva[a]	Day lily	Verbena hastata	Blue vervain
Hesperis matronalis[a]	Dame's rocket	Verbascum thapsus[a]	Mullein
Hydrophyllum virginianum	Virginia water leaf	Viola sp.	Viola
Impatiens biflora	Jewelweed	Vitus riparia	Riverbank grape
Iris versicolor	Blue flag iris		

[a]Nonnative species. *[b]Threatened in Wisconsin.* *[c]On watch in Wisconsin.*

Source: SEWRPC.

Table 23

SHRUBS AND TREES OBSERVED IN WETLANDS OF POWERS LAKE AREA: 1990

Species Name	Common Name
Acer negundo	Box elder
A. saccharinum	Silver maple
A. saccharum	Sugar maple
Ailanthus altissima[a]	Tree of heaven
Betula pumila	Bog birch
Carya ovata	Shagbark hickory
Cornus amomum	Silky dogwood
C. racemosa	Grey dogwood
C. stolonifera	Red osier dogwood
Fraxinus pennsylvanica	Green ash
Juniperus virginiana	Red cedar
Larix laricina	Tamarack
Lonicera X bella[a]	Hybrid honeysuckle
L. tartarica[a]	Tartarian honeysuckle
Morus rubra	Red mulberry
Physocarpus opulifolius	Ninebark
Populus deltoides	Cottonwood
P. tremuloides	Quaking aspen
Prunus serotina	Blackcherry
Quercus macrocarpa	Bur oak
Rhamnus cartharticus[a]	Common buckthorn
R. frangula[a]	European buckthorn
Rhus vernix	Poison sumac
Ribes americana	Wild black current
Robinia pseucoacacia[a]	Black locust
Rosa multiflora[a]	Multiflora rose
Rubus occidentalis	Black raspberry
Salix spp.	Willow
S. babylonica[a]	Weeping willow
S. bebbiana	Beaked willow
S. fragilis[a]	Crack willow
S. interior	Sandbar willow
S. nigra	Black willow
Sambucus canadensis	Elderberry
Thuja occidentalis	White cedar
Tilia americana	Basswood
Ulmus americana	American elm
Viburnum opulus[a]	Highbush cranberry

[a]*Nonnative species.*

Source: SEWRPC.

are: 1) existing outdoor recreational sites; 2) potential outdoor recreation and related open space sites; 3) historic, archaeological, and other cultural sites; 4) significant scenic areas and vistas; and 5) natural and scientific areas.

Primary Environmental Corridors: Primary environmental corridors in the Powers Lake direct drainage area are shown on Map 22. About 1.6 square miles, or about 47 percent of the drainage area, were identified as primary environmental corridor. The areas consist of all of the remaining high-value wetlands and wildlife habitat areas including, in addition to Powers Lake itself, the large wetland complex located to the northeast of the Lake, the intermittent stream flowing through this wetland and into Powers Lake, and the undeveloped floodlands and shorelands.

These areas are subject to urban encroachment because of their desirable natural resource amenities. Unplanned or poorly planned intrusion of urban development into these corridors, however, not only tends to destroy the very resources and related amenities sought by the development, but tends to create severe environmental and development problems as well. These problems include, among others, water pollution, flooding, wet basements, failing foundations for roads and other structures, and excessive infiltration of clear water into sanitary sewerage systems. The preservation of such corridors is, thus, one of the major ways in which the water quality of Powers Lake can be maintained.

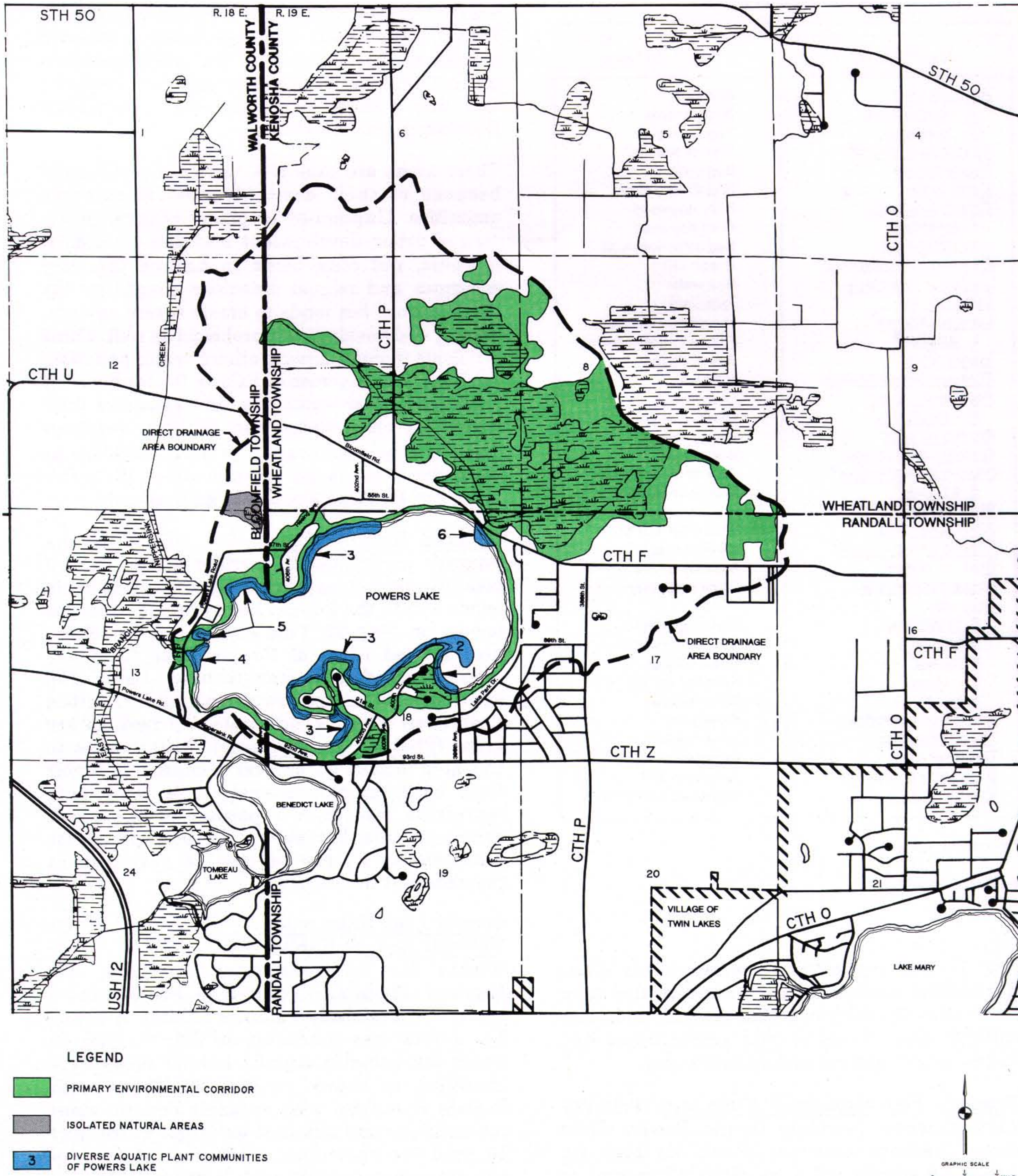
Isolated Natural Areas: In addition to the primary environmental corridor areas, a small concentration of natural resource base elements exists within the Powers Lake drainage area, as shown on Map 22. This approximately 10-acre area located north of Powers Lake Road has been identified as an isolated natural area. The area consists of shallow marsh and disturbed fresh (wet) meadow, dominated by reed canary grass (Phalaris arundincaeae). Disturbances to this area include water level changes and runoff from adjacent agricultural lands. This area represents less than 1 percent of the direct drainage area but should be considered for preservation as the process of development proceeds within the area.

Specific Lake Areas with Valuable Aquatic Habitat

Within the environmental corridors, the Regional Planning Commission has identified areas as particularly valuable habitat. A shoreline survey was conducted on July 5, 1990, in which six valuable aquatic habitat areas were identified, as shown on Map 22. These areas include shorelines with valuable aquatic plant communities and adjacent wetlands which may be used for spawning, feeding or shelter by aquatic animals which reside in Powers Lake.

Map 22

ENVIRONMENTALLY VALUABLE AREAS IN THE POWERS LAKE DRAINAGE AREA



Source: SEWRPC.

Table 24

SHRUBS AND TREES ALONG THE POWERS LAKE SHORELINE: 1990

Species Name	Common Name	Location Designated on Map 22
Acer saccharinum	Silver maple	3,6
Cornus amomum	Silky dogwood	6
Juniperus virginiana	Red cedar	3
Picea glauca	White spruce	3
Picea pungens[a]	Colorado blue spruce	3
Pinus resinosa[b]	Red pine	4
Populus deltoides	Cottonwood	1,4
Quercus macrocarpa	Bur oak	1,3,4
Robinia psuedoacacia[a]	Black locust	3
Salix sp.	Willow	6
S. babylonica[a]	Weeping willow	3
S. interior	Sandbar willow	1,4
S. nigra	Black willow	1,5
Sambucus canadensis	Elderberry	3,4
Tilia americana	Basswood	3,4
Ulmus americana	American elm	1,3,4

[a]*Nonnative species.*

[b]*Planted tree species.*

Source: SEWRPC.

The aquatic macrophyte species that were identified during this survey are listed in Table 14; shrubs and trees found along the shoreline are listed in Table 24.

All six valuable aquatic habitat areas have the following:

1. Northern Pike Spawning Habitat and Protection for Juvenile Fish
Northern pike utilize the emergent plants found in all valuable shoreline areas and the shallow wetlands adjacent to valuable areas one, four, and six as spawning habitat. Larval northern pike remain in the spawning area for a month or more and depend on zooplankton and aquatic insects for food. Stands of bulrushes and cattails minimize turbidity from wave action and suspend eggs off the bottom of the lake, where they could be suffocated by low oxygen levels and silt deposition. Plant cover in these areas provide protection for vulnerable juvenile fish.

2. Crappie, Bluegill, and Largemouth Bass Spawning Habitat and Protection for Juvenile Fish
Crappies, bluegills, and largemouth bass spawn along the shores of Powers Lake in areas of sand and gravel substrate. These species clean silt from the bottom by fanning, lay their eggs, and fan them to keep them supplied with oxygen. Crappies, largemouth bass, and bluegills remain in shallow water for their first year and feed on zooplankton and later, plants. Plant cover in these areas provide protection for vulnerable juvenile fish.

3. Habitat for Predator Hunting and Foraging
Intermediate plant cover of about 30 to 50 percent of the lake bottom appears optimum for the growth of most fish species. If cover is very dense, predator fish such as walleyed pike, largemouth bass, and northern pike are restricted from hunting within the dense foliage. The

valuable areas of Powers Lake include a combination of plant species in moderate densities which allow excellent forage and predator hunting habitat.

4. Food Source and Protective Cover for Waterfowl, Songbirds, Shorebirds, and Muskrats
   Aquatic plants, including muskgrass (Chara sp.), common pondweed (Potamogeton natans), wild celery (Vallesneris americana), and lesser duckweed (Lemna minor), are good sources of food for waterfowl, shorebirds, and songbirds. Cattails found in Honey Bear Bay provide food for muskrats and make excellent nesting sites for birds because the dense growth render it difficult for ground predators to reach locations where nests have been built.

Groundwater Resources

Groundwater resources constitute an extremely valuable element of the natural resource base in the Powers Lake area. The groundwater reservoir not only sustains lake levels by providing an estimated 32 percent of the total water inflows to Powers Lake and maintains the good water quality of the Lake, contributing only about 1 percent of the total phosphorus loading to the Lake, but also comprises a major source of water supply for primarily domestic water uses in the Powers Lake area.

Groundwater moves through the unconsolidated glacial drift, extending about 100 to 150 feet below ground surface in the Powers Lake area, from areas of recharge toward multiple points of discharge, such as streams, lakes, wetlands, and wells. Water level data collected at seven monitoring wells by the U. S. Geological Survey in 1987 indicate that Powers Lake is receiving groundwater from the surrounding upland areas.

The upland areas surrounding Powers Lake which may be expected to recharge the local groundwater flow system to Powers Lake were approximately delineated by the Commission based upon soils data, including texture, slope, permeability, stratigraphy and depth to groundwater; surface water elevations and surface topography; and existing land use. Further refinement of the delineation of the areas which may be expected to recharge the shallow groundwater flow system influencing Powers Lake would require extensive geologic mapping and groundwater monitoring.

As shown on Map 23, the approximate boundary of maximum extent of Powers Lake groundwater influence, that is, the farthest point where precipitation may fall, infiltrate the soil surface, and eventually flow into Powers Lake as groundwater, extends beyond the tributary surface drainage area to the south, north, and west, and covers about 3,554 acres. Of this area, about 2,373 acres, or 67 percent, may be recharging the shallow groundwater system. Forested land covers about 277 acres, or 8 percent of the total area, and is important for the maintenance of the groundwater levels as it promotes slow infiltration of precipitation into the soil and reduces runoff.

RECREATIONAL USE

Four types of surveys were conducted to investigate the present recreational use of Powers Lake. A questionnaire was mailed to each resident of the Powers Lake Management District to survey existing lake uses, desired lake uses, and locally perceived problems and concerns. Results of the questionnaire are presented in Appendix A. Boat counts were taken on the Lake on several weekdays and weekends during the Summer of 1990. In order to help estimate potential resident boating pressures, the type and number of boats and watercraft moored on the Lake and docked onshore were also counted. A winter recreational use survey was conducted in 1991 to estimate the weekend and weekday lake use for winter activities.

Resident Characteristics

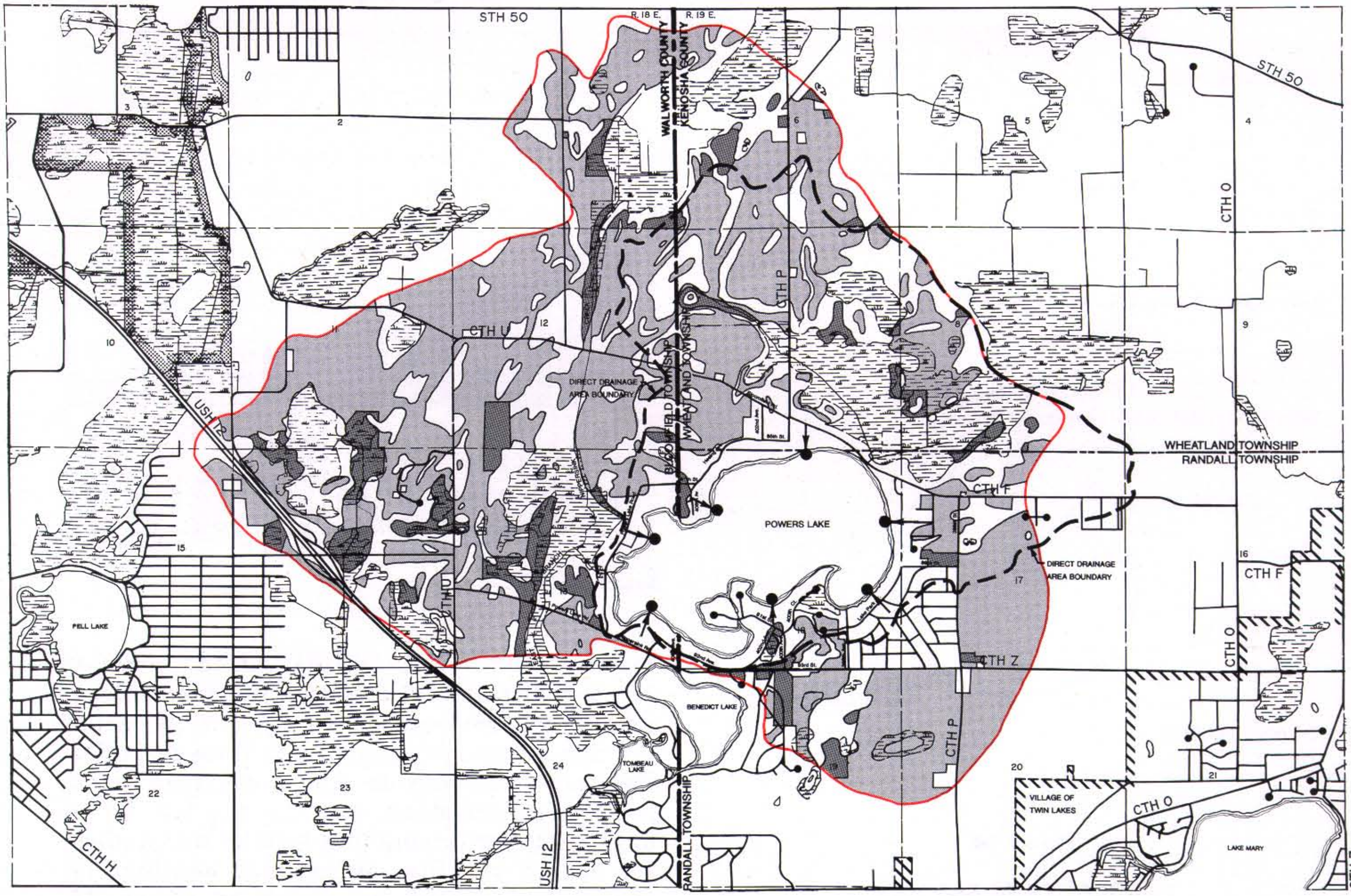
Of the 298 questionnaires mailed to residents of the Lake Management District in the Summer of 1990, 168 were completed and returned, a response rate of 56 percent. As shown in Figure 13, 30 percent of the respondents lived on the Lake year round, while the remainder were summer residents or had weekend cottages. The majority, or 79 percent of the respondents, have lived in the Powers Lake area more than 10 years; 21 percent have lived in the area between one and 10 years; while less than 1 percent of the respondents were new to the area, having lived there less than one year.

Summer Recreational Activities

Figure 14 presents the results of the recreational activities survey section of the questionnaire. Among the respondents, over 50 percent participated in power boating, swimming, scenic

Map 23

GROUNDWATER RECHARGE AREAS FOR POWERS LAKE



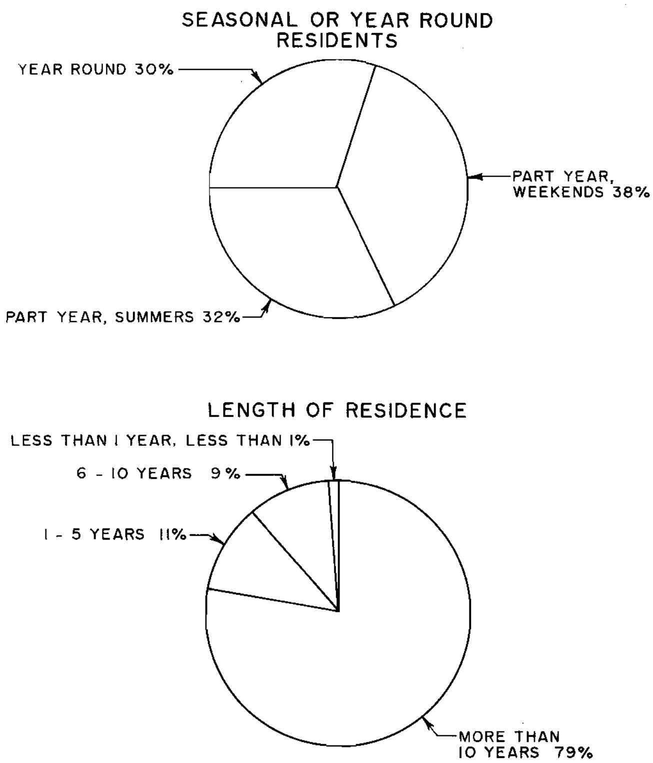
LEGEND

- POTENTIAL GROUNDWATER RECHARGE AREA (NON-URBAN LAND USE, HIGH PERMEABILITY, AND LOW SLOPE ANGLE)
- FORESTED AND A POTENTIAL GROUNDWATER RECHARGE AREA
- MAXIMUM EXTENT OF POWERS LAKE GROUNDWATER INFLUENCE
- DRAINAGE AREA BOUNDARY
- GROUNDWATER OBSERVATION WELL
- APPROXIMATE GROUNDWATER FLOW DIRECTION

Source: SEWRPC and U. S. Geological Survey.

Figure 13

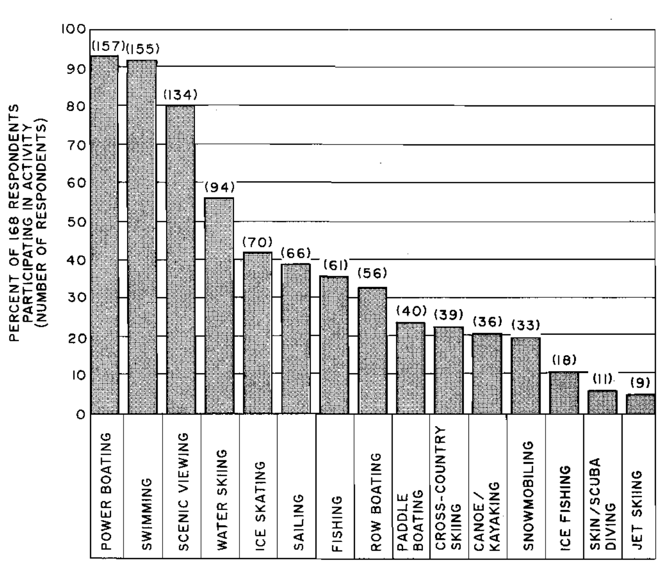
POWERS LAKE RESIDENT CHARACTERISTICS: 1990



Source: SEWRPC.

Figure 14

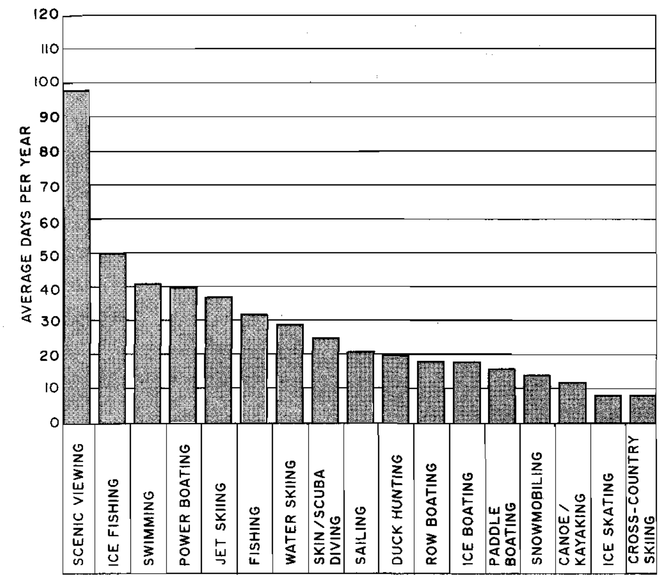
RECREATIONAL ACTIVITY SURVEY OF POWERS LAKE: 1990



Source: SEWRPC.

Figure 15

AVERAGE NUMBER OF DAYS RESIDENTS PARTICIPATED IN RECREATIONAL ACTIVITY ON POWERS LAKE: 1990



Source: SEWRPC.

viewing, and waterskiing. Other popular summer recreational activities included sailing, fishing, and rowboating, with over 30 percent of the respondents participating in these activities. For those respondents who participated in a particular recreational activity, the number of days spent performing that activity was highest for scenic viewing, swimming, boating, jet skiing, and fishing, as shown on Figure 15. Those respondents who enjoyed scenic viewing did so an average of about 98 days per year, while those who enjoyed swimming, boating, fishing, and jet skiing did so an average of about 32 to 41 days per year.

In 1990, there was one public beach on Powers Lake, located on the southeast side of the Lake. Results of the questionnaire indicated that 155 of the respondents, or 92 percent, swim at least occasionally in Powers Lake, although not necessarily at the public beach. People were observed swimming along the shoreline or from boats during several of the survey periods, and also from and near the public beach.

Winter Recreational Activities

Among the popular winter recreational activities, according to the questionnaire, were ice-skating, cross-country skiing, snowmobiling,

Table 25

WINTER RECREATIONAL USE SURVEY ON POWERS LAKE: 1991

Date and Time	Weekend Participants						
	Ice Fishing	Scenic Viewing	Snowmobiling	Ice Sailing	Sledding/ Skiing	Other	Total
February 23							
9:15 a.m.	62	0	0	0	2	2	66
11:30 a.m.	63	0	0	0	0	0	63
2:15 p.m.	32	5	1	4	0	3	45
4:30 p.m.	27	0	4	0	0	0	31
Total	184	5	5	4	2	5	205
Mean	46	1	1	1	1	1	51

Date and Time	Weekday Participants						
	Ice Fishing	Scenic Viewing	Snowmobiling	Ice Sailing	Sledding/ Skiing	Other	Total
February 26							
10:15 a.m.	6	0	0	0	0	0	6
1:15 p.m.	7	0	0	0	0	0	7
Total	13	0	0	0	0	0	13
Mean	7	0	0	0	0	0	7

NOTE: While during this survey only ice fishing activity was observed, other activities are also known to be carried out.

Source: SEWRPC.

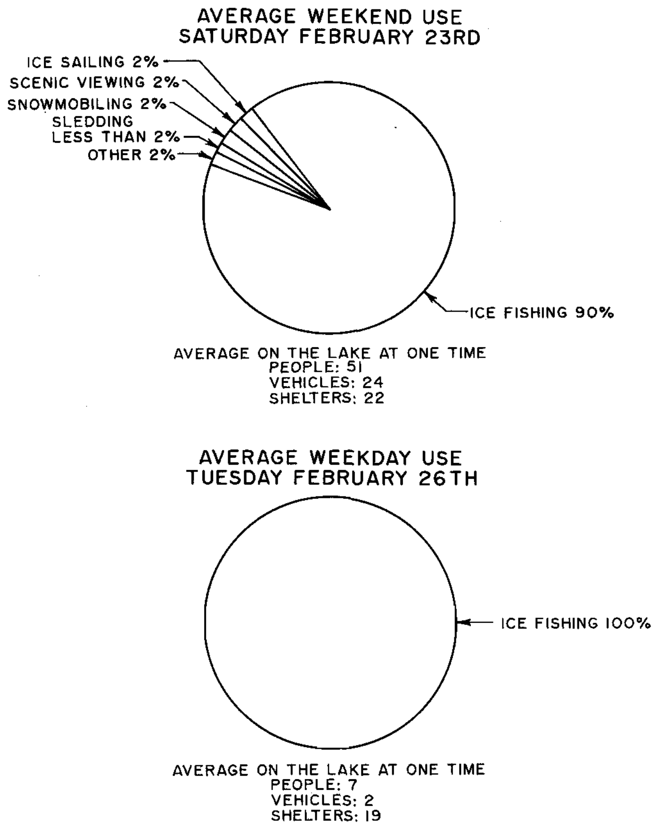
and ice fishing. Between 11 and 42 percent of the respondents took part in these activities. Those respondents who participated in a winter recreational activities of snowmobiling, cross-country skiing, and skating did so an average of about eight to 14 days.

A survey of winter recreational use was made in February 1991. Four surveys of current use were made on Saturday, February 23, and two surveys were made on Tuesday, February 26. The survey results, as reported in Table 25 and Figure 16 indicate that the vast majority of people using the lake at that time were ice fishing. During the weekend surveys, the number of people who were ice fishing was as high as 63 and as low as 27, with an average of about 46 fishermen. During the weekday surveys, the number of people who were ice fishing in the morning and afternoon was six and seven, respectively. Other activities observed during the surveys included snowmobiling, scenic viewing, ice sailing, and sledding.

In addition to recreational activities, the number and approximate location of vehicles and ice shelters on the Lake were observed and the results reported in Table 26 and shown on Map 24. Vehicles and ice shelters were observed to cluster in several areas on the Lake, the primary location being near the lake access at Bloomfield Road (CTH F). The four weekend surveys indicated that an average of 24 vehicles and 22 shelters were on the Lake, while the two weekday surveys indicated that an average of three vehicles and 19 shelters were on the Lake.

Figure 16

POWERS LAKE WINTER USE SURVEY: 1991



Source: SEWRPC.

Table 26

VEHICLES AND SHELTERS ON POWERS LAKE: WINTER 1991

Date and Time	Vehicles	Shelters
Weekend		
February 23		
9:15 a.m.	23	24
11:30 a.m.	30	26
2:15 p.m.	23	22
4:30 p.m.	18	17
Total	94	89
Mean	24	22
Weekday		
February 27		
10:15 a.m.	2	19
1:15 p.m.	3	19
Total	5	38
Mean	3	19

Source: SEWRPC.

Boating Pressures

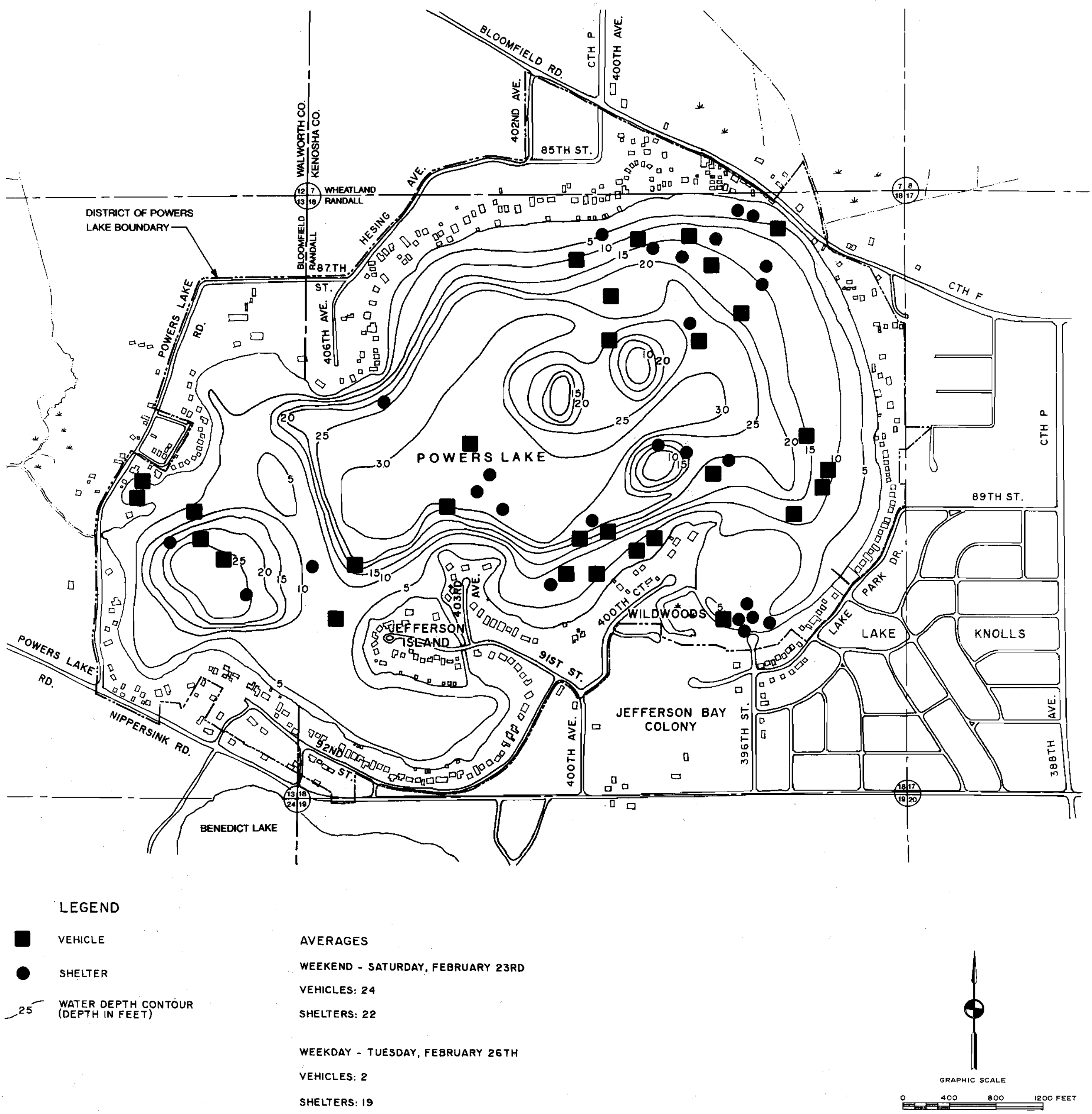
As expected, boat and other watercraft traffic on Powers Lake was higher on weekends than on weekdays, as reported in Figure 17 and Table 27. Four weekend surveys of the Lake conducted on July 1, 1990, indicated that boat counts at any one time were as high as 80 and as low as 45, with an average of about 67 boats. Three weekday surveys of the Lake conducted on July 2, 1990, indicated that boat counts at any one time were as high as 27 and as low as 10, with an average of 19 boats.

A comparison of 1990 boat counts with boat counts obtained during aerial surveys of the Lake by the Wisconsin Department of Natural Resources in the 1960s[9] indicates that boating activities have increased on Powers Lake and that there has been a shift in recreational activities from fishing to fast boating. In 1969, the Department reported that about 39 boats, on average, engaged in fishing, pleasure boating, and waterskiing were on Powers Lake at any one time during the weekend, compared to the 1990 survey finding that an average of 45 fishing, pleasure, and skiing boats were present at any one time during the weekend. The average number of fishing boats on the Lake at any one time during the weekend in the 1960s was about 22, while the average number of fishing boats on the Lake at any one time during the weekend according to the 1990 survey was about 16. The average number of weekend pleasure boats and waterski boats on the Lake in the 1960s was reported to be about 14 and three, respectively, while in 1990 the average number of weekend pleasure boats and waterski boats was about 22 and seven, respectively, according to the survey. Observations of jet skiing on Powers Lake ranged from four to 11 jet skis on the Lake during the weekend and from zero to two jet skis on the Lake during the weekday.

[9] *Ibid.*

Map 24

VEHICLES AND SHELTERS ON POWERS LAKE: WINTER 1991: 11:30 A.M. SURVEY



AVERAGES

WEEKEND - SATURDAY, FEBRUARY 23RD

VEHICLES: 24

SHELTERS: 22

WEEKDAY - TUESDAY, FEBRUARY 26TH

VEHICLES: 2

SHELTERS: 19

Source: SEWRPC.

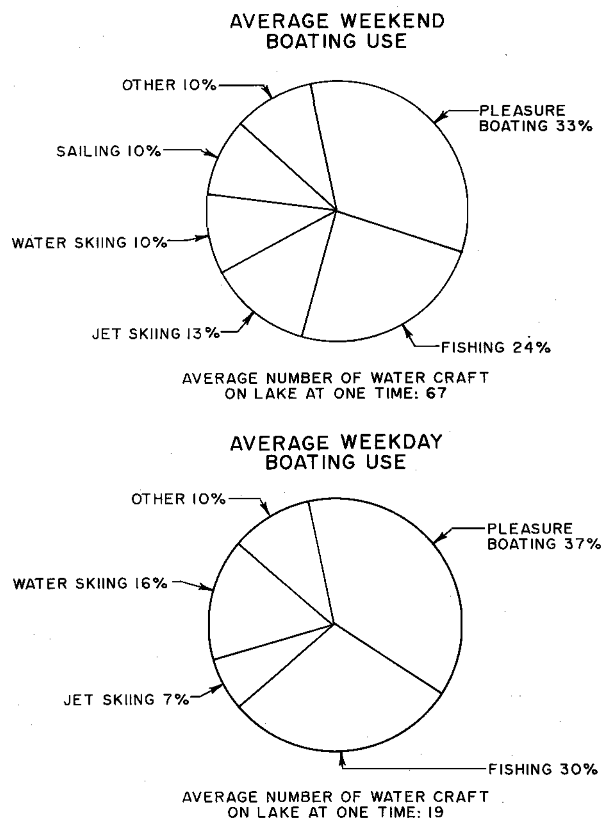
The counts of motorized pleasure boats and ski boats indicate that boating pressures on Powers Lake are above critical levels on the weekends and below critical levels on the weekdays. The Regional Planning Commission recommends about 16 acres of usable lake area[10] per boat as a minimum density for safe waterskiing and fast boating. Because the usable area of Powers Lake for fast boating purposes is about 324 acres, the maximum number of ski boats, fast boats, and sailboats that can safely use the Lake at any one time is 20. The number of pleasure boats, including ski boats, fast boats, and sailboats on the Lake at any one time during the weekend surveys ranged from 25 to 46. Thus, during all of the four weekend surveys, the maximum boat density for safe use was exceeded. The number of pleasure boats, including ski boats, fast boats, and sailboats, on the Lake at any one time during the week ranged from three to 15, well below critical levels.

To evaluate boating pressures, the Wisconsin Department of Natural Resources applies a maximum recommended boating density of one boat per 10 acres of total lake surface area. This criterion applies to all boats: pleasure boats, ski boats, canoes, rowboats, fishing boats, and sailboats. Applying the Department guidelines to the total lake area of 459 acres, a total of about 46 boats could utilize Powers Lake safely at any one time. The 1990 survey indicated that more than 46 boats and jet skis were on Powers Lake during the three late morning and afternoon weekend surveys; the average number of boats and watercraft on Powers Lake for all the surveys was 67. During the 1990 weekday survey, the highest number of boats and jet skis on Powers Lake was 27, with an average number of boats and watercraft for the surveys of 19.

A total of 745 boats and watercraft were docked or moored on Powers Lake in the Summer of 1990. The largest percentage of boats, about 35 percent, were powerboats, as shown in Figure 18. Powerboats with motors exceeding 25 horsepower constituted about 28 percent of the total number of boats, and those with motors less than or equal to 25 horsepower constituted about 7 percent of the total. Jet skis accounted for about 2 percent of the total resident boats and watercraft.

Figure 17

POWERS LAKE BOATING USE SURVEY: 1990



Source: SEWRPC.

Anglers' Perception of Fishing Quality

According to the mail survey and as shown in Figure 19, panfish, largemouth bass, yellow perch, and crappies were the most frequently caught fish in the year preceding the survey date. Trends in fish population for the last five years as perceived by anglers are also shown in Figures 20 and 21. The majority of anglers believe that there has been a decrease in the walleyed and northern pike populations and an increase in numbers of longnose gar and carp. When asked to rate the fishing quality of Powers Lake, 27 percent of those responding rated the fishing quality as good, 53 percent rated it as fair, and 19 percent rated it as poor.

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[10] *Usable surface water is defined as that area of a lake which can be safely utilized for motor boating, sailing, and waterskiing. This area includes all surface water which is a minimum distance of 200 feet from shorelines and which is free of submerged or surface obstacles and at least five feet in depth.*

Table 27

BOATING USE SURVEY ON POWERS LAKE: 1990

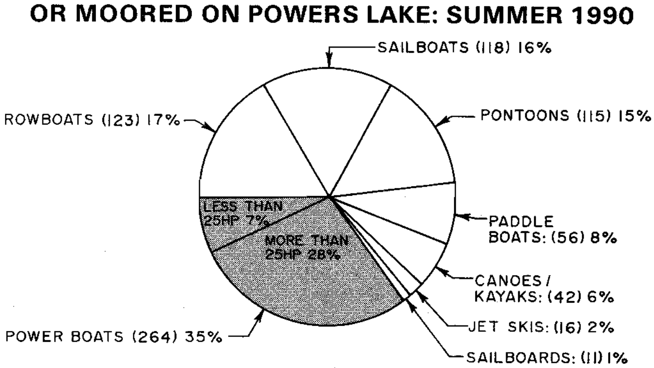
Date and Time	Weekend Boating Activity						
	Fishing	Pleasure	Skiing	Sailing	Jet Skiing	Other	Total
July 1							
10:45-11:00 a.m.	15	9	4	12	4	1	45
11:45-12:00 a.m.	17	22	7	13	10	6	75
12:45-1:00 p.m.	16	23	6	1	11	10	67
1:45-2:00 p.m.	16	33	11	2	9	9	80
Total	64	87	28	28	34	26	267
Mean	16	22	7	7	9	7	67

Date and Time	Weekday Boating Activity						
	Fishing	Pleasure	Skiing	Sailing	Jet Skiing	Other	Total
July 2							
10:00-10:15 a.m.	5	2	1	0	0	2	10
12:45-1:00 p.m.	5	9	3	0	2	1	20
3:30-4:15 p.m.	7	10	5	0	2	3	27
Total	17	21	9	0	4	6	57
Mean	6	7	3	0	1	2	19

Source: SEWRPC.

Figure 18

RESIDENT BOATS AND WATERCRAFT DOCKED OR MOORED ON POWERS LAKE: SUMMER 1990

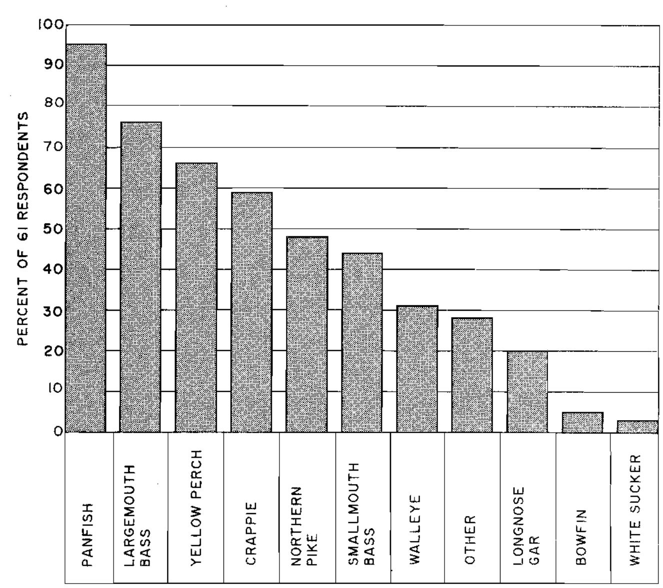


TOTAL NUMBER OF RESIDENT BOATS AND WATER CRAFT: 745

Source: SEWRPC.

Figure 19

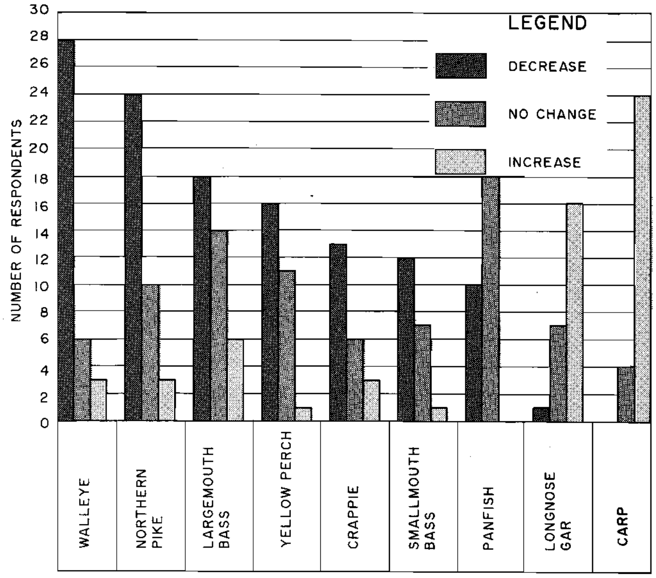
SPECIES OF FISH CAUGHT IN POWERS LAKE BY ANGLERS: 1990



Source: SEWRPC.

Figure 20

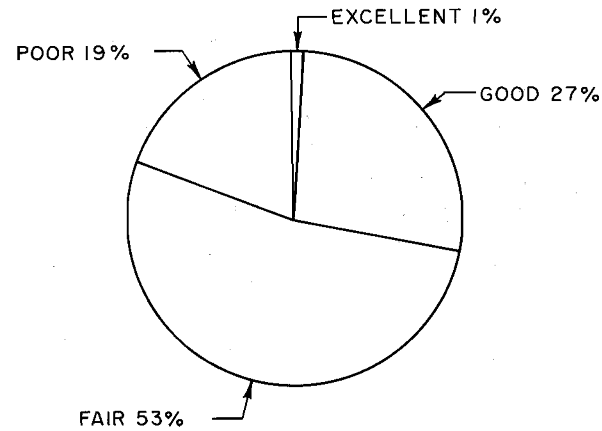
POWERS LAKE ANGLERS' PERCEPTION OF FISH POPULATION CHANGES WITHIN THE LAST FIVE YEARS (1985-1990)



Source: SEWRPC.

Figure 21

POWERS LAKE ANGLERS' PERCEPTION OF FISHING QUALITY: 1990



78 RESPONDENTS

Source: SEWRPC.

During the winter survey on Saturday, February 23, 21 out of the 27 people on the ice were interviewed between 5:30 p.m. and 6:30 p.m. as to the number of hours engaged in ice fishing, number and type of fish caught, and the quality of fishing experience at Powers Lake. People interviewed fished at Powers Lake an average of 3.5 hours and caught an average of two fish, primarily panfish, although smallmouth bass, northern pike, and rock bass were also caught. When asked to rate the ice fishing quality of Powers Lake, 36 percent of those questioned rated the fishing quality as good and 45 percent rated it as fair.

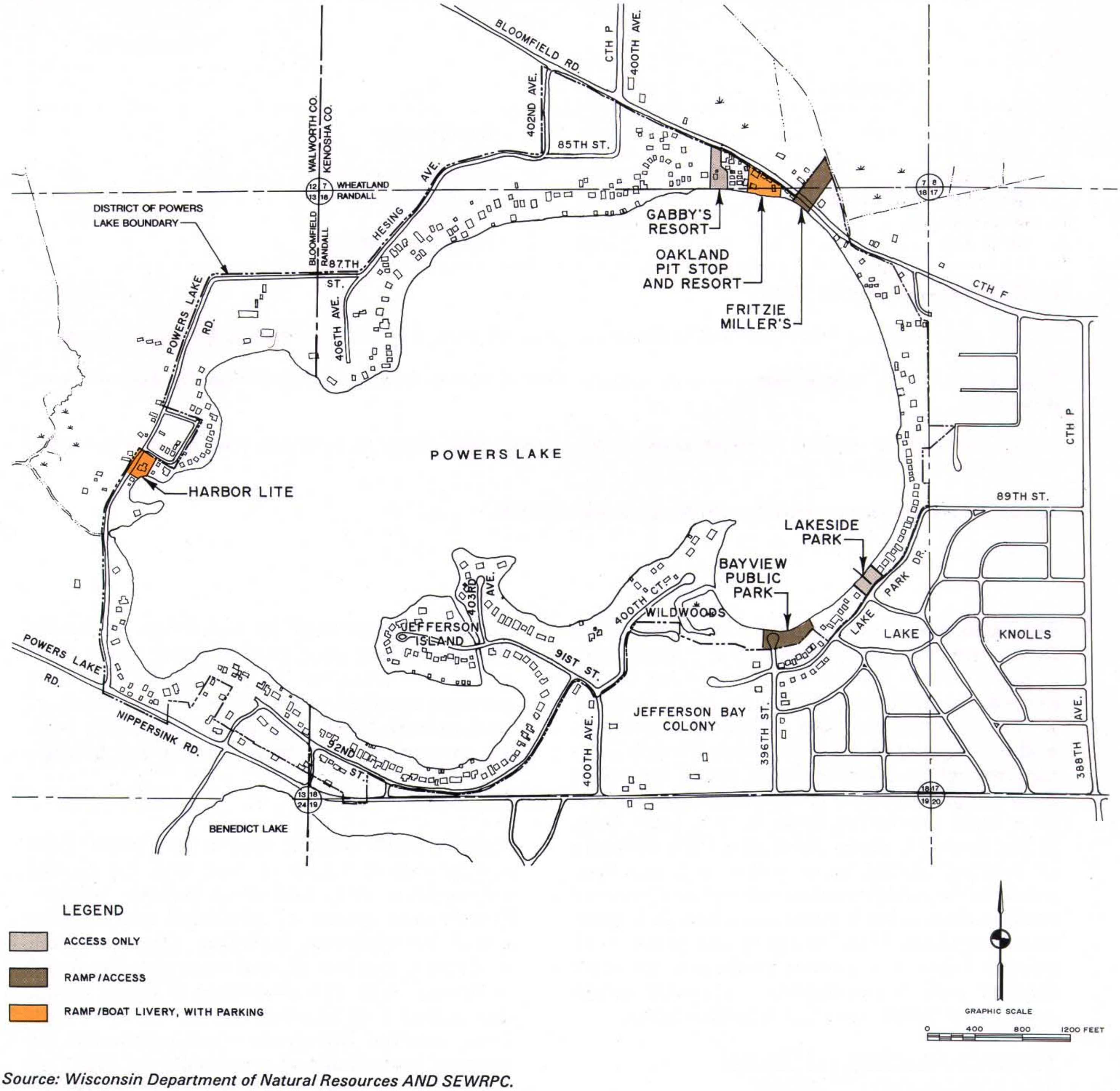
Public Access

In 1985, the Wisconsin Department of Natural Resources surveyed lake access sites around Powers Lake. This information was updated by Commission staff in 1991. The results of the survey are presented on Map 25 and Table 28. There are six public access sites on Powers Lake. Two of these sites are owned by the Town of Randall and four are privately owned. Of the four privately owned access sites, three have a ramp and provide parking for a total of 43 cars with trailers. The Department evaluated the adequacy of the existing public access sites for nonresident use. A site was judged to be adequate if it was publicly owned, had sufficient facilities for boat launching and parking, and charged reasonable fees compared to the standard fees charged in state parks. Private sites were not considered adequate because there can be no assurance that the sites will remain open from one year to the next nor can there be any assurance concerning the reasonableness of fees charged for access.

The Department, under guidelines established in Chapters NR 1.90 and NR 1.92 of the Wisconsin Administrative Code, recommended that at least one access and public boat launching site be provided on all major inland lakes. The Department recommendation for a publicly owned boat launching facility is not met on Powers Lake. Consequently, Departmental policies would require the development of a publicly owned boat launching facility if the Lake District is to receive financial and/or technical assistance for in-lake and watershed management programs. Such programs could include lake rehabilitation, nonpoint source water pollution control, fish management, and water safety aids.

Map 25

POWERS LAKE PUBLIC ACCESS SITES: 1990



Source: Wisconsin Department of Natural Resources AND SEWRPC.

Table 28

PUBLIC ACCESS SITES ON POWERS LAKE: 1991

Location	Owner	Type	Available Parking Spaces	
			Car-Trailer	Car
Bayview Public Park	Town	Ramp/access	0	0
Lakeside Park	Town	Access only	0	22
Fritzie Miller's	Private	Ramp/boat livery[a]	20	0
Oakland Pit Stop & Resort	Private	Ramp/boat livery[b]	13	16
Gabby's Resort	Private	Access only	0	10
Harbor Lite	Private	Ramp/boat livery[c]	10	14

NOTE: All fees are as of May 1991.

[a]*Launch and storing fees: $8.00 daily; $50 to 60 per season, launch only; $250 to 350 per season, launch and storage.*

[b]*Boat rental: $10 per rowboat with two safety cushions; $400 to 500 per season, docking. Launch fees have not been determined.*

[c]*Boat rental: $10 per rowboat, $1.50 per safety cushion. Launch fees: $8.00, 15 to 19 feet; $15, 21 to 25 feet; $18, 25 to 29 feet; $20, 29 to 30 feet.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

The Department is developing a statewide policy for the purchase, development, and maintenance of public access sites to lakes. A ranking system has been established which sets high, medium, or low priorities for lakes regarding acquisition and development for public access. Powers Lake has been given a high-priority rating for public access acquisition and development because it is in a high population area; it is a large lake, larger than 500 acres; there is a high diversity of boating during open water and excellent potential for a high-quality fishery; and existing public access is inadequate according to Department guidelines. Under the proposed policy, high priority lakes will receive preference for state funding and implementation of public access acquisition, development, and maintenance.

Wisconsin Department of Natural Resources Recreational Rating

A recreational rating technique has been developed by the Department of Natural Resources to characterize the recreational value of inland lakes. As shown in Table 29, Powers Lake received 68 out of the possible 72 points, indicating that high-quality, diverse recreational opportunities are provided by the Lake. Favorable features include good quality water and a sand and gravel shoreline. In general, Powers Lake provides excellent opportunities for a variety of outdoor recreational activities, particularly boating, swimming, aesthetic enjoyment, and fishing.

SUMMARY

Aquatic plants supply oxygen to Powers Lake and provide a source of food and habitat for zooplankton, fish, and other aquatic wildlife. Twenty-three species of submerged and floating-leaved macrophytes, including Chara, milfoil, wild celery, pondweeds, and waterlilies are found in Powers Lake. The abundance of Chara on the lake bottom may help prevent the spread of more weedy species. Blue-green algae dominated the summer phytoplankton community in 1987, but did not reach excessive concentrations. Currently, there is no known use of algicides, herbicides, or mechanical harvesting on the Lake.

Zooplankton are an important link in the aquatic food chain, consuming phytoplankton and providing a source of food for fish. The

Table 29

RECREATIONAL RATING OF POWERS LAKE: 1990

Space: Total Area - 459 acres   Total Shore Length - 5.0 miles

Ratio of Total Area to Total Shore Length: 0.14

Quality (18 maximum points under each heading)

Fish:		
X 9 High production	___ 6 Medium production	___ 3 Low production
X 9 No problems	___ 6 Modest problems such as infrequent winterkill, small rough fish problems	___ 3 Frequent and overbearing problems such as winterkill, carp, excessive fertility
Swimming:		
X 6 Extensive sand or gravel substrate (75 percent or more)	___ 4 Moderate sand or gravel substrate (25 to 50 percent)	___ 2 Minor sand or gravel substrate (less than 25 percent)
X 6 Clean water	___ 4 Moderately clean water	___ 2 Turbid or darkly stained water
X 6 No algae or weed problems	___ 4 Moderate algae or weed problems	___ 2 Frequent or severe algae or weed problems
Boating:		
X 6 Adequate water depths (75 percent of basin more than five feet deep)	___ 4 Marginally adequate water depths (50 to 75 percent of basin more than five feet deep)	___ 2 Inadequate depths (less than 50 percent of basin more than five feet deep)
___ 6 Adequate size for extended boating (more than 1,000 acres)	X 4 Adequate size for some boating (200 to 1,000 acres)	___ 2 Limit of boating challenge and space (less than 200 acres)
X 6 Good water quality	___ 4 Some inhibiting factors such as weedy bays, algae blooms, etc.	___ 2 Overwhelming inhibiting factors such as weed beds throughout
Aesthetics:		
___ 6 Existence of 25 percent or more wild shore	X 4 Less than 25 percent wild shore	___ 2 No wild shore
X 6 Varied landscape	___ 4 Moderately varied landscape	___ 2 Unvaried landscape
X 6 Few nuisances such as excessive algae carp, etc.	___ 4 Moderate nuisance conditions	___ 2 High nuisance condition

Total Quality Rating: 68 out of a possible 72

Source: Wisconsin Department of Natural Resources and SEWRPC.

zooplankton community during the Summer of 1987 was found to be typical of a southeastern Wisconsin, mesotrophic lake. Copepods dominated in June and August, rotifers dominated in July.

Historically, Powers Lake has supported a good walleye-bass-panfish population. According to a 1990 survey of Powers Lake anglers, the most frequently caught fish types are panfish, largemouth bass, yellow perch, and crappies. The majority of anglers who responded to the survey have perceived a decline in walleyed and northern pike and an increase in carp over the past five years.

Approximately 47 percent of the Powers Lake drainage area and about 33 percent of the land area has been designated as a primary environmental corridor, with a high concentration of natural, recreational, historical, aesthetic, and scenic resources that should be preserved and protected. Included in the corridor are about 312 acres of wetlands which provide habitat for spawning fish, migrating waterfowl, and area wildlife. Powers Lake itself is also a part of the corridor, and the Regional Planning Commission has identified shoreline areas of the Lake that contain valuable aquatic plant communities used for spawning, feeding, or shelter purposes for aquatic animals.

According to a 1990 recreational use survey of Powers Lake, the most popular activities are powerboating, swimming, scenic viewing, and waterskiing. Winter activities include ice skating, cross-country skiing, snowmobiling, and ice fishing. Weekend boating concentrations on Powers Lake have reached unsafe levels according to the Commission and Wisconsin Department of Natural Resources boating safety density standards and surveys conducted in 1990.

The Wisconsin Department of Natural Resources guidelines for a publicly owned boat launching facility are currently not met on Powers Lake. Consequently, Departmental policies would normally require the development of a publicly owned boat launching facility if the Lake District is to receive financial and/or technical assistance for in-lake and watershed management programs. Such programs could include lake rehabilitation, nonpoint source water pollution control, fish management, and water safety aids.

The Department of Natural Resources has identified Powers Lake as providing high-quality and diverse recreational opportunities and has classified it as a high-priority lake for public access acquisition and development.

Chapter VI

WATER USE OBJECTIVES AND WATER QUALITY STANDARDS

The areawide water quality management plan adopted by the Regional Planning Commission, as set forth in SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000, recommends water use objectives and supporting water quality standards for all major lakes and streams in the Region. The water use objectives recommended for Powers Lake are full warm-water fishery and full-body contact recreational use. The water quality standards which support these objectives are set forth in Table 30. Standards are recommended for temperature, pH, dissolved oxygen, fecal coliform, and total phosphorus.

The total phosphorus standard of 0.02 milligram per liter (mg/l) applies to lakes during spring turnover, when the lakes are not stratified and maximum vertical mixing is occurring. The achievement of this standard is expected to prevent excessive macrophyte and algae growths in most lakes, although lake rehabilitation techniques may also be required to avoid seasonal problems associated with the recycling of phosphorus from the bottom sediments. Excessive total phosphorus levels may stimulate large growths of algae and aquatic macrophytes, which interfere with recreational use. As these plant masses die and decompose, dissolved oxygen depletion, which threatens the survival of fish and aquatic life, may result. Although many factors are involved, one pound of phosphorus may produce from 1,000 to 10,000 pounds wet weight of aquatic plant material. The decomposition of this amount of plant material, generated from one pound of phosphorus, could consume 100 pounds or more of dissolved oxygen.

The phosphorus concentration in the Lake is directly related to the phosphorus load contributed to the Lake by the Powers Lake inlet, by stormwater runoff from urban and rural lands in the direct drainage area, by onsite sewage disposal systems, by atmospheric sources, and by groundwater; however, some recycling of phosphorus from the lake bottom sediments also occurs.

Table 30

RECOMMENDED WATER QUALITY STANDARDS FOR POWERS LAKE

Water Quality Parameter	Water Quality Standard
Maximum Temperature (°F)	89[a,b]
pH Range (standard units)	6.0-9.0[c]
Minimum Dissolved Oxygen (mg/1)[b]	
30-Day Mean	5.5
Seven-Day Mean	6.0[d]
One-Day Mean	4.0-5.0[e]
Absolute	2.5
Maximum Fecal Coliform (counts per 100 ml)	200-400[f]
Maximum Total Phosphorus (mg/1)	0.02[g]

[a] *There should be no temperature changes that may adversely affect aquatic life. Natural daily and seasonal temperature fluctuations should be maintained. The maximum temperature rise above the existing natural temperature should not exceed 3°F.*

[b] *Dissolved oxygen and temperature standards apply to the epilimnion of stratified lakes; the dissolved oxygen standard does not apply to the hypolimnion of stratified inland lakes. Trends in the period of anaerobic conditions in the hypolimnion of stratified lakes should be considered important to the maintenance of water quality, however.*

[c] *The pH should be within the range of 6.0 to 9.0 standard units, with no change greater than 0.5 unit outside the estimated natural seasonal maximum and minimum.*

[d] *A minimum dissolved oxygen standard of 6.0 milligrams per liter (mg/l) for a seven-day mean applies only between March 15 and July 31 for the support of embryonic, larval, and early juvenile stages of warmwater species.*

[e] *A minimum dissolved oxygen standard of 5.0 mg/l for a one-day mean applies only between March 15 and July 31 for the support of embryonic, larval, and early juvenile stages of warmwater species. For the remainder of the year, a minimum dissolved oxygen standard of 4.0 mg/l for a one-day mean applies.*

[f] *Fecal coliform levels should not exceed a monthly geometric mean of 200 counts per 100 milliliters (ml) based on not fewer than five samples per month, nor a monthly geometric mean of 400 counts per 100 ml in more than 10 percent of all samples during any month.*

[g] *The recommended total phosphorus standard applies only during spring, when maximum vertical mixing is underway.*

Source: SEWRPC.

The present in-lake phosphorus concentration of 0.012 mg/l is below the Commission standard of 0.02 mg/l, the level considered necessary to prevent nuisance algae and macrophyte growth. However, it is estimated that the Lake currently receives over 700 pounds of phosphorus per year. As discussed in Chapter IV, only about 16 percent of the phosphorus budget leaves Powers Lake through the outflow and the remaining 84 percent is lost to sedimentation. The accumulation of nutrients and sediments in Powers Lake may eventually lead to water quality problems including increased turbidity, nuisance algae and macrophyte growth, and an unbalanced fishery. When water quality deteriorates, management efforts to restore the lake are often costly and their success unpredictable. Preventive measures to control the loadings to Powers Lake will reduce the risk of future water quality problems and the need for in-lake management.

As discussed in Chapter IV, agricultural land use contributed the greatest portion of phosphorus and sediment loads to Powers Lake. Analyses conducted as part of the regional water quality management plan recommended a 25 percent reduction in nonpoint source pollutant loadings from the direct drainage area in order to maintain the desired in-lake water quality standard. In addition, the adopted Kenosha County agricultural soil erosion plan, as set forth in SEWRPC Community Assistance Planning Report No. 164, Kenosha County Agricultural Soil Erosion Control Plan, recommends cropland soil erosion control objectives and standards for croplands in Kenosha County. Although the objective of this soil erosion control plan is to maintain long-term productivity of soils through the prevention of excessive cropland soil erosion, such control will also assist in maintaining surface water quality. The soil erosion control standards which support this objective for the Powers Lake drainage area are outlined in Table 31.

Table 31

RECOMMENDED CROPLAND SOIL EROSION CONTROL STANDARDS FOR POWERS LAKE DRAINAGE AREA

Date	Standard
July 1, 1993	Average soil erosion rate for all cropland in Kenosha County should not exceed T-value
July 1, 1995	Soil erosion rate on individual cropland fields should not exceed two times T—value
January 1, 2000	Soil erosion rate on individual cropland fields should not exceed T-value

NOTE: "T-value" is the tolerable soil loss rate, the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely, as determined by the U. S. Soil Conservation Service.

Source: SEWRPC.

Chapter VII

ALTERNATIVE POWERS LAKE MANAGEMENT MEASURES

INTRODUCTION

Potential measures for the management of water quality and recreational use for Powers Lake include watershed management measures and in-lake techniques, to maintain and improve water quality, and boating and lake basin management measures, to improve recreational experiences and opportunities.

Watershed management measures, which are intended to eliminate or significantly reduce the pollutant loads to the lake, include nonpoint source control in urban and rural areas, proper land use activities, and onsite sewage disposal system management. In-lake techniques, which are intended to treat the symptoms of lake eutrophication and prevent shoreline erosion, include nutrient inactivation, fish and aquatic plant management, shoreline protection measures, and improvements to the lake outlet structure. Alternatives considered to enhance the recreational use of Powers Lake include space and time zoning for recreational activities, restrictions on jet ski use, increased enforcement of the boating ordinance, dredging of designated shallow areas, and provision of public access sites.

WATERSHED LAND MANAGEMENT ALTERNATIVE MEASURES FOR NONPOINT SOURCE POLLUTION CONTROL

Watershed management measures may be used to reduce nonpoint source pollutant loadings from urban sources, such as runoff from residential, commercial, industrial, transportation, and recreational land uses; construction activities; and onsite sewage disposal systems, and from rural sources, such as runoff from cropland, pasture, and woodland; livestock wastes; and atmospheric contributions. The alternative measures considered in this report are presented in SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000, 1979; and SEWRPC Community Assistance Planning Report No. 164, Kenosha County Agricultural Soil Erosion Control Plan, 1989.

The water quality analyses presented previously in this report indicate that the in-lake total phosphorus concentration between 1986 and 1989 averaged 0.012 milligrams per liter (mg/l), which falls within the Commission's recommended water quality standards. The pollutant loading from sources such as runoff from rural and urban areas in the Powers Lake drainage area should, nevertheless, be of concern because the presence of toxic materials, sediment, and phosphorus in stormwater runoff has been well documented and the body of evidence linking nonpoint source pollution with undesirable water quality impacts is growing. Furthermore, it has been shown that much of the phosphorus entering Powers Lake is deposited in the sediments rather than being carried out through the lake outlet. It is considered important to minimize this buildup of phosphorus in the sediments. Water quality analyses reported in Chapter IV indicate that there is currently little impact on lake water quality due to release of phosphorus from the sediments. However, if phosphorus release from the sediments should increase, its impact on water quality could become significant.

Additional alternative watershed measures for protecting the quality of water entering Powers Lake include measures for protecting wetlands in the Powers Lake drainage area and for protecting groundwater recharge areas in the uplands surrounding Powers Lake. These measures include acquisition of wetlands by public and private organizations and development of wetland and groundwater education programs.

Urban Nonpoint Source Control

This discussion is divided into two parts. The first part concerns the role of construction erosion as a nonpoint source of pollutants. Construction areas are considered to include a wide array of situations including urban renewal projects, individual site development within the existing urban area, and new subdivision development. The second part concerns existing urban areas as pollution sources. These areas include established residential, commercial, industrial, highway, and open space land uses.

Construction Site Erosion Control: During 1985, development occurred on 18 acres of land in the Powers Lake drainage area. As discussed in Chapter III, no significant changes in land use conditions are envisioned in the Powers Lake direct drainage area. However, construction activity may be expected from individual site development associated with infilling of existing platted lots and redevelopment activities in existing developed areas.

Previous experience in Wisconsin and throughout the country has underscored the importance of land development as a nonpoint source of pollutants. As indicated in Chapter IV, construction sites in the Powers Lake drainage area may be expected to produce suspended solids and phosphorus at rates several times higher than established commercial or industrial land uses. The data in Chapter IV indicate that even a small amount of construction may result in relatively large pollutant loadings to surface waters.

Construction site erosion control measures are temporary measures that can reduce pollutant loadings during stormwater runoff events. Such measures include revegetation practices, such as temporary seeding, mulching, and sodding; and runoff control measures, such as filter fabric fences, straw bale barriers, inlet protection devices, diversion swales, sediment traps, and sedimentation basins. Construction erosion control measures may be expected to reduce pollutant loadings from construction sites by about 75 percent. While this practice is expected to reduce the phosphorus loadings to Powers Lake by about 3 percent because of the relatively small amount of land planned to be developed, it is nevertheless an important pollutant control measure to prevent localized short-term loadings of phosphorus and sediment from the upstream tributary drainage area. Although erosion control costs are highly variable, depending on site specific conditions, capital costs may be expected to range typically from about $1,500 per acre if sedimentation basins are not required, to about $3,000 per acre if such basins are required. Annual operation and maintenance costs may be expected to average about 5 percent of the capital costs, or from about $75 to about $150 per acre per year.

Construction erosion control measures are required under the provisions of the current County-Town zoning requirements as set forth in the Walworth County Construction Site Erosion Control Ordinance for the Town of Bloomfield and in the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance and in the Kenosha County Subdivision Control ordinance for the Towns of Randall and Wheatland in the Powers Lake drainage area. The Walworth County Construction Site Erosion Control Ordinance, which was adopted in 1990, is based on a model ordinance for construction erosion control developed by the Wisconsin League of Municipalities in cooperation with the Wisconsin Department of Natural Resources (DNR), and is set forth in Wisconsin Construction Site Best Management Practices Handbook, 1989. The ordinance requires the submittal of a control plan for land-disturbing activities, which includes the locations and dimensions of all site control measures prior to permit approval; sets forth standards, criteria, and specific measures for erosion control; and identifies enforcement procedures which may require, upon notice of ordinance violation, work completed within 24 hours to come to full compliance after which work would be performed by the County Technician or designee.

The Kenosha County Subdivision Control Ordinance includes provisions which require the preparation and submittal of erosion and sedimentation control plans prior to construction; sets forth requirements limiting vegetation removal; and identifies certain other measures for erosion control. Violations of this ordinance are subject to appropriate legal action or proceedings by the County.

The Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance provides for water quality protection by prohibiting activities, such as construction erosion, that would harm, pollute, contaminate, or cause nuisances to surface waters and by prohibiting the storage and discharge of soils in such a manner that would promote their discharge to surface or ground waters, and by setting forth general requirements for vegetation removal in selected areas. Violations of the ordinance have up to 30 days after notification to comply with the ordinance to avoid fines.

It is recommended that Kenosha County adopt construction site erosion control ordinance. This would provide certain specific standards, criteria, and measures relating to erosion control not now provided in the county zoning and subdivision ordinances. It is recommended that the ordinance provisions be applicable to all construction and require a relatively high level of control in areas draining directly to inland lakes, such as Powers Lake. Such controls could include the provision of silt fences, sedimentation basins, rapid revegetation of disturbed areas, control of "tracking" from the site, and careful planning of the construction sequence to minimize areas of disturbed vegetation and sod. The proper administration of a countywide construction site erosion control ordinance may require additional staffing. The implementation of construction erosion control measures in the Powers Lake drainage area may be expected to reduce the phosphorus loading from developing land to Powers Lake by about 75 percent and to reduce the total loading to the Lake by about 3 percent.

Although the direct impact of construction erosion control measures on water quality may be expected to be minimal in the Powers Lake area, this management measure should be a component of the comprehensive lake management plan for Powers Lake in order to avoid localized short-term pollutant loading impacts. Construction erosion control is considered a sound development practice which should be incorporated into all local development regulations.

Existing Urban Areas: In addition to contributing sediments and nutrients to Powers Lake, as rural sources do, urban sources also contribute toxic substances, especially metals such as lead, cadmium, copper, and zinc. Within the drainage areas to Powers Lake, urban nonpoint sources are particularly important, because most of the urban land is located immediately adjacent to the lake. As described in Table 13 in Chapter IV, shoreline drainage-related nonpoint source pollution contributes just about 35 percent of the total phosphorus loading to Powers Lake.

Applicable urban nonpoint source control measures include wet detention basins, grassed swales, and good urban "housekeeping" practices. Generally, the application of low-cost urban housekeeping practices may be expected to reduce nonpoint source loadings from the urban lands by about 25 percent. Properly designed wet detention basins can remove a large percentage, up to 80 percent, of the loading of particulate pollutants and may also allow biological uptake of nutrients to occur. The minimum basin size would be about 0.25 acre; all basins would retain a mean permanent pool depth of about five feet. Although site-specific hydrologic and hydraulic analyses are required to properly locate, design, and size wet detention basins and to select outflow rates, three preliminary sites have been identified and are listed in Table 32. One constraint on the use of basins is the availability of suitable sites. Sites may be suitable if they contain adequate open land area for the development of the basin, are on or near a well-defined drainage system, and drain an appropriately sized area which generates significant pollutant loadings.

Public education programs can be developed to encourage good urban housekeeping practices, to promote the selection of building and construction materials which reduce the runoff contribution of metals and other toxic pollutants, and to promote the acceptance and understanding of the proposed pollution abatement measures and the importance of lake water quality protection. Urban housekeeping practices and source controls include restricted use of fertilizers and pesticides; improved pet waste and litter control; the substitution of plastic for galvanized steel and copper roofing materials and gutters; proper disposal of motor vehicle fluids; increased leaf collection; and reduced use of street deicing salt. Particular attention should be given to reducing pollutant loadings from high pollutant loading areas, such as commercial sites, parking lots, and material storage areas. To the extent practicable, rooftop and parking lot stormwater runoff should be diverted to areas covered by pervious soils and appropriate vegetation, rather than being directly discharged to impervious surfaces and storm sewers. Material storage areas may be enclosed or periodically cleaned, and diversion of stormwater away from these sites may further reduce pollutant loadings.

Other measures, such as reduced use of leaded gasoline and air pollution abatement, which may be implemented on a regional or national level, may also be expected to reduce loadings of certain pollutants including metals. For example, the reduced use of leaded gasoline since 1974 has contributed to reduced dissolved lead levels in nearly two-thirds of the major rivers in the United States.[1]

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[1] *R. B. Alexander and R. A. Smith, "Trends in Lead Concentrations in Major U. S. Rivers and Their Relation to Historical Changes in Gasoline Lead Consumption," Water Resources Bulletin, Vol. 24, No. 3, June 1988, pp. 557-569.*

Table 32

POTENTIAL WET DETENTION BASIN SITES TO SERVE EXISTING DEVELOPMENT

Site Number	Location	Roughly Estimated Drainage Area (acres)	Development Served	Viability
1	T1N, R19E NW¼ Section 17	14	Low-density residential	Unlikely, located in yard area between existing residences
2	T1N, R19E NE¼ Section 17	25	Residential and agricultural	Naturally functions as retention basin under existing conditions; thus would not provide a significant reduction in pollutant loadings
3	T1N, R19E SE¼ Section 7 (southwest of post office)	7 (might be expanded to 9.5 acres through modification of existing drainage pattern to include runoff from area north of Bloomfield Road)	Predominantly residential, some commercial	Would probably require removal of two residences

Source: SEWRPC.

Grassed drainage swales, including grassed roadway ditches, may be expected to reduce pollutant loadings through both filtering and infiltration. Properly designed grassed swales may be expected to remove 20 to 40 percent of the particulate pollutant loadings which drain to the swales, although reductions for dissolved pollutants are much lower.

Proper design and application of urban nonpoint source control measures such as grassed swales requires the preparation of a ditched stormwater management system plan that addresses stormwater drainage problems, controls nonpoint sources of pollution, and helps reduce downstream flooding. Based on a preliminary evaluation, however, it is estimated that three wet detention basins, combined with about 500 lineal feet of grassed swale and good urban housekeeping practices, could provide an approximately 50 percent reduction in pollutant loadings from the treated urban lands within the drainage area tributary to Powers Lake. It is estimated that implementation of these practices will reduce the total pollutant loading to Powers Lake by 9 percent when combined with the low-cost measures described in the subsequent paragraph. These measures would entail an estimated capital cost of $90,000 and an annual operation and maintenance cost of about $4,300.

The preliminary evaluation indicated that only a limited number of locations for the detention basins are available in the area. Table 32 presents selected data for three potential sites. Review of the distribution of the pollutant loadings relative to the location of the potential sites for the detention basins indicates that such basins would be relatively ineffective and costly since patterns of stormwater flow to the Lake are generally short overland sheet flows, making it difficult to collect and detain stormwater runoff from a reasonably large area at one location. In addition, as discussed in Chapter VI, a large reduction in pollutant loading is not required to achieve water quality standards. Thus, it may be concluded that a high level of urban nonpoint source control, which includes stormwater treatment facilities like detention basins, does not appear to be a necessary element of a water quality management plan for Powers Lake. The inclusion of low cost urban housekeeping practices and public education efforts is considered desirable in such a plan. These practices are expected to reduce the phosphorus loading from the urban sources by about 25 percent and the total loading to the Lake by about 6 percent.

Rural Nonpoint Source Control

As discussed in Chapter IV, erosion from agricultural and other rural lands is the primary contributor of sediment and phosphorus to Powers Lake. Suspended sediment can make it difficult for some fish to feed, can cause gill abrasion, and may induce increased susceptibility to disease. In addition, suspended sediment can contribute to elevated water temperatures and lowered dissolved oxygen concentrations. Sediment in streams can destroy fish habitat by covering spawning areas and filling in pools needed for cover. Sediment in lakes can decrease the depth of bays and provide large areas conducive to the growth of rooted aquatic plants. Soil eroded from cropland also carries plant nutrients and pesticides into waterways, leading to eutrophication and toxic conditions for aquatic biota. Map 26 presents the soil loss rates of agricultural fields in the Powers Lake area expressed in multiples of their T-values, or tolerable soil loss rates. As discussed in Chapter VI, soil loss rates that are higher than the T-value indicate excessive cropland erosion. The results of a survey conducted in 1990 by the Walworth and Kenosha County Soil Conservation Services shown on Map 26 indicate that about 591 acres out of 680 acres of agricultural lands surveyed had soil loss rates in excess of their T-value. In 1990, about 29 acres, or 4 percent of the fields surveyed, had soil loss rates that were 1.1 to 1.9 times the T-values; about 383 acres, or about 56 percent, had soil loss rates of 2.0 to 2.4 times the T-values; and about 179 acres, or about 26 percent, had soil loss rates of at least 2.5 times the T-value.

Nonpoint source pollution control measures such as reduced tillage on continuous row crops, contour cropping, contour strip-cropping, terracing, crop rotation, and shoreland buffers were considered as the primary means of reducing rural loadings. Improved fertilizer and pesticide management would also help reduce runoff loadings of nutrients and toxic pesticides. Critical area seeding may be required to control erosion from special problem areas. The estimated effectiveness of these erosion control practices is summarized in Table 33. More detailed information on these practices and related costs can be found in SEWRPC Community Assistance Planning Report No. 164, Kenosha County Agricultural Soil Erosion Control Plan. Detailed farm conservation plans will be required to adapt and refine erosion control practices for individual farm units. Farm conservation plans constitute such detailed plans. Generally prepared with the assistance of the U. S. Soil Conservation Service or County Land Conservation Department staffs, they identify desirable tillage practices, cropping patterns, and rotation cycles, considering the specific topography, hydrology, and soil characteristics of the farm; identify the specific resources of the farm operator; and articulate the farm operator's objectives as owner and manager of the land.

The Agricultural Nonpoint Source (AGNPS) Pollution Model[2] was used to estimate the reductions, after implementation of best management practices on agricultural lands, in storm-generated sediment and phosphorus loadings to Powers Lake via the Powers Lake tributary, which drains primarily agricultural lands and wetlands north of the Lake. The model uses a modified form of the universal soil loss equation, sediment routing equations, and chemical transport equations and requires information on hydrology, soils, upland and channel drainage, and agricultural management. Information for model inputs came from the Kenosha and Walworth County Soil Conservation Committees, climatic data, land use, topographic maps, and aerial photographs. Sediment and phosphorus loadings under existing cropping practices and under proposed conservation practices were simulated for the 1.2-inch, 24-hour and 2.4 inch, 24-hour, two-year recurrence interval, storm events; the 3.2-inch, 24-hour, five-year recurrence interval, storm event; and the 3.8-inch, 24-hour, 10-year recurrence interval, storm event. The conservation practices used in the model were based on those set forth in SEWRPC Community Assistance

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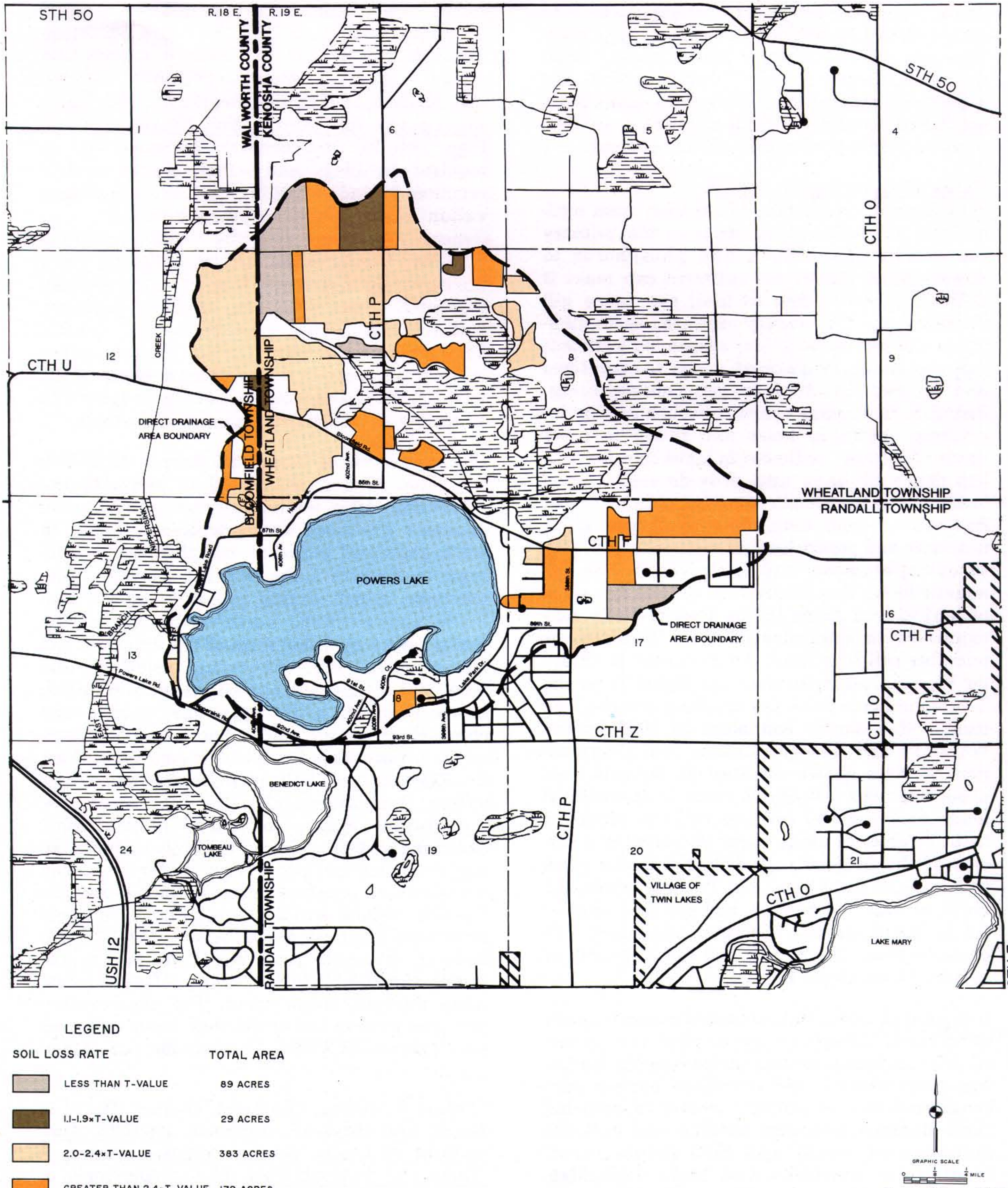
[2]*Robert A. Young, Charles A. Onstad, David D. Bosch, and Wayne P. Anderson, AGNPS, Agricultural Nonpoint Source Pollution Model, A Watershed Analysis Tool, U. S. Department of Agriculture Conservation Research Report 35, 1987.*

Map 26

SOIL LOSS RATE AND TOTAL AREAS OF AGRICULTURAL FIELDS IN THE DRAINAGE AREA TO POWERS LAKE: 1990



Source: Kenosha County and Walworth County Soil Conservation Services.

Planning Report No. 164, Kenosha County Agricultural Soil Erosion Control Plan. It should be noted that the model results are based on general types and amounts of practices and that detailed farm conservation plans would be required to refine model inputs for specific conservation practices.

Figure 22 and Maps 27 through 32 show model-estimated existing sediment and phosphorus loadings and expected sediment and phosphorus loadings if conservation practices, such as contour strip-cropping are implemented. For the two-year, five-year, and 10-year recurrence interval storm events, implementation of practices on agricultural lands to control nonpoint sources is expected to achieve between 51 and 65 percent reduction in sediment delivered and between 50 and 52 percent reduction in phosphorus loadings to the lake via the Powers Lake tributary. For the 1.2-inch rainfall event, the reductions in sediment and phosphorus after implementation of conservation practices are expected to be less than 10 percent.

Thus, the development of control measures on rural lands identified as having excessive erosion may be expected to reduce the nonpoint source pollutant loadings, specifically sediment and phosphorus, from agricultural areas within the Powers Lake drainage area by about 30 percent; and to reduce the total annual phosphorus loading to Powers Lake by about 12 percent. The costs associated with implementation of the practices required to reduce agricultural soil erosion are difficult to estimate as detailed farm conservation plans have not been prepared. Assuming that farmers will be eligible to receive financial assistance to implement conservation practices under state and federal cost-sharing programs, a preliminary estimate of the total capital cost for conservation tillage and contour strip cropping on about 591 acres is approximately $36,000. Annual operation and maintenance would entail a cost of about $2,000.

Table 33

ESTIMATED EFFECTIVENESS OF EROSION CONTROL PRACTICES

Primary Practices	Approximate Soil Loss Reduction[a] (percent)
Conservation Tillage (up and down the slope)	55 to 85
Contouring (moldboard plow)	10 to 50
Contour Strip-Cropping (moldboard plow)	75 to 95
Terracing (moldboard plow)	60 to 80
Crop Rotation (moldboard plow, up and and down the slope)	Variable[b]
Grassed Waterways	Up to 90 in grassed channel
Permanent Vegetative Cover	Up to 90

[a]*In comparison to soil loss assuming continuous corn cropping and moldboard plowing up and down the slope.*

[b]*Depends upon type and sequence of crops grown.*

Source: *U. S. Soil Conservation Service, Waukesha County Land Conservation Department, and SEWRPC.*

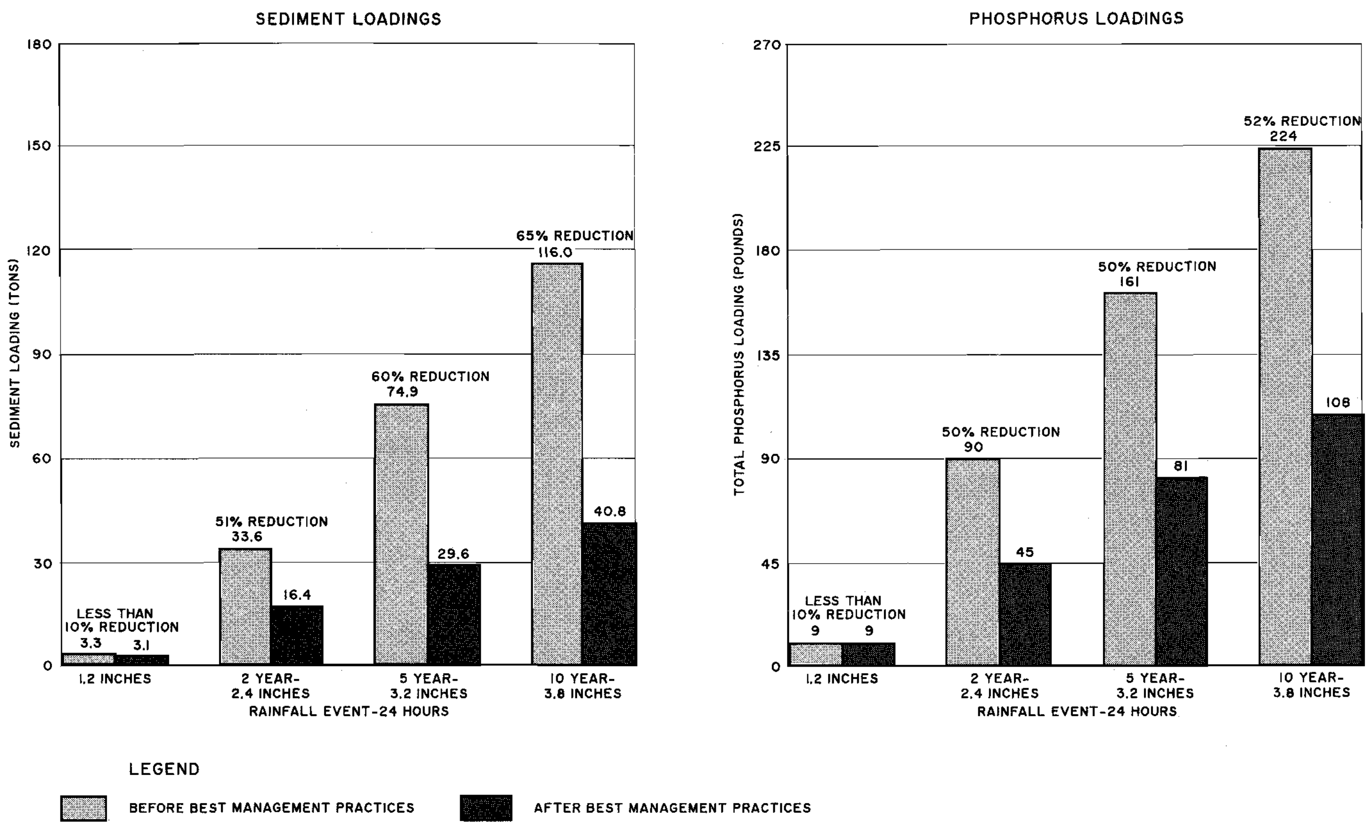
Onsite Sewage Disposal System Management

As reported in Chapter IV, onsite sewage disposal systems in the Powers Lake direct drainage area are estimated to contribute about 10 percent of the total phosphorus loading to the Lake. In addition to lake water quality considerations, sewage disposal options in the area have implications for groundwater quality and property values. Recognizing these potential concerns, a facility planning program specifically designed to evaluate the conditions of the onsite sewage disposal systems around Powers Lake, as well as around Benedict and Tombeau Lakes, was initiated in Fall 1990 by the Towns of Randall, Wheatland, and Bloomfield. This program is intended to evaluate the condition of the existing onsite sewage disposal systems and consider alternative means of resolving any identified problems. The alternatives which are to be considered include:

- The continued use of onsite sewage disposal systems but replacing existing systems with new conventional septic tank systems, mound systems, in-ground pressure systems, or holding tanks, as appropriate.
- The provision of common septic tank effluent infiltration fields to serve clusters of residences in selected areas.
- The provision of a centralized public sanitary sewerage system with conveyance of sewage to, and treatment at, one of the existing sewage treatment plants operated by the Village of Twin Lakes or Genoa City.

Figure 22

SEDIMENT AND PHOSPHORUS LOADINGS TO POWERS LAKE VIA THE POWERS LAKE TRIBUTARY BEFORE AND AFTER BEST MANAGEMENT PRACTICES



Source: SEWRPC.

The evaluation of alternative plans includes an assessment of the existing onsite sewage disposal systems. That assessment is being based upon in-lake water quality monitoring, including septic tank leachate surveys as discussed in Chapter IV, as well as onsite inspections of selected systems; groundwater quality monitoring in selected areas; and an evaluation of data on soils, depth to groundwater, lot sizes, and resultant options for replacement onsite systems. Alternative types of collection systems including gravity and low pressure sewer systems are being evaluated.

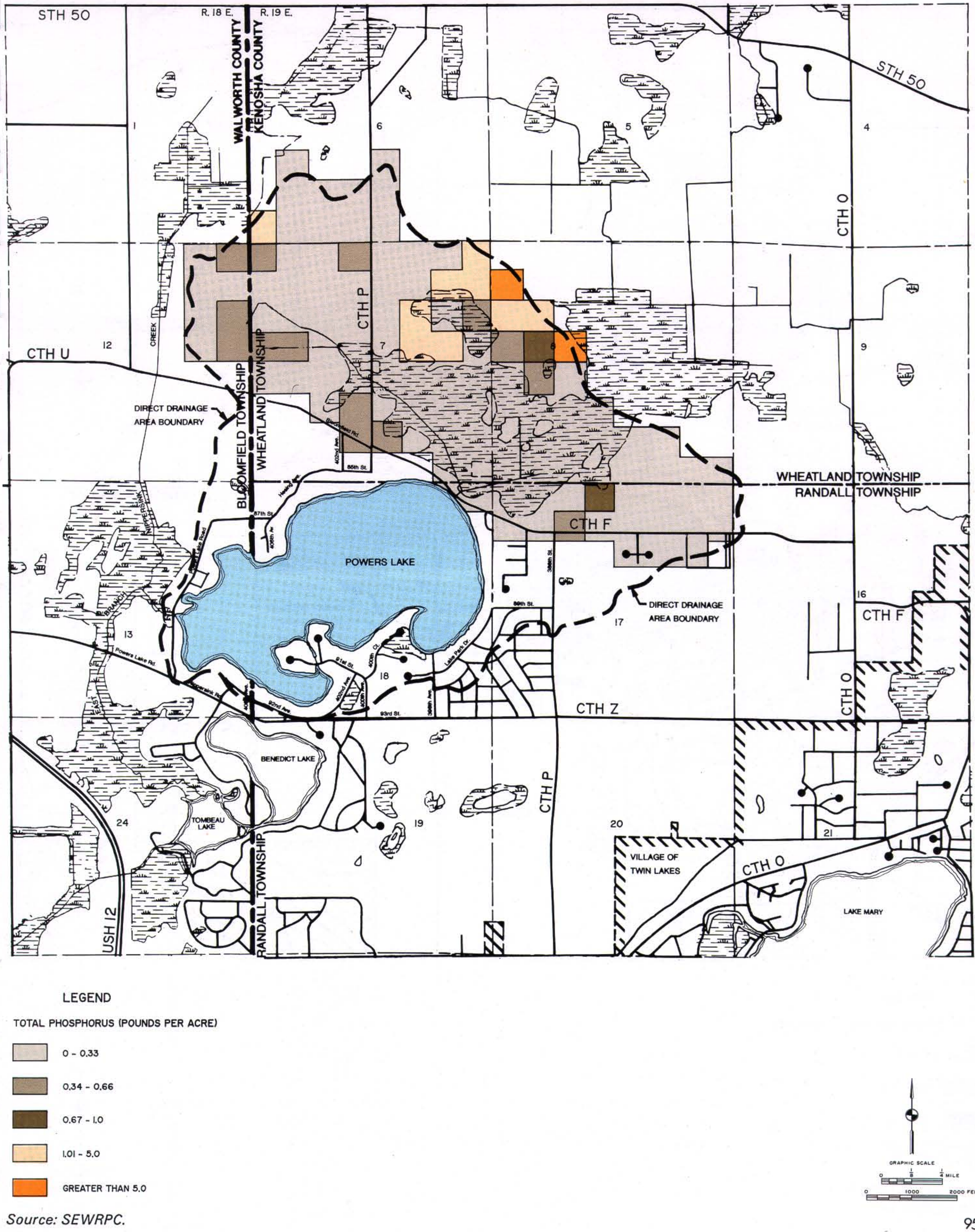
The provision of a centralized sanitary sewer system is expected to eliminate the entire phosphorus loading to Powers Lake from septic systems, which is estimated to be 10 percent of the loading. The implementation of other alternatives would reduce the phosphorus loadings to Powers Lake by less than 10 percent.

LAND USE AND ZONING REGULATION ALTERNATIVES

A fundamental and basic element of any water quality management effort for Powers Lake is the promotion of a sound land use pattern in the tributary watershed. The type and location of future urban and rural land uses in the watershed will determine to a considerable degree the character, magnitude, and distribution of nonpoint sources of water pollution; the practicality of, as well as the need for, various forms of land management; the practicality of various forms of sewage treatment and disposal; and, ultimately, the water quality of the Lake. Existing and planned year 2010 land use patterns and existing zoning regulations were described in Chapter III. In general, it was found that the existing zoning is consistent with the planned future land use pattern in the drainage area to Powers lake. Further consideration was given to alterna-

Map 27

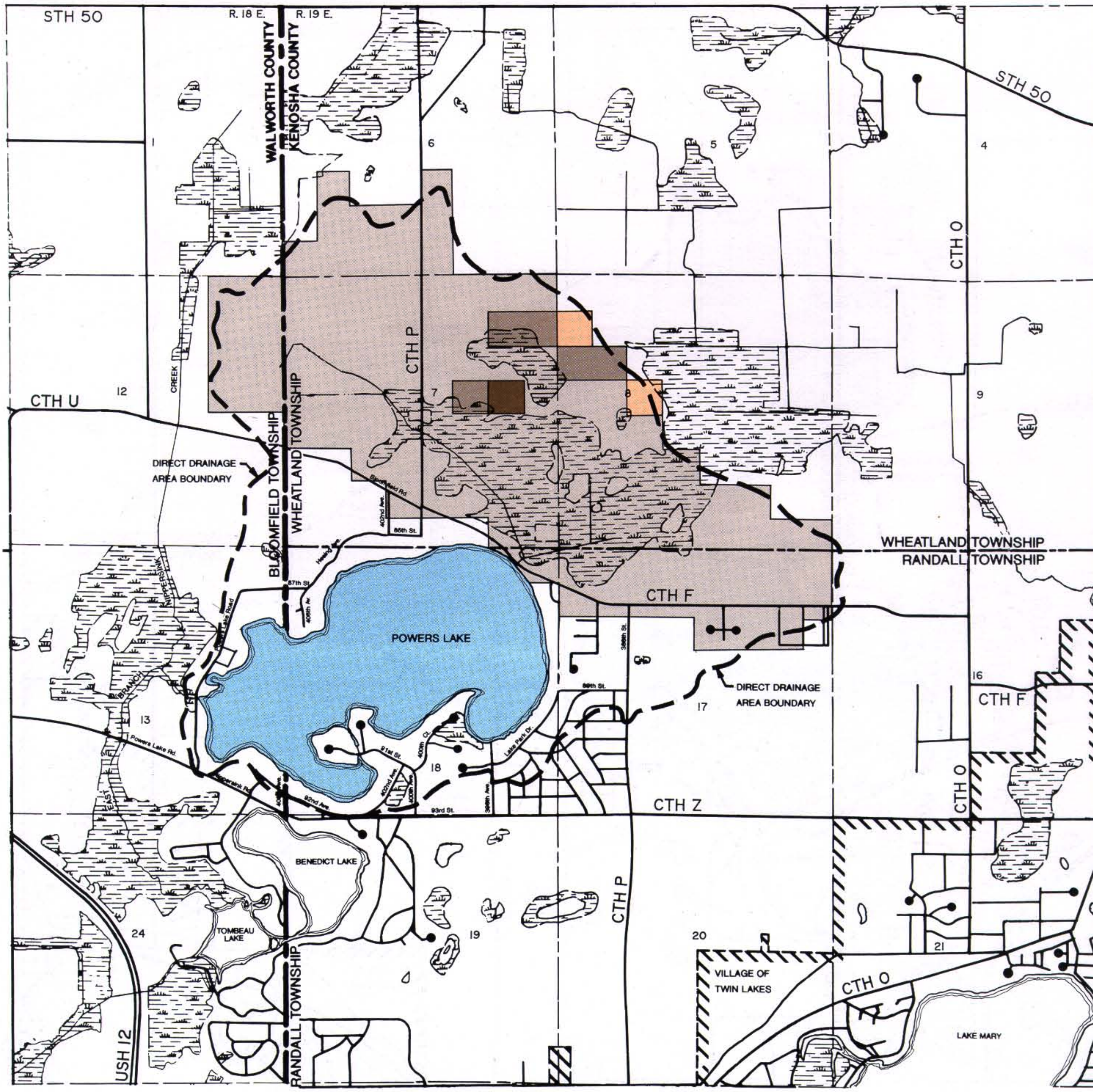
SIMULATED TOTAL PHOSPHORUS YIELDS UNDER EXISTING CONDITIONS IN THE DRAINAGE AREA TRIBUTARY TO THE POWERS LAKE INLET FOR A TWO-YEAR, 24-HOUR STORM EVENT



Source: SEWRPC.

Map 28

EXPECTED TOTAL PHOSPHORUS YIELDS UNDER BEST MANAGEMENT PRACTICES IN THE DRAINAGE AREA TRIBUTARY TO THE POWERS LAKE INLET FOR A TWO-YEAR, 24-HOUR STORM EVENT



LEGEND

TOTAL PHOSPHORUS (POUNDS PER ACRE)

- 0 - 0.33
- 0.34 - 0.66
- 0.67 - 1.0
- 1.01 - 5.0

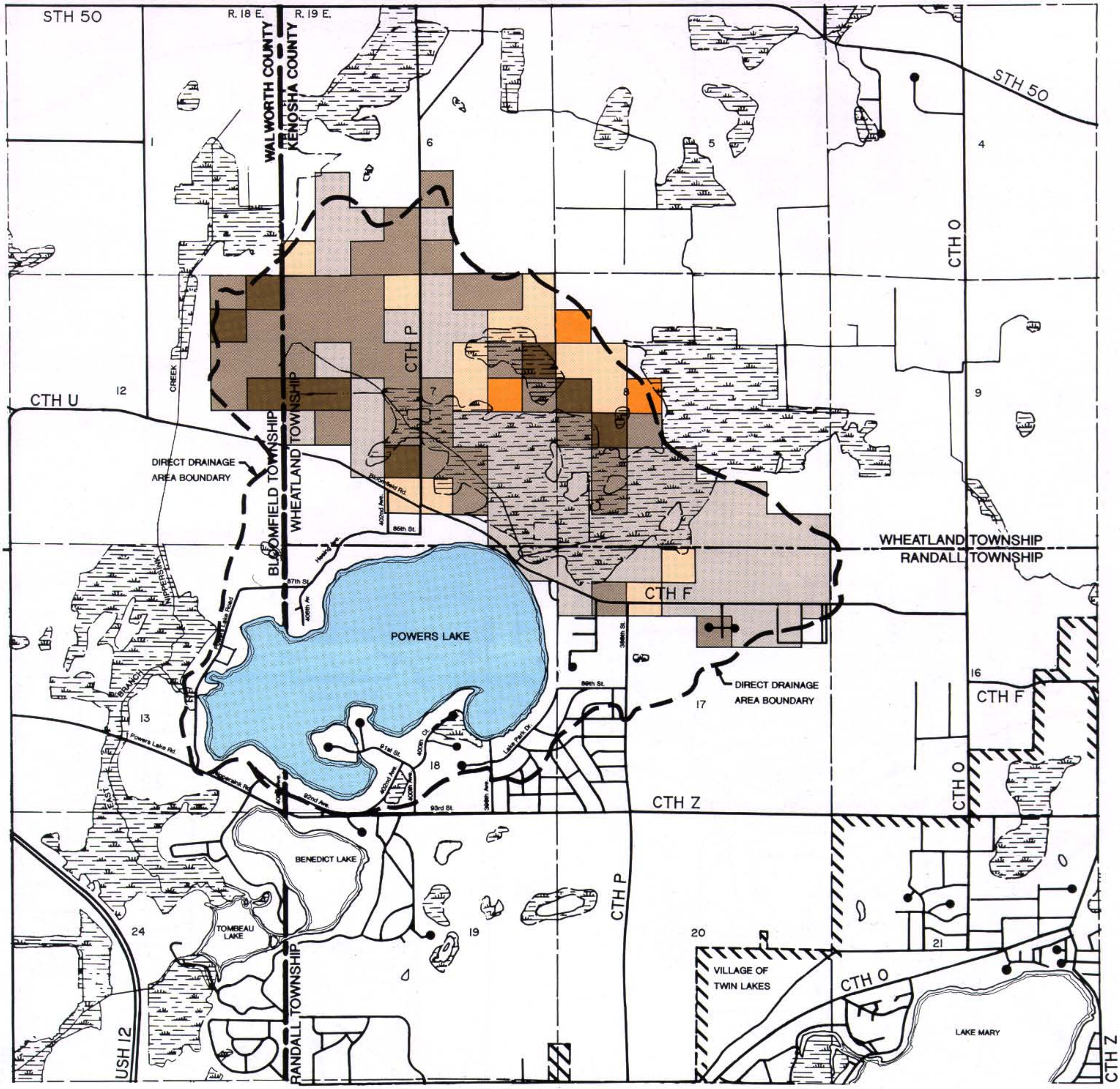
NONE GREATER THAN 5.0

GRAPHIC SCALE

Source: SEWRPC.

Map 29

SIMULATED TOTAL PHOSPHORUS YIELDS UNDER EXISTING CONDITIONS IN THE DRAINAGE AREA TRIBUTARY TO POWERS LAKE INLET FOR A FIVE-YEAR, 24-HOUR STORM EVENT



LEGEND

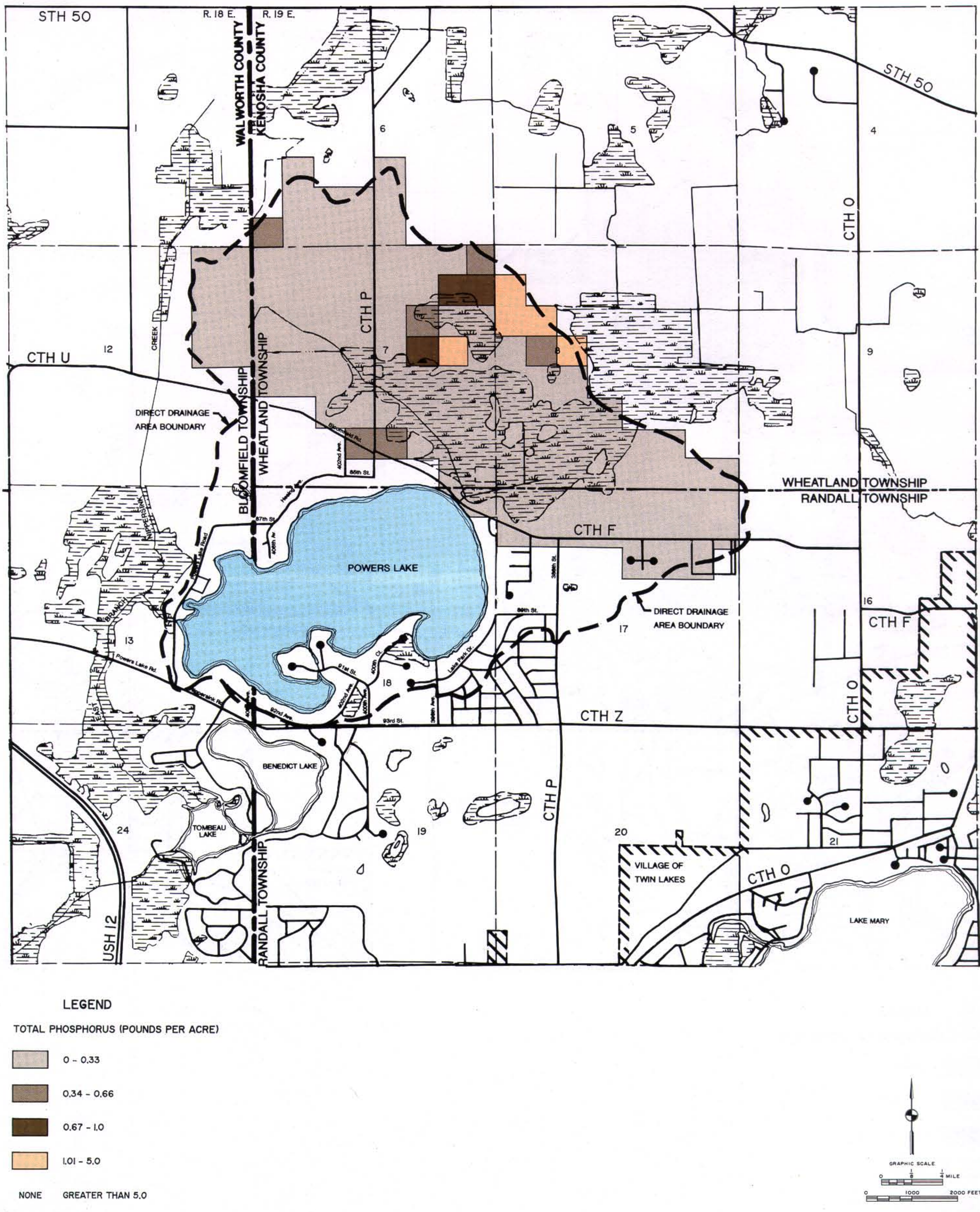
TOTAL PHOSPHORUS (POUNDS PER ACRE)

- 0 - 0.33
- 0.34 - 0.66
- 0.67 - 1.0
- 1.01 - 5.0
- GREATER THAN 5.0

Source: SEWRPC.

Map 30

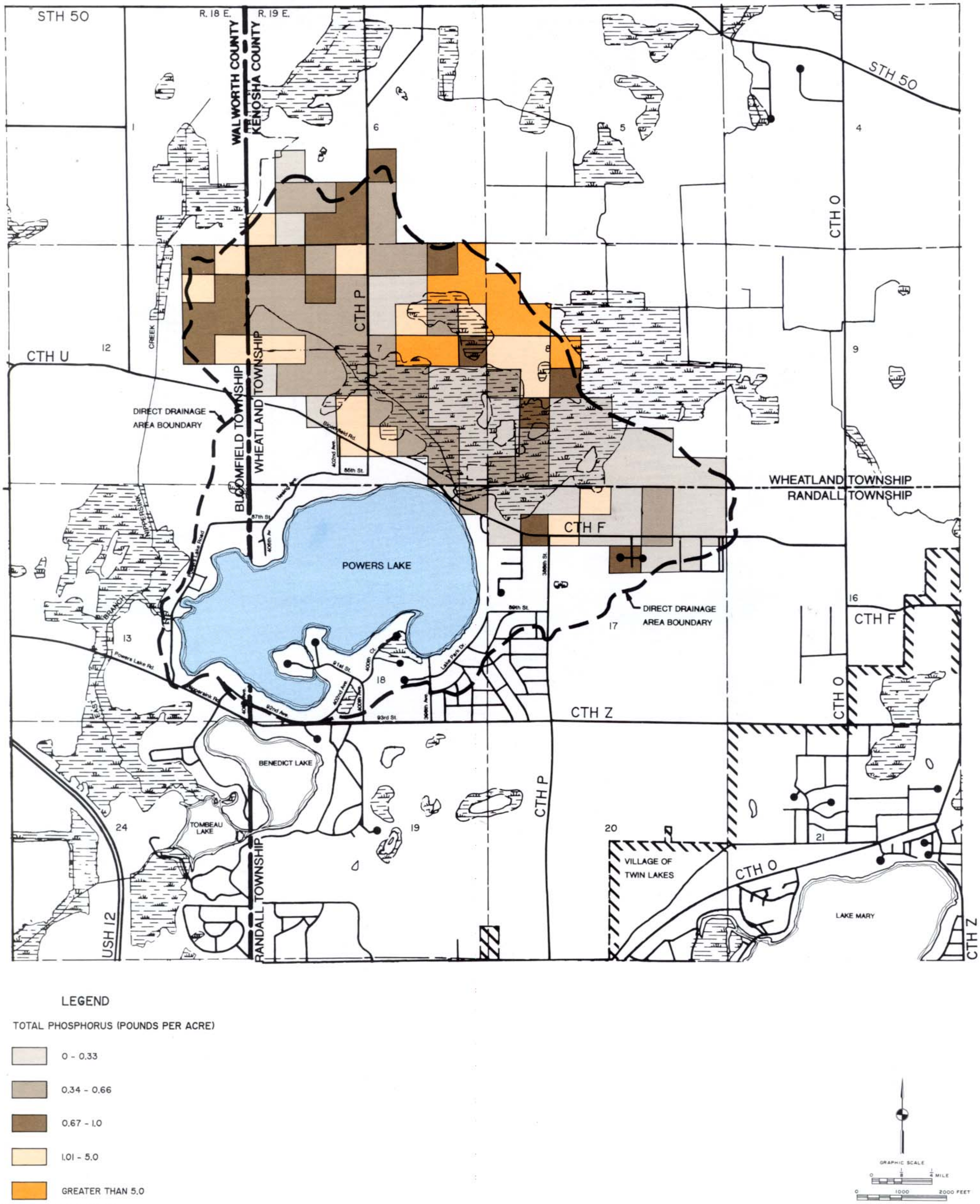
EXPECTED TOTAL PHOSPHORUS YIELDS UNDER BEST MANAGEMENT PRACTICES IN THE DRAINAGE AREA TRIBUTARY TO THE POWERS LAKE INLET FOR A FIVE-YEAR, 24-HOUR STORM EVENT



Source: SEWRPC.

Map 31

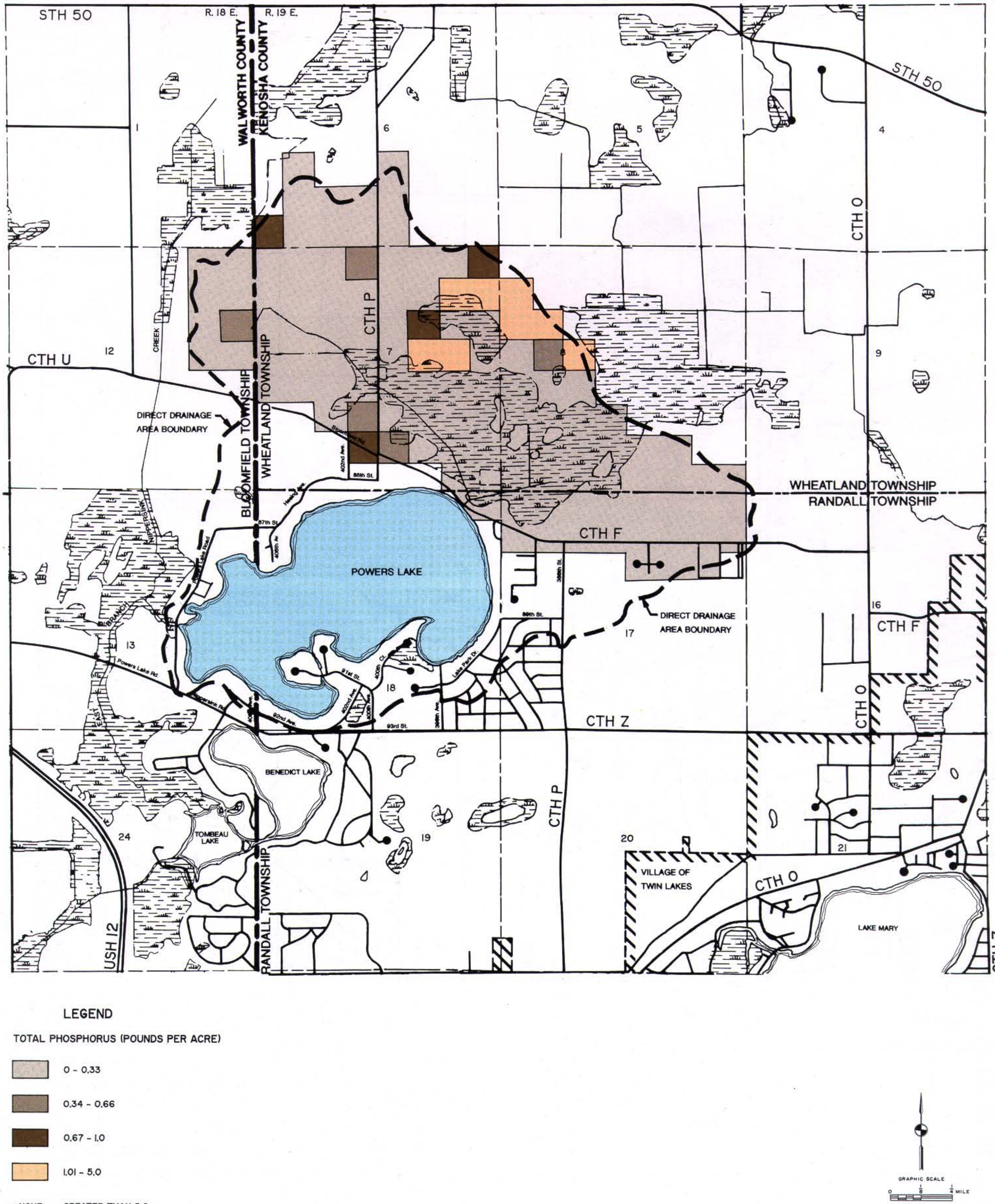
SIMULATED TOTAL PHOSPHORUS YIELDS UNDER EXISTING CONDITIONS IN THE DRAINAGE AREA TRIBUTARY TO THE POWERS LAKE INLET FOR A 10-YEAR, 24-HOUR STORM EVENT



Source: SEWRPC.

Map 32

EXPECTED TOTAL PHOSPHORUS YIELDS UNDER BEST MANAGEMENT PRACTICES IN THE DRAINAGE AREA TRIBUTARY TO THE POWERS LAKE INLET FOR A 10-YEAR, 24-HOUR STORM EVENT



Source: SEWRPC.

tives for increasing protection of wetland and groundwater recharge areas in the Powers Lake drainage area.

Wetland Protection

Wetland protection can be accommodated through regulation, acquisition, and, to lesser degree, by public education programs. These programs are measures that should be considered for inclusion in the recommended Powers Lake management plan.

Regulations: Wetlands in the Powers Lake direct drainage area are currently protected to a degree under the U. S. Army Corps of Engineers 404 Permit Program, the Wisconsin Shoreland Zoning Program, and local county-town zoning ordinances. The wetlands protected under each of these regulatory programs are shown on Map 33. The map indicates that almost all wetland areas in the Powers Lake direct drainage area are protected under one or more of the federal, state, county, and local regulations.

The U. S. Army Corps of Engineers 404 Program is a federal program that regulates the placement of fill in wetlands throughout the nation. Under this program, however, only wetlands five acres in size or larger or wetlands within Regional Planning Commission-designated primary environmental corridors are regulated. Through the use of nationwide permits, filling of one acre or less is allowed without individual permits or prior approval in wetlands five acres or less in size, except in designated primary environmental corridors. It should be noted that the U. S. Army Corps of Engineers requires only that permits be obtained for filling of wetlands; its jurisdiction does not regulate many other activities and does not necessarily prevent filling, since permits for such activities are approved under certain circumstances.

Under the State Shoreland Zoning Program, set forth in Wisconsin Administrative Codes NR 115 and 117, all wetlands within 1,000 feet of a lake, pond, or flowage, or within 300 feet of navigable waters, must be regulated through joint state-county-local ordinances. In the Powers Lake drainage area, the Town of Bloomfield has zoned the wetland located at the outlet of Powers Lake as Conservancy and zoned another seven-acre area as B-5 Commercial. The Town of Randall has placed the wetland located in the Wildwoods Subdivision in C-1 Lowland Resource Conservancy zoning and the wetland located east of Jefferson Bay in R-3 Urban Single-Family Residential zoning. The wetland complex located northeast of Powers Lake is zoned C-1 Lowland Resource Conservancy. No new urban development is permitted in the C-1 Lowland Resource Conservancy districts and onsite soil absorption sewage disposal systems, holding tanks, or private wells used to obtain water for ultimate human consumption are not permitted. Activities such as pasturing of livestock, cultivation of agricultural crops, and the practice of silviculture are permitted in these wetlands. Filling, flooding, dredging, tiling, and excavating are essentially prohibited.

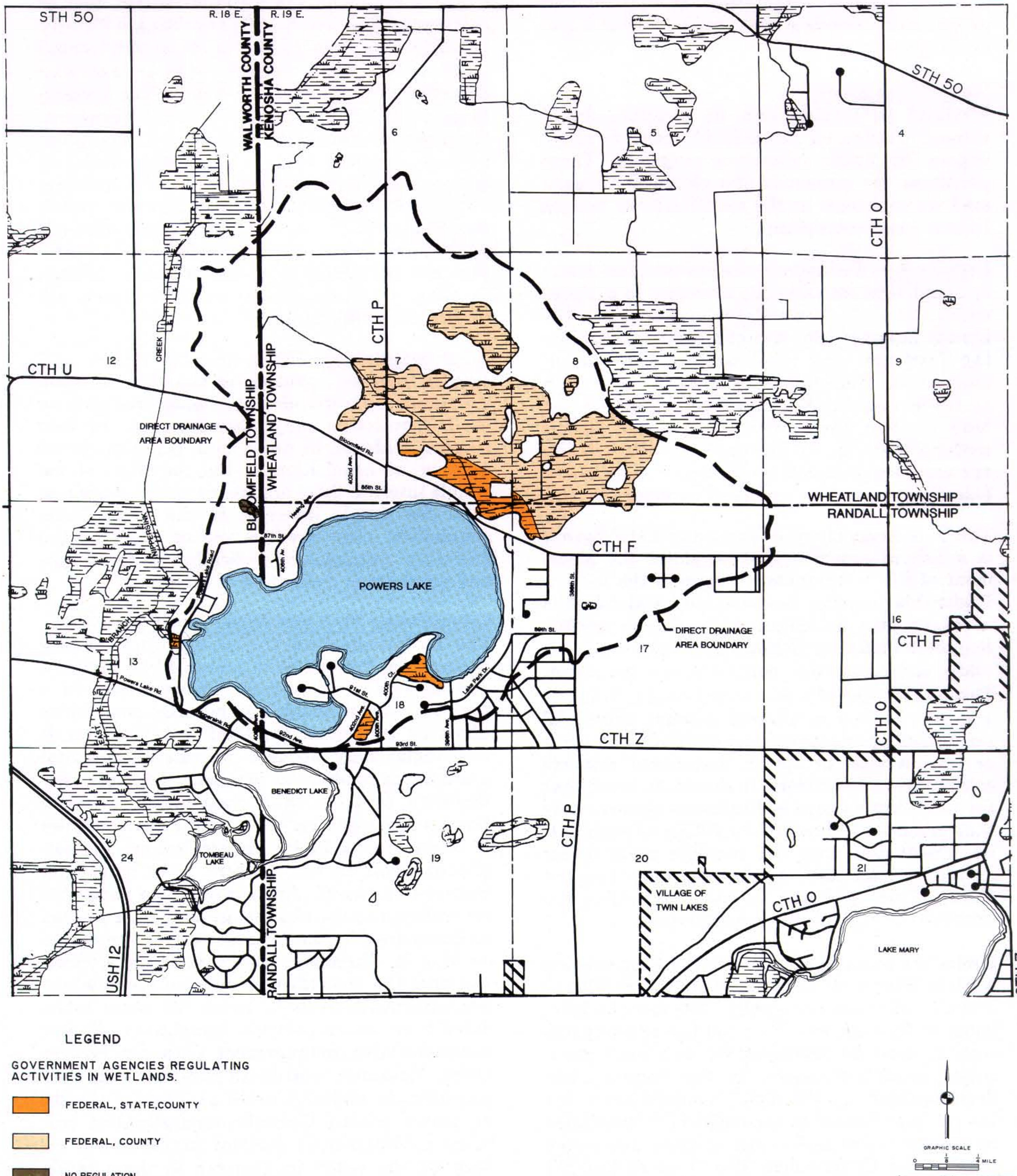
Land Acquisition: While properly drawn and strictly enforced regulations can provide some protection for wetlands, other measures such as land acquisition may also be used. In this respect, it should be noted that, while the usual manner of acquisition is the purchase of fee simple interest, there are means of acquiring less than fee simple interests in the land. Thus, acquisition may involve one or more of the following: purchase or dedication in fee simple and purchase or dedication of easements.

Groundwater Recharge Area Protection

The hydrologic and the phosphorus loading budgets for Powers Lake presented in Figure 4 and Table 13, respectively, indicate that, in a normal year, although groundwater contributes about 32 percent of the total water inflows, it contributes only about 1 percent of the total phosphorus loading to the Lake. Groundwater, therefore, is a source of good-quality water to Powers Lake and serves to dilute other inflows of water having higher concentrations of phosphorus such as the Powers Lake inlet and stormwater runoff. Areas which are favorable for recharging the shallow groundwater system as determined by the factors involved are shown on Map 21. Therefore, protection of areas which recharge the groundwater system, areas where precipitation is likely to reach the water table, should be an important component of any comprehensive management plan for Powers Lake. Valuable nearshore forested potential groundwater recharge areas are located wholly or partly within Commission-designated primary environmental corridor lands shown on Map 22. As noted in Chapter V, these lands should be preserved in essentially natural, open space uses. Preservation of these lands would

Map 33

WETLAND REGULATION IN THE POWERS LAKE DRAINAGE AREA



Source: SEWRPC.

not only serve to reduce nonpoint source pollutant loadings to Powers Lake but also to maintain good quality groundwater inflow to the Lake.

Groundwater Education: Basic groundwater principles are poorly understood by the majority of the public due, in part, to the inability to observe groundwater, its movement, and impacts of pollution. Thus, groundwater resources are under constant threat of modification due to activities which diminish groundwater quantity and impair groundwater quality.

Public education programs can be developed to promote the protection of groundwater recharge areas, but first must promote understanding of the hydrologic cycle and its groundwater components; the importance of groundwater to lake water quantity and quality and to drinking water supplies; and the sources and movement of pollutants that may threaten groundwater resources and Powers Lake.

IN-LAKE MANAGEMENT

Alternative in-lake management measures considered for Powers Lake include nutrient inactivation to improve water quality conditions, shoreline erosion control, fish management, and aquatic plant control.

Nutrient Inactivation

In lakes such as Powers Lake, where the bottom waters become devoid of oxygen during summer stratification, there is a potential for large amounts of phosphorus to be released from the sediments, leading to poor water quality conditions. Internal phosphorus recycling, or phosphorus release from the sediments, was not found to occur in Powers Lake during the study period, but because the potential exists for this condition, nutrient inactivation was considered as a management measure.

Aluminum sulfate, commonly referred to as alum, is a chemical compound that has been used successfully to inactivate nutrients in lakes. It is applied in liquid form to the deeper parts of the lake, forming a precipitate of aluminum hydroxide. This precipitate combines with phosphorus and particulate matter in the water column and settles to the lake bottom within a few hours. Typically, a one- to two-inch layer of flocculent will cover the sediments, forming a chemical and physical barrier that retards the transfer of nutrients from the sediments, making them unavailable to algae.

Alum treatments have thus been effectively utilized to reduce high rates of internal phosphorus recycling and to reduce nuisance algae growths that depend on high phosphorus levels in lake water. Alum is not directly effective in controlling aquatic macrophytes, but the abundance of rooted and floating plants may be reduced by limiting the availability of phosphorus. A potentially negative effect of alum treatment is that the increase in water transparency may allow existing nuisance plants to spread to areas of deeper water.

Nutrient inactivation with alum is a long-term control method, and one treatment may reduce the phosphorus concentration in the water column by as much as 80 percent for a period of from five to 10 years. Effectiveness decreases if the layer of flocculent becomes dispersed or buried in loose, organic sediments. In shallower water, wave action may wash much of the alum to the center of the lake, reducing the efficiency of the treatment. Incoming sediment from nonpoint sources can cover the layer of flocculent and substantially reduce its effectiveness. Thus, the reduction or elimination of external sources must complement alum treatment to achieve water quality improvement.

As discussed in Chapter IV, it was not found that large amounts of phosphorus were released from the sediments of Powers Lake in 1987. Hence, an alum treatment is not required or recommended at this time.

Shoreline Erosion Control

Shoreline erosion is evident in scattered locations around Powers Lake, as shown on Map 3 in Chapter II. This erosion not only interferes with such shoreline activities as swimming, but also results in the retreat, as much as one foot per year in some areas, of land because it sloughs into the lake. It deposits sediment and nutrients into the lake itself, contributing to the formation of lake-bottom sediments suitable for supporting excessive aquatic plant growth. The erosion occurring on the eastern shoreline may be attributed to the following factors:

1. Maintenance of lawns to the lake edge has probably increased the rate of shoreline erosion. The shallow root system of lawn

grass fails to bind the soil sufficiently in place and allows undercutting and filtering of sediment particles through the unstable shore slopes. The lack of vegetation at the waterline serves as an indicator of active erosion.

2. Wave action is the primary direct cause of shoreline erosion when the lake is not ice-covered. Shoreline erosion by wave action is most evident along the eastern shoreline of lakes in southeastern Wisconsin because of prevailing westerly winds. The waves undercut the exposed shoreline slopes, resulting in sloughing of the shore into the lake.

3. High lake levels may increase the shoreline erosion by exposing higher areas to direct wave action and by saturating normally unsaturated shoreline soils, thereby reducing the adhesiveness of the soil particles.

4. Ice action may be the single most important primary cause of shoreline erosion on Powers Lake. Powers Lake is normally covered by ice from about early December to late March. Ice-related activities physically scour the shoreline and prevent the establishment of a stable vegetative cover.

Three alternative shoreline erosion control techniques are discussed below: vegetative buffer strips, rock revetments or riprap, and wood bulkheads. Other techniques, including steel pile bulkheads, concrete walls, and flexible, sand-filled tubes, are also available, but are substantially more costly. The three alternatives considered were selected because they can be constructed, at least partially, by local lake residents; because most of the construction materials involved are readily available; because the technique would, in most cases, enable the continued use of the immediate shoreline; and because the measures are visually "natural" or "semi-natural" and should not significantly affect the aesthetic qualities of the lake shoreline. The cost estimates presented below are for the control of the about 1,750 feet of unstable shoreline identified in Chapter II.

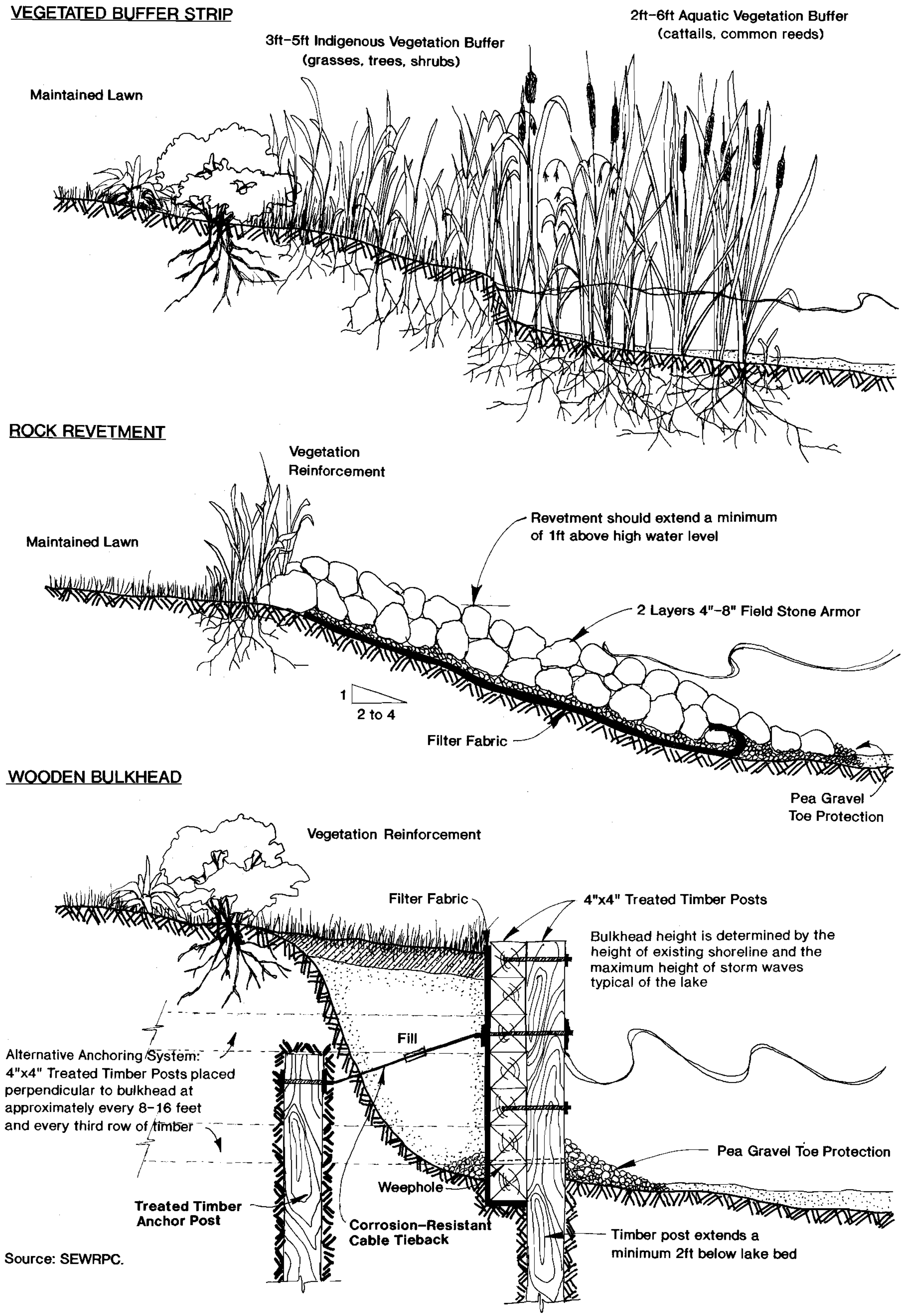
Vegetative Buffer Strips: The simplest, least costly, and most natural method of reducing shoreline erosion is the provision of a vegetative buffer strip immediately adjacent to the lake (see Figure 23). This technique is accomplished by encouraging natural vegetation rather than maintaining lawns within five to 10 feet of the lakeshore or by encouraging establishment of emergent aquatic vegetation two to six feet lakeward of the eroding shoreline. Aquatic species such as cattails (Typha spp.) and common reed (Phragmites communis), may be suitable in the littoral areas along the eroding shores. Taller grasses invaded initially by weeds, and later by other species of grasses, forbs, and shrubs, should be encouraged on the shoreline. Some transplanting or seeding with carefully chosen indigenous plant types can decrease the time needed for this succession of plant species.

Desired plant species which may be expected and encouraged to invade the buffer strip or which could be planted include arrowhead (Sagittaria latifolia), cattail (Typha spp.) common reed (Phragmites communis), water plantain (Alisma plantago-aquatica), bur-reed (Sparganium eurycarpum), and blue flag (Iris versicolor) in the wetter areas; jewelweed (Impatiens biflora), elderberry (Sambucus canadensis), giant goldenrod (Solidago gigantea), marsh aster (Aster simplex), red-stem aster (Aster puniceus), and white cedar (Thuja occidentalis) in the drier areas. In addition, trees and shrubs such as silver maple (Acer saccharinum), American elm (Ulmus americana), black willow (Salix nigra), and red-osier dogwood (Cornus stolonifera) could become established. These plants will develop a more extensive root system than the lawn grass and the aboveground portion of the plants will protect the soil against the erosive forces of rainfall and wave action. A narrow path to the lake could still be maintained to provide access to the lake for boating, swimming, fishing, and other activities. A vegetative buffer strip would also serve to trap nutrients and sediments washing into the lake via direct overland flow. This alternative would involve only minimal cost.

Rock Revetments: Rock revetment, or riprap, is a highly effective method of shoreline erosion control applicable to many types of erosion problems, especially in areas of low banks and shallow water. The technique, as shown in Figure 23, involves the shaping of the shoreline slope, the placement of a porous filter material, such as sand, gravel, or pebbles, on the slope, and the placement of rocks on top of the filter

Figure 23

PLAN ALTERNATIVES FOR SHORELINE EROSION CONTROL



NOTE: Design specifications shown herein are for typical structures. The detailed design of shore protection measures must be based on detailed analysis of local conditions.

Source: SEWRPC.

material to protect the slope against the actions of waves and ice. The advantages of a rock revetment are that the structure is highly flexible and not readily weakened by movements caused by settling or ice expansion; it can be constructed in stages and requires little or no maintenance. The disadvantages of a rock revetment are that it limits the use of the immediate shoreline because its rough, irregular rock surfaces are unsuitable for walking; a relatively large amount of filter material and rocks must be transported to the lakeshore; and excavation and shaping of the shore slope may cause temporary disruptions and contribute sediment to the lake. If improperly constructed, the revetment may fail. A rock revetment along the entire 1,750 feet of unstable shoreline built by a private contractor would involve a total capital cost of about $35,000, or about $20 per lineal foot. By providing labor and some materials, lake residents could reduce this cost by up to 50 percent.

Wooden Bulkhead: A wooden bulkhead, depicted in Figure 23, prevents landslides, or slope failure, and provides protection against wave action and, to a lesser extent, ice action. A series of horizontal boards are bolted to a series of vertical posts sunk into the soil at the waterline. A stone toe is provided on the lakeside to protect against undercutting. A sunken cable tieback to an anchored "deadman" is used to prevent the bulkhead from slipping towards the lake. Advantages of a wooden bulkhead are that it provides substantial protection and maintains the shoreline in a fixed position and the materials are readily available. Bulkheads may be considered less visually appealing than rock revetments; are less flexible and more susceptible to ice damage; and repair of a bulkhead is considerably more difficult and expensive than repair of a rock revetment. A wooden bulkhead for the entire unstable shoreline installed by a private contractor would involve a total capital cost of about $10,500, or about $6.00 per lineal foot. As with rock revetments, the provision of labor and some materials by local residents could substantially reduce this cost.

Fish Management

Powers Lake provides high-quality habitat for a healthy, warmwater fishery. Good water quality, adequate dissolved oxygen levels, sand/gravel shorelines, and a moderate and diverse plant community contribute to the maintenance of a fish population that is dominated by desirable sport fish. Winterkill and the presence of rough fish are not problems.

Table 34 presents a summary of the habitat of Powers Lake fish species, potential problems that are perceived by Powers Lake anglers or that are known to occur in lakes similar to Powers Lake, and management solutions of these problems. Specific management alternatives are discussed below.

Fish Surveillance Program: The fish population of Powers Lake has not been thoroughly studied since 1969. The existing condition of the fishery is, therefore, not well understood. Three general types of surveys can be considered to determine the condition of the fishery of the Lake. The first type of survey would primarily use shocking techniques and would be conducted during several nights in the fall of the year. Such a survey would provide valuable information on the species, size, and age of the fish present. However, such a survey would not be adequate to fully assess the condition of the fishery. This type of survey may be expected to cost about $2,500 and is often provided by the Wisconsin Department of Natural Resources at no local cost as part of its ongoing work program.

The second type of survey is more comprehensive, including surveys during the spring, summer, and fall, and the use of both netting and shocking techniques. Such a survey would provide complete data on the fishery and would provide a sound basis for formulating stocking and other management recommendations. This type of survey may be expected to cost of $20,000 to $30,000 and may be provided by the Wisconsin Department of Natural Resources at no local cost if it can be specifically included and approved as an element of the Department's long-range work program.

A third type of survey is a creel census to determine the composition of the angler catch and determine if overharvest of some game species is occurring. The need for the creel census should be determined by the results of the initial fish survey. Such a survey would include the use of at least one full-time creel census taker during the spring, summer, and fall fishing seasons. The census taker would use both a boat and stations at lake-access site stations to secure information. Such a census may be expected to cost $12,000 to $15,000.

Table 34

POWERS LAKE FISH MANAGEMENT

Species	Primary Adult Food Source	Habitat	Potential Problems in Powers Lake[a]	Management Alternatives
Predator Fish				
Northern Pike	Bullheads, sunfish, perch, suckers, minnows, smaller northern pike, other vertebrates, leeches	Spawn in wetlands adjacent to lake; vegetation utilized as refuge for young and for hunting cover for all ages; optimal midsummer plant cover of 30 to 75 percent of shallow water area	Loss of habitat	Protect natural habitat Develop artificial spawning marshes
			Poor growth rates	Increase spawning habitat of existing forage species Stock to supplement natural reproduction
			Overharvest	Enforce bag limits Encourage catch and release program
Walleyed Pike	Perch, bullheads, darters, minnows, crayfish, insects, worms	Spawn on windswept rocky shores, sandbars, and gravelly shoals; live near or on lake bottom; travel through open water, feeding primarily at night	Lack of habitat	Improve/create spawning habitat
			Poor natural reproduction	Stock to maintain population
			Overharvest	Enforce bag limits Encourage catch and release program
Largemouth Bass	Bluegills, bullheads, perch, other largemouth bass, minnows, crayfish, frogs, large insects	Spawn on sand/gravel nests in shallows, adults prefer shallow areas, less than 20 feet deep, with 40 to 60 percent plant cover	Heavy predation on young/competition with panfish	Habitat protection
			Overharvest	Enforce bag limits Encourage catch and release program
Smallmouth Bass	Perch, sunfish, small suckers, young bass, minnows, crayfish	Spawn over sand/gravel bottoms where there is a current; prefer deeper water than largemouth bass, except when feeding	Lack of habitat	Protect existing habitat
			Overharvest	Enforce bag limits Encourage catch and release program
Panfish[b]	Macrophytes, zooplankton, insect larvae, insects, minnows and juvenile fish	Habitat varies with species; most spawn along sand and gravel shores, although perch prefer vegetation; many forage in beds of aquatic plants or just beyond the plant bed margin; crappies prefer open water rather than the shelter of plant beds; bullheads are primarily bottom feeders	Stunting (slow growth due to overpopulation and limited food source)	Balance predator/prey relationship through stocking and/or panfish removal Encourage panfish harvest by anglers
Rough Fish[c]	Aquatic plants, forage and game fish	Bottom dwelling species; tolerant of low dissolved oxygen levels	Feeding and spawning activities destroy habitat of desirable species, and increase turbidity	Maintain good water quality to reduce potential increase of rough fish Chemical eradication of large populations

[a]*These problems are known to occur in other regional lakes and/or are perceived as problems by Powers Lake anglers surveyed in 1990. The Powers Lake fish population requires further study to determine the existing problems.*

[b]*Panfish species include: bluegills, pumkinseed, green sunfish, crappies, rock bass, warmouth bass, yellow perch, bullheads.*

[c]*Rough fish species include: carp, white sucker, long-nose gar, bowfin, redhorse, lake chubsucker.*

Sources: Wisconsin Department of Natural Resources, G. C. Becker; S. Eddy and J. C. Underhill; SEWRPC.

Habitat Protection: Loss of habitat should be a primary concern of any fish management program. The environmentally valuable areas identified in Chapter V are the most important areas to be protected. Either limiting or restricting powerboats in these areas will prevent significant disturbance to fish nests and aquatic plant beds. Aquatic plant control should be avoided in these areas and limited to hand removal in other areas of the lake. Dredging, filling, and the construction of piers and docks should be discouraged in these areas. Water level fluctuations can also alter fish habitat. The potential effects of any proposed perturbations in water levels on the fishery should be studied carefully before considering implementation. Finally, the importance of maintaining good water quality cannot be overemphasized as a fish habitat protection measure. Because all of these alternatives are preventive in nature, no cost is associated with them.

Stocking: Fish stocking is a management method used to supplement naturally reproducing species or to maintain populations of species with poor natural reproduction. Stocking of sport fish encourages angler use of the lake and can be used to maintain a balanced predator-prey relationship. Proper stocking of fish requires a thorough understanding of the existing fish population. Predator fish should not normally be stocked to control a panfish population that is already stunted. Once panfish become so abundant that the population is stunted, the number of predators required to control them is probably higher than the capacity of the lake.[3] Overstocking or stocking when native predators are already present in adequate numbers may result in one or more of the following problems: 1) competition of stocked fish and native fish may force stocked fish out of a lake and into adjacent water bodies where their presence may be undesirable, 2) overcrowded fish populations may be more susceptible to bacterial, viral, or parasitic infections, and 3) overstocking may have an unfavorable effect on angling success.[4]

In Powers Lake, stocking of northern and/or walleyed pike by the Wisconsin Department of Natural Resources or local fishery organizations is an alternative to be considered further to supplement the existing predator fish population. This may help prevent a stunted panfish population. Stocking largemouth and smallmouth bass is not normally needed where habitat conditions are favorable and is seldom successful where they are not.[5]

Regulations and Public Education: To reduce the risk of overharvest, the Wisconsin Department of Natural Resources has regulated the allowable number and size of certain fish species caught by anglers. The open season, size limits, and bag limits for fish species of Powers Lake are given in Table 35. Enforcement of these regulations is critical to the success of any sound fish management program.

Chemical Eradication and Lake Drawdown: In lakes with an unbalanced fishery, dominated by carp and other rough fish, chemical eradication has been used to manage the fishery. The fish toxicant rotenone is used to eradicate the existing fish population and thereafter desired predator fish and panfish are reintroduced into the lake. Lake drawdown is often used along with the chemical treatment. Drawdown will expose spawning areas and eggs, and concentrate fish in shallow pools, thereby increasing their availability to anglers, commercial harvesters, or chemical eradication treatments. The newly created habitat will also benefit desired gamefish populations. Chemical eradication is a drastic, costly measure whose end results may be highly unpredictable. An estimated cost of a rotenone treatment of Powers Lake is $410,000; the majority of this cost is for the chemical itself. Because the rough fish population is not currently excessive, this management alternative is not recommended.

Aquatic Plant Management

Although macrophytes and phytoplankton are important to the overall health of a lake, excessive and/or unwanted aquatic plant growth can disrupt the natural ecosystem, detract from the aesthetic quality of the lake, and interfere with such recreational lake uses as

[3] *H. Snow, Effects of Stocking Northern Pike in Murphy Flowage, Wisconsin, Wisconsin Department of Natural Resources Technical Bulletin No. 50, 1974.*

[4] *G. C. Becker, Fishes of Wisconsin, University of Wisconsin Press, Madison, Wisconsin, 1983.*

[5] *Wisconsin Department of Natural Resources, Fish and Wildlife Comprehensive Plan, 1979.*

Table 35

1991 OPEN SEASON, SIZE LIMITS, AND BAG LIMITS FOR FISH SPECIES OF POWERS LAKE[a]

Species	Open Season	Daily Limit	Minimum Size
Northern Pike	May 4-March 1	2	None
Walleyed Pike	May 4-March 1	5	15 inches
Largemouth and Smallmouth Bass	May 4-March 1	5 of each	14 inches
Rock Bass	Open all year	None	None
Bluegill, Pumpkinseed (sunfish), Crappie, and Perch	Open all year	50 in total	None
Bullhead	Open all year	None	None
Rough Fish	Open all year	None	None

[a]*Limits and sizes set forth in this table are for Powers Lake. Daily limits and minimum sizes vary between lakes.*

Source: Wisconsin Department of Natural Resources.

boating and swimming. Techniques available to control nuisance aquatic plants include chemical herbicides, mechanical harvesting, and lake bottom covers.

Aquatic Herbicides: Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. Chemicals are applied to the growing plants either in liquid or granular form.

The advantages of using chemical herbicides to control aquatic macrophyte growth are the relatively low cost and the ease, speed, and convenience of application. However, the disadvantages associated with chemical control include the following:

1. Although the short-term, lethal effects of chemicals are relatively well known, potential long-term, sublethal effects, especially on fish and fish-food organisms, are relatively unknown.

2. The elimination of macrophytes reduces their competition with algae for light and nutrients. Thus increased algae blooms may develop.

3. Since much of the dead plant material is not removed from the lake, the nutrients contained in the plant material will later be released to the water. Decomposition of the dead plant bodies also consumes dissolved oxygen and increases the potential for fish kills.

4. The elimination of macrophyte beds destroys important cover, food sources, and spawning areas for desirable fish species.

5. Adverse impact on other aquatic organisms may be expected. At the concentrations used for macrophyte control, Diquat has been known to kill the zooplankton Daphnia and Hyalella. Both Daphnia and Hyalella are important fish foods and Daphnia is a primary food for the young of nearly all fish species.[6]

6. Areas must be re-treated in the following season and weed beds may need to be retreated more than once in a summer.

7. Many of the chemicals available are nonselective and nontarget, desirable species are effected by the treatment.

[6]*P. A. Gilderhus, "Effects of Diquat on Bluegills and Their Food Organisms," The Progressive Fish-Culturist, Vol. 2, No. 9, 1967, pp. 67-74.*

The advantages and disadvantages of chemical macrophyte control also apply to chemical control of algae. In addition, copper, the active ingredient in algicides, may accumulate in the bottom sediments. Excessive amounts of copper are toxic to fish, benthic animals, and humans.

Cost of chemical treatments vary widely. Large, organized treatments are more efficient and offer smaller unit costs for commercial applications than to individual treatments. Other factors, such as the type of chemical used and the number of treatments needed, are also important. Estimated costs for lakes in southeastern Wisconsin range from $200 to $400 per acre.

Because of the lack of nuisance plant growth and the negative effects of chemical treatments, this alternative is not recommended for Powers Lake.

Aquatic Plant Harvesting: Mechanical harvesting of aquatic macrophytes is conducted with specialized harvesting equipment, consisting of an apparatus which cuts four to six feet below the water surface and a conveyor system to pick up the cut plants to be hauled to shore. Advantages of macrophyte harvesting include the following:

1. Harvesting removes the plants from the lake. The removal of this plant biomass will decrease the rate of accumulation of organic sediment. A typical plant harvesting of submerged macrophytes from eutrophic lakes in southeastern Wisconsin can remove from 140 to 1,100 pounds of biomass per acre per year.[7]

2. Harvesting removes plant nutrients, including nitrogen and phosphorus, which would otherwise re-fertilize the lake as the plants decay. A typical harvest of submerged macrophytes from eutrophic lakes in southeastern Wisconsin can remove four to 34 pounds of nitrogen per acre per year, and 0.4 to 3.4 pounds of phosphorus per acre per year. In addition to the physical removal of nutrients, plant harvesting may reduce internal nutrient recycling. Several investigators have shown that aquatic macrophytes can act as nutrient pumps, recycling nutrients from the bottom sediments into the water column. Ecosystem modeling by Loucks and Weiler indicated that a harvesting 50 percent of the macrophytes in Lake Wingra, Wisconsin, could reduce the instantaneous phosphorus availability by 30 percent, with a maximum reduction of 40 to 60 percent, depending on the season.[8]

3. Repeated macrophyte harvesting may reduce the regrowth of certain aquatic macrophytes. The regrowth of milfoil has been reported to decrease as harvesting frequency was increased.[9]

4. Where dense growths of filamentous algae are closely associated with macrophyte stands, they may be removed simultaneously.

5. The remaining macrophyte stalks after harvesting provide cover for fish and fish food organisms, and stabilize the bottom sediment from wind erosion.

6. Selective macrophyte harvesting may reduce stunting of panfish in lakes where excessive cover has influenced predator-prey relationships. By allowing a increase

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[7]*Burton, et al., 1978.*

[8]*E. B. Welch, M. A. Perkins, K. Lynch, and P. Hufschmidt, "Internal Phosphorus Related to Rooted Macrophytes in a Shallow Lake," Conference Proceedings, Madison, Wisconsin, February 14-16, 1979, ed. J. E. Breck, R. T. Prentki, and O. L. Loucks, pp. 81-99; G. B. Lie, "The Influence of Aquatic Macrophytes on the Chemical Cycles of the Littoral," ed. Breck et al., 1979, pp. 101-106; D. H. Landers, "Nutrient Release from Senescing Milfoil and Phytoplankton Response," ed. Breck et al., 1979, pp. 127-143; J. W. Barko and R. M. Smart, "The Role of Myriophyllum spicatum in the Mobilization of Sediment Phosphorus," ed. Breck et al., 1979, pp. 177-190; O. L. Loucks and P. R. Weiler, "The Effects of Harvest Removal of Phosphorus on Remineralized P. Sources in a Shallow Lake," ed. Breck et al., 1979, pp. 191-210.*

[9]*S. Nichols and G. Cottam, "Harvesting As A Control for Aquatic Plants," Water Resources Bulletin, Vol. 8, No. 6, December 1972, pp. 1205-1210; and J. K. Neel, S. A. Peterson, and W. L. Smith, "Weed Harvest and Lake Nutrient Dynamics," EPA-660/3-73-001, 1973.*

in harvest of young panfish, both gamefish and the remaining panfish may show increased growth.[10]

7. The cut plant material may be used as mulch.

The disadvantages of macrophyte harvesting include the following:

1. Harvesting is most effective in water depths greater than two feet. Large harvesters cannot operate in shallow water or around docks and buoys.

2. The reduction of aquatic macrophytes by harvesting reduces their competition with algae for light and nutrients. Thus, increased algae blooms may develop.

3. Fish, especially young-of-the-year bluegills and largemouth bass, as well as fish prey organisms, are frequently caught in the harvester. As much as 5 percent of the juvenile fish population can be removed by harvesting. A Department of Natural Resources study found four pounds of fish removed per ton of plants removed.[11]

Harvesting costs for lakes in southeastern Wisconsin average about $550 per acre. Macrophyte harvesting to control excessive growth of aquatic vegetation has never been required on Powers Lake. Limited dense concentration of milfoil occur at several scattered locations. However, the overall moderate aquatic macrophyte growth characteristics of Powers Lake does not warrant initiation of a harvesting program.

Lake Bottom Covering: Lake-bottom covers and light screens provide limited control of rooted plants by creating a physical barrier and reducing the sunlight available to the plants. They have been used to create swimming beaches on muddy shores, to improve the appearance of lakefront property, and to open channels for motorboating.

Sand and gravel are usually readily available and relatively inexpensive to use as cover materials, but plants readily recolonize covered areas in about a year. Synthetic material, such as polyethylene, polypropylene, fiberglass, and nylon, can provide relief from rooted plants for several years. The screens are flexible and can be anchored to the lakebed in spring or draped over plants in summer.

The advantage of bottom covers and screens is that the control can be confined to specific areas, the covers and screens are usually unobtrusive and create no disturbance on shore, and the covers are relatively easy to install over small areas. The disadvantage of bottom covers and screens is that they do not reduce eutrophication of the lake, they are expensive, they are difficult to spread and anchor over large areas or obstructions, they can slip on steep grades or float to the surface after trapping gases beneath them, and they may be difficult to remove or relocate.

Screens and covers should not be used in areas of strong surfs, heavy angling, or shallow waters where motorboating occurs. They should also not be used where aquatic vegetation is desired for fish and wildlife habitat. To minimize interference with fish spawning, screens should be placed before or after spawning. A permit from the Wisconsin Department of Natural Resources is required for use of sediment covers and light screens. Permits require inspection by the DNR staff during the first two years, with subsequent permits issued for three-year periods.

The estimated cost of lake-bottom covers to control plant growth along a typical shoreline property, an area of about 700 square feet, ranges from $30 for burlap to $180 for aquascreen. Because of the limitations involved, lake-bottom covers as a control method for aquatic plant growth are not recommended for Powers Lake.

Aquatic Macrophyte Survey: To monitor changes in the diversity and abundance of the Powers Lake aquatic macrophyte community, a periodic survey should be developed that includes, at a minimum, a study of: species present, distributional map of species, relative abundance of species, and permanent collection of species observed.

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[10] *J. E. Breck, and J. F. Kitchell, "Effects of Macrophyte Harvesting on Simulated Predator-Prey Interactions," ed. Breck et al., 1979, pp. 211-228.*

[11] *Wisconsin Department of Natural Resources, Environmental Assessment, Aquatic Plant Management Program, 3rd Edition, 1990.*

The survey should follow the Wisconsin Department of Natural Resources methodology, a modification of the Jesson and Lound (1962) approach. The lake should be surveyed in late June or early July, with a follow-up survey conducted at the end of the summer. Such a survey can be important in monitoring the spread of exotic species such as Eurasian water milfoil. Changes in the aquatic macrophyte community diversity and abundance often indicate changes in the water quality of the lake. The aquatic macrophyte community of Powers Lake should be surveyed at least every five years to detect such changes. An estimated cost of one survey is $3,000, or $12,000 for four surveys conducted between 1991 and 2010.

Public Education: Aquatic plant management usually centers on the eradication of nuisance aquatic plants for the improvement of recreational lake use. The majority of the public view all aquatic plants as "weeds" and lake residents may spend considerable time and money removing desirable plant species from the lake without considering the environmental impacts. Thus, public education is an important component of an aquatic plant management program and should include information and education on:

1. The types of aquatic plants in Powers Lake and their value to water quality, fish, and wildlife.

2. The preservation of existing stands of desirable plant species.

3. The identification of nuisance species and methods of preventing nuisance plant growth.

4. Alternative methods of controlling existing nuisance plant beds, including the positive and negative aspects of each method.

An organized aquatic plant identification/education day is one method of providing "hands-on" education to lake residents. Common species of plants found in southeastern Wisconsin lakes are illustrated in Appendix B of this report. Other sources of information and technical assistance include the Department of Natural Resources and the UW-Extension Service. The aquatic plant species list provided in Chapter V may serve as a checklist for individuals interested in identifying the plants near their residence. Conducted on an annual basis, residents can record changes in the abundance and types of plants in the lake.

Of the 23 submerged floating and free floating aquatic plant species found in Powers Lake during surveys conducted in 1967, 1986, and 1990, Eurasian water milfoil is one of the few species likely to cause lake use problems. As discussed in Chapter V, milfoil, like most aquatic plants, can reproduce by fragments and often forms dense beds. Because milfoil growth in Powers Lake is not extensive, organized hand removal of the plant from around docks and piers is feasible. Residents should also be encouraged to collect fragments that wash ashore after storms or from weekend boat traffic. Plant fragments can then be used as mulch on gardens.

Milfoil and other aquatic plants can be transported to lakes as fragments on boats and boat trailers. To prevent unwanted introductions of plants into lakes, boaters should remove all plant fragments from their boats and trailers when exiting the lake. Providing receptacles for the plant fragments at boat landings of Powers Lake will remind boaters of this practice and keep fragments from littering the landing. Posters and pamphlets are available from the DNR and UW-Extension Service that provide information and illustrations of milfoil, and discuss the importance of removing plant fragments from boats.

RECREATIONAL USE MANAGEMENT

Summer Recreational Use

Safe boating limits are exceeded at Powers Lake during summer weekends according to the Commission's observations and the safe-boating density standards set by the Commission and the Wisconsin Department of Natural Resources.

During summer weekend peak afternoon hours, the safe number of pleasure boats, including ski boats, powerboats, and sailboats, using the former criteria was exceeded by as many as 26 boats. During this same period, using the latter criteria for all boats and watercraft, the safe number of boats and watercraft was exceeded by as many as 34 boats.

Other indications that boating pressure is a problem at Powers Lake were revealed in the questionnaire sent to the lake district residents.

About 90 percent of those responding felt boating conditions were either crowded or extremely crowded on Powers Lake on the weekend. When asked to list concerns about Powers Lake, respondents identified, after water quality, the number of jet skiers and the number of boats as the major issues.

Section 30.77 of the Wisconsin Statutes authorizes local units of government to enact ordinances that serve the public interests of health and safety on Wisconsin lakes. Currently, the Town of Randall and Town of Bloomfield ordinances provide for the regulations listed in Table 36.

Alternative measures to reduce the potential for recreational use conflict, and to promote the safe use of Powers Lake include time and space zoning of the lake, limiting boat speed, increasing enforcement, and educating both resident and nonresident users of Powers Lake.

Zoning: Time zoning of Powers Lake would limit various recreational uses to specific hours of the day. Alternative measures to limit water skiing and fast boating hours include:

1. Restrict motorboating to slow-no-wake all or portions of the time between the hours of 12:00 p.m. and 3:00 p.m. on Saturdays, Sundays, and legal holidays.

2. Prohibit water skiing between the hours of 2:00 p.m. and 4:00 p.m. on Saturdays, Sundays, and legal holidays.

3. Restrict water skiing to the hours from 10:00 a.m. to 4:00 p.m. on Saturdays, Sundays, and legal holidays.

4. Designate slow-no-wake hours on Saturdays, Sundays, and legal holidays from the hours of 6:00 p.m. to 10:00 a.m.

Space zoning of Powers Lake would restrict activities to designated areas of the lake. Alternative measures include:

1. Designate Knolls and Honey Bear Bays as slow-no-wake areas. Parts of Knolls and Honey Bear Bays have been designated as environmentally valuable areas and should be protected from fast boating impacts. In addition, designating Knolls Bay as slow-no-wake would lessen the potential for boating conflicts as boats exit and enter the lake via the access on 396th Street.

2. Designating Jefferson Bay as slow-no-wake would lessen the potential for boating conflicts to occur as boats and water skiers attempt to turn around in the Bay. The mouth of Jefferson Bay is about 580 feet wide. Slow-no-wake zones occupy 200 feet on either side, leaving a 180-foot-wide traffic lane.

3. Designate lake space for water skiing and fast boating, and for slow boating, fishing, and swimming, as shown on Map 34.

Speed Control: Measures to limit the operation of motorboats at excessive speeds include establishing a maximum speed of 40 miles per hour (mph) during daytime hours and prohibiting the operation of a motorboat so as to produce "rooster tails" more than four feet high or 20 feet long.

Enforcement: Enforcement of boating regulations deters recreational use conflicts and promotes lake safety. As the number of boats and watercraft has increased to excessive levels at Powers Lake during the weekends, an alternative measure for enhancing the safe use and wellbeing for those using Powers Lake would be to increase weekend safety patrols.

Enforcement of the town ordinances is carried out by the Powers Lake Water Police who are officers, employees, and agents of Randall and Bloomfield Townships. Presently, there are eight personnel who patrol Powers, Benedict, and Tombeau Lakes only on the weekends. On average, five water police spend about 58 hours per weekend on Powers Lake between Memorial Day and Labor Day. Approximately 49 percent of the respondents to the questionnaire felt that enforcement should be increased on Powers Lake and favored "all day", or 10:00 a.m. until dark, weekend patrols.

Increasing the hours of the safety patrol from an average of 58 to 66 hours per weekend would probably necessitate hiring and training of additional personnel. The estimated cost for wages and training of one water safety police would be $2,000.

Jet Ski Regulation: The personal watercraft, or jet ski, has become increasingly popular on lakes in southeastern Wisconsin, but it also has become a major concern for Powers Lake Management District residents according to the

Table 36

SELECTED TOWN OF RANDALL AND TOWN OF BLOOMFIELD BOATING ORDINANCES

BOATING, SWIMMING AND ZONE RESTRICTIONS

(1) Traffic Lane. A traffic lane is hereby established embracing the waters of the lake in its entirety, excepting therefrom that area between the shore and a line 200 feet in distance from and parallel to the shoreline, or as posted by navigation aids.

(2) Speed Restrictions. (Rep. & Rec., Sec. 42-87) No motorboat shall be operated within the traffic lane at a speed greater than "slow-no-wake" between the hours of sunset and 10 o'clock a.m. Outside the traffic lane, no motorboat shall be operated at any time at a speed greater than "slow-no-wake", and it being further provided that no person shall operate a motorboat on the waters of said lakes at a speed greater than is reasonable and prudent under the conditions, and having regard for the actual and potential hazards then existing.

(3) Passing. No person shall operate a motorboat or sailboat in the traffic lane within 100 feet of any swimmer, motorboat not under power, anchored boat or boat propelled by muscular power or sailboat at a speed greater than "slow-no-wake".

(4) In this Chapter "slow-no-wake" means the slowest possible speed so as to maintain steerage.

TRAFFIC RULES

(1) Rights of Way. Boats leaving or departing from pier, dock or wharf shall have the right of way over all other boats approaching such dock, pier or wharf. Boats propelled entirely by muscular power shall yield the right-of-way to sailboats, when necessary to avoid risk of collision.

SWIMMING

(1) From Boats. No person shall swim from any boat unless such boat is anchored.

(2) Distance from Shore or Base. No person shall swim more than one hundred (100) feet from the shore or more than twenty-five (25) feet from any pier (unless within marked authorized areas), anchored raft or boat, unless he is accompanied by a boat manned by a competent person and having readily available a ring buoy. For every person swimming there shall be at least one (1) person in the boat and at least one (1) throwable personal floatation device for each person swimming.

WATER SKIING

(1) Area. All water skiing is forbidden outside the traffic lane.

(2) Tow Lines. There shall be no more than two (2) tow lines per boat, and no more than one (1 persons per tow line for water skiing or similar sport.

(3) Safety Device. Any person or persons being towed on water skis, surfboard, aquaplane or similar contrivance must wear a life saving device approved by the United States Coast Guard of type 1, 2, or 3.

(4) Direction of Travel. The boats by means of which water skis, surfboards, aquaplanes or similar contrivances are being towed, must follow a counterclockwise direction in the traffic lane.

(5) Conformity. The drivers or operators of all boats by means of which water skis, surfboards, aquaplanes or similar objects are being towed, and the riders of such objects, must conform to the same rules and clearances as provided in this Chapter for motorboats.

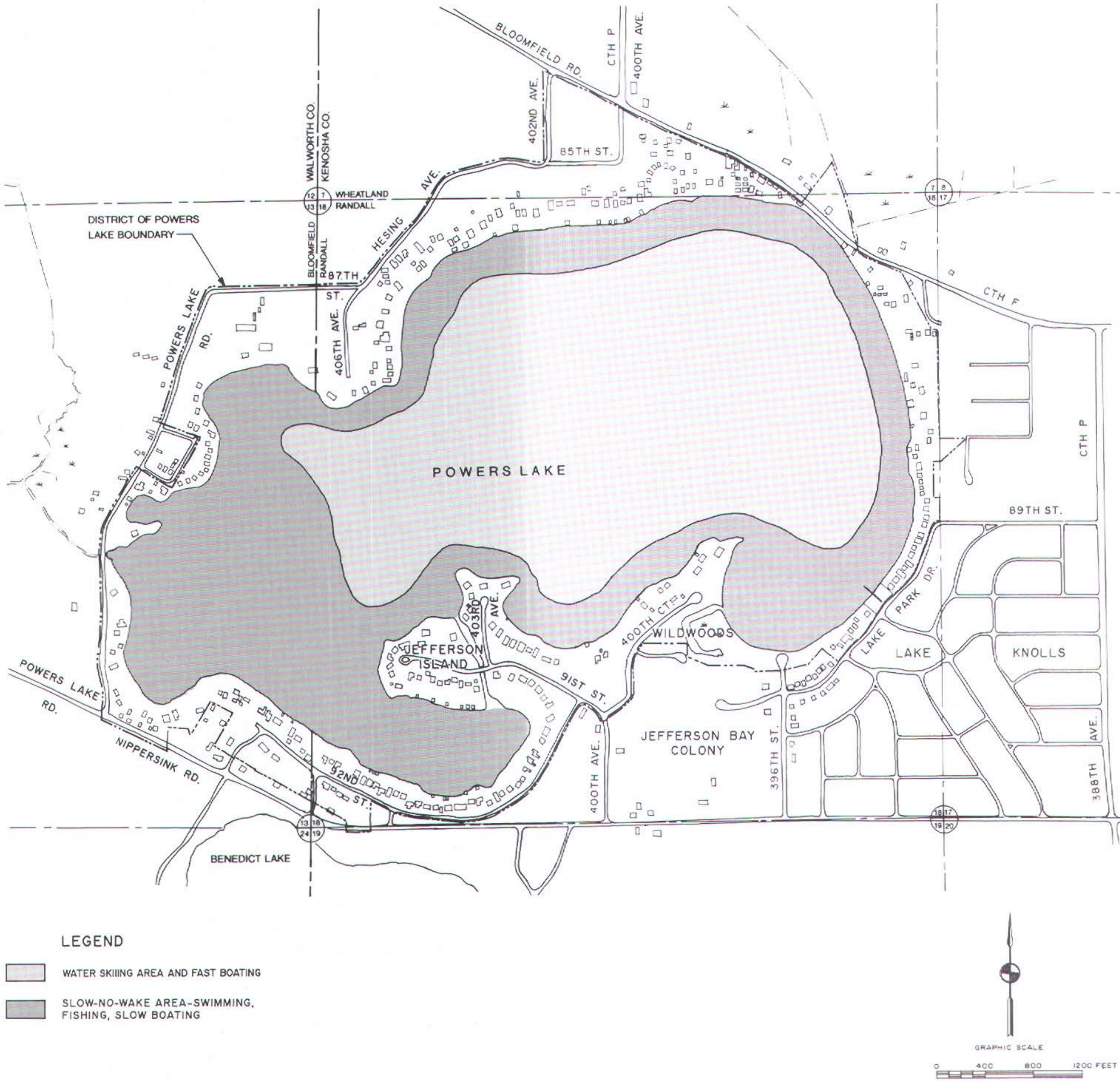
SANITARY

(1) Littering Waters and Ice. No person shall deposit, place or throw away from the shore, boat, raft, pier, platform or similar structure, any cans, bottles, debris, refuse, garbage, solid or liquid waste, sewage or effluent into the waters of the lake or upon the ice when formed.

Source: Randall Township Municipal Code.

Map 34

WEEKEND LAKE USE ZONING FOR POWERS LAKE



Source: Wisconsin Department of Natural Resources and SEWRPC.

results of the 1990 questionnaire survey. The number of jet skiers was the second greatest concern of the respondents while only nine respondents reported to be owners of jet skis. Restricting jet skis to certain times and areas on Powers Lake was favored by 75 percent of the respondents. When asked how boating ordinances could be improved, respondents answered most often that jet skiing should be restricted and some of the respondents favored a total ban.

The reasons for lake residents concern of jet ski use on Powers Lake stem from the apparent reckless manner in which the jet ski is operated, the noise which such skis generate, and the acceleration in numbers of jet skis on the lake in the recent past.

Alternative measures for improving the operation of jet skis and promoting the safe and equitable use of the lake resource include education measures and space and time zoning of the lake to restrict jet ski use. Under Chapter 30 of the Wisconsin Statutes, the personal watercraft is included in the definitions of boat and motorboat. Therefore, the operator of a jet ski on Powers Lake is regulated by the Statutes and the Randall and Bloomfield town ordinances.

Personal watercraft, or jet skis, are subject to regulations, including limiting the noise level to 86 dBA or less, measured on an "A" weight decibel scale; requiring floatation devices and fire extinguishers on the watercraft; and requiring an operator between the ages of 10 and 12 to have a parent or an adult of at least 18 years of age with him. The operator of a jet ski on Powers Lake is subject to Randall and Bloomfield town ordinances, including restriction of speed to slow-no-wake between the hours of sunset and 10:00 a.m. and outside of the traffic lane at all times. Additionally, the ordinance prohibits operation of a motorboat, including jet skis, in the traffic lane within 100 feet of any swimmer, motorboat not under power, anchored boat or boat propelled by muscular power, or sailboat at a speed greater than slow-no-wake.

Those who operate jet skis need to be aware that jet skis are presently regulated by existing Wisconsin Statutes and local ordinances. Education measures include, but are not limited to:

1. Developing jet ski displays at public access sites and in local commercial establishments where resident and nonresident lake users may congregate. These displays would provide information primarily on state statutes and local ordinances and secondarily on the dangers of jet skis and common sense actions.

2. Establish a program to post volunteers at the public access sites during peak weekend hours to summarize and give out information on statutes and ordinances for motorboat and jet ski users.

3. Set up a resident/nonresident workshop and invite speakers to address safety issues and recreational use. The workshop could be combined with a lake clean-up day or fish jamboree.

4. Publish and disseminate a newsletter to residents and nonresidents providing information on Powers Lake and recreational use including present problems with jet ski safety.

5. Establish a voluntary jet ski safety course.

In addition to education measures, jet skiing on Powers Lake could be restricted, via zoning, to certain times and/or areas on the lake.

Presently, legislation is being proposed at the state level to specifically regulate jet skis apart from motorboats and other watercraft. However, until such legislation is effected, jet skis are regulated as motorboats, and alternatives for restricting jet ski use on Powers Lake would be the same as stated earlier in this chapter in the Recreational Use Management section.

Winter Recreational Use

The results of the 1990 mail survey and observations from the 1991 winter recreational use survey indicate that popular winter activities on Powers Lake include ice fishing, ice skating, snowmobiling, cross-country skiing, and iceboating.

Reports by the Powers Lake Water Police and comments of the Lake District residents indicate that winter recreational use results in problems of increased litter, snowmobile noise, and safety hazard and untimely and hazardous ice shanty setup and removal.

Alternative measures to reduce littering by those using the lake in the winter, and to promote the safe and considerate use of snowmobiles and the safe and common-sense operations related to ice fishing include:

1. Increase winter surveillance by the Powers Lake Water Police or ordinance enforcement officers. a surveillance program would be initiated after an analysis of safety hazards related to winter recreational activities.

2. Prepare and publish a winter recreational use fact sheet including a summary of pertinent ordinances, common sense and safe use measures for snowmobile operation, ice-fishing, and ice shanty use.

3. Increase the posting at all public access sites of readily visible signage describing snowmobile ordinances, the Wisconsin Statutes, and local ordinances pertaining to ice shanties and littering.

Public Access

As described in Table 28 and Map 25 in Chapter V, there are currently six public access sites on Powers Lake. Four of these sites have a boat ramp and associated parking facilities. A total of 43 car-trailer and 30 car parking places are available at the sites with the boat ramps. One of these four sites with the boat ramp is owned by the Town and three are privately owned. The existing access has been judged to be inadequate to meet current Department of Natural Resources guidelines in place as of early 1991. In 1988, the Wisconsin Department of Natural Resources assigned Powers Lake a high priority for development of an improved public access.[12]

As part of the Powers Lake Management Plan, the Commission was requested by the Powers Lake Management District to identify areas which would be most suitable for the development of a public access site. Guidelines set forth in NR1 state that the public should be able to park within reasonable walking distances, in no case more than one-quarter mile, from the lake; adequate automobile and boat trailer parking, for Powers Lake a minimum of 23 car-trailer parking units, should be provided where boating is involved; and a minimum access width of 60 feet should be provided. Such a site would require an area of about 1.5 acres. Furthermore, according to DNR guidelines,[13] sites should be selected based on the following considerations: suitability of the site for serving the public; environmental impacts; and local opposition.

The specific criteria used to locate potential public access sites on a preliminary basis are listed in Table 37. Sites should be located adjacent to, or have safe access to, arterial highways; be of an adequate size, not less than one acre, for launching, parking, and maneuvering; and include a buffer zone between public and private properties. Physically, the site should be relatively flat, and require minimal site preparation and shoreline alteration. In addition, it is considered preferable to locate the site outside of an existing residential area.

The criteria listed in Table 37 were applied to the area within one-quarter mile of Powers Lake, and, based upon that application, two areas were identified within which an access site could be developed or improved.

The two areas are listed in Table 38 and are shown on Map 35. Area one is located in Randall and Wheatland Townships along the northeast shoreline on Bloomfield Road. Area two is located in Bloomfield Township along the southwest shoreline on Powers Lake Road. The two potential public access areas range in size from 0.5 to 2.7 acres. Additional parking areas within one-quarter mile of the potential access sites at locations one and two are about five and 27 acres, respectively. Land use and zoning are primarily commercial, recreational, and agricultural in area one and commercial, residential, and agricultural in area two.

The improvement of public access to Powers Lake is considered to be a measure which should be included in the Powers Lake management plan. In this regard, it is important to consider the following findings and considerations pertinent to this recommendation based upon a March 12, 1991, proposed Public Access Policy developed by the Wisconsin Department of Natural Resources. The proposed policy is to be the subject of public hearings in the future.

[12] *Wisconsin Department of Natural Resources, Proposed Public Boat Access Policy for Wisconsin's Navigable Bodies of Water, March 1991.*

[13] *Ibid.*

Table 37

CRITERIA USED TO EVALUATE POTENTIAL PUBLIC-ACCESS SITES

Site Conditions	Basis for Elimination of Public-Access Sites
Land Use	Wetland and other environmentally sensitive areas, and immediately adjacent residential areas
Environmentally Valuable Areas	Designated environmentally valuable areas which contain high value wetlands, plant and animal aquatic habitats, and shorelands
Slope Conditions	Slopes greater than 6 percent
Areal Extent	Sites less than one acre
Site Width and Buffer Strip	Sites less than 100 feet wide. Sites with less than 60-foot buffer on either side
Parking Distance from Access Point	If parking is not at launch site, sites farther than a one-quarter mile from launch site
Proximity to Access Roads	Sites with long distances from arterial highways, or sites adjoining arterial highways with unsafe access

Source: SEWRPC.

Table 38

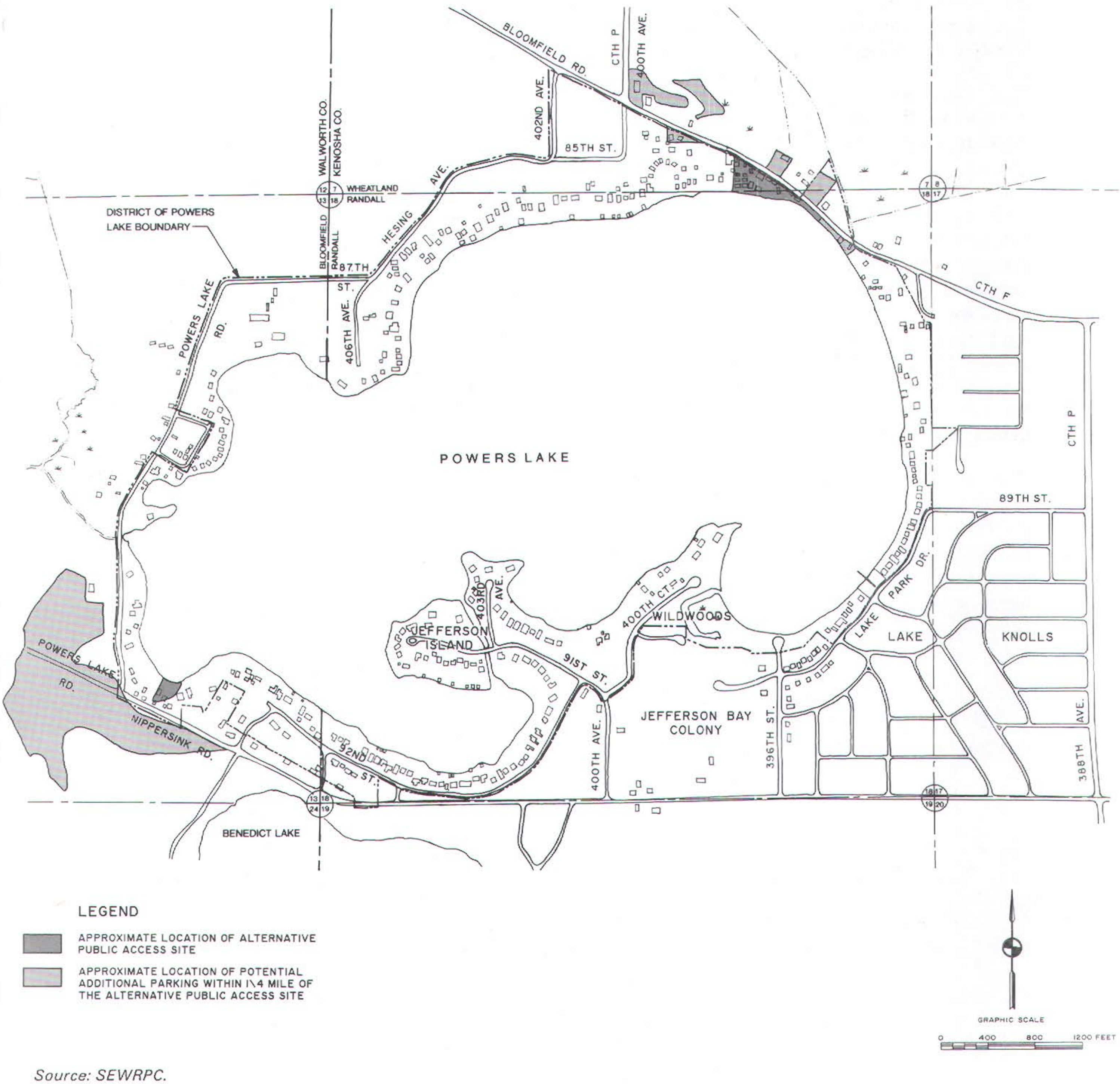
POTENTIAL PUBLIC-ACCESS SITES

Site Number	Location	Site Area (acres)	Parking Area Within One-Quarter Mile (acres)	Existing Land Use	Existing Zoning	Street Access
1 (northeast part of lake)	Randall and Wheatland Townships Approximately 800 feet along shoreline on CTH F/Bloomfield Road	2.7	5.2	Commercial Recreational Agricultural	Commercial Recreational Agricultural	CTH F/Bloomfield Road
2 (southwest part of lake)	Bloomfield Township Approximately 150 feet of shoreline on Powers Lake Road/CTH Z	0.5	26.6	Commercial Agricultural	Residential Agricultural	Powers Lake/CTH Z

Source: SEWRPC.

Map 35

ALTERNATIVE PUBLIC-ACCESS SITES FOR POWERS LAKE



Source: SEWRPC.

1. As reported in Chapter V, the current boating use on Powers Lake with the access available exceeds the recommended levels on weekends based upon both the Regional Planning Commission and Wisconsin Department of Natural Resources criteria.

2. The eight private and public access sites located on the lake, in aggregate, provide parking spaces which appear to meet the intent of the Wisconsin Department of Natural Resources recommendation for a public site. It is recognized that the current access sites are not public and thus there can be no assurance that the sites will remain open from one year to the next and that reasonable fees will be charged. However, the aforementioned proposed Public Access Policy acknowledges the availability of private access sites as a factor to be considered in prioritizing development of public sites.

3. The recommended Powers Lake management plan includes recommendations for limiting boating in certain areas of Powers Lake, based upon the need to protect environmentally sensitive areas. Thus, the available space for boating may be less than the 324 acres currently usable for fast boating.

4. Preference should be given to acquiring an existing private access site, or siting a proposed site in a commercial or open space area, rather than in a residential neighborhood.

Lake Litter

Because Powers Lake is a popular site for summer and winter recreational activities, lake litter can accumulate quickly, detracting from the natural aesthetics of the Lake, adding to lake water quality problems, and causing potential health problems. Trash barrels should be provided at all major access sites and because many lake users are nonresidents, sanitary facilities and fish cleaning stations should be provided. Annual lake clean-up days are effective in removing accumulated litter from shorelines and outlet structures. A winter cleanup, conducted near the end of ice-fishing season, can remove litter and ice-shanty remains from the ice, before it enters the lake. These litter prevention activities component of the public education program, including posting warnings and other information regarding littering, should be considered for inclusion in the Powers Lake Management Plan.

DREDGING

Selected areas on Powers Lake were considered for dredging. These areas were identified by the Powers Lake Management District, and include areas where excessive sediment deposition has been known to occur and areas which are too shallow for safe navigation. These potential dredging areas, including Lake Knolls Bay, Jefferson Bay, Jefferson Island, and Honey Bear Bay, are shown on Map 36. Dredging would involve the removal of bottom sediments, and the disposal of those sediments at an upland site. Besides removing nutrient-rich muck deposits and improving navigation and access, a reduction in macrophyte growth may occur in those areas since less light would reach the bottom.

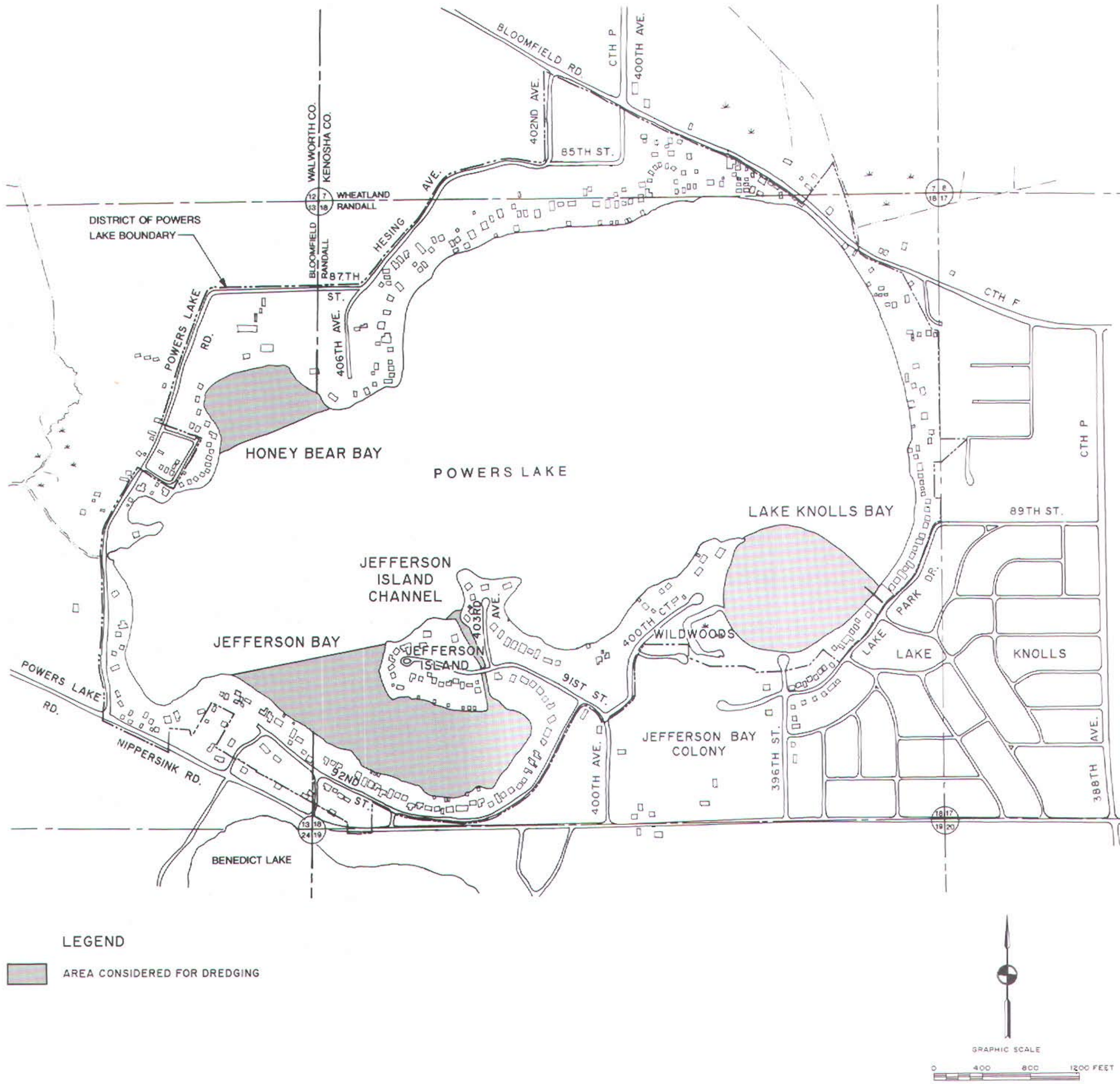
Surveys were conducted in Summer 1990 at each of the potential dredging areas to determine water depth, sediment type, and where possible, thickness of the soft sediments. Water depth was measured by inserting a graduated rod into the lake until the bottom was reached. Sediment type and thickness were determined by collecting sediments with a sediment core sampler which was inserted down into the lake bottom until a hard substratum was reached or to a maximum depth of ten feet. Measurements of water depth and characterization of bottom sediments were made at a total of 77 sample sites located along 21 transects, as shown on Maps 37 through 39. All of these areas have been dredged in the past.

Longitudinal profiles of Lake Knolls Bay, Honey Bear Bay, and Jefferson Island Channel and representative cross sections of the bottom sediment for conditions in Jefferson Bay and Jefferson Island Channel are shown in Figures 24 through 26 and 27 and 28, respectively. At most of the sample locations the water depths ranged from two to five feet. In general, bottom sediments sampled consisted of marl and muck. Primarily marl sediments were found at Lake Knolls Bay, Jefferson Bay, and Honey Bear Bay. Muck was the dominant soil type sampled in Jefferson Island channel.

Dredging may have serious, though generally short-term, adverse effects on Powers Lake.

Map 36

AREAS CONSIDERED FOR DREDGING IN POWERS LAKE



Source: SEWRPC.

These adverse effects include increased turbidity caused by sediment resuspension, oxygen depletion as the organic sediments mix with the overlying water, water temperature alterations, and destruction of benthic habitats. There may also be impacts at the upland disposal sites, such as odor problems, restricted use of the site, and trucking disturbances associated with heavy truck traffic.

Dredging requires a State of Wisconsin permit under Section 30.20 of the Wisconsin Statutes, and must comply with standards set forth in Chapter NR 347 of the Wisconsin Administrative Code. Chapter NR 347 also includes guidelines for sampling and analysis of dredge spoils.

Dredging Method

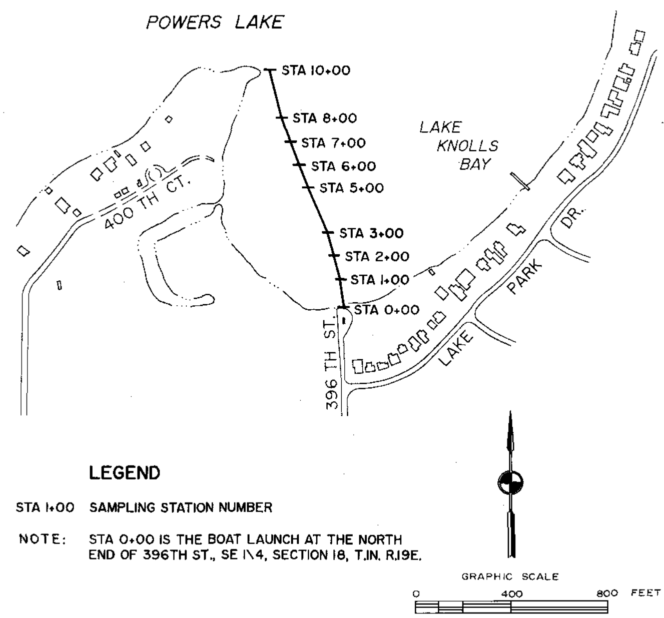
The selection of dredging equipment and methods depends upon the amount and characteristics of the sediments to be removed, the dredging depth, site and access restrictions, the disposal site conditions, and cost. There are two primary methods of dredging: hydraulic and mechanical. Hydraulic dredges employ a rotating cutterhead to loosen the sediment, which is then excavated with a high capacity pump. The removed dredge spoil slurry is pumped directly to a disposal area through a movable, large diameter pipe. The dredge spoil solids are allowed to settle in the disposal site, and the resultant "clean" water may be discharged back to the water body or allowed to evaporate.

A small portable hydraulic dredge may be suitable for use in all of the proposed dredging project areas. The typical small hydraulic dredge may be about ten feet wide and 40 feet long, and operate in water as shallow as two feet. It can dredge to a maximum depth of about 15 feet at a maximum rate of about 120 cubic yards of sediment per hour. The dredge spoils slurry normally has a solids content of from 10 to 20 percent.

The advantages of hydraulic dredging, compared to mechanical dredging, is that less turbidity and sediment resuspension occurs; the dredging can often be completed in less time; and there is less disturbance of the shoreline area. The disadvantages of a hydraulic dredge include the need for a larger disposal site because the water content of the slurry is higher than mechanical dredge spoils, and the need to locate a disposal site within about one-half mile

Map 37

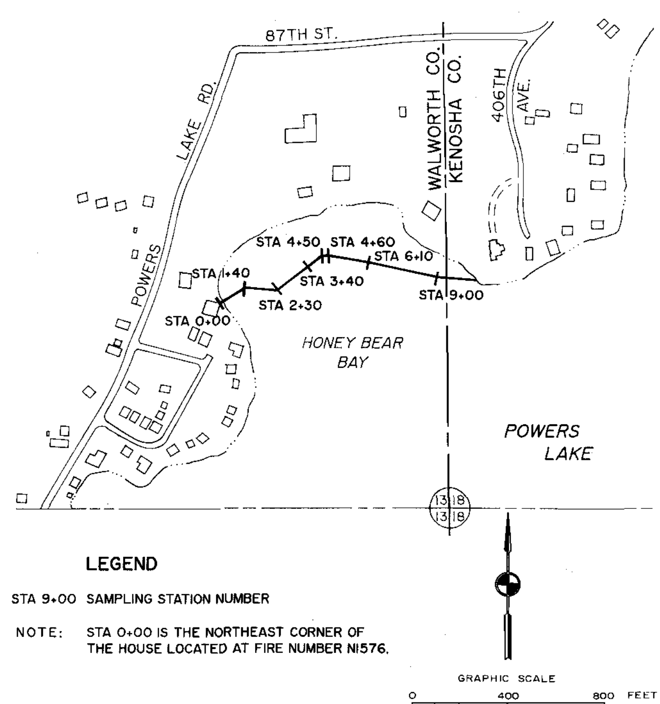
LOCATION OF SAMPLING TRANSECTS IN LAKE KNOLLS BAY



Source: SEWRPC.

Map 38

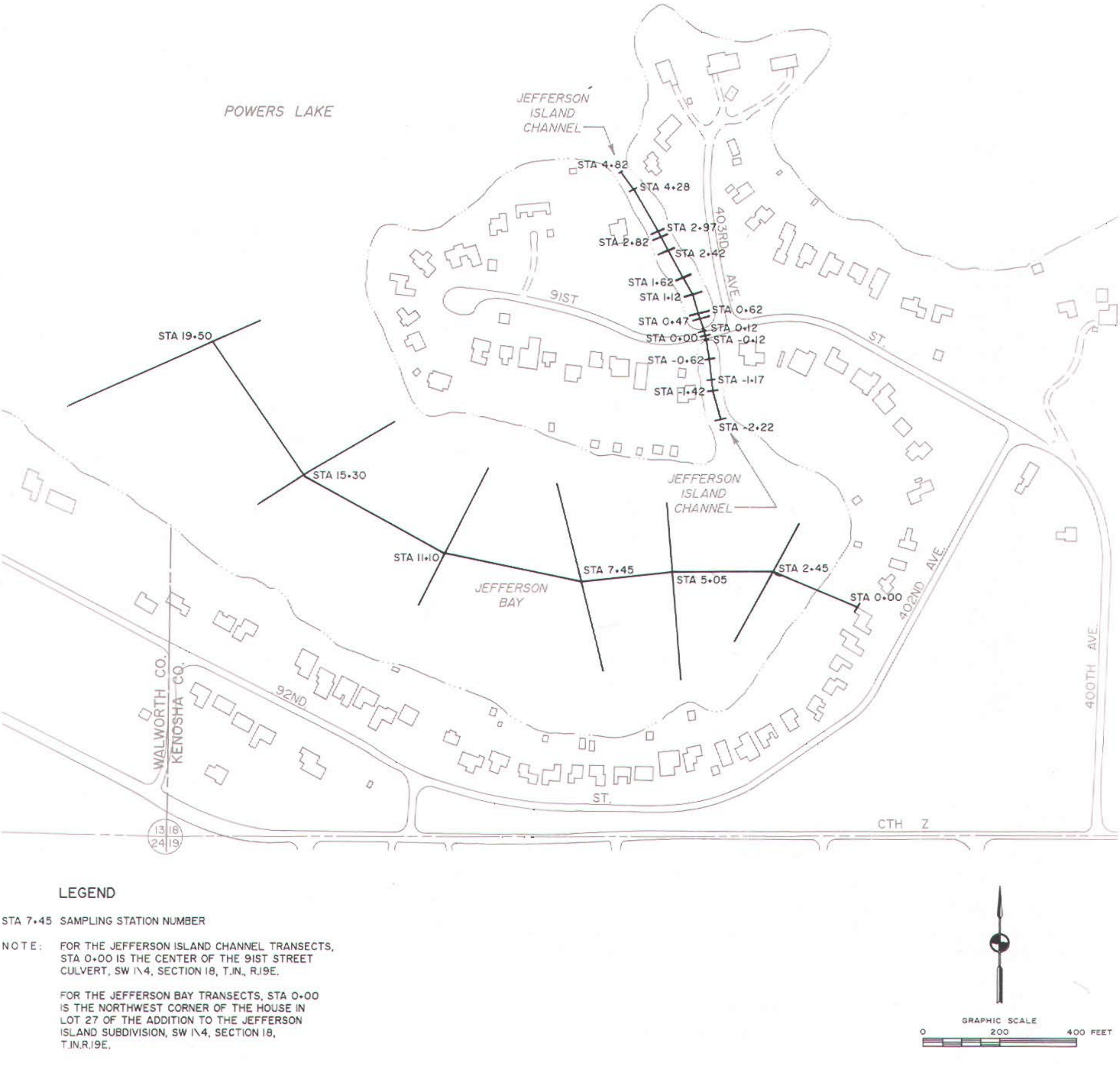
LOCATION OF SAMPLING TRANSECTS IN HONEY BEAR BAY



Source: SEWRPC.

Map 39

LOCATION OF SAMPLING TRANSECTS IN JEFFERSON BAY AND THE JEFFERSON ISLAND CHANNEL



LEGEND

STA 7·45 SAMPLING STATION NUMBER

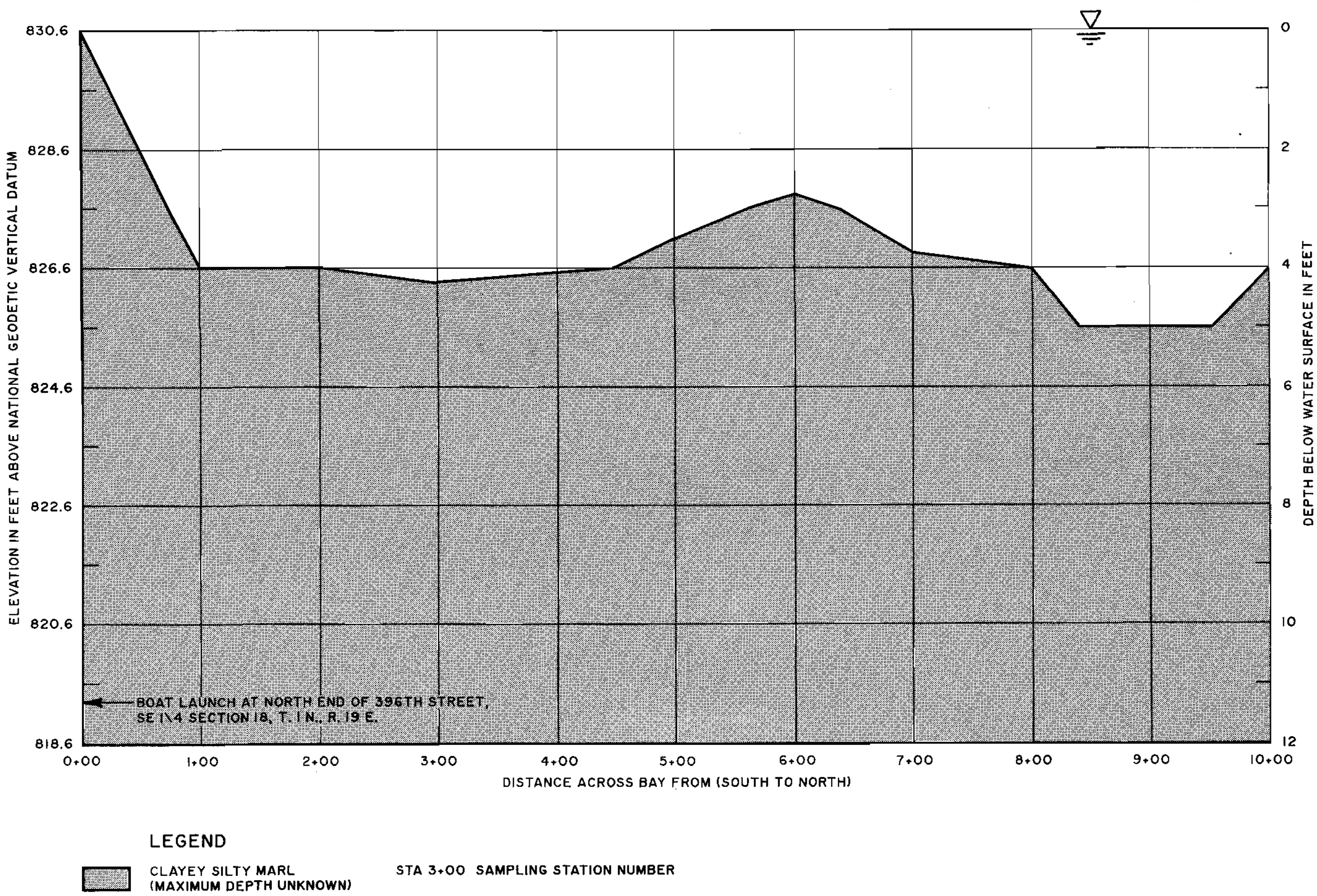
NOTE: FOR THE JEFFERSON ISLAND CHANNEL TRANSECTS, STA 0·00 IS THE CENTER OF THE 91ST STREET CULVERT, SW I\4, SECTION 18, T.1N., R.19E.

FOR THE JEFFERSON BAY TRANSECTS, STA 0·00 IS THE NORTHWEST CORNER OF THE HOUSE IN LOT 27 OF THE ADDITION TO THE JEFFERSON ISLAND SUBDIVISION, SW I\4, SECTION 18, T.1N.,R.19E.

Source: SEWRPC.

Figure 24

LONGITUDINAL PROFILE OF LAKE KNOLLS BAY



Source: SEWRPC.

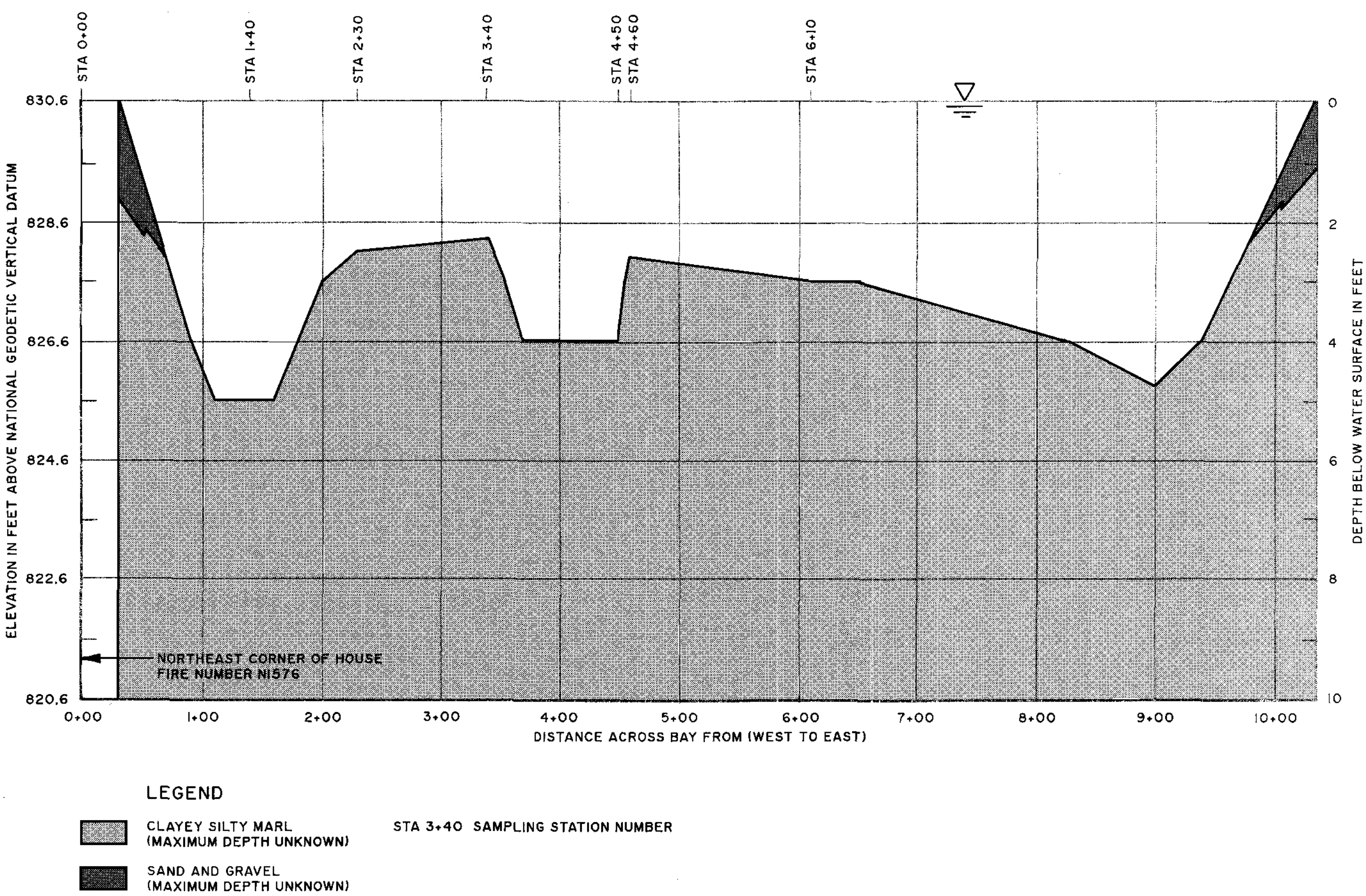
of the dredging site in order to be economically feasible. Hydraulic dredging may be more economical than mechanical dredging when a large volume of sediments is to be removed, where the disposal site is located close to the dredge site, and where a mechanical dredge would have to be barge-mounted. However, for Powers Lake, hydraulic dredging conducted by a private firm on a contract basis may be expected to be more costly than mechanical dredging, entailing a unit dredging cost of about $4.00 to $6.00 per cubic yard of sediment, measured in place.

Mechanical dredging utilizes dragline equipment, consisting of a bucket suspended from a boom, to physically remove the sediment. For small to medium size inland lakes, the dragline equipment would be situated onshore and would require shore areas to be relatively flat and open. The sediment dredged from a channel or lake would be either stockpiled onshore or placed directly onto trucks which would transport the sediment, at approximately its in-place solids content, to the disposal site.

The advantages of mechanically dredging the sediments from the lake bottom and the Jefferson Island channel include a lower cost than hydraulic dredging; the need for a smaller disposal site because the solids content of the dredge spoils would be higher; and the ability to use disposal sites located a farther distance from the dredge site. The disadvantages of mechanical dredging include the production of high turbidity; disturbance of the shoreline area; increased truck traffic and related disturbances; and a longer time period required for the conduct of the dredging operation. Mechanical dredging conducted by a private firm on a contract basis

Figure 25

LONGITUDINAL PROFILE OF HONEY BEAR BAY



Source: SEWRPC.

may be expected to entail a unit dredging cost of about $3.00 to $3.50 per cubic yard of sediment, measured in place.

Disposal Alternatives

Locating a dredge spoils disposal site frequently constitutes a serious constraint on the feasibility of a dredging project. Proposals for disposing of dredge spoils on a particular site may generate strong local opposition and may be precluded by local zoning ordinances.

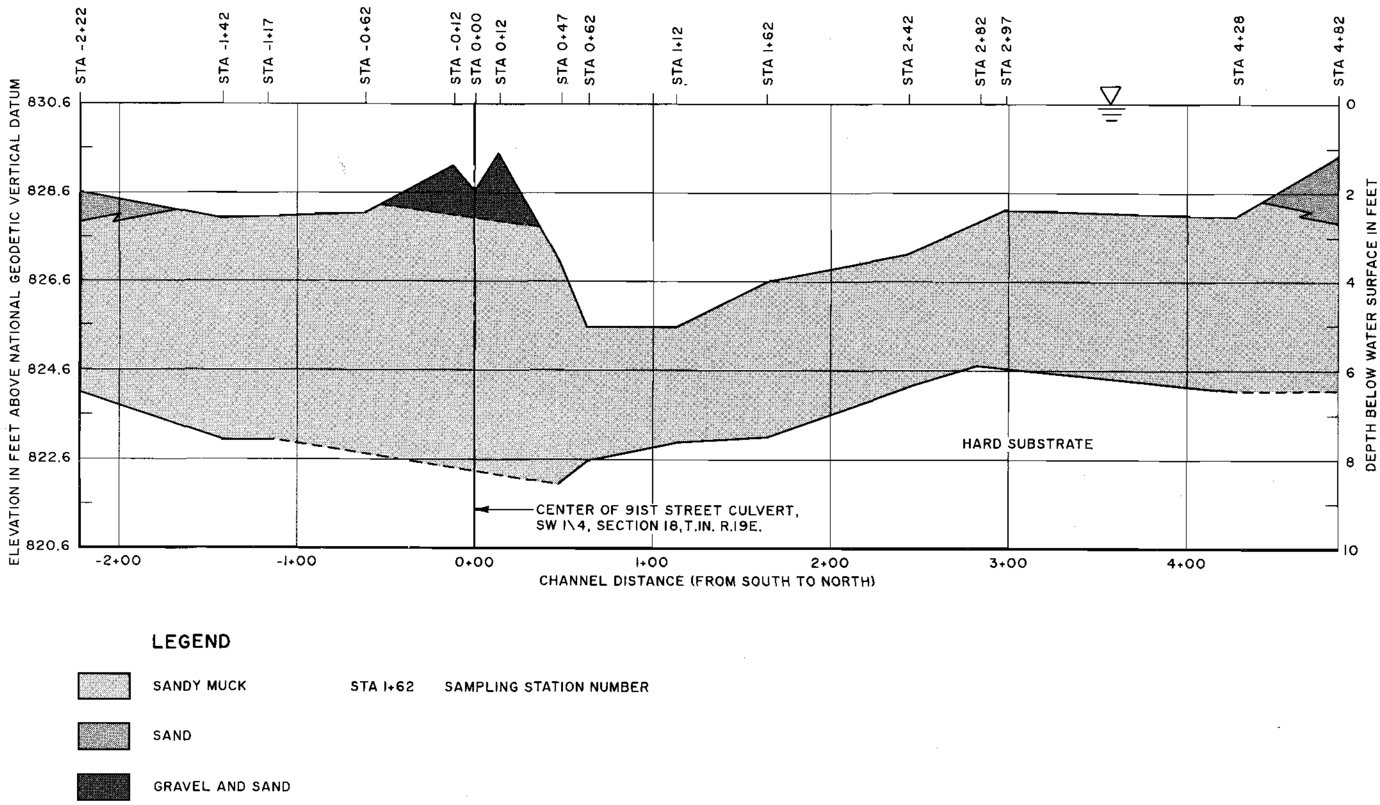
The ultimate selection of a specific site for the disposal of dredge spoils must be based upon detailed, site-specific studies carefully evaluating economic, social, environmental, and technological considerations. The conduct of these site specific studies is costly and time consuming. However, a generalized site selection study can provide useful information on the availability of suitable sites. The findings of such a generalized study as set forth in this report provide an indication of where the most feasible dredge spoils disposal sites may be located and aid in the preparation of preliminary cost estimates.

The identification of potential disposal sites requires the establishment and application of site evaluation criteria. The criteria used should be based upon state regulatory requirements and upon sound environmental protection guidelines. For the purpose of the analyses conducted under this study, it was assumed that the dredge spoils would be landspread on open or agricultural land, or landfilled at a disposal site.

Criteria used in the selection of suitable disposal sites included existing and proposed land use, the existence of a flood hazard, the existence of primary environmental corridors, soil and slope

Figure 26

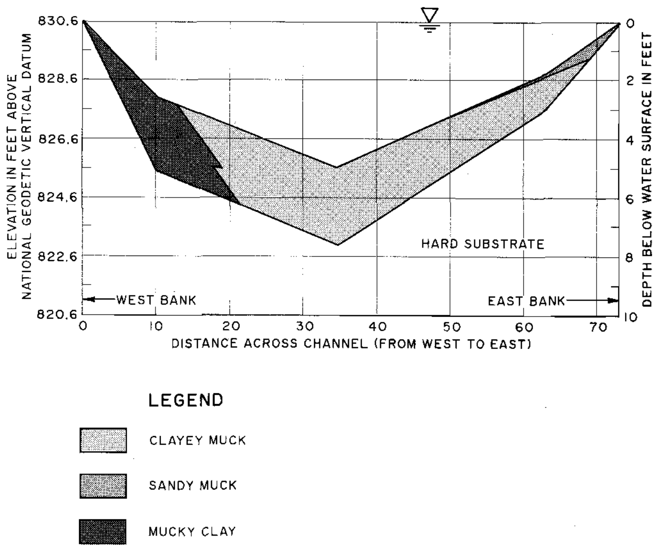
LONGITUDINAL PROFILE OF JEFFERSON ISLAND CHANNEL



Source: SEWRPC.

Figure 27

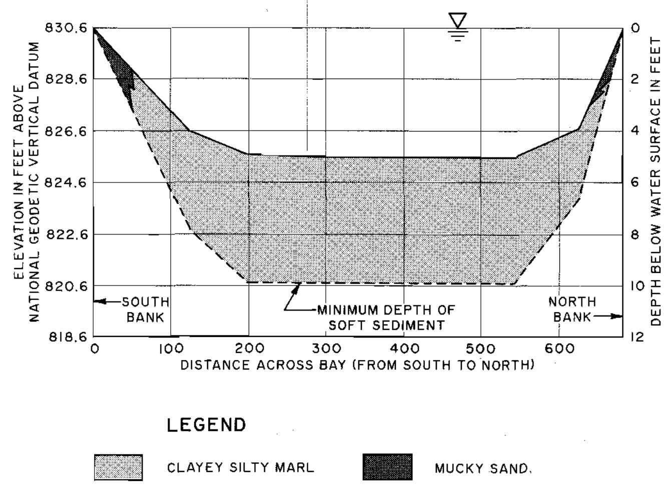
CROSS-SECTION OF THE JEFFERSON ISLAND CHANNEL AT TRANSECT STATION 1+12



Source: SEWRPC.

Figure 28

CROSS-SECTION OF JEFFERSON BAY AT TRANSECT STATION 2+45



Source: SEWRPC.

Table 39

CRITERIA USED TO EVALUATE POTENTIAL DREDGE SPOIL DISPOSAL SITES

Site Conditions	Basis for Elimination of Potential Disposal Sites
Land Use	Residential, commercial, industrial, transportation, communication, utilities, governmental and institutional, recreational, wetland, and surface water
Primary Environmental Corridor	Primary environmental corridors which contain high value woodlands, wetlands, wildlife habitats, and shorelands
Flood Hazard	Land within the 100-year floodplain
Soil Conditions	Soils unsuitable for area-type landfills based on flooding hazard, permeability, depth to water table, depth to bedrock, and slope
Slope Conditions	Slopes greater than 6 percent
Areal Extent	Sites less than one acre
Distance from Dredge Site	Areas greater than a two-mile one-way transportation distance if a mechanical dredging method is used; and greater than one-half mile one-way distance if a hydraulic dredging method is used
Proximity to Wetlands, Watercourses or Residential Land Uses	Land within 300 feet of a wetland, watercourse, or residential land use

Source: SEWRPC.

limitations, areal extent, distance from the dredging site, and distance from a watercourse. The specific criteria used to evaluate potential disposal sites are listed in Table 39. These criteria were applied to the area within about two miles of the potential dredging sites, and based upon that generalized application, seven potential dredge spoil disposal sites were identified.

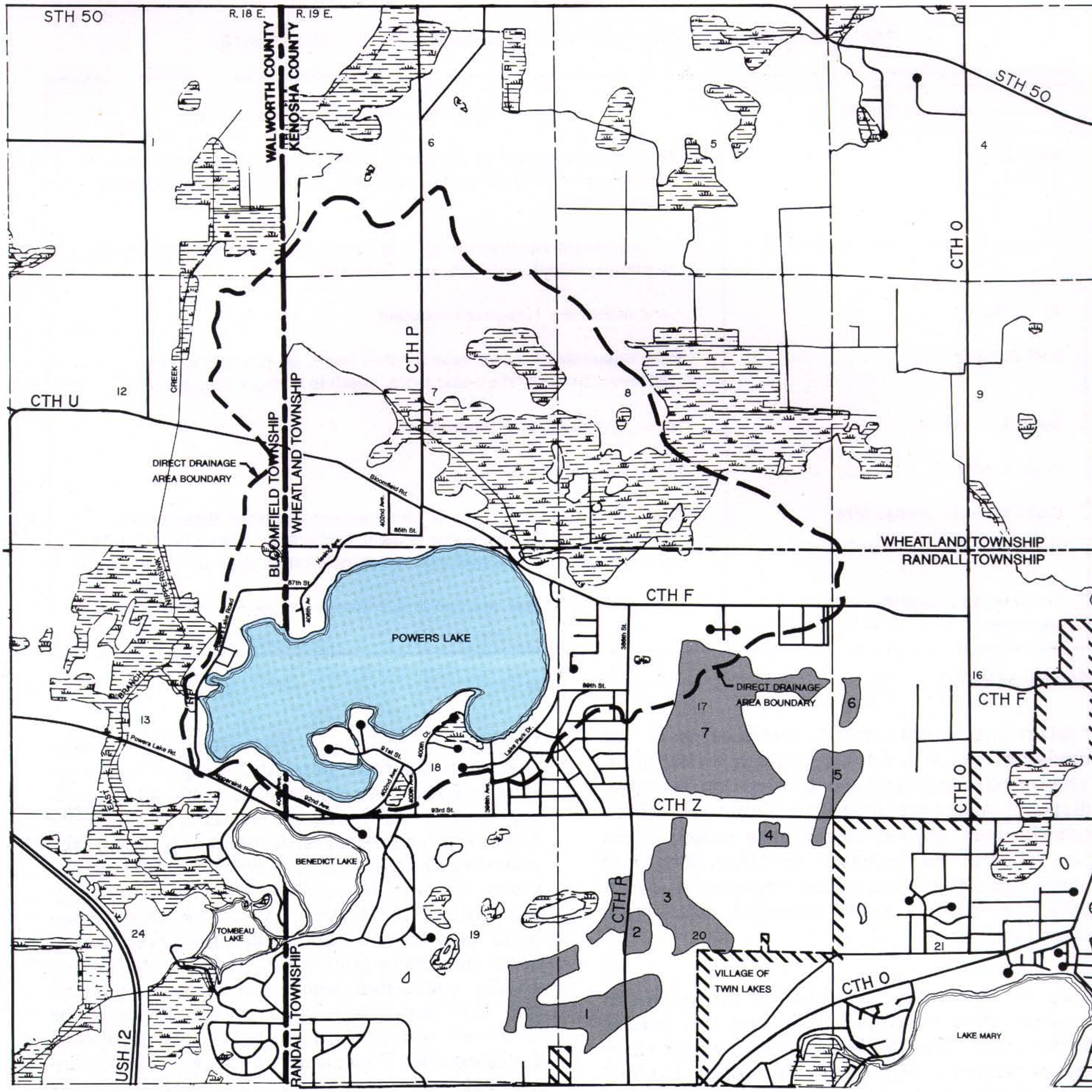
Map 40 shows the location of the potential disposal sites identified, including the needed buffer areas. The analysis indicates that there are no suitable sites available within one-half mile of the dredging areas for placement of dredge spoils removed by hydraulic dredging. Suitable sites for the placement of dredge spoils removal by mechanical dredging within two miles of the potential dredging sites, range in area from about four to 136 acres. Further investigation would be needed to evaluate the available sites, as well as the potential economic, social, and environmental impacts related to the use of each site for dredge spoils disposal.

Dredging Alternatives: The alternatives evaluated for the four potential project areas in Powers Lake are compared in Table 40. According to the analyses, there are no suitable disposal sites located within one-half mile of the potential dredging sites, thereby eliminating the hydraulic dredging method as a feasible dredging method in Powers Lake. The unit dredge costs used for mechanical dredging were based upon the assumption that shoreline structures and/or vegetation would not impede dredging and that an adequate disposal site could be obtained within two miles of the potential dredging site. To estimate total cost, the dredging costs were increased by 25 percent to account for engineering, legal, and administrative fees and contingencies.

Knolls Bay would be dredged to remove loose marl sediments to improve boat navigation in the Bay and enhance boating access for those people launching boats at this site. From the survey conducted on July 5, 1990, the Commission identified Knolls Bay, shown on Map 21, as an environmentally valuable area, having

Map 40

ALTERNATIVE DREDGE SPOIL SITES FOR POWERS LAKE



LEGEND

APPROXIMATE LIMITS OF ALTERNATIVE DISPOSAL SITES INCLUDING BUFFER AREA

Source: SEWRPC.

Table 40

DREDGING ALTERNATIVES FOR POWERS LAKE

Alternative Site	Mean Depth of Dredged Channel (feet)	Volume of Sediments Removed (cubic yards)	Disposal Site Volume Required[a] (cubic yards)	Weeks of Active Dredging Required[b]	Total Cost[c]
Knolls Bay	- -[d]	- -	- -	- -	$ - -
Honey Bear Bay	- -[d]	- -	- -	- -	- -
Jefferson Island Channel	6	2,500	2,500	1.6	11,000
Jefferson Bay	5 10	17,200 44,400	17,200 44,400	10.8 27.8	75,300 194,200

[a]*To calculate the needed volume of a disposal site, it was assumed that the solids content of mechanical dredge spoils would be the same as the in-place sediments, about 30 percent solids. Thus, the disposal site volume would be the same as the volume of sediments removed.*

[b]*It was assumed that the productivity of mechanical dredging with a single dragline or clamshell would be 40 cubic yards of in-place sediments per hour for 40 hours per week.*

[c]*Includes the dredging and disposal cost plus 25 percent for engineering, legal, and administrative fees and contingencies. The costs do not include the land costs for the dredge spoils disposal sites, which may be expected to cost about $2,000 to $4,000 per acre.*

[d]*Not recommended for dredging.*

Source: SEWRPC.

diverse aquatic vegetation and an adjacent wetland which may be used for spawning, feeding, or shelter purposes by fish and other aquatic animals. Because of the potentially adverse impacts that dredging may have on the diverse plant communities and other aquatic life in Knolls Bay, dredging in Knolls Bay is not recommended.

The Jefferson Island Channel would be dredged to remove primarily organic sediments to improve boat navigation. In addition to the organic sediments, as shown in Figure 26, sand and gravel have been washing off the banks into the channel in the vicinity of culverts, while sand has been deposited at both north and south channel inlets. Water depths in the channel range from about one to five feet. Jefferson Island Channel would be dredged to a mean depth of about six feet. Approximately 2,500 cubic yards of sediment, along with rocks, logs, and other debris, would be excavated. The estimated cost for mechanical dredging, not including land acquisition for spoils disposal, is $11,000.

Three options for dredging Jefferson Bay to improve boat access and navigation were considered: the entire Bay to a mean depth of 10 feet and along the eastern shoreline to mean depths of five and 10 feet. To achieve a mean depth of ten feet in Jefferson Bay about 192,000 cubic yards of sediment would need to be removed.

Mechanical dredging of the entire Bay utilizing a dragline situated onshore would not be feasible because of the limited reach of the dragline. As noted earlier, hydraulic dredging would not be economically practical because of the lack of disposal sites within a one-half-mile distance. Dredging the entire Bay, therefore, is not a recommended alternative.

In Jefferson Bay, an area approximately 100 feet wide, 1,700 feet long, and five feet deep or 10 feet deep could be dredged to enhance boating access and improve swimming conditions for residents along the eastern shoreline of the Bay. About 17,200 cubic yards, and about 44,400 cubic yards of sediment, along with other debris, would have to be removed to achieve the five-foot and 10-foot depths, respectively. The estimated cost for mechanical dredging, not including land acquisition for spoils disposal, is $75,300 for a five-foot-deep area and $194,200 for a 10-foot-deep area.

The eastern shoreline of Jefferson Bay, as shown on Map 21, was identified as an environmentally valuable area after a survey was completed on July 5, 1990, by the Commission staff. Dredging in this area would have to be considered for incorporation into the recommended plan in conjunction with the recommendations for preserving fish and aquatic habitat area. If recommended, certain mitigation measures might also be required.

Dredging of the marl sediments in Honey Bear Bay would improve boat navigation and recreational use in the Bay. As shown in Figure 25, the present configuration of the bay floor indicates past dredging efforts. Water depths in the Bay range from more than two feet to about five feet, also shown on Figure 25.

Honey Bear Bay was identified as an environmentally valuable area after a survey was completed on July 5, 1990, as shown on Map 21. Because of the potentially adverse impacts that dredging may have on the diverse plant communities and other aquatic life in Honey Bear Bay, and the limited benefits that dredging would provide, this alternative is not recommended.

Harbor Lite's Bay Dredging: At the June 20, 1991, board meeting of the Powers Lake Management District, the Regional Planning Commission was requested to evaluate the need for dredging along the northern entrance to Harbor Lite's Bay to improve boat access. From general inventory data collected in 1990, it was estimated that water depths in this area ranged from two to two and one-half feet. Dredging an area about 25 feet wide, 30 feet long, and six feet deep would require the removal of about 1,500 cubic yards of sediment at an estimated cost of $8,000, not including cost of dredged material disposal. Such land costs are variable and are estimated to range from $2,000 to $5,000. Because Harbor Lite's Bay was identified as an environmentally valuable area, dredging, if recommended, may require mitigation measures. The extent of the dredging is relatively limited. Thus this additional dredging area is considered a viable option is to be considered further in the recommended plan.

LAKE WATER LEVEL CONTROL

Description of the Existing Controls on Lake Levels

As shown on Figure 29, the Powers Lake outlet consists of a six-foot-wide by 1.4-foot-high reinforced concrete box culvert with a gravel bed and concrete sills poured flush with the lake and stream beds at the upstream and downstream ends of the culvert, respectively. The culvert is located under Powers Lake Road and discharges to a natural stream which flows through a wetland and enters the East Branch of Nippersink Creek about 850 feet downstream of the Powers Lake outlet. The streambed drops about 1.2 feet over its 850-foot length for a slope of 0.0014 foot per foot.

Under the present outlet configuration, there is no single structure which controls lake water levels. In addition to conditions influencing surface and groundwater inflow to the Lake, water levels are determined by the interaction of several interdependent factors, including the water level of the East Branch of Nippersink Creek, the capacity of the stream between the lake outlet and the Creek, and, to a lesser degree, the capacity of the box culvert outlet. Beaver dams have periodically been constructed across the stream flowing through the wetland downstream of the lake outlet. Those dams have impounded outflow from the Lake and raised lake levels abnormally prior to their removal.

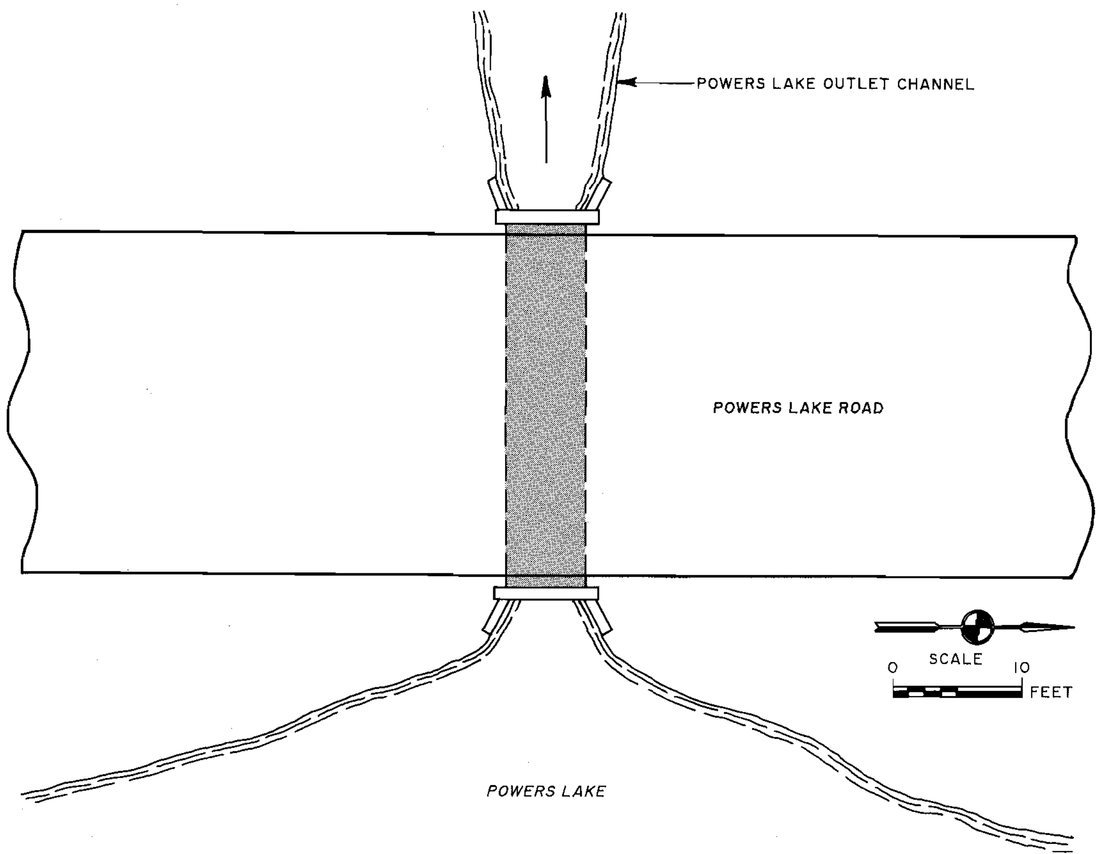
Existing Data on Lake Water Levels

As presented on Figure 3 in the climate and hydrology section of Chapter II of this report, lake water level data were collected for the period from October 16, 1986 to October 15, 1987. Over that time period, a generally decreasing trend in the lake level was observed, with a net drop in the level of 0.8 feet. The average lake level over the period of measurement was approximately 833.1 feet National Geodetic Vertical Datum (NGVD) and the peak level was 833.5 feet NGVD. Weekly lake levels have been recorded by a Lake District observer and reported to the U.S. Geological Survey from the summer of 1990 to the date of publication of this report. No other data are available which would enable characterization of the long-term fluctuations in lake levels. Based on observation and measurement of lake levels, the lake level has fluctuated a maximum of about two feet since the drought period of 1988.

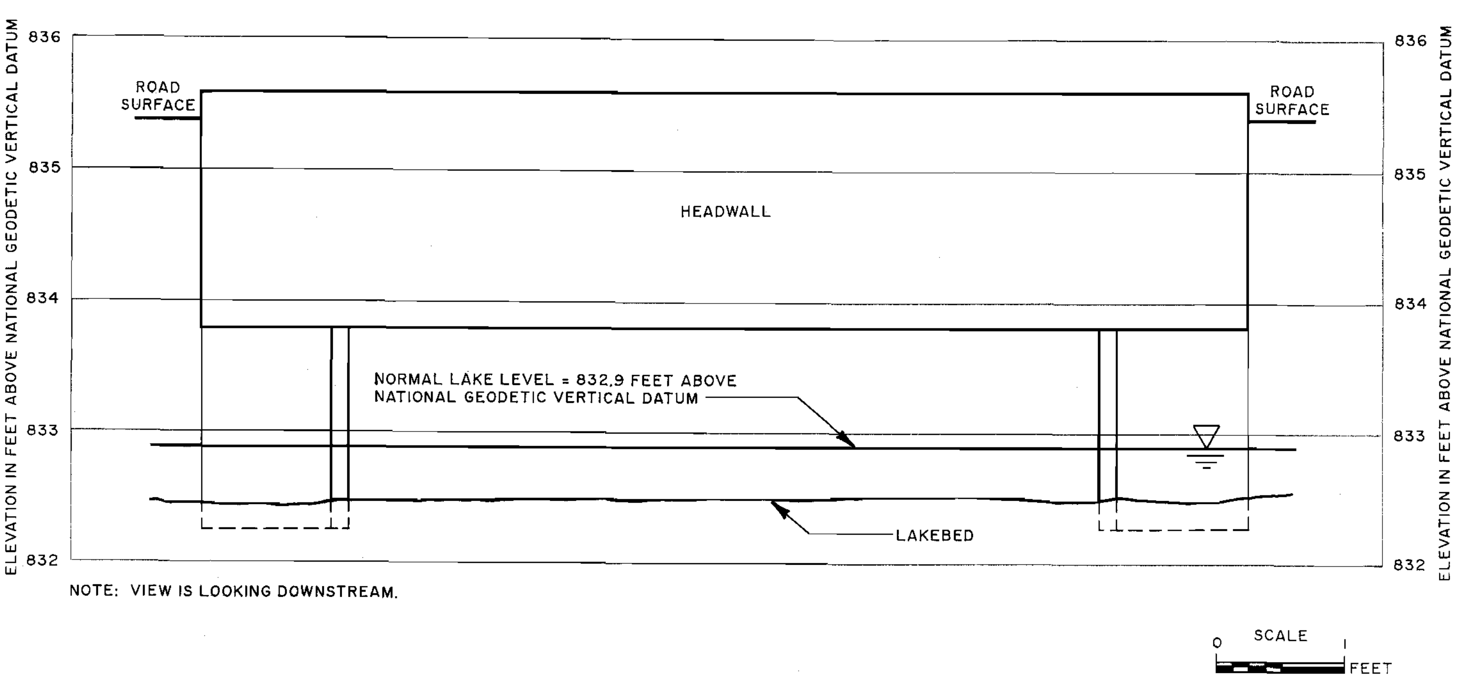
Figure 29

PLAN AND PROFILE OF EXISTING POWERS LAKE OUTLET STRUCTURE

PLAN VIEW



PROFILE



Source: SEWRPC.

High Lake Level Problems

Problems have been reported regarding high lake levels which, in conjunction with wind, motor-boating activities, and ice action have caused shoreline erosion. As set forth in Chapter II of this report, in 1990 about 47 percent of the Powers Lake shoreline was structurally protected. About one third of the protection structures require repair. Of the remaining 53 percent of the shoreline that was not protected by structures, 89 percent was found to be stable and well-vegetated. Thus while erosion has occurred at locations scattered along the shoreline, it is not considered to be a major or widespread problem.

One source of inconvenience to those who operate motorboats and jet skis on the lake is a restriction on wakes during periods of high lake levels. The boating ordinance for the Townships of Randall and Bloomfield requires that all watercraft be operated at slow speeds, creating no wakes under the following conditions: 1) on Jefferson Bay when the level of Powers Lake exceeds 833.6 feet NGVD and 2) on Powers Lake, within 400 feet of the shore, when the level of the Lake exceeds elevation 833.9 feet NGVD. The level which would cause restriction of wakes on Jefferson Bay is about 0.5 foot above the mean lake level and 0.1 foot above the peak level recorded in the October 1986 through October 1987 period. Although below-normal precipitation occurred during that period as a whole, the occurrence of the peak level followed a period of heavy rains in September 1986. The highest recorded lake level since data recording was resumed in 1990 was recorded in April of 1991 and was less than 0.1 foot below the level under which wake restrictions would be in effect on Jefferson Bay. There is no documentation of the number of times that wake restrictions have been imposed, or of the duration of the wake restrictions, on Jefferson Bay or on the rest of Powers Lake. The chairman of the Lake District indicated that restrictions were imposed once on Jefferson Bay but never on the remainder of the Lake since the pertinent section of the ordinance became effective in 1987.

Low Lake Level Problems

Problems with boats hitting the lake bottom when docking at piers have been reported during low-water periods in the late summer and fall. Also some difficulties with boat access to Jefferson Bay have been reported during low water periods.

Alternative Approaches to Regulation of Lake Levels

The regulation of the level of Powers Lake can be improved by modifying the outlet to increase its hydraulic capacity and to enable greater manipulation of lake levels through the provision of a gated structure at the outlet. Such an approach should be coupled with a program to preserve the existing storage of stormwater runoff in the wetland and natural depression areas within the area tributary to the lake and to continue the use of roadside swale drainage systems for existing and new development in the tributary area.

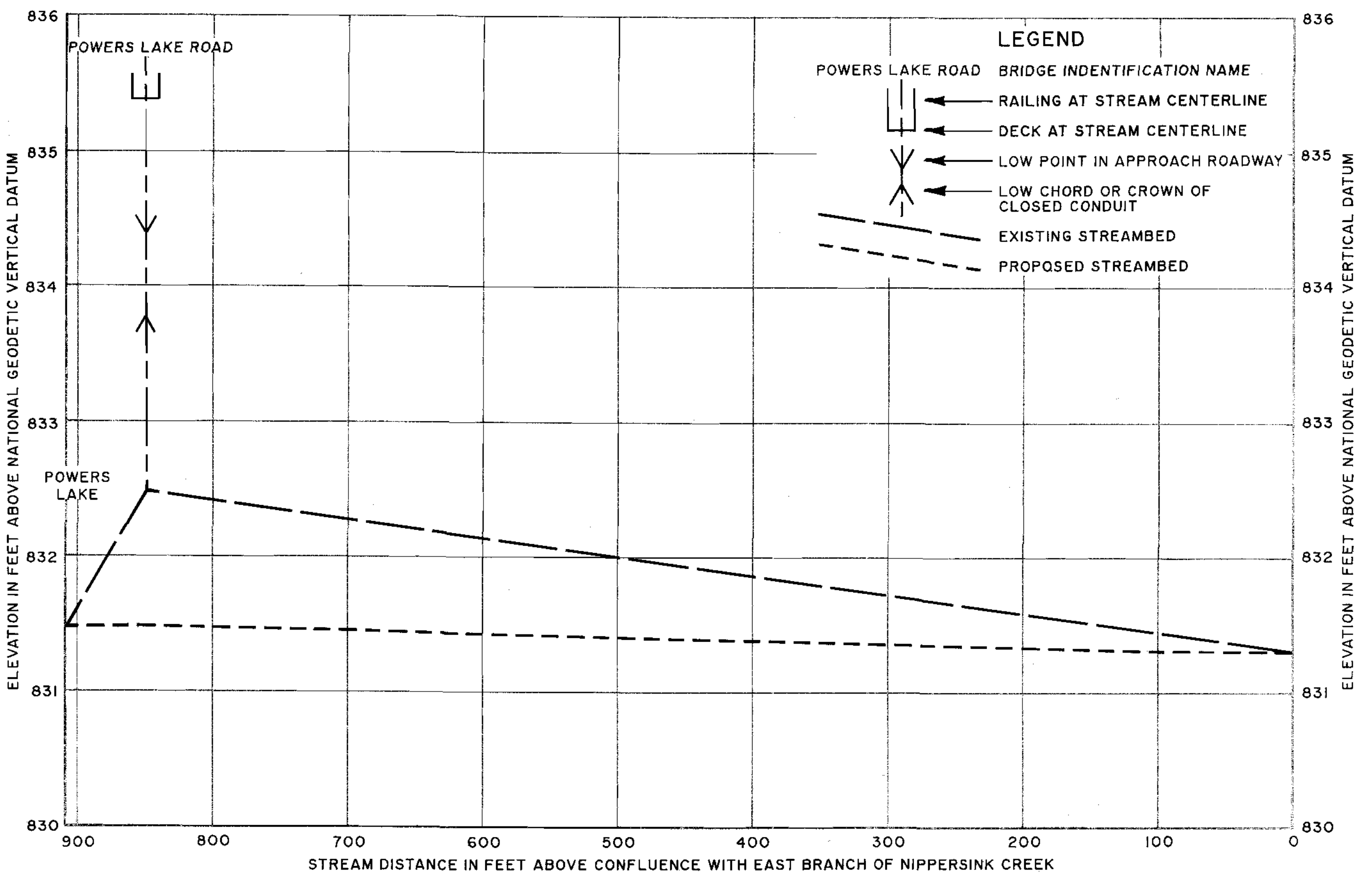
Field observations made in May 1991 during a period of relatively high lake levels, indicate that the existing outlet structure does not significantly increase lake levels above those which would be attained without the structure. That is, the change in water level is less than 0.1 foot from the upstream side of the outlet culvert to the downstream side. In order to increase the hydraulic capacity of the outlet, modifications to the downstream channel would be required. Such modifications could include widening and deepening of the channel.

It should be noted that without the downstream channel modifications the net effect of installing a control structure in the existing channel would be to increase the lake water levels. The increase in levels would occur with this type of structure because the hydraulic capacity of the outlet would not be increased, but the control structure would be operated to maintain lake levels above existing levels during low and average flows. Therefore, lake levels would be higher at the beginning of periods of increased lake inflows, the lake outflow could not be increased above its existing rate in order to draw the lake down, and peak lake levels would be higher. Thus, the option of installing a control structure without downstream channel modifications is not recommended.

Structural Alternative for Control of Lake Levels: A structural alternative for the regulation of lake levels was investigated. The alternative calls for increasing the hydraulic capacity of the 850-foot long Powers Lake outlet channel by widening the channel and lowering the existing streambed a maximum of one foot between the lake and the East Branch of Nip-

Figure 30

STREAMBED PROFILE FOR THE POWERS LAKE OUTLET CHANNEL



Source: SEWRPC.

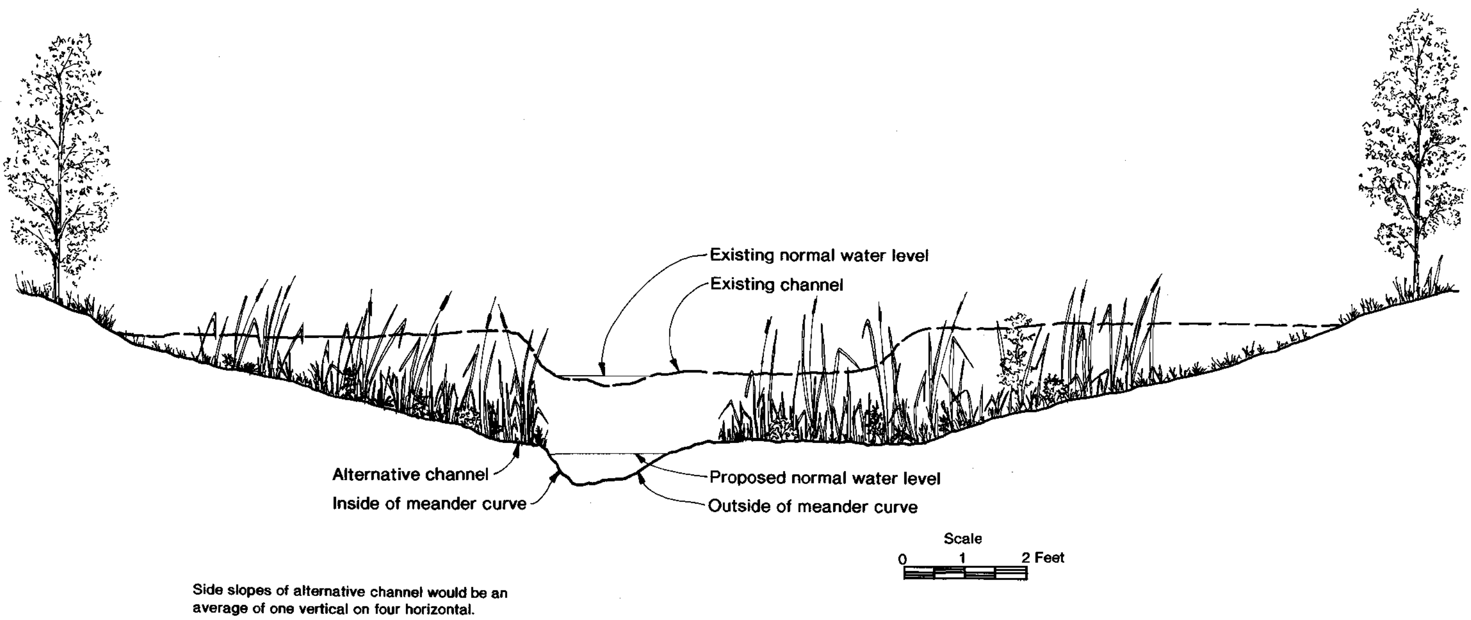
persink Creek, as shown on Figure 30. The amount of outlet channel deepening which is possible is limited by the streambed elevation of 831.3 feet NGVD for the East Branch of Nippersink Creek at its confluence with the outlet channel. As shown on Figure 31, the modified channel would have a six-foot-wide bottom, average side slopes of about one vertical on four horizontal, and a depth of 1.5 to two feet. The channel would be constructed with a low-flow channel provide aquatic habitat; channel meanders would be provided to promote the formation of an alternating series of deep pools and shallow riffles, similar to those found in a natural stream. Flow velocities in the channel would be relatively low; therefore, sediment which might accumulate on the channel bed would have to be removed periodically.

In conjunction with the modification of the outlet channel, the existing box culvert outlet structure would be replaced with a double seven-foot-wide by three-foot-high reinforced concrete box culvert. The new culvert would have an upstream extension with a concrete sill and sidewalls with slots to accommodate timber stop logs. The alternative outlet structure is shown on Figure 32. The crest of the concrete sill would be about 0.7 foot above the bottom of the box culverts and the box culverts would be backfilled with 0.7 foot of rock riprap and gravel, similar to the existing streambed. The capital and annual operation and maintenance costs of the outlet structure modification alternative are set forth in Table 41.

Advantages of Structural Control of Lake Levels: The net effect of installing a system for the regulation of lake levels would be to reduce seasonal and long-term fluctuations so that a desirable level can be maintained. In practice, the definition of an acceptable range in lake levels would be somewhat subjective and would vary with the various lake uses, since different lake uses require different ideal operating levels.

Figure 31

CROSS-SECTION OF ALTERNATIVE POWERS LAKE OUTLET CHANNEL



Source: SEWRPC.

Disadvantages of Structural Control of Lake Levels: The Department of Natural Resources discourages channel modification except as a last resort in providing flood control or stormwater drainage improvements to prevent flooding of buildings and alleviate hazards to human health and life. The Department also discourages the construction of impediments to fish migration. During low-flow periods when the stop logs would be in place, fish migration would be obstructed between the East Branch of Nippersink Creek and Powers Lake. Based on the DNR policies on channel modification and fish migration and on the the location of the stream through a wetland, it is questionable whether the permits required to implement an outlet structure project involving channel modification would be granted.

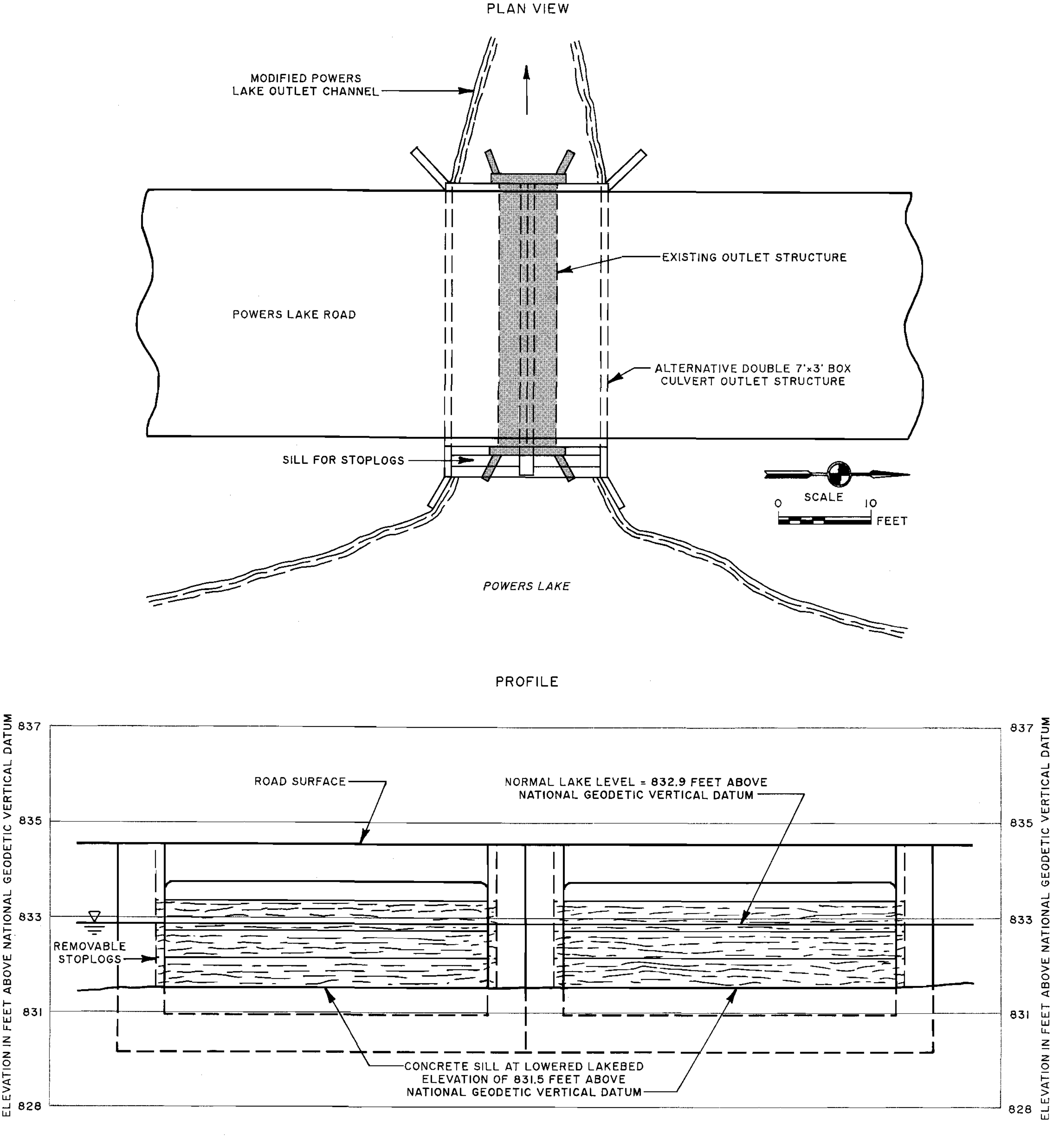
Changes in lake operation may effect the large wetland located upstream of the lake. That wetland, in conjunction with the restricted lake inlet, currently functions to moderate inflows to the lake and to remove nonpoint source pollutants prior to delivery to the lake. Changes in the hydrologic regime of that wetland resulting from manipulation of lake levels may change the hydrologic and ecologic balance which has been established.

Conclusion Regarding
Control of Powers Lake Levels

Data collected, and complaints lodged, to date do not support the need for increased control over the water levels of Powers Lake. The approximate fluctuation in lake levels of about two feet, based on available data and observations since October of 1986, is not inordinately large for a natural lake of the size and drainage area of Powers Lake. Because the need for greater control of lake levels has not been demonstrated and because of the disadvantages attendant to the provision of increased control of levels as set forth above, it is recommended that the existing outlet of the Lake be maintained; that the existing storage of stormwater runoff in the wetland and natural depression areas within the drainage area tributary to the Lake be maintained; that the enforcement of the existing town boating ordinance be continued; that the channel be properly maintained, based upon periodic inspection; that beaver dams downstream of the outlet be periodically located and removed; and that the current program of systematic recording of lake levels be maintained and used to document the frequency and duration of periods of problems with boat access to piers and wake restrictions.

Figure 32

PLAN AND PROFILE OF ALTERNATIVE POWERS LAKE OUTLET STRUCTURE



NOTE: VIEW IS LOOKING DOWNSTREAM

Source: SEWRPC.

Table 41

SELECTED CHARACTERISTICS OF ALTERNATIVE LAKE MANAGEMENT MEASURES FOR POWERS LAKE

Alternative Measure	Description	Estimated Cost		Considered Viable for Inclusion in Recommended Plan	Estimated Percent Reduction in Phosphorus Loading from Source	Estimated Percent Reduction in Phosphorus Loading
		Capital	Operation and Maintenance			
1. Rural Nonpoint Source Pollution Control	Buffer strips, conservation tillage, contour cropping, improved fertilizer and pesticide management, critical area vegetation	$ 36,000	$2,000	Yes	30	12
2. Construction Erosion Control	Adoption and enforcement of construction and erosion control ordinance	- -[a]	2,000[a]	Yes	75	3
3. Urban Nonpoint Source Pollution Controls (high level)	Selected detention ponds, grassed swales, urban housekeeping practices	90,000	4,300	No	70	9
3a. Urban Nonpoint Source Pollution Controls (moderate level)	Urban housekeeping practices and public education	2,000	500	Yes	25	6
4. Sanitary Sewerage System Modifications	Provision of improved sewerage facilities	- -[b]	- -[b]	Yes	100	10
5. Wetland and Groundwater Recharge Area Protection	Modify zoning ordinance or otherwise protect wetlands and other groundwater recharge areas	- -	- -	Yes	NA	NA
5a. Wetland and Groundwater Recharge Area Protection	Purchase selected areas	130,000	1,500	Yes	NA	NA
6. Nutrient Inactivation	Alum treatment	65,000	- -	No	80	NA
7. Shoreline Erosion Control	Vegetative buffer strips Rock revetments Wooden bulkheads	- -[c] - -[c] - -[c]	- -[c] - -[c] - -[c]	Yes Yes Yes	NA NA NA	NA NA NA
8. Fish Management	Stocking, fish survey, creel census, and public education activities	20,000 to 30,000[d]	- -	Yes	NA	NA
9. Fish Management	Fish eradication by Rotenone treatment	410,000	- -	No	NA	NA
10. Aquatic Plant Management	Plant survey	12,000[e]	- -	Yes	NA	NA
11. Aquatic Plant Control	Chemical treatment	- -[f]	- -	No	NA	NA
12. Aquatic Plant Control	Weed harvesting	- -[g]	- -	No	NA	NA

Table 41 (continued)

Alternative Measure	Description	Estimated Cost		Considered Viable for Inclusion in Recommended Plan	Estimated Percent Reduction in Phosphorus Loading from Source	Estimated Percent Reduction in Phosphorus Loading
		Capital	Operation and Maintenance			
13. Aquatic Plant Control	Lake bottom covering	$ - -[h]	$ - -	No	NA	NA
14. Public Access Site Development or Improvement	Acquire land for public access	- -[i]	- -[i]	Yes	NA	NA
15. Recreational Use Zoning	Space and time zoning to restrict fast boating and jet skiing	- -[i]	- -[i]	Yes	NA	NA
16. Impose Maximum Speed Limit	Establish 40 mph as maximum speed	0	0	Yes	NA	NA
17. Increase Water Police Enforcement	Extend weekend hours	- -[j]	- -[j]	Yes	NA	NA
18. Dredging	Dredging and disposal of dredged material from selected sites	- -[k]	- -[k]	Yes	NA	NA
19. Education Measures	Variety of measures to educate public on water quality and recreational use issues	3,500	1,500	Yes	NA	NA
20. Provide Structural Control of Lake Outflows	Replace existing outlet structure with double seven-foot-wide by three-foot-high reinforced concrete box culvert and deepen and widen 850-foot-long outlet channel	50,000	500	No	NA	NA

NOTE: NA indicates data not available.

[a] *Costs include the provision of construction erosion control measures on about two acres per year of land under development.*

[b] *Cost of alternative means of providing sanitary sewer service for the Powers Lake area is under study by private consultants.*

[c] *Cost for vegetative buffer strip is minimal, cost for rock revetments is about $20 per lineal foot, for wooden bulkhead about $6.00 per lineal foot.*

[d] *Cost for including a comprehensive survey. Creel census would add about $12,000. Cost may be borne all or in part by Wisconsin Department of Natural Resources.*

[e] *Cost includes four surveys at $3,000 each, with survey repeated every five years.*

[f] *Costs range from $100 to $300 per property, assuming 300-foot by 100-foot treatment area.*

[g] *Costs range from $150 to $400 per property, assuming a 300-foot by 100-foot channel.*

[h] *Costs range from $30 to $180 per property, assuming about 700 square feet of covering.*

[i] *Costs variable.*

[j] *Cost depends on wages and training for additional personnel.*

[k] *Five sites considered. See Table 40 and text for costs for each site.*

Source: SEWRPC.

SUMMARY

Table 41 contains a summary of pertinent characteristics and estimated costs of alternative measures considered for management of Powers Lake. The recommended lake management plan for Powers Lake as described in Chapter VIII was developed based upon consideration of the advantages and disadvantages of each alternative, including costs; of desired reductions in pollutant loadings; of desired protection and maintenance of water quality; and of desired recreational use objectives.

Chapter VIII

RECOMMENDED MANAGEMENT PLAN FOR POWERS LAKE

INTRODUCTION

This chapter presents a recommended management plan, including attendant costs, for Powers Lake. This plan is based upon the land use and physical, biological, and water quality inventory findings; pollution source and loading analyses; land use and population forecasts; and alternative lake management plan evaluations described in previous chapters of this report. The plan sets forth the recommended means for: 1) protecting and enhancing water quality conditions so as to provide a level of water quality suitable for full body contact recreational use and for the maintenance of healthy communities of warmwater fish and other aquatic life; 2) improving opportunities for water-based recreational activities; 3) protecting and enhancing the fishery and other aquatic resources, wildlife habitat, and wetland areas; and 4) reducing shore erosion. The recommended plan elements were selected from among the alternatives considered as described in Chapter VII, based upon the degree to which the desired water use objective and the related biological and recreational use objectives could be expected to be met by the alternatives, and also upon consideration of costs and implementability. Consideration was also given to comments received from Powers Lake residents during and following the August 2, 1991, Powers Lake Management District annual meeting, during which a presentation on the plan was made.

Analysis of water quality and biological conditions indicated that the general condition of the water quality in Powers Lake is good, but reduction of external pollutant loads is necessary and desirable to maintain the existing level of water quality. Water-based recreational activities are constrained by excessive powerboat traffic and by increasing numbers of jet skis, which create unsafe conditions and conflict with other recreational activities. In addition to recommended in-lake management measures, this section of the report also sets forth recommendations for related land use control, land management, and shore protection measures for Powers Lake.

As discussed in Chapter VII, major in-lake water quality and macrophyte control projects are not deemed necessary to meet the water use, recreational aquatic resource protection, or shore erosion control objectives, nor is a water level control system required at outlet of the Lake. Rather, a program to reduce pollutant loadings and to protect land resources deemed important to lake water quality is recommended.

The preliminary recommended Powers Lake management measures are graphically summarized on Map 41 and are listed in Table 42. The recommended management plan for Powers Lake provides an overall strategy for the maintenance and enhancement of lake water quality, for the protection of environmentally valuable areas and fishery resources, for the restriction of boating activities to safe and environmentally sound levels, for the prevention of shoreline erosion, for the provision of adequate public access, and for the enhancement of recreational activities.

It is recommended that the Powers Lake Management District take the lead in implementing the plan. The recommended plan measures are described in the following paragraphs.

LAND USE AND ZONING

A fundamental element of a sound management plan and program for Powers Lake is the proper development of the lands lying in the drainage area tributary to the Lake. The type and location of urban and rural land uses in the tributary drainage area determines the character, magnitude, and distribution of nonpoint sources of pollution, the practicality of and the need for various methods of land management, and, ultimately, the water quality of the lake.

The recommended land use plan for the drainage area tributary to Powers Lake has a design year of 2010, and is described in Chapter III. The content and framework for the plan is the regional land use plan as prepared and adopted by the Regional Planning Commission. The

Map 41

PRELIMINARY RECOMMENDED LAKE USE PLAN FOR POWERS LAKE

LEGEND

ENVIRONMENTALLY VALUABLE AREA PROTECTION

- SLOW NO-WAKE BOATING ONLY
- NO WEED HARVESTING OR HERBICIDE USE
- LIMIT PIER AND DOCK CONSTRUCTION
- LIMIT DREDGING

WETLAND AREA CONSIDERED FOR REZONING FROM R-3 URBAN SINGLE-FAMILY RESIDENTIAL TO C-1 LOWLAND RESOURCE CONSERVANCY

ISOLATED NATURAL AREA CONSIDERED FOR REZONING FROM B-5 COMMERCIAL RECREATIONAL BUSINESS TO C CONSERVATION

SHORELINE PROTECTION

MAINTAIN EXISTING, STABLE, UNPROTECTED SHORELINE

SHORE MODIFICATION/PROTECTION

- WITHIN ENVIRONMENTALLY VALUABLE AREAS: PROTECT EXISTING, UNPROTECTED AND UNSTABLE SHORELINE WITH VEGETATION, AND MAINTAIN EXISTING STRUCTURES OR REPLACE WITH VEGETATION
- OUTSIDE ENVIRONMENTALLY VALUABLE AREAS: REPAIR AND MAINTAIN EXISTING PROTECTION STRUCTURES, AND PROTECT UNSTABLE AND UNPROTECTED AREAS USING VEGETATION AND STRUCTURES

RECREATIONAL USE MANAGEMENT

SLOW NO-WAKE BOATING ONLY

FAST BOATING AND WATERSKIING ALLOWED 10:00AM TO NOON AND 3:00PM TO SUNSET ON SATURDAYS, SUNDAYS, AND LEGAL HOLIDAYS, AND 10:00AM TO SUNSET ON WEEKDAYS

POST ORDINANCES, PROVIDE SUMMER AND WINTER RECREATIONAL USE FACTS SHEETS AND PROVIDE WASTE DISPOSAL CONTAINERS AT PUBLIC ACCESS SITES

- INCREASE WEEKEND ENFORCEMENT OF BOATING ORDINANCE
- CONDUCT SURVEYS OF WEEKEND RECREATIONAL USE

LIMITED DREDGING FOR BOAT ACCESS

PUBLIC ACCESS

RECOMMENDED AREA FOR A PUBLIC ACCESS SITE WITH LIMITED PARKING

POTENTIAL PARKING AREA FOR A PUBLIC ACCESS SITE

MONITORING PROGRAM

- CONDUCT FISH SURVEY
- CONDUCT AQUATIC MACROPHYTE SURVEY
- CONTINUE WATER QUALITY SAMPLING

Source: SEWRPC.

Table 42

PRELIMINARY RECOMMENDED LAKE MANAGEMENT PLAN FOR POWERS LAKE

Plan Element	Management Measures
Land Use and Zoning	Wetland Zoning Rezone two wetland areas currently zoned for development to C-1 Lowland Resource Conservancy
Water Quality	Rural Nonpoint Source Pollution Control Crop rotation, contour cropping, contour strip-cropping, conservation tillage, fertilizer and pesticide management, permanent vegetative cover, buffer strips Implement public education program
	Construction Site Erosion Control Adopt and enforce construction erosion control ordinances
	Urban Nonpoint Source Pollution Control Implement public education program promoting good housekeeping practices and low-cost urban practices
	Onsite Sewage Disposal Systems Management Facility planning recommendations expected late 1991
Wetland Protection	Wetland Acquisition Purchase wetlands up to 306 acres, over time Prepare management plan for wetlands to be acquired
In-Lake Management	Protection of Environmentally Valuable Areas Prohibit dredging, restrict boating to slow-no-wake, limit aquatic plant control, and construction of piers and docks in Knolls and Honey Bear Bays Limit dredging, aquatic plant control, and construction of piers and docks in other environmentally valuable areas
	Monitoring Programs Fish surveys, comprehensive aquatic macrophyte survey, water quality sampling
	Aquatic Plant Control Hand (rake) removal of milfoil in selected areas
	Shoreline Protection Revegetate unprotected and unstable shoreline in environmentally valuable areas and maintain existing structures Protect unprotected and unstable shoreline outside of environmentally valuable areas using vegetation and structures
Recreational Use Management	Boating Ordinance Revisions Restrict motorboating to slow-no-wake between the hours of 12:00 p.m. and 3:00 p.m. on Saturdays, Sundays, and legal holidays Designate Knolls, Honey Bear and Jefferson Bays as slow-no-wake areas Increase posting of boating ordinances at all public access sites. Display ordinances and Wisconsin Statutes pertaining to boating and jet skis. Post ordinance, fine assessments, and disposal information relative to littering. Provide waste disposal containers. Post Statutes and local ordinances relative to snowmobiling and ice shanties Increase patrol hours and effectiveness of the Powers Lake Water Police during the weekends, consider retention and training of additional police officers Consider extending police surveillance during evening hours in winter Develop, publish, and disseminate to residents and nonresidents at public access sites fact sheets providing information on summer and winter recreational use
	Public Access Consider acquisition of shoreline property and property for additional parking
	Dredging Limit dredging for boat access in Jefferson Island Channel and in Jefferson and Harbor Lite's Bays; institute mitigation measures

Source: SEWRPC.

regional land use plan recommends that no significant additional urban land use development be encouraged in the drainage area tributary to Powers Lake. Some infilling of existing platted lots is expected to occur, however, which may result in increases in the number of residents and households. Such urban uses should be permitted to occur, however, only in those portions of the drainage area which are covered by soils suitable for the intended use, which are not subject to special hazards such as flooding, and which are not environmentally sensitive, that is, are not encompassed within Regional Planning Commission delineated environmental corridors as those corridors are described and delineated in Chapter V.

As discussed in Chapter III, the applicable existing county-town zoning ordinances are generally consistent with the recommended future land use pattern within the direct drainage area to Powers Lake, and serve to implement the recommended land use plan. Thus, the 1991 zoning is recommended to remain as is except in the case of two isolated wetland parcels. Map 41 shows the location of the wetland areas. An approximately 10-acre isolated natural area containing shallow marsh and disturbed freshwater wet meadow is located northwest of the Lake in the Town of Bloomfield and currently zoned Commercial-Recreational Business. It is recommended that this isolated natural area, part of which has been identified as a potential groundwater recharge area, be rezoned to C-1, Lowland Resource Conservation. An approximately four-acre wetland containing wet-mesic hardwoods is located east of Jefferson Bay in the Town of Randall and is currently zoned R-3 Urban Single-Family Residential. This wetland is located in both the shoreland area and the designated primary environmental corridor, as shown on Maps 20 and 21. Any filling of the wetland would require an individual permit from the U. S. Army Corps of Engineers. Furthermore, the wetland site could not be used for dredge spoil disposal according to the requirements of Chapter NR 115 and 117 of the Wisconsin Administrative Code and Chapter 30 of the Wisconsin State Statutes. This wetland area was also identified as a potentially important groundwater recharge area. It is recommended that this wetland area be rezoned from Urban Single-Family Residential to C-1, Lowland Resource Conservancy. In view of these zoning revisions, it is recommended that these wetland areas be acquired by the Powers Lake Management District or the Town of Randall in order to protect these resources.

Any easements granted to individuals for lake access and/or other activities within the wetlands considered for rezoning should be reviewed and continued unless these activities have a negative impact on the resources and functions of the wetlands.

WATER QUALITY RELATED RECOMMENDATIONS

As discussed in Chapters VI and VII, the water quality of Powers Lake is generally of a relatively high quality, with the water quality standards for the maintenance of a warmwater sport fish and for full-body contact aquatic recreational use being currently met. It is, however, recommended that nutrient loadings to the Lake be reduced in order to protect and enhance water quality. As noted in Chapter VI, the majority of the phosphorus loading entering the Lake is deposited in the Lake through sedimentation. The accumulation of nutrients in the sediments of Powers Lake may eventually lead to water quality problems, including increased turbidity, nuisance algae and macrophyte growth, and an unbalanced fishery. It is therefore considered necessary to minimize the buildup of phosphorus in the sediments.

Based upon review of the sources of phosphorus loadings to Powers Lake as described in Chapter IV, the only significant controllable sources of phosphorus to the Lake are rural and urban nonpoint sources, including construction site erosion, and onsite sewage disposal. Thus, control of these sources is recommended. Technical and financial assistance from the state and federal governments may be available to help implement such pollution control activities.

Rural Nonpoint Source Pollution Control

The implementation of nonpoint source pollution controls in rural areas within the Powers Lake drainage area requires the cooperative efforts of the Powers Lake Management District, Walworth and Kenosha Counties, and the Walworth and Kenosha Counties Land Conservation Committees. The recommended responsibilities of each governmental agency are set forth in Table 43. The development of rural nonpoint source pollution abatement practices to control

Table 43

LOCAL GOVERNMENTAL MANAGEMENT AGENCIES AND RESPONSIBILITIES FOR NONPOINT SOURCE WATER POLLUTION CONTROL

Urban Nonpoint Source Management Agency	Local Land Use Planning and Zoning	Undertake Construction Erosion Control Program	Review Public Works Maintenance Practices	Conduct Educational and Informational Program	Provide Technical Assistance
Urban					
Kenosha and Walworth Counties	X	X	- -	X	- -
Kenosha and Walworth County Land Conservation Committees	- -	- -	- -	X	X
Powers Lake Management District	X[a]	- -	X	X	- -
Towns of Bloomfield, Randall, and Wheatland	X	X	X	- -	- -

Rural Nonpoint Source Management Agency	Local Land Use Planning and Zoning	Develop and Implement Detailed Plan for Rural Practices	Conduct Educational and Informational Program	Provide Technical Assistance
Rural				
Kenosha and Walworth Counties	X	- -	X	- -
Kenosha and Walworth County Land Conservation Committees	- -	X	X	X
Powers Lake Management District	X[a]	- -	X	- -

[a]*Review and make recommendations.*

Source: SEWRPC.

sediment and nutrient runoff require highly localized, detailed, and site-specific efforts.

As shown on Map 26, approximately 591 acres in the drainage area tributary to Powers Lake exhibit excessive soil loss rates. Accordingly, it is recommended that the Kenosha County and Walworth County Land Conservation Committees work with the property owners concerned to develop plans for the design of detailed conservation measures and practices on each farm in the drainage area. Such practices could include conservation tillage, contour cropping, crop rotation, improved fertilizer and pesticide management, vegetated buffer strips, and critical area vegetation. In addition, it is recommended that the Kenosha and Racine County Land Conservation Committees, in cooperation with the University of Wisconsin-Extension Service, establish a public education program. Imple-

Implementation of the conservation practices identified in the detailed farm plans may be expected to reduce the phosphorus loss from the agricultural land by about 30 percent, and to reduce the total phosphorus loading to Powers Lake by about 12 percent, assuming 75 percent implementation of the recommended measures.

Urban Nonpoint Source Pollution Controls

The development of urban nonpoint source pollution abatement measures for the Powers Lake area is expected to be primarily the responsibility of private property owners. Accordingly, it is recommended that the Powers Lake Management District work with property owners to attain application of the urban land management practices described in Chapter VII, mostly low cost, good urban housekeeping practices, such as fertilizer and pesticide use management, critical area protection, litter and pet waste controls, and leaf and yard waste storage and disposal controls. The promotion of these measures will require a public education program. Additionally, the public education program should present information on the groundwater resources of the area and measures, such as onsite sewage disposal system management and waste disposal, to protect these resources.

As discussed in Chapter VI, the inclusion of additional facilities to provide for a "high level" of urban nonpoint source control, including stormwater treatment facilities such as detention basins, does not appear to be an effective and necessary element of a water quality management plan for the existing urban areas surrounding Powers Lake at this time. This conclusion was reached because the stormwater flow to the Lake is relatively diffuse, with no good locations for concentrating the flow at treatment facilities, and because lake water quality conditions are relatively good, requiring only maintenance and limited reductions in pollutant loadings. As an initial step in carrying out the recommended urban practices, it is suggested that a fact sheet identifying specific residential land management practices beneficial to the water quality of Powers Lake be prepared and distributed to property owners by the Powers Lake Management District with the assistance of the University of Wisconsin-Extension Service. The recommended urban measures may be expected to provide about a 25 percent reduction in urban nonpoint source pollution runoff, and about a 6 percent reduction in phosphorus loading to Powers Lake.

Construction Site Erosion Controls

It is recommended that the Towns of Bloomfield, Randall, and Wheatland continue their efforts to control soil erosion from construction activities. As noted in Chapter VII, the Town of Bloomfield has enacted a construction erosion control ordinance which is based upon a model ordinance presented in Wisconsin Construction Site Best Management Practices Handbook, 1989, and which was developed by the Wisconsin Department of Natural Resources (DNR) in cooperation with the Wisconsin League of Municipalities. It is recommended that Kenosha County adopt a construction erosion control ordinance applicable to the unincorporated area of the county based on that model ordinance. This would add certain specific standards, criteria, and measures for erosion control to the ordinance provisions. It is recommended that the ordinance provisions be applicable to all construction and allow for a relatively high level of control in areas draining directly to Powers Lake and other environmentally sensitive areas in the drainage area tributary to the Lake. Such controls could include the use of silt fences, sedimentation basins, rapid revegetation of disturbed areas; the control of "tracking" from the site; and careful planning of the construction sequence to minimize the areas disturbed. Although the proper implementation of a countywide construction site erosion control ordinance may require additional staffing, the implementation of construction erosion control measures in the Powers Lake drainage area may be expected to reduce the phosphorus loading to Powers Lake by about 3 percent. In addition, the use of construction erosion control practices will also minimize localized short-term impacts which can be more significant than indicated by the total lake pollutant loading analysis.

Onsite Sewage Disposal Systems Management

Onsite sewage disposal systems in the Powers Lake direct drainage area are estimated to contribute about 10 percent of the total phosphorus loading to the Lake. In addition to lacustrine water quality considerations, sewage disposal options in the area have implications for public health, for groundwater quality, and for property values. Recognizing these implications, a facility planning program specifically designed to evaluate the conditions of the onsite sewage disposal systems around Powers, Benedict, and Tombeau Lakes was initiated in Fall 1990 by the cooperative actions of the Towns of Randall, Wheatland, and Bloomfield. This program is intended to evaluate the condition of the existing onsite sewage disposal systems and consider alternative means of resolving any identified problems. The final recommendations of this facility planning program are expected to be available by the end of 1991.

The facility plan is expected to recommend one of the following three options, or a combination of these options:

- The continued use of onsite sewage disposal systems, but with existing systems replaced by new conventional septic tank systems, mound systems, in-ground pressure systems, or holding tanks, as appropriate.

- The provision of common septic tank effluent infiltration fields serving clusters of residences in selected areas.

- The provision of a centralized public sanitary sewerage system with conveyance of sewage to, and treatment at, one of the existing sewage treatment plants operated by the Villages of Twin Lakes or Genoa City.

It is recommended that the Towns of Bloomfield, Randall, and Wheatland and the Powers Lake Management District take an active role in implementing the recommendations developed under the facilities planning program. In the case of the first two options, the responsibility for implementation will have to rely primarily with local units of government, including Kenosha and Walworth Counties. In the case of the third option, the provision of a public sewer system, implementation will require the formation of a sanitary district, utility district, or a lake district with sanitary district powers.

The provision of a public sanitary sewer system for the urban areas around Powers Lake may be expected to reduce the phosphorus loading to the Lake by about 10 percent. The implementation of the other options is expected to be somewhat less effective.

Evaluations of the existing onsite sewage disposal system were completed in 1990 and 1991. These evaluations considered the type and age of the onsite sewage disposal systems, soil types, depth to groundwater, land surface slopes, lot sizes, and related potential for installing replacement systems. As part of the evaluations, onsite inspections were performed on about 15 percent of the systems in the study area. In addition, data on the existing systems were obtained from county records for about 15 percent of the systems. Well water samples were obtained at selected sites and analyses conducted for potential contaminants associated with malfunctioning onsite sewage disposal systems. Finally, a leachate survey was also conducted to locate potential problem areas along the shoreline of Powers Lake. The conclusion of the analyses is that the long-term continued use of the existing sewage disposal systems around Powers Lake is not recommended. Because of lot size and other restrictions, the use of holding tanks would be the only type of onsite system applicable as a replacement for the existing systems in significant portions of the area. Such an option is not considered a viable long-term solution due to the high maintenance cost, loss of property values, and the impacts on the area's character of trucking holding tank wastes on local roads. It is therefore recommended that consideration be given to installing a public sanitary sewerage system during the planning period. Further information on the need for such a system and the timing of its construction can only be provided by the ongoing facility planning program.

WETLAND PROTECTION

As stated in Chapter V, wetlands cover about 312 acres, or 14 percent, of the drainage area tributary to Powers Lake. These wetlands perform an important set of natural functions which make them particularly valuable resources. The wetlands serve as traps which retain sediments and nutrients, helping to maintain the good water quality of Powers Lake. These wetlands are also important in maintaining a relatively stable water budget and lake level for Powers Lake. In addition, the wetlands provide essential breeding, nesting, resting, and feeding grounds and predator escape cover for many forms of fish and wildlife. They also have the potential of providing recreational, research, and educational opportunities and add to the aesthetics of the Powers Lake area. In order to assure the protection and preservation of the remaining wetlands in the Powers Lake drainage area, which are critical to the health of the Powers Lake ecosystem, it is recommended that the Towns of Randall and Wheatland and the Powers Lake Management District acquire all such wetlands by purchase of fee simple interest.

Acquisition provides the greatest assurance that the wetland areas will be permanently preserved in a natural, open condition. Published SEWRPC reports have proposed the acquisition of wetland acreage northeast of Powers Lake by public or private resource preservation and protection agencies. SEWRPC Planning Report No. 12, A Comprehensive Plan for the Fox River Watershed, published in 1970, proposed the acquisition of high-value lake-oriented woodlands and wetlands within primary environmental corridors. SEWRPC Community Assistance Planning Report No. 131, A Park and Open Space Plan for Kenosha County, published in 1987, proposed that the wetlands located northeast of Powers Lake be publicly acquired and designated as a natural area of local significance.

Priorities for purchasing wetlands in the Powers Lake Drainage Area covering about 306 acres are shown on Map 42. These priorities are based on an analysis of the estimated soil loss rates of adjacent agricultural lands; proximity of the wetland area to watercourses and drainage ditches, to the Powers Lake tributary, and directly to Powers Lake itself; and, to the extent known, the characteristics of the existing wetland plant and animal communities. Wetland acquisition priorities should be refined after the completion of a comprehensive survey and mapping of site characteristics, including locations of various wetland communities and threatened species.

It is recommended that wetlands which are ranked as very high priority, as shown on Map 42, be purchased first. These wetland areas cover about 146 acres, including those wetlands located adjacent to agricultural lands exhibiting excessive soil erosion and the two remaining urban wetlands located west of Knolls Bay in Wildwoods and east of Jefferson Bay. Wetlands ranked as high priority should be purchased after the acquisition of very high priority wetlands. These wetlands cover about 83 acres and lie primarily along watercourses and drainage ditches and the Powers Lake Tributary. Wetlands ranked moderate priority should be purchased following the acquisition of high priority wetlands. These wetlands cover about 77 acres and lie adjacent to rural lands that are eroding but not excessively. The plan envisions that these wetlands would be acquired over time at fair market value, assuming a willing buyer and a willing seller. Estimates of wetland acquisition costs, based upon assessed valuations of about $425 per acre and upon review of selected parcel values, are: $62,000 for the very high priority wetlands, $35,300 for the high priority wetlands, and $33,000 for the moderate priority wetlands.[1]

Funding for Wetland Acquisition

Potential funding sources for acquisition of the wetlands in the Powers Lake drainage area include state programs, such as the Urban Green Space program administered by the Wisconsin Department of Natural Resources and also donations from private citizens. Private conservation organizations, such as the Nature Conservancy and land trust organizations, also promote wetland protection through acquisition. The Urban Green Space Program provides funds to municipalities, nonprofit organizations, and lake management districts for the purchase of open, undeveloped land, including wetlands, either in fee simple or to acquire development rights to open lands. Site surveys, landowner contact, land appraisal, application filing, and funding approval are steps typically required for public acquisition of wetlands through this program. Landowner contact and land appraisal should be done according to Wisconsin Department of Natural Resources guidelines and procedures. Application could be filed by the Towns of Wheatland and Randall and/or by the Powers Lake Management District, with assistance from consultants as necessary.

A survey of the wetlands in the Powers Lake drainage area was completed by the Regional Planning Commission, as reported in Chapter V. Further assessment of the wetlands, including determination of the size and diversity of the plant and animal communities present and an evaluation of the populations, if present, of rare, threatened, and endangered species will be done by the Commission in 1991 under a Natural Area Assessment Program currently being conducted cooperatively by the Commission, the seven counties comprising the Region, and the Wisconsin Department of Natural Resources.

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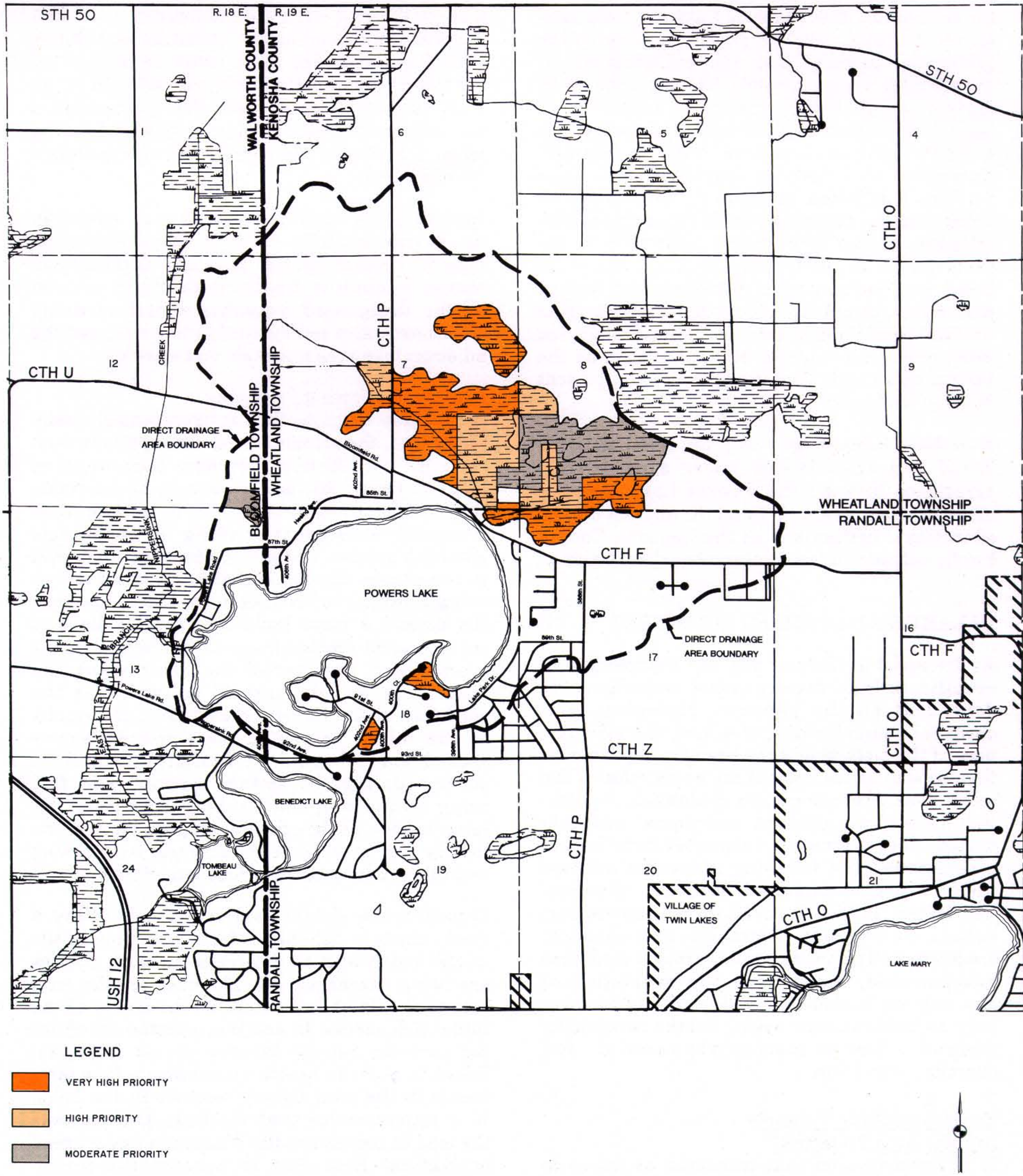
[1] *Under the countywide assessment program in Kenosha County, the assessed valuation of property is intended to represent full market value, as determined by the County Assessor. Property values as indicated on the 1985 assessment roll adjusted to 1991 dollars were used in estimating wetland acquisition costs.*

Map 42

WETLAND ACQUISITION PRIORITIES FOR THE POWERS LAKE DRAINAGE AREA



Source: SEWRPC.

Wetland Management Program

A management plan for the wetlands proposed for acquisition in the Powers Lake drainage area should be prepared. The plan should guide the protection, preservation, and enhancement of the wetland areas over time. The plan should be designed to achieve: 1) necessary support management activities that will encourage the utilization of the wetland area by wildlife, waterfowl, and fish; 2) opportunities for the resident population, including elderly and disabled persons, to participate in passive resource-oriented outdoor recreational activities; 3) the development of interpretive facilities and trail-based outdoor recreation facilities; and 4) support management activities that enhance rare wetland communities such as the calcareous fen community, and such threatened species as the beaked spike rush, Eleocharis rostellata, present in these wetlands.

A wetland management program could be established and administered under a cooperative agreement between the Powers Lake Management District, Town of Randall, and such local educational institutions as the Kenosha County Public Schools, or local volunteer organizations.

IN-LAKE MANAGEMENT MEASURES

As discussed in Chapter VII, the applicability of specific in-lake management techniques is dependent on the physical, biological, and chemical characteristics of a lake, the effectiveness of the method and the need for implementation, as well as the costs of the application of the techniques. Accordingly, an evaluation of potential in-lake management techniques was conducted. That evaluation eliminated from further consideration the following measures: nutrient inactivation, mechanical aeration, chemical herbicides, lakewide mechanical harvesting, bottom covers, lake drawdown and chemical eradication. The in-lake management measures recommended, based upon the evaluation of alternatives, include protection of environmentally valuable in-lake areas, in-lake monitoring programs, limited macrophyte removal, and shoreline protection.

Environmentally Valuable
In-Lake Area Protection

It is recommended that measures be taken to preserve and protect environmentally valuable areas of the Lake as shown on Map 41. In order to prevent disturbance of the most important ecological sites, it is recommended that fast motorboating be prohibited in Knolls and Honey Bear Bays and that these areas be marked by the Towns of Bloomfield and Randall with buoys and signs to help enforce the recommended restriction. Dredging or placing material on the lakebed in Knolls and Honey Bear Bays should be prohibited.

Aquatic plant control should be discouraged in the environmentally valuable areas shown on Map 41. Construction of piers and docks should also be minimized. Dredging should be avoided in the designated valuable shoreline areas unless excessive sedimentation has rendered the adjacent lake area unusable and unsafe.

In-Lake Monitoring Programs

In addition to protecting environmentally valuable areas, the recommended management measures include utilizing Wisconsin Department of Natural Resources fishery surveys to determine the condition of the sport fishery in the Lake and, if needed, subsequent stocking of appropriate gamefish species. The surveys could be conducted in two phases: the first including a limited survey using shocking techniques in the fall of the year, the second a more inclusive survey. The first survey would provide limited information on the species, size, and age of the fish present, but would not be adequate to fully assess the condition of the fishery. Based upon the results of the initial survey, a more comprehensive second survey could be designed to include surveys during the spring, summer, and fall, using both netting and shocking techniques. The latter survey would provide complete data on the fishery and serve as a sound basis for stocking and other management recommendations.

Consideration should be given to conducting a creel census to determine the composition of the angler catch and to determine if game species are being overharvested. The need for the creel census should be determined by the results of the initial fish survey. In addition, specific schedules for periodic fishery surveys should be established in order to assess and evaluate long-term trends in the total fishery resource in the Lake. It is recommended that the Lake District take the lead in requesting the Wisconsin Department of Natural Resources to conduct the recommended fishery survey.

It is further recommended that the in-lake water quality sampling program to assess the effects of watershed management measures be continued. This sampling program should include measurements of total phosphorus, chlorophyll-a, and water clarity, as well as the development of temperature and dissolved oxygen profiles. The Powers Lake Management District is currently continuing to conduct a water quality sampling and analysis program under contract with the U. S. Geological Survey.

A comprehensive aquatic macrophyte survey, as described in Chapter VII, is recommended for Powers Lake and should be conducted at least every five years. The information from such periodic surveys would allow the Lake District to monitor the changes in the abundance, distribution and composition of the aquatic macrophyte community. If plant growth becomes excessive, this baseline information can be used to evaluate the need for future programs of aquatic plant control.

Aquatic Plant Control

The results of the aquatic macrophyte survey conducted by the Regional Planning Commission in 1990 and by Applied Research and Technology in 1986 indicated that the aquatic plant growth in Powers Lake was not excessive and an intensive control program was not required. However, localized beds of milfoil create nuisance problems near some piers and docks and deter swimmers. Hand (rake) removal of milfoil around piers and docks is recommended to alleviate this problem and prevent further spread. If problems become more severe, it may be necessary to use small mechanical harvesting equipment which could be leased, rented, or purchased by the District.

Shoreline Protection

The recommended shoreline management measure in all the areas designated as environmentally valuable and in adjacent wetland and wildlife habitat is to revegetate about 1,125 feet of unstable, unprotected shoreline. About 6,975 feet of shoreline within environmentally valuable areas was protected by structures in 1990. It is recommended that these structures be maintained by using selected types of natural vegetation or appropriate structural measures as described in Chapter VII. Recommended shoreline protection measures outside the environmentally valuable areas for about 550 feet of unstable, unprotected shoreline include revegetation and the establishment of such structures as revetments or bulkheads, described in Chapter VII. Outside environmentally valuable areas, approximately 3,420 feet of shoreline was protected in 1990 by structures that had at least partially failed. It is recommended that these structures be repaired and maintained.

RECREATIONAL USE MANAGEMENT

Powers Lake accommodates participation in extensive recreational uses including summer activities like boating, swimming, viewing, waterskiing, sailing, and fishing and winter activities like ice-skating, snowmobiling, and ice fishing. As emphasized in Chapters V and VII, safe-boating density standards as promulgated by the Commission and the Wisconsin Department of Natural Resources are greatly exceeded during summer weekends at Powers Lake.

Four weekend surveys of the Lake conducted on July 1, 1990, indicated that boat counts at any one time were as high as 80 and as low as 45, with an average of about 67 boats. Three weekday surveys of the Lake conducted on July 2, 1990, indicated that boat counts at any one time were as high as 27 and as low as 10, with an average of 19 boats.

The Regional Planning Commission recommends about 16 acres of usable lake area[2] per boat as a minimum density for safe waterskiing and fast boating. Because the usable area of Powers Lake for fast boating purposes is about 324 acres, the maximum number of ski boats, fast boats, and sailboats that can safely use the Lake at any one time is 20. The number of pleasure boats, including ski boats, fast boats, and sailboats on the Lake at any one time during the weekend surveys ranged from 25 to 46. Thus, during all of the four weekend surveys, the maximum boat density for safe use was exceeded.

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[2] *Usable surface water is defined as that area of a lake which can be utilized safely for motorboating, sailing, and waterskiing. This area includes all surface water which is a minimum distance of 200 feet from shorelines, free of submerged or surface obstacles, and at least five feet in depth.*

To evaluate boating pressures, the Wisconsin Department of Natural Resources applies a maximum recommended boating density of one boat per 10 acres of total lake surface area. This criterion applies to all boats: pleasure boats, ski boats, canoes, rowboats, fishing boats, and sailboats. Applying the Department guidelines to the total lake area of 459 acres, a total of about 46 boats could utilize Powers Lake safely at any one time. The 1990 survey indicated that unsafe conditions occurred during the three afternoon weekend surveys, when the average number of boats and watercraft on Powers Lake for the surveys was 67.

A total of 745 boats and watercraft were docked or moored on Powers Lake in the summer of 1990. The largest percentage of boats, about 35 percent, were powerboats, as shown in Figure 18. Powerboats with motors exceeding 25 horsepower constituted about 28 percent of the total number of boats, and those with motors less than, or equal to, 25 horsepower constituted about 7 percent of the total. Jet skis accounted for about 2 percent of the total resident boats and watercraft.

Observations and reports by the Powers Lake Water Police of increased jet ski use on Powers Lake in 1990 and 1991 indicate that these safety problems are being aggravated. In addition, the results of the Lake District residents' survey identified boating conflicts as the major lake issue to be dealt with. Thus, the most important recreational use management consideration for Powers Lake is the prevention of unsafe boating conditions.

Escalating winter recreational use on Powers Lake, resulting in problems of increased litter, snowmobile noise and safety hazards, and untimely and hazardous ice shanty setup and removal was evidenced by the comments of the Lake District residents and reports by the Powers Lake Water Police.

The following measures, described on Map 41, are recommended primarily to promote safer conditions on the Lake during the weekends and secondarily to ensure both fast and slow boating opportunities.

<u>Boating Ordinance Revisions</u>

It is recommended that the Towns of Randall and Bloomfield amend existing boating ordinances in the following manner and that these ordinances be made consistent.

1. Restrict motorboating to slow-no-wake between the hours of 12:00 p.m. and 3:00 p.m. on Saturdays, Sundays, and legal holidays. This regulation would help reduce safety hazards and recreational use conflicts associated with motorboating activities.

2. Designate Knolls and Honey Bear Bays as slow-no-wake areas. This regulation, presented earlier in the chapter, would help protect environmentally valuable areas and lessen potential for boating conflicts in Knolls Bay.

3. Designate Jefferson Bay as a slow-no-wake area. This regulation would reduce safety hazards as boats and water skiers attempt to turn around in the Bay which has a narrow traffic lane, 180 feet wide, at its mouth. Also, this regulation would reduce wave action in the Bay, thus lessening shoreland erosion.

4. Increase the posting of readily visible signage describing the boating ordinance regulations at all public access sites. Specifically, displays of the Wisconsin Statutes and local ordinances pertaining to jet skis and the dangers of jet ski use should be installed at the public access sites.

5. Increase the posting of readily visible signage describing the ordinance provisions, fine assessments, and disposal information relative to littering at all public access sites. Also, containers for waste disposal should be provided and maintained.

6. Increase the posting of readily visible signage during the winter season describing the snowmobiling ordinances at all public access sites. Additionally, displays of Wisconsin Statutes and local ordinances pertaining to ice shanties and littering should be installed at all public access sites.

7. It is recommended that the enforcement capability of the ordinances be increased; consideration should be given to increasing the patrol hours and the effectiveness

of the Powers Lake Water Police during the weekends and to the hiring and training of additional police officers.

8. The Towns of Randall and Bloomfield should consider extending limited surveillance of lake activities during winter evening hours by the Powers Lake Water Police or ordinance enforcement officers. A surveillance program would be initiated after an analysis of safety hazards related to winter recreational activities. Additionally, ordinance revisions could be considered to promote the safe use of Powers Lake during the winter.

9. Develop and publish two Powers Lake recreational use fact sheets, one for summer and one for winter. Information on the fact sheet could include selected ordinances, common-sense and safe-use measures for boat, jet ski, and snowmobile operation, and for ice fishing and ice shanty use. These fact sheets should be made available at the public access sites and mailed to Lake District residents.

Implementation of the above recommended measures does not guarantee that the excessive numbers of boats, recreational use conflicts, and unsafe conditions will be eliminated during weekends at Powers Lake. However, many of these recommended measures have been used successfully to establish safer conditions at other lakes in the Southeastern Wisconsin Region. Weekend surveys of recreational use should be continued after measures have been implemented to document their impact.

Public Access

It is recommended that the Towns of Randall and Bloomfield, the Powers Lake Management District, and the Wisconsin Department of Natural Resources continue to consider cooperatively the potential development of a public access site for the Lake. The areas recommended to be considered for the development of a public access site and parking area are shown on Map 41 and were chosen after a field inspection of the existing and proposed public access sites within these recommended areas. The Towns of Randall and Bloomfield, Powers Lake Management District, and Wisconsin Department of Natural Resources should consider the acquisition of shoreline property for the access site, and property for additional parking.

As noted in Chapter V, of the six public access sites on Powers Lake, three have ramps and provide parking for a total of 43 cars with trailers and 30 trailerless cars. Fees charged for launching are variable at the sites and may be excessive according to Chapter NR 190 of the Wisconsin Administrative Code. Two of the public access sites provide access only, one site provides swimming opportunities and parking for 22 cars.

Plans for acquiring and developing the designated public access and parking properties should be refined by the local units of government in cooperation with the Wisconsin Department of Natural Resources after consideration of the type and extent of existing public access facilities and possible lease agreements between the owners of these sites and local units of government.

Dredging

Dredging is recommended for the Jefferson Island Channel to improve boat navigation. If dredged to a recommended mean depth of six feet, a total of about 2,500 cubic yards of dredge spoil would have to be removed from the Channel.

Dredging to a depth of five feet to improve boat access along the eastern shoreline of Jefferson Bay is recommended along with measures to protect the environmentally valuable area in the Bay which may be disturbed as a result of dredging. As part of the dredging project, it is recommended that a comprehensive survey of the environmentally valuable area in Jefferson Bay by a qualified biologist delineate in the field and mark specific sites of diverse plant communities and sand and gravel substrates. Dredging in these areas should be minimized and protective measures implemented, such as barriers, refined limits of project, equipment selection, as well as revegetation of disturbed areas. Upon recommendations of the biologist, dredging should be completed during a time period which would least affect the environmentally valuable areas.

Dredging a strip 25 feet wide to a depth of six feet to improve boat access along the northern side of Harbor Lite's Bay is recommended along with measures to protect the environmentally valuable area in the Bay which may be disturbed as a result of dredging. As part of the dredging project, it is recommended that a comprehensive survey of the environmentally valuable area in Harbor Lite's Bay by a qualified biologist delineate in the field and mark specific sites of diverse plant communities and sand and gravel substrates. Dredging in these areas should be minimized and protective measures implemented, such as barriers, refined limits of project, equipment selection, as well as revegetation of disturbed areas. Upon recommendations of the biologist, dredging should be completed during a time period which would least affect the environmentally valuable areas.

Potential dredge spoil disposal sites which have been identified are shown on Map 40 and listed in Table 40.

PUBLIC REACTION TO THE PRELIMINARY RECOMMENDED POWERS LAKE MANAGEMENT PLAN

The preliminary Powers Lake Management Plan was presented by the Commission at the annual meeting of the Powers Lake Management District held at the Randall Town Hall on August 2, 1991. This presentation constituted, in effect, a public hearing on the preliminary plan. Previous meetings of the Commission and the Lake District Board to review the lake management alternatives and proposed recommended management actions were held on May 20 and June 20, 1991. These meetings were open to the public and the meetings were reported in the Kenosha News. Additionally, copies of the proposed plan were available from Lake District Board members and from Lake District residents who received copies at the meetings.

The presentation of the study findings and proposed recommended plan at the annual meeting initiated discussion by residents of the Lake District, who were primarily concerned about the following three proposed recommendations:

1. The designation of Jefferson, Knolls, and Honey Bear Bays as slow-no-wake areas.

2. The restriction of motorboating to slow-no-wake between the hours of 12:00 p.m. and 3:00 p.m. on Saturdays, Sundays and holidays.

3. The acquisition of 306 acres of wetlands in the drainage area.

At the annual meeting, the residents were asked to submit written comments on the proposed lake management plan to the Lake District Board by September 3, 1991. After review and consideration of the comments made by the Lake District residents, the preliminary plan was revised as described below.

Jefferson Bay

The recommendation to designate Jefferson Bay as a slow-no-wake area was made primarily to promote the safety and well being of the users of Powers Lake based on the physical nature of the Bay, observations of Commission staff, and comments of some residents. The traffic lane in the mouth of Jefferson Bay is less than 180 feet wide, an adequate distance to allow for one fast boat to pass one slow boat safely, such as a rowboat, with the allowance of 100 feet between them, as designated in the local boating ordinances. However, as the number of boats in Jefferson Bay increases, the potential for unsafe conditions also increases. Observations made by Commission staff indicated that some motorboats and jet skis were passing anchored boats at distances closer than 100 feet. A secondary consideration in recommending this limit on fast boating was to reduce the shoreline erosion resulting from boat-generated wave action. Responses to the questionnaire sent to residents of the Lake District also had suggested that consideration be given to closing Jefferson Bay to fast boating.

At the public hearing and in written comments subsequent to the hearing, several residents of Jefferson Bay commented that the Bay should not be designated as a slow-no-wake area. Their reasons included the following:

1. Because of the restrictive nature of the Bay, it is a good area to offer initial instruction to beginning water skiers, particularly children.

2. Decreased housing values could result if fast boating were to be prohibited in the Bay.

3. Hazardous conditions that may exist are tempered by the awareness of the lake users who exercise caution when entering and leaving the Bay.

4. There have been no known accidents in the Bay, therefore there is no need at the present times to prohibit fast boating to promote safety.

Knolls and Honey Bear Bays

The recommendation to designate Knolls and Honey Bear Bays as slow-no-wake areas was made to minimize disturbance that could potentially be caused by fast boating in the environmentally valuable areas that were designated in parts of the Bays by the Commission, as shown on Map 22, and in areas within the Bays adjacent to the environmentally valuable areas. Disturbances caused by motorboating activities may stress aquatic communities directly or indirectly in a number of ways, including altering the composition and biomass of plant communities when rooted macrophytes are removed and root systems are disturbed[3] and interfering with the feeding activities of fish populations as sediments are resuspended, inhibiting sight-feeders and clogging gills.[4,5] In addition, the restriction on fast boating was recommended for Knolls Bay to lessen the potential for boating conflicts that could arise because of boat traffic around the piers, including the newly constructed pier, and from boats entering and exiting the Lake via the access on 396th Street.

Comments of residents of the Lake District after the annual meeting indicated that some Lake District residents and some residents of the Lake Knolls Subdivision are concerned that the recommendation to designate the entire Bays as slow-no-wake areas would restrict areas on an already crowded lake for starting and dropping off waterskiers and turning around, particularly on windy days.

Fast Motorboating Restrictions

The recommendation to restrict fast motorboating between the hours of 12:00 p.m. and 3:00 p.m. on Saturdays, Sundays, and holidays was made primarily to promote the safety and wellbeing of users of the Lake by reducing the unsafe number of fast boating activities that occur during the afternoon weekend hours as determined by weekend boat counts, the number of resident boats, and comments by residents on the questionnaire. An informal survey of boating ordinances for other lakes in the Region indicated that some have enacted restrictions on fast boating activities. The effect of these restrictions on safety is unknown. Zoning of lake recreational activities by either space or time has been recognized by the Wisconsin Department of Natural Resources as promoting safer conditions on lakes by reducing boating conflicts, as reflected in the language of the proposed model boating ordinance.[6]

At the annual meeting and in written comments provided subsequent to the hearing, a number of residents indicated concern regarding this recommendation. The primary concern was that the proposed reduction in time available to use the Lake for fast boating activities was too severe. The residents indicated a preference for using the Lake for fast boating activities during the afternoon weekend hours.

Wetland Acquisition

The acquisition of 306 acres of wetlands in the Powers Lake drainage area was recommended to afford the greatest protection for the functions performed by the wetlands including the maintenance of the water quality and relatively stable lake levels. A few residents voiced concern at the annual meeting about the economic impact of purchasing the wetlands, because they are taken off the tax rolls. The residents indicated that the wetlands were in fact protected under other regulations, and thus there was no need to provide further protection. There was also testimony at the public hearing favoring the wetland acquisition recommendations.

Notwithstanding the protection offered by federal legislation, primarily under Section 404 of the Clean Water Act (33 United States Code, Section 1344) and by state regulation, primarily under the Shoreland Zoning Program (Wiscon-

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[3]*K. J. Wagner, "Assessing Impacts of Motorized Watercraft on Lakes: Issues and Perceptions," Proceedings of a National Conference on Enhancing the State's Lake Management Programs, January 1991.*

[4]*K. E. Snearley, Environmental Inventory of the Chain of Lakes and Fox River Region of Illinois, June 1977.*

[5]*E. Stern and W. Stickle, Effects of Turbidity and Suspended Material in Aquatic Environments, U. S. Army Corps of Engineers Technical Report No. TR-D-78-21, 1971.*

[6]*Wisconsin Department of Natural Resources, Draft Public Boating Policy, March 12, 1991, p. 28.*

sin Administrative Codes NR 115 and 117) and under Surface Water Protection, (Chapters 30 and 31 of Wisconsin Statutes), losses of wetlands in the Southeastern Wisconsin Region still continues. Not only has there been a loss of over 4,000 acres of wetlands in the Region between the years of 1970 to 1985, but the rate of wetland loss has accelerated. Between the years of 1970 and 1975, 1975 and 1980, and 1980 and 1985, 770 acres, 1,600 acres, and 1,640 acres of wetlands, respectively, were lost.[7]

A similar trend occurs in Randall Township. Between the years 1980 and 1985, 91 acres were lost, primarily to agricultural conversion. Between 1985 and 1990, 185 acres were lost. Thus, the rate of wetland acreage lost more than doubled in ten years.

Map 33 indicates the applicability of regulations for wetland protection in the Powers Lake drainage area. It should be noted that the majority of the area is partially protected by the U. S. Army Corps of Engineers 404 Program. However, under that program, in selected uses and for certain uses the filling of wetland is permitted. As noted in Chapter VII, county conservancy zoning also applies to the majority of the wetlands in the Powers Lake drainage area. However, this zoning also allows certain uses of wetlands which could be detrimental to lake water quality.

Final Recommendations

Upon due consideration of the comments made on the preliminary plan by the Lake District residents at and subsequent to the annual meeting of the District, the District Board directed that the preliminary plan be revised in the following manner:

1. Elimination of the designation of Jefferson Bay as a slow-no-wake area. Lake user awareness of the potential safety hazard that exists in Jefferson Bay may be adequate to keep the Bay accident-free. It is recommended that boating activity in Jefferson Bay be monitored by the Powers Lake Water Patrol. If safety problems escalate in the future, the slow-no-wake designation may be reconsidered.

2. The redelineation of the designated slow-no-wake areas in Knolls and Honey Bear Bays to protect most of the environmentally valuable areas within the Bays and to allow for the continuation of fast boating activities in areas not designated as environmentally valuable. To delineate properly the slow-no-wake area at the entrance to Knolls Bay, as shown on Map 43, to allow for safe fast boating activities, it is recommended that the Powers Lake Water Police and the Bloomfield and Randall Town Boards review and modify, if necessary, the placement of buoys and give consideration to the purchase of additional buoys. Subsequently, a map delineating buoy placement in Knolls Bay should be available to lake users. It is recommended that the slow-no-wake areas designed to protect environmentally valuable areas be marked with special colored buoys, or by some other means, along with the no-wake buoys.

3. The appointment of independent observers by the Lake District Board to survey boating activities on the Lake during weekends throughout the summer of 1992 to document the number of boats, including a count of nonresident boats, and determine if unsafe conditions still prevail. This recommendation is made in lieu of restricting fast boating on Saturdays, Sundays, and holidays. It is further recommended that the Lake District Board appoint persons to explore how boating restrictions at other regional lakes have increased safe conditions. It is recommended that the District's information and education program include an element directed at improving safety by voluntary actions of users of the Lake. It is also recommended that the results of these survey and educational efforts be reviewed following the 1992 boating season and recommendations be developed for improving safety if the surveys indicate the need to do so.

4. To foster an awareness and an understanding of the physical and biological characteristics of Powers Lake and its watershed so that Lake District residents may be better informed to act on important issues regarding the management of the Lake, it is recommended that the Powers

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[7]*Acreage lost in the "net" acreage, that is, the total acreage loss minus acreage of wetlands restored.*

Lake District Board take the lead role in developing and implementing an information and education program focusing on the ecology of Powers Lake. In developing and implementing the program, the Board should draw upon expertise and resources of the University of Wisconsin-Extension. The program should emphasize the dissemination of information on the natural systems within the Lake and the impacts of disturbances on these systems. Educational activities would be directed to both permanent and seasonal residents and could include talks by invited speakers and lake demonstration projects as well as mailings of informational material.

It should be noted that the recommendation for the acquisition of 306 acres of wetlands remains in the final lake management plan.

The final plan recommendations are summarized in Table 44 and are shown on Map 43.

COST ANALYSIS

The costs, expressed in 1991 dollars, of the recommended nonpoint source pollution abatement measures, in-lake management techniques, and lake-use recreational measures for the Powers Lake drainage area are set forth in Tables 45 and 46. The total capital cost of the recommended plan, presented in Table 45, is about $352,700 over a 20-year plan implementation period, with an average annual operation and maintenance cost of about $18,000.

It is recommended that the Powers Lake Management District consider funding an estimated total of $103,000 in capital and $3,600 in operation and maintenance costs of the recommended lake management measures, as shown in Table 46. Spreading these costs over a ten-year period, the Powers Lake Management District would fund an estimated $10,380 annually in capital costs and $4,800 annually in operation and maintenance costs.

Table 44

RECOMMENDED LAKE MANAGEMENT PLAN FOR POWERS LAKE

Plan Element	Management Measures
Land Use and Zoning	Wetland Zoning Rezone two wetland areas currently zoned for development to C-1 Lowland Resource Conservancy
Water Quality	Rural Nonpoint Source Pollution Control Crop rotation, contour cropping, contour strip-cropping, conservation tillage, fertilizer and pesticide management, permanent vegetative cover, buffer strips Implement public education program
	Construction Site Erosion Control Adopt and enforce construction erosion control ordinances
	Urban Nonpoint Source Pollution Control Implement public education program promoting good housekeeping practices and low-cost urban practices
	Onsite Sewage Disposal Systems Management Facility planning recommendations expected late 1991
Wetland Protection	Wetland Acquisition Purchase wetlands up to 306 acres, over time Prepare management plan for wetlands to be acquired
In-Lake Management	Protection of Environmentally Valuable Areas Prohibit dredging, restrict boating to slow-no-wake in environmentally valuable areas as delineated on Map 43, limit aquatic plant control, and construction of piers and docks in Knolls and Honey Bear Bays Limit dredging, aquatic plant control, and construction of piers and docks in other environmentally valuable areas
	Monitoring Programs Fish surveys, comprehensive aquatic macrophyte survey, water quality sampling
	Aquatic Plant Control Hand (rake) removal of milfoil in selected areas
	Shoreline Protection Revegetate unprotected and unstable shoreline in environmentally valuable areas and maintain existing structures Protect unprotected and unstable shoreline outside of environmentally valuable areas using vegetation and structures
	Education Develop and implement an information and education program focusing on the ecology of the Lake
Recreational Use Management	Boating Ordinance Revisions Investigate safety issues and recommend boating restrictions Purchase and place additional buoys to delineate slow-no-wake areas in Jefferson, Knolls, and Honey Bear Bays Increase posting of boating ordinances at all public access sites. Display ordinances and Wisconsin Statutes pertaining to boating and jet skis. Post ordinance, fine assessments, and disposal information relative to littering. Provide waste disposal containers. Post Statutes and local ordinances relative to snowmobiling and ice shanties Increase patrol hours and effectiveness of the Powers Lake Water Police during the weekends, consider retention and training of additional police officers Consider extending police surveillance during evening hours in winter Develop, publish, and disseminate to residents and nonresidents at public access sites fact sheets providing information on summer and winter recreational use
	Public Access Consider the acquisition of shoreline property and property for additional parking
	Dredging Limit dredging for boat access in Jefferson Island Channel and in Jefferson and Harbor Lite's Bays; institute mitigation measures

Source: SEWRPC.

Map 43

RECOMMENDED LAKE USE PLAN FOR POWERS LAKE

LEGEND

ENVIRONMENTALLY VALUABLE AREA PROTECTION

- NO WEED HARVESTING OR HERBICIDE USE
- LIMIT PIER AND DOCK CONSTRUCTION
- LIMIT DREDGING

WETLAND AREA CONSIDERED FOR REZONING FROM R-3 URBAN SINGLE-FAMILY RESIDENTIAL TO C-I LOWLAND RESOURCE CONSERVANCY.

ISOLATED NATURAL AREA CONSIDERED FOR RE-ZONING FROM B-5 COMMERCIAL-RECREATIONAL BUSINESS TO C CONSERVATION

SHORELINE PROTECTION

MAINTAIN EXISTING STABLE, UNPROTECTED SHORELINE

WITHIN ENVIRONMENTALLY VALUABLE AREAS:

PROTECT EXISTING, UNPROTECTED AND UNSTABLE SHORELINE WITH VEGETATION

MAINTAIN EXISTING STRUCTURES OR REPLACE WITH VEGETATION

OUTSIDE ENVIRONMENTALLY VALUABLE AREAS:

PROTECT UNSTABLE AND UNPROTECTED AREAS USING VEGETATION AND STRUCTURES

REPAIR AND MAINTAIN EXISTING PROTECTION STRUCTURES

RECREATIONAL USE MANAGEMENT

SLOW NO-WAKE BOATING ONLY

FAST BOATING AND WATERSKIING ALLOWED 10:00 AM TO SUNSET

BUOY PLACEMENT TO BE DETERMINED BY THE POWERS LAKE WATER POLICE AND BLOOMFIELD AND RANDALL TOWN BOARDS

POST ORDINANCES, PROVIDE SUMMER AND WINTER RECREATIONAL USE FACT SHEETS AND PROVIDE WASTE DISPOSAL CONTAINERS AT PUBLIC ACCESS SITES

- INCREASE WEEKEND ENFORCEMENT OF BOATING ORDINANCE
- CONDUCT SURVEYS OF WEEKEND RECREATIONAL USE

LIMITED DREDGING FOR BOAT ACCESS

PUBLIC ACCESS

RECOMMENDED AREA FOR A PUBLIC ACCESS SITE WITH LIMITED PARKING

POTENTIAL PARKING AREA FOR A PUBLIC ACCESS SITE

MONITORING PROGRAM

- CONDUCT FISH SURVEY
- CONDUCT AQUATIC MACROPHYTE SURVEY
- CONTINUE WATER QUALITY SAMPLING

GRAPHIC SCALE

0 400 800 1200 FEET

Source: SEWRPC.

Table 45

ESTIMATED COST OF THE RECOMMENDED LAKE MANAGEMENT MEASURES FOR POWERS LAKE: 1990-2010

Water Quality or Lake Management Measures	Estimated Cost 1990-2010[a] Capital	Estimated Cost 1990-2010[a] Average Annual Operation and Maintenance	Potential Funding Sources
Nonpoint Source Pollution Controls			
Rural Nonpoint Source Pollution Controls	$ 36,000	$ 2,000	U. S. Department of Agriculture, Wisconsin Department of Natural Resources, local residents
Construction Erosion Control	- -	2,000[b]	Private firms and individuals
Urban Nonpoint Source Pollution Controls	2,000	500	Powers Lake Management District, UW-Extension, and local residents
Onsite Sewage Disposal Management	- -[c]	- -[c]	- -
Wetland Acquisition			Wisconsin Department of Natural Resources, Towns of Randall and Wheatland, local residents and other private organizations and individuals
Very High Priority	62,000	500	
High Priority	35,300	500	
Moderate Priority	33,000	500	
Fish and Wildlife Management	25,000[d]	- -	Wisconsin Department of Natural Resources[e]
Aquatic Plant Management	12,800[f]	- -	Powers Lake Management District
Water Quality Sampling	- -	1,800	Powers Lake Management District, U. S. Geological Survey
Dredging	- -[g]	- -	Local residents
Jefferson Island Channel	11,000		
Jefferson Bay	73,300		
Harbor Lite's Bay	6,600		
Shoreline Protection	53,000	7,500	Local residents
Additional Water Police	700[h]	1,200	Towns of Bloomfield and Randall, and Wisconsin Department of Natural Resources
Information and Education	2,000	1,500	Powers Lake Management District, UW-Extension, Wisconsin Department of Natural Resources
Public Access Site Development	- -[i]	- -[i]	Wisconsin Department of Natural Resources and local units of government
Total	$352,700	$18,000	- -

[a]*All costs expressed in May 1991 dollars.*

[b]*Costs include the provision of construction erosion control measures on about one to four acres per year of land under development.*

[c]*Costs will depend upon findings and recommendations of ongoing facility plan. Because septic system management is a function necessary for public health, maintenance of groundwater quality, maintenance and enhancement of property values as well as lake water quality, these costs are not directly included in the lake management plan costs.*

[d]*Comprehensive two-week survey.*

[e]*Wisconsin Department of Natural Resources funding will probably be subject to development and operation of an adequate public access site on Powers Lake.*

[f]*Cost includes four surveys at $3,200 each; survey to be repeated every five years.*

[g]*Costs do not include land acquisition for spoil disposal.*

[h]*Cost includes wages and expenses for training.*

[i]*Land costs and operation and maintenance costs are variable.*

Source: SEWRPC.

Table 46

ESTIMATED COST OF THE RECOMMENDED LAKE MANAGEMENT MEASURES FOR POWERS LAKE TO BE BORNE BY THE POWERS LAKE MANAGEMENT DISTRICT: 1990-2010

Water Quality or Lake Management Measures	Estimated Cost 1990-2010[a]		Estimated Annual Cost Over 10-Year Period	
	Capital	Average Annual Operation and Maintenance	Capital	Operation and Maintenance
Nonpoint Source Pollution Controls				
Rural Nonpoint Source Pollution Controls	$ 9,000[a]	$ 500	$ 900	$ 500
Construction Erosion Control	--	--	--	--
Urban Nonpoint Source Pollution Controls	2,000	500	200	500
Onsite Sewage Disposal Management	--	--	--	--
Wetland Acquisition	70,000[b]	500	7,000	500
Fish and Wildlife Management	8,000[c]	--	800	--
Aquatic Plant Management	12,800[d]	--	1,280	--
Water Quality Sampling	--	1,800	--	1,800
Dredging	--	--	--	--
Shoreline Protection	--	--	--	--
Additional Water Police	--	--	--	--
Information and Education	2,000	1,500	200	1,500
Public Access Site Development	--	--	--	--
Total	$103,800	$4,800	$10,380	$4,800

[a] *All costs assumed to be 25 percent of total cost.*

[b] *Costs assumed to be 50 percent of total cost with the remaining 50 percent coming from other funding sources, such as the Urban Green Space Program and private donations. Cost includes $4,000 for management plan for acquired wetlands. Acquisition costs would be refined after completed land appraisal.*

[c] *Cost assumed to be 30 percent of total cost. Study to be done in cooperation with Wisconsin Department of Natural Resources.*

[d] *Cost includes four surveys.*

Source: SEWRPC.

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Chapter IX

SUMMARY

The preparation of this lake management plan for Powers Lake was a cooperative effort by the Southeastern Wisconsin Regional Planning Commission, The Powers Lake Management District, the U. S. Geological Survey, Kenosha and Walworth Counties, and private consultants. The planning effort included the design and conduct, from October 1986 to October 1987, of a water quality sampling program encompassing sampling for quality of not only the lake water itself but of the inflows to and outflows from the Lake; together with inventories and analyses of the existing land use pattern; the physiography and natural resource base of the drainage area; the recreational use of the Lake; and the management practices of the watershed. The objectives of the plan are to provide for the protection and enhancement of water quality conditions; the management of recreational opportunities; the protection and enhancement of fishery and other aquatic resources and of wildlife habitat, as well as woodland and wetland areas; and the control of excessive water level fluctuations and the reduction of shore erosion.

Analysis of water quality and biological conditions indicates that the general condition of water quality in Powers Lake is good, but reduction of external pollutant loads from rural and urban areas and the preservation of the natural resource base will be necessary to maintain the existing level of water quality. Water-based recreational activities are constrained by excessive powerboat traffic and by increasing numbers of jet skis, which create unsafe conditions during weekends and conflict with other recreational activities.

Powers Lake is a 459-acre lake located in close proximity to the large metropolitan areas of Chicago and Milwaukee, within U. S. Public Land Survey Section 18, Township 1 North, Range 19 East, Town of Randall, Kenosha County, and within U. S. Public Land Survey Section 13, Township 1 North, Range 18 East, Town of Bloomfield, Walworth County. The Lake has a maximum depth of 33 feet and a mean depth of 16 feet. Powers Lake has a tributary drainage area of 2,177 acres, or 3.4 square miles.

INVENTORY FINDINGS

Population

- In 1985 the resident population of the Powers Lake drainage area was estimated by the Regional Planning Commission at 880 permanent residents and 700 seasonal residents.

Land Use

- As of 1985, approximately 1,767 acres, or 81 percent of the 2,177-acre drainage area, was still in rural land uses, as shown on Map 13, with agriculture the dominant rural land use. Approximately 410 acres, or 19 percent of the drainage area, was in urban land uses, with residential uses the dominant urban land use.

Water Quality

- Measurements of the primary water quality indicators, as presented in Figure 6, total phosphorus, chlorophyll-a, and water clarity indicated that Powers Lake continues to have good water quality.

Water Budget

- Precipitation and groundwater provide over 70 percent of the water inflow to Powers Lake, as shown in Figure 2. The approximately 30 percent remainder of the inflow is via the Powers Lake inlet and from shoreline drainage. About 60 percent of water outflow is via the Powers Lake outlet. The remaining approximately 40 percent is lost through evaporation from surface of the Lake.

Sediment Yields

- Approximately 591 acres of the 680 acres of agricultural lands within the drainage area tributary to Powers Lake were identified in 1990 as having excessive soil erosion. As shown on Map 26, about 29 acres, or 4 percent, had soil loss rates that were 1.1 to 1.9 times the tolerable soil loss rate, or T-value, as determined by the U. S. Soil Conservation Service; about 383 acres, or 56 percent, had soil loss rates that were 2.0 to 2.4 times the T-value; and about 179 acres, or 26 percent, had soil loss rates that were at least 2.5 times the T-value.

Phosphorus Loading

- Phosphorus is delivered to the Lake primarily from inflows via the Powers Lake inlet and from shoreline drainage, as indicated in Table 13. Some 84 percent of the phosphorus leaves the water column by sedimentation, and some 16 percent by the Lake outlet.

Natural Resource Base 1990

- Wetland areas, as shown on Map 21, covered about 312 acres, or about 14 percent of the drainage area tributary to the Lake, including a 294-acre wetland complex comprised of a variety of wetland plant communities.

- Woodlands covered about 112 acres, or about 5 percent of the drainage area.

- High-value wildlife habitat, including woodlands and wetlands, as shown on Map 21, covered about 557 acres, or about 26 percent of the drainage area.

- Environmentally valuable areas with important aquatic habitat used for shelter, spawning, and feeding by aquatic animals include the Lake's bottom; the shoreline areas of Knoll's Bay, Honey Bear Bay, and Jefferson Bay; and the Powers Lake shoreline, as shown on Map 22.

Recreational Use

- The number of ski boats, powerboats, and sailboats on the Lake at any one time during the 1990 weekend surveys, as indicated in Table 27, ranged from 25 to 46, exceeding the safe-boating density of 20 such boats as promulgated by the Regional Planning Commission. The average number of all boats and watercraft on the Lake at any one time during the weekend was 67.

- A total of 745 boats and watercraft were docked or moored on the Lake in the summer of 1990.

- According to the 1990 mail survey, as presented in Appendix A, anglers caught panfish most often and perceived a decline in the number of walleyed and northern pike and an increase in the number of longnose gar and carp being caught.

- The number of participants engaged in winter activities on the Lake during the 1991 weekend surveys ranged from 31 to 66. During this same period, the number of vehicles on the Lake ranged from 18 to 30 and the number of shelters ranged from 17 to 26. Ice fishing was the primary activity; the average number of fish caught by weekend anglers within an average time period of 3.5 hours was two.

- Eighty percent of the anglers responding to the mail survey and 81 percent of winter anglers surveyed rated fishing quality as good or fair.

Shoreline Protection

- About 47 percent of the 1990 shoreline was protected by 133 structures, of which 43 exhibited collapse or other types of failure. Of the 53 percent of the shoreline not protected by structures, 12 percent, or about 1,750 feet of shoreline, was found to be actively eroding, as shown on Map 3.

Public Access

- In 1990, there were six public access sites on Powers Lake, as shown on Map 25. Two of these were owned by the Town of Randall and four were privately owned. Of the six access sites, four had a ramp and provided parking for a total of 43 car-trailers. Areas were identified, using selected criteria, within which an access site could be developed or improved.

ALTERNATIVE LAKE MANAGEMENT MEASURES

About 35 lake management measures were evaluated as part of the planning process. The alternative measures which have been eliminated from or incorporated into the recommended plan are described in the following section.

Alternative measures evaluated but deemed unnecessary or inappropriate included a high level of nonpoint source pollution control, including wet detention basins; nutrient inactivation; drawdown and chemical eradication; use of aquatic herbicides and aquatic plant harvesting; lake bottom covering; waterskiing restrictions; slow-no-wake hours restriction on weekends from 6:00 p.m. to 10:00 a.m.; space zoning for fast and slow boating, swimming, and fishing; establishing a maximum boating speed of 40 miles per hour; prohibiting "rooster tail" wakes more than four feet high or 20 feet long; dredging in Knoll's Bay and Honey Bear Bay and most of Jefferson Bay; and construction of a control structure on the Lake outlet.

The preliminary lake management plan for Powers Lake, shown on Map 41 and presented in Table 42, was presented by the Commission at The Powers Lake Management District Annual Meeting on August 2, 1991. Concerns were raised by Powers Lake residents relating to three of the preliminary recommendations for recreational uses of the Lake. These three recommendations were 1) limiting boating to slow-no-wake in Jefferson, Knolls, and Honey Bear Bays; 2) prohibiting fast boating activities from 12:00 p.m. to 3:00 p.m. on weekends and holidays; and 3) purchasing about 306 acres of wetlands within the drainage area. The residents were asked to submit written comments on the proposed lake management plan to the Board by September 3, 1991.

THE RECOMMENDED PLAN

Upon due consideration of the comments made on the preliminary plan by the Lake District residents at and subsequent to the annual meeting of the District, the preliminary plan was revised. These preliminary plan revisions were presented at the Powers Lake Management District Board meeting held on October 3, 1991. The management recommendations for Powers Lake, as shown on Maps 42 and 43 and presented in Table 44, were developed within the framework of the adopted regional water quality management plan, the Kenosha County soil erosion control plan, and the Kenosha County park and open space plan and include:

For maintenance and enhancement of the water quality:

1. The implementation of nonpoint source pollution controls was recommended for both urban and rural areas in the drainage area tributary to the Lake, including a public education program and improved urban and agricultural land management, with technical and financial assistance from the state and federal governments. Implementation of rural and urban measures may be expected to provide about a 18 percent reduction in phosphorus loadings to the Lake.
2. The improvement of construction erosion control by Kenosha County through the adoption and enforcement of a construction erosion control ordinance based on the model ordinance presented in Wisconsin Construction Site Best Management Practices Handbook, 1989, was recommended. Construction erosion control measures may be expected to reduce phosphorus loadings to Powers Lake by about 3 percent.
3. The implementation of the recommendations of the facility planning program evaluating existing onsite sewage disposal systems and the need for installing a public sanitary sewer system to serve the existing urban development was recommended. The provision of a centralized sanitary sewer system is expected to eliminate 10 percent of the phosphorus loadings to the Lake.

For wetland protection:

1. The purchase, over the long term, of 306 acres of wetlands in the drainage area tributary to the Lake, as shown on Map 42, and the preparation and implementation of a management plan for these wetlands were recommended.
2. The rezoning of two wetland parcels, shown on Map 43, one located in the Town of Randall and one located in the Town of Bloomfield, was recommended.

For in-lake management:

1. The protection of the environmentally valuable areas within the Lake, as shown on Map 43, and along the Lake's shoreline, including such measures as the prohibition of fast motorboating, limiting of dredging and filling activities, aquatic plant control by harvesting and chemical means, and construction of piers and docks was recommended. Limited dredging for boat access in Harbor Lite's Bay, Jefferson Bay, and Jefferson Island channel was recommended, with mitigation measures as needed.
2. The implementation of in-lake monitoring of fish and aquatic macrophytes and the continuance of water quality sampling were recommended.

3. The protection of the shoreline in such environmentally valuable areas, as those shown on Map 43, by vegetating unstable, unprotected shoreline and by vegetating or maintaining structures along protected shoreline, was recommended. The protection of the shoreline outside environmentally valuable areas, as shown on Map 43, by vegetating and erecting structures along unprotected, unstable reaches and also repairing and maintaining structures along protected reaches, was also recommended.

For recreational use management:

1. The designation of slow-no-wake areas in Knolls and Honey Bear Bays to protect most of the environmentally valuable areas within the Bays and to allow for the continuation of fast boating in areas not designated as environmentally valuable was recommended. To delineate the slow-no-wake area at the entrance to Knolls Bay properly, as shown on Map 43, to allow for safe fast boating activities, it was recommended that the Powers Lake Water Police and the Bloomfield and Randall Town Boards review and modify, if necessary, the placement of buoys and give consideration to the purchase of additional buoys. Subsequently, a map delineating buoy placement in Knolls Bay should be made available to lake users. It is recommended that the slow-no-wake areas designed to protect environmentally valuable areas be marked with special colored buoys or by other means along with the no-wake buoys.

2. The appointment of independent observers by the Lake Management District Board to survey boating activities on the Lake during weekends throughout the summer of 1992 to document the number of boats, including nonresident boats, and determine if unsafe conditions still prevail, was recommended. This recommendation is made in lieu of restricting fast boating on Saturdays, Sundays, and holidays. It is further recommended that the Board appoint persons to explore how boating restrictions at other regional lakes have increased safe conditions. It is recommended that the District's information and education program include an element directed at improving safety by voluntary actions of users of the Lake. It was also recommended that the results of these survey and educational efforts be reviewed after the 1992 boating season and that recommendations be developed for improving safety if the surveys indicate the need to do so.

3. It was recommended to increase the posting at all public access sites of readily visible signage describing:

   - boating ordinance regulations relative to boating and jet skis;
   - ordinance provisions, fine assessments, and disposal information relative to littering;
   - Wisconsin Statutes and local ordinances relative to snowmobiling and ice shanties.

4. An increase in the patrol hours and the effectiveness of the Powers Lake Water Police during the weekends, with consideration to the retention and training of additional police officers, was recommended.

5. The extension by the Towns of Randall and Bloomfield of limited surveillance of lake activities during winter evening hours by the Powers Lake Water Police or ordinance enforcement officers was recommended. A surveillance program should be initiated after an analysis of safety hazards related to winter recreational activities. Ordinance revisions could also be considered to promote the safe use of Powers Lake during the winter.

6. The preparation and publication of two Powers Lake recreational use fact sheets, one for summer and one for winter, were recommended. Information contained could include summaries of pertinent ordinances, and common-sense and safe-use measures for boat, jet ski, and snowmobile operation and for ice-fishing and ice shanty use. These fact sheets should be made available at the public access sites and mailed to Lake District residents.

7. To foster an awareness and an understanding of the physical and biological characteristics of Powers Lake and its watershed so that Lake District residents

watershed so that Lake District residents may be better informed to act on important issues regarding the management of the Lake, it was recommended that the Powers Lake District Board take the lead role in developing and implementing an information and education program focusing on the ecology of Powers Lake. In developing and implementing the program, the Board should draw upon expertise and resources of the University of Wisconsin-Extension.

The program should emphasize the dissemination of information on the natural systems within the Lake and the impacts of disturbances on these systems. Educational activities would be directed to both permanent and seasonal residents and could include talks by invited speakers and lake demonstration projects, as well as mailings of informational material.

For public access:

1. The refinement of plans for the acquisition and development of designated public access and parking facilities, as shown on Map 43, by the local units of government and the Wisconsin Department of Natural Resources after further consideration of the type and extent of existing privately owned public access facilities and possible lease agreements between the owners of these sites and local units of government was recommended.

The recommended plan would entail a capital cost of about $352,700 and an annual maintenance cost of about $18,000, as shown in Table 45.

Powers Lake is a valuable natural resource in the Southeastern Wisconsin Region. There is a delicate, complex relationship between the water quality conditions of a lake and the land uses within the drainage area tributary to a lake. The increases in population, urbanization, income, leisure time, and individual mobility forecast for the Region may be expected to result in additional pressure for development in the drainage area of lakes in southeastern Wisconsin and for water-based recreation on the lakes themselves. Without the adoption and administration of an effective lake management program for Powers Lake, based upon comprehensive water quality management and related land use plans, the water quality protection needed to maintain conditions in Powers Lake suitable for recreational use and for the fish and other aquatic life will not be provided.

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APPENDICES

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Appendix A

POWERS LAKE USE SURVEY

Conducted by the
Southeastern Wisconsin Regional Planning Commission
In Cooperation with The District of Powers Lake
Summer 1990

I. BACKGROUND (please circle one)

A. Are you a:
55 1. year round resident
57 2. part year resident, summer
68 3. part year resident, weekends

B. How many years have you used Powers Lake?
1 1. less than 1 year
19 2. 1 year to 5 years
16 3. 6 years to 10 years
132 4. more than 10 years

168/298 = 56% response

II. RECREATIONAL USE
How do you use Powers Lake (check all that apply)?

61 A. Fishing (If you do not fish, skip to B) Days per Year Average 32, Range 2 - 280

1. Which species of fish did you catch last year (check all that apply)?

29 a. Northern Pike
19 b. Walleye
46 c. Largemouth Bass
27 d. Smallmouth Bass
2 e. White Sucker
58 f. Panfish
40 g. Yellow Perch
36 h. Crappie
12 i. Longnose Gar
3 j. Bowfin
17 k. other (name)

2. Which of the following fish do you think have increased (write I), decreased (write D), or remained the same (write S) in number within the last 5 years?

	D	I	S		D	I	S
a. Northern Pike	24	3	10	g. Yellow Perch	16	1	11
b. Walleye	28	3	6	h. Crappie	13	3	6
c. Largemouth Bass	18	6	14	i. Longnose Gar	1	16	7
d. Smallmouth Bass	12	1	7	j. Bowfin	2	2	4
e. White Sucker	2	4	2	k. Carp	--	24	4
f. Panfish	10	0	18	l. other (name)	--	4	2

3. How do you rate the fishing quality of Powers Lake?

1 a. excellent
21 b. good
41 c. fair
15 d. poor

4. Have you gone ice-fishing on Powers Lake over the past year?
   19 a. Yes 76 b. No

		Average	Range
	B. Boating		
157	1. power boating	Days per Year 40	1-180
29	a. Motor size less than or equal to 25 hp.		1-180
125	b. Motor size greater than 25 hp.		2-120
94	2. water skiing	Days per Year 29	1-120
9	3. jet skiing	Days per Year 37	10-60
66	4. sailing	Days per Year 21	1-120
36	5. canoe/kayaking	Days per Year 12	1-50
40	6. paddle boating	Days per Year 16	4-40
56	7. row boating	Days per Year 18	1-100
155	C. Swimming	Days per Year 41	5-120
134	D. Scenic Viewing	Days per Year 98	2-365
11	E. Skin/Scuba Diving	Days per Year 25	2-90
1	F. Duck Hunting	Days per Year 20	20
33	G. Snowmobiling	Days per Year 14	2-60
39	H. Cross-Country Skiing	Days per Year 8	2-30
70	I. Ice Skating	Days per year 8	1-30
7	J. Other (specify)	- -	- -
18	Ice Fishing	Days per Year 50	50
2	Ice Boating	Days per Year 18	6-30

III. ISSUES

Rank		A. What are your concerns about Powers Lake (check all that apply)?
1	153	1. general water quality
3	138	2. number of boats
	101	3. speed of boats
	97	4. size of boats
	70	5. number of water skiiers
2	141	6. number of jet skiiers
	75	7. decline in fishery resources
	97	8. excessive noise

106 9. excessive algae

4 127 10. excessive aquatic weeds

77 11. farm runoff

58 12. urban stormwater runoff

99 13. development around the lake

5 125 14. failing septic systems

66 15. shoreline erosion

20 16. too high water levels

99 17. too low water levels

34 18. water levels that fluctuate too much

69 19. outlet dam maintenance

68 20. wetland preservation

80 21. sedimentation/shallow areas

3 22. other (please specify) race track
1 swimmers' itch

B. On summer weekdays, how crowded do you feel when on the water?

5 extremely crowded
13 crowded
150 not crowded

C. On summer weekends, how crowded do you feel when on the water?

76 extremely crowded
69 crowded
16 not crowded

IV. MANAGEMENT

A. Do you favor construction of a public boat launch with parking facilities on Powers Lake?
7 a. Yes 160 b. No

B. What days and hours would you like the Safety Patrol on Powers Lake?
Weekends, 10 a.m.-dark; Weekends, "all day"; Every day, 10 a.m.-dark; Weekends and periodically during the week.

C. Do you think that the present boating ordinances are:

6 too strict
111 strict enough
50 not strict enough

D. Are the present boating ordinances adequately enforced?

81 a. Yes   78 b. No

If no, why not? 1) Not enough patroling;
2) Concerned with manner of enforcement;
3) Not enough enforcement;
4) Enforcement is selective/sporatic;
5) Difficult to reach Safety Patrol when needed.

E. Which of the following activities should be restricted to <u>certain areas</u> (check all that apply)?

57 swimming
53 power boating
65 water skiing
126 jet skiing
12 fishing
13 other boating
36 snowmobiling
1 other (please specify)

F. Which of the following activities should be restricted to <u>certain hours</u> (check all that apply)?

1 swimming
100 power boating
116 water skiing
131 jet skiing
9 fishing
14 other boating
46 snowmobiling
___ other (please specify)

G. How would you improve the present boating ordinances?

#1 Restrict jet ski use (except, follow waterskiing rules)
#2 Increase enforcement
#3 Enforce rules for/restrict water skiing
#4 Ban jet skis
#5 Restrict access to lake
#6 Limit engine size

V. COMMENTS (May provide additional comments on back)

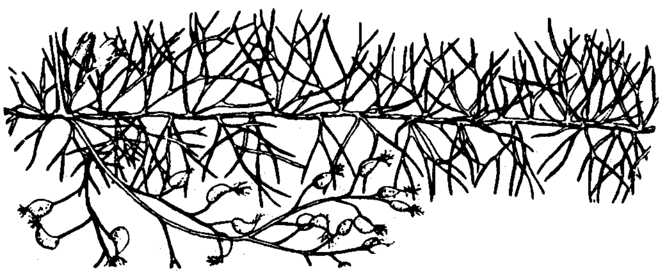
#1 Noise is a problem
#2 Septic systems should be improved and maintained
#3 Improve number and maintenance of bouys
#4 Concerned about size and speed of boats
#5 Concern for general water quality
#6 Ordinances are satisfactory but need to be enforced
#7 Boaters should be aware of rules (post at launches)
#8 Jet skis are a nuisance
#9 Need for sanitary facilities for visitors (boaters and ice fishermen).

Thank you for taking the time to complete this survey form. Please return this form to the Regional Planning Commission in the enclosed addressed and stamped envelope by July 25, 1990.

Appendix B

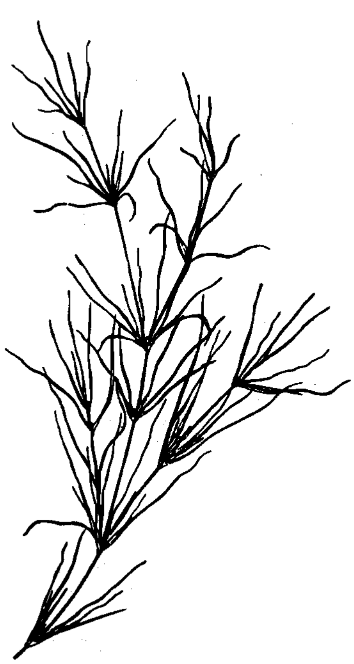
AQUATIC MACROPHYTES FOUND IN THE VICINITY OF POWERS LAKE

BLADDERWORT (Utricularia sp.)



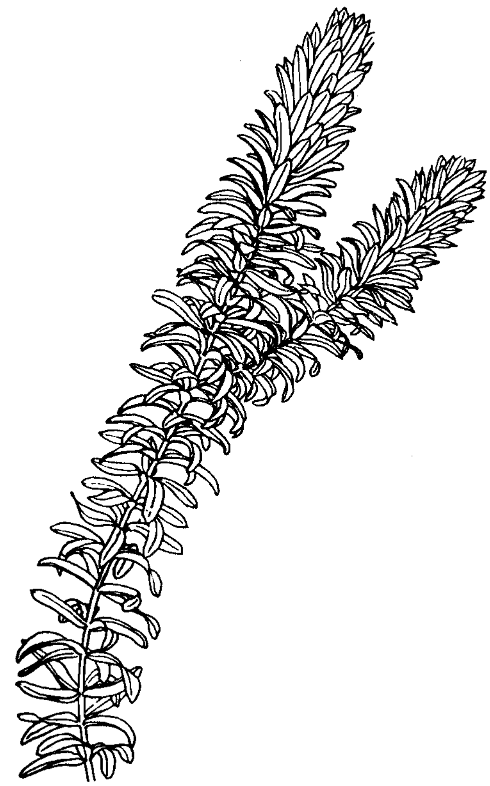
Bladderwort is a carnivorous plant which occurs in shallow ponds and lakes or on wet soils. The small bladders are traps which catch tiny animal life, particularly crustaceans. Bladderwort provides some food and cover for fish. It is never abundant enough to become a nuisance.

BUSHY PONDWEED (Najas flexilis)



Bushy pondweed is a common species in ponds, small lakes, and slow-moving streams in southeastern Wisconsin. It provides food and cover for fish. Bushy pondweed may become a nuisance during late summer in some lakes.

COMMON WATERWEED (Anacharis canadensis)



Common waterweed is a submerged plant which usually occurs in hard water. It provides cover for many small aquatic organisms which serve as food for the fish population. Waterweed is an aggressive plant and may suppress the growth of other aquatic plants.

COONTAIL (Ceratophyllum demersum)

Coontail is a submerged plant which prefers hard water. It supplies cover for shrimp and young fish and supports insects which are valuable as fish food. A heavy growth of coontail is an indication of very fertile lake conditions.

CURLY LEAF PONDWEED (Potamogeton crispus)

Curly leaf pondweed is an introduced plant species which does well in hard or brackish water which is usually polluted. However, curly leaf pondweed does provide good food, shelter, and shade for fish and is valuable for early spawning fish.

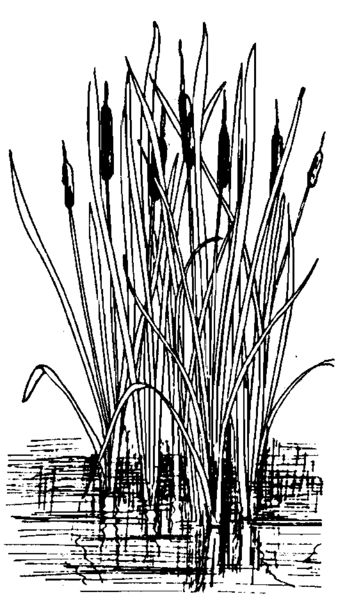
FLOATING LEAF PONDWEED (Potamogeton natans)

Floating leaf pondweed has leaves which float on the surface with the rest of the plant submerged. It provides food and shelter for fish and other aquatic species.

LARGE LEAF PONDWEED (*Potamogeton amplifolius*)

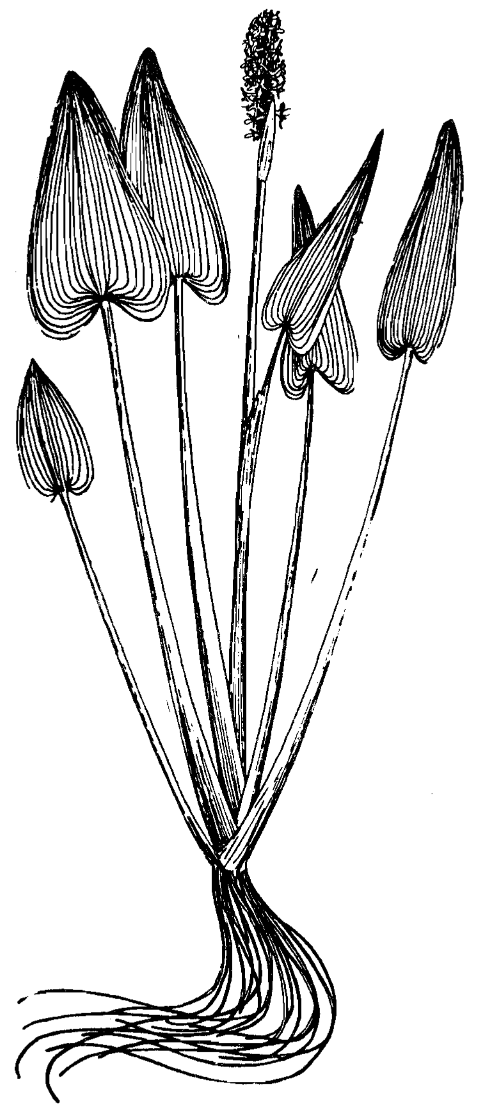
Large leaf pondweed is usually found in relatively hard water. Submersed, it supports insects and provides a good food supply for fish.

NARROW-LEAVED CATTAIL (*Typha angustifolia*)



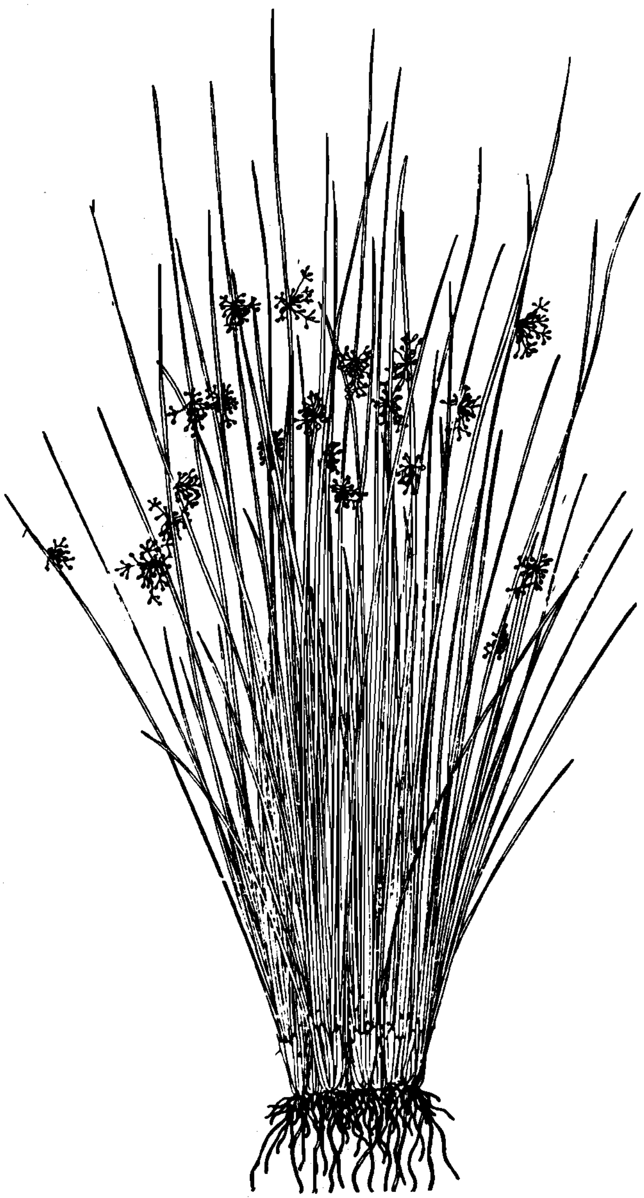
Narrow-leaved cattail may appear in almost any wet place. It is used as a spawning area for sunfish and shelter for various species of young fish, as well as a variety of other forms of wildlife. Cattails often occur in dense stands and therefore may become a nuisance.

PICKEREL WEED (*Pontederia cordata*)



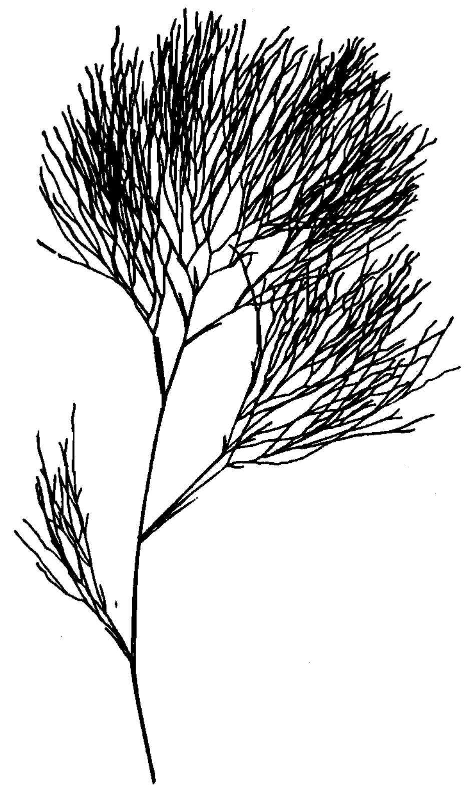
Pickerel weed is common in shallow water with muddy shores. It provides shade and shelter for fish but has only slight value as food and cover. Pickerel weed usually is not abundant enough to be a nuisance.

RUSH (Juncus sp.)



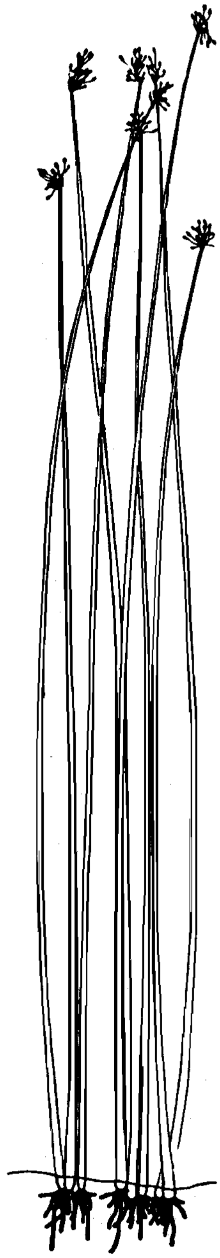
Rushes are an emergent aquatic plant with a widespread habitat which ranges from wet meadows and lakeshores to shallow pools. Thick growths of rushes often form spawning grounds for rock bass, bluegills, and other sunfish.

SAGO PONDWEED (Potamogeton pectinatus)



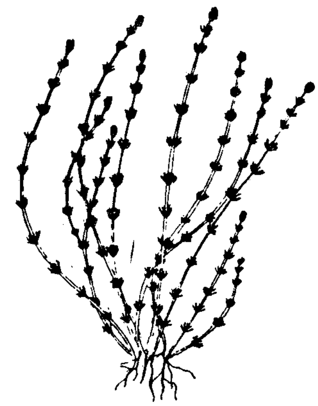
Sago pondweed is found in hard or brackish water of lakes and slow-flowing streams. Sago pondweed provides food and shelter for young trout and other fish.

SOFTSTEM BULRUSH (*Scirpus validus*)



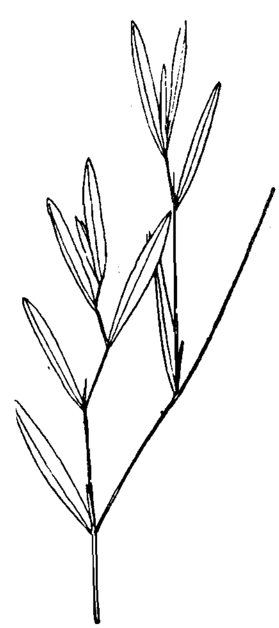
Softstem bulrush is an emergent aquatic species. It supports insects and provides food for young fish and many species of waterfowl.

MUSKGRASS (*Chara vulgaris*)



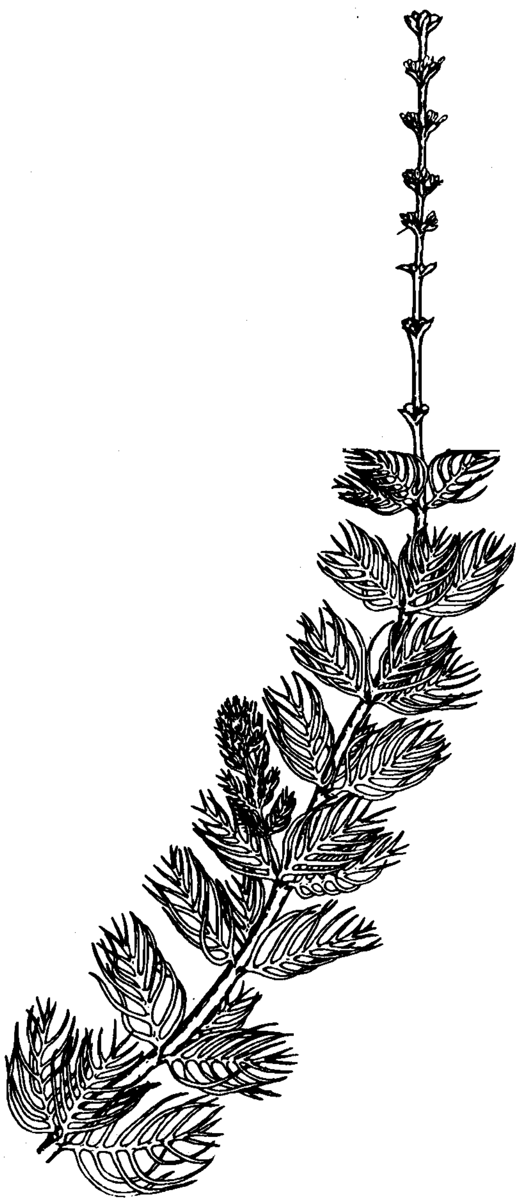
Muskgrass is a type of algae which usually occurs in hard water. It provides fair cover for fish and produces excellent food for young trout, large- and smallmouth bass, and black bass.

VARIABLE PONDWEED (*Potamogeton gramineus*)



Variable pondweed is a submergent species. However, it will occasionally grow on muddy shores. Variable pondweed provides food and cover for fish.

WATER MILFOIL (Myriophyllum sp.)



Water milfoil is a submergent plant which may cause extensive weed problems in lakes and streams. However, when not overabundant, water milfoil provides cover for fish and is a valuable food source for many forms of aquatic life.

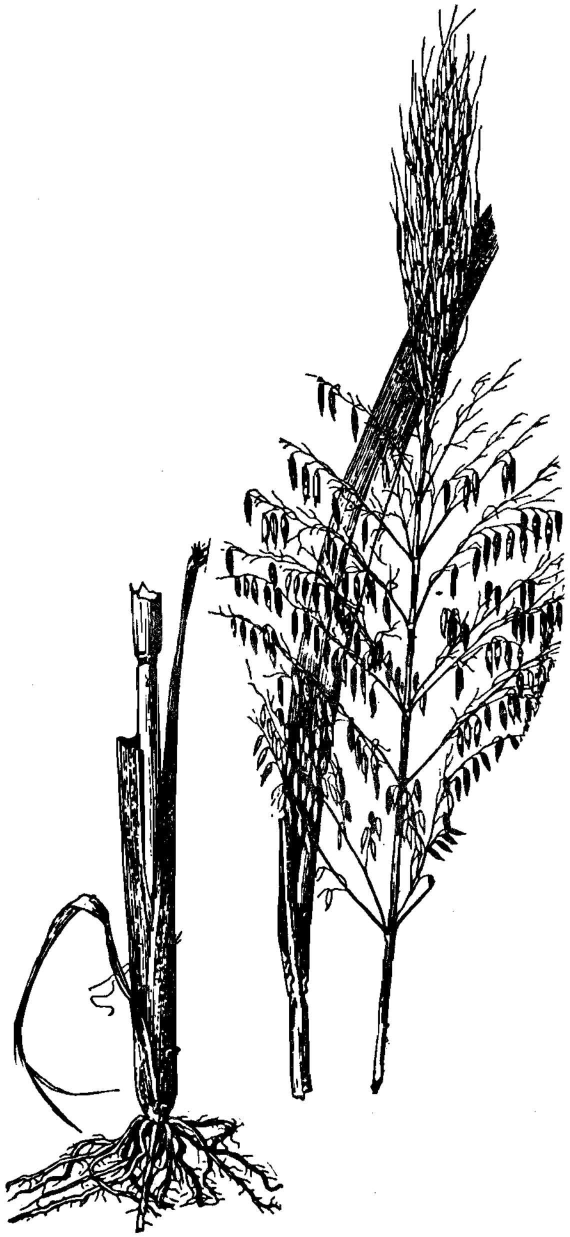
WATER SMARTWEED (Polygonum natans)

Water smartweed is found along the shoreline of shallow water. It provides food and cover for fish and wildlife. Water smartweed is never abundant enough to cause aquatic nuisance problems.

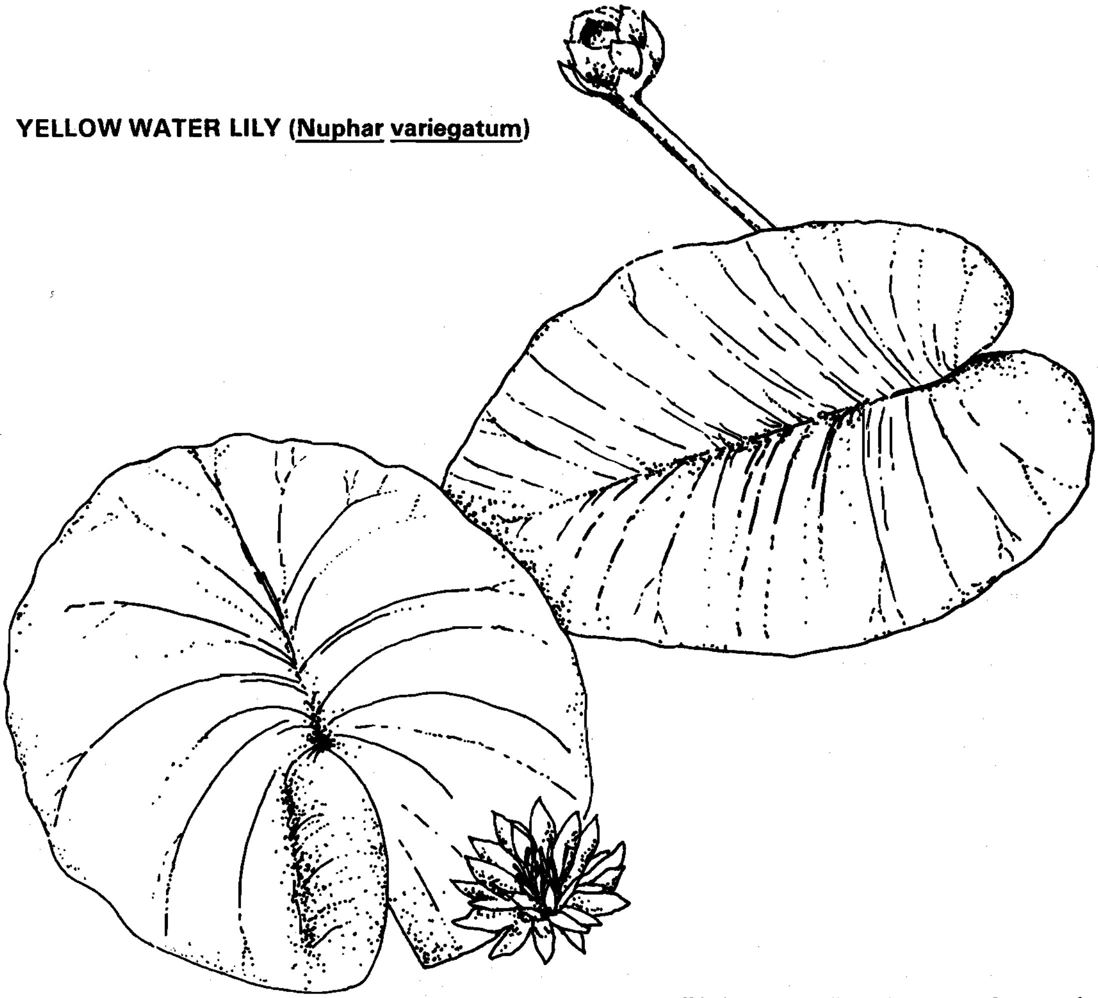
WILD RICE (Zizania aquatica)

WILD CELERY OR EEL GRASS (Vallisneria americana)

Eel grass is a submersed plant which provides shade, shelter, and food for fish. It supports insects and is a valuable food source for waterfowl. Sometimes forming dense growths, eel grass may be undesirable in swimming areas.



Wild rice is a valuable emergent aquatic grass. Wild rice prefers clean water with low turbidity during the growing season. Wild rice is an annual grass with seeds that depend on sufficient light penetration in spring and early summer for germination. Wild rice is an important food source for many species of fish and waterfowl. It is also a food source for humans.



Yellow water lily and white water lily are found in shallow portions of lakes and ponds. The leaves float on the surface of the water and algae and insects often grow under the leaves. Yellow and white water lilies provide shade and shelter for fish but may cause problems because of the extensiveness of their beds in shallow portions of lakes.