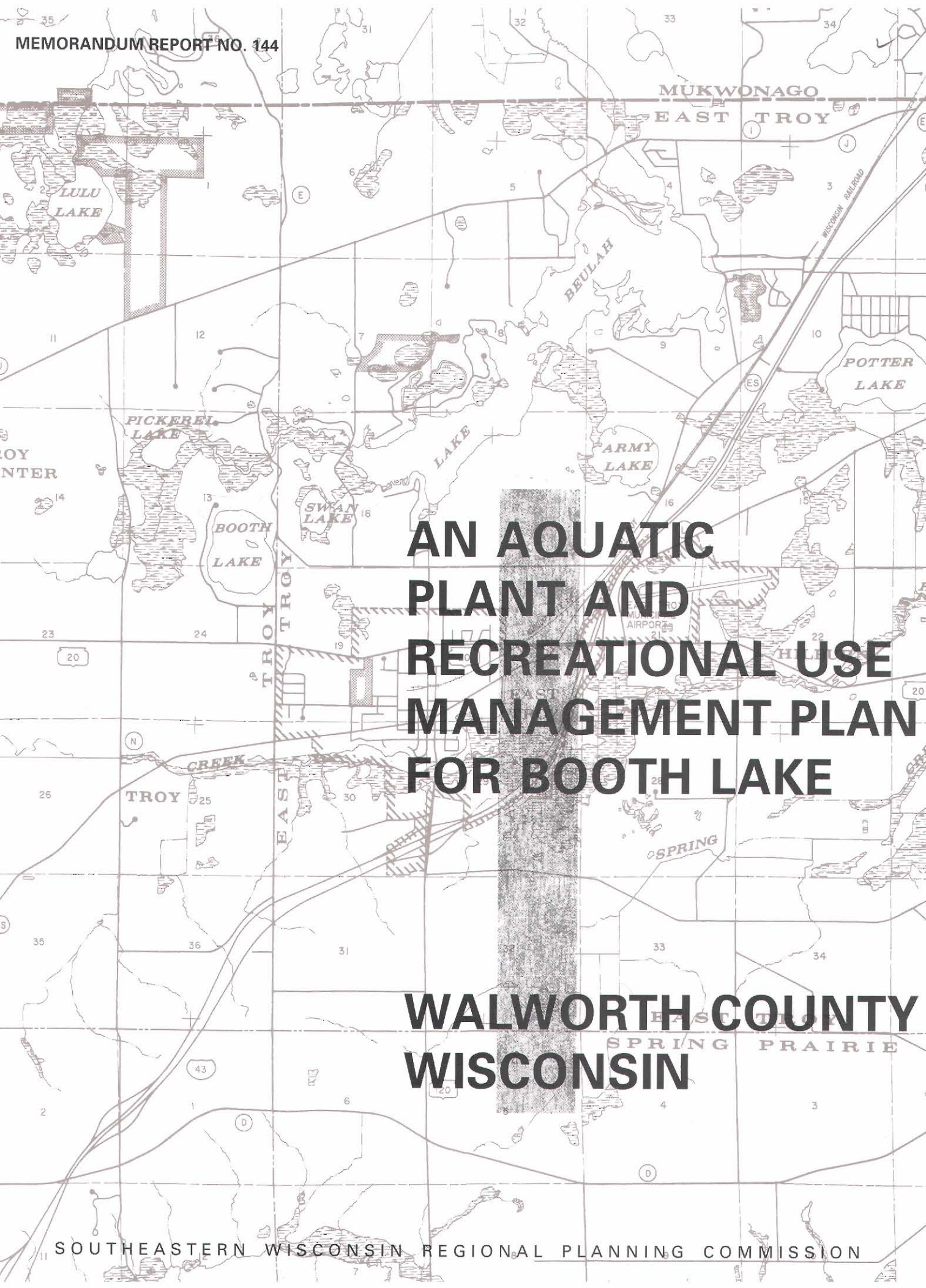
MEMORANDUM REPORT NO. 144



AN AQUATIC PLANT AND RECREATIONAL USE MANAGEMENT PLAN FOR BOOTH LAKE

WALWORTH COUNTY WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Special acknowledgement is due to Dr. Jeffrey A. Thornton, CLM, PH, SEWRPC Principal Planner, Dr. Thomas M. Slawski, SEWRPC Senior Planner; Ms. Christine M. Hinz, former SEWRPC Planner; Ms. Rachel E. Lang, former SEWRPC Senior Biologist; and Mr. Edward J. Schmidt, SEWRPC Research Analyst, for their contributions to the conduct of this study and the preparation of this report.

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AN AQUATIC PLANT AND RECREATIONAL USE MANAGEMENT PLAN FOR BOOTH LAKE WALWORTH COUNTY, WISCONSIN

Prepared by the

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The preparation of this publication was financed in part through a grant from the Wisconsin Department of Natural Resources Lake Management Planning Grant Program.

September 2003

Inside Region $ 5.00
Outside Region $ 10.00

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Chapter I

INTRODUCTION

Booth Lake, located in the Town of Troy, Walworth County, Wisconsin, is a valuable natural resource offering a unique setting and variety of recreational and related-use opportunities to the small residential community and to visitors using the Lake. The Lake is an integral part of this lake-oriented community. There is the perception that changing conditions could potentially adversely affect the recreational and aesthetic value of the Lake. Seeking to improve the usability and prevent the deterioration of the natural assets and recreation potential of Booth Lake, the riparian residents formed the Booth Lake Management District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district, to undertake a lake-oriented program of community involvement, education, and management. The District participates in the Wisconsin Department of Natural Resources Self-Help Monitoring Program, and has contracted with the U.S. Geological Survey for water quality monitoring services.

This report sets forth an inventory of the aquatic plant communities present within Booth Lake, and represents part of the ongoing commitment of the Booth Lake Management District and Town of Troy, in cooperation with the Village and Town of East Troy, to sound planning with respect to the Lake. The inventory developed for this study was prepared by the Southeastern Wisconsin Regional Planning Commission, with the assistance of the Booth Lake Management District, during 2000 and 2001.

The aquatic plant survey of Booth Lake was conducted by Commission staff with the assistance of the members of the Booth Lake Management District lake monitoring committee using the modified Jesson and Lound[1] transect method employed by the Wisconsin Department of Natural Resources for aquatic plant surveys throughout the State. Fisheries data, gathered by a private consultant to the District, and water quality data, gathered under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program by the Booth Lake Management District and by the U.S. Geological Survey, are also incorporated into this plan as appropriate. This planning program was funded in part by a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Booth Lake Management District under the Chapter NR 190 Lake Management Planning Grant Program.

The scope of this report is limited to consideration of the factors affecting aquatic plant communities present within Booth Lake and the recreational uses of the Lake. However, this plan forms an integral part of any future comprehensive lake management plan for Booth Lake. The preparation of a comprehensive lake management plan for Booth Lake will require additional water quality and biological data collection and analysis.

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[1]*Jesson, R. and R. Lound, Minnesota Department of Conservation Game Investigational Report No. 6,* An Evaluation of a Survey Technique for Submerged Aquatic Plants, *1962.*

The recreational lake use goals and objectives for Booth Lake were developed in consultation with the Booth Lake Management District. The goals and objectives are:

1. To protect and maintain public health, and to promote public comfort, convenience, necessity, and welfare, through the environmentally sound management of the vegetation, fishery, and wildlife populations in and around Booth Lake;

2. To provide for high-quality, water-oriented recreational and aesthetic opportunities for residents and visitors to Booth Lake, and manage the aquatic plant communities in the Lake in an environmentally sound manner; and,

3. To effectively manage the water quality of Booth Lake to maintain an healthy aquatic plant community and, thereby, better facilitate the conduct of water-related recreation, improve the aesthetic value of the resource to the community, and enhance the resource value of the waterbody.

This inventory, which conforms to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes*,[2] should serve as an initial step in achieving these objectives over time.

[2]*This plan has been prepared pursuant to the standards and requirements set forth in three chapters of the* Wisconsin Administrative Code*: Chapter NR 1, "Public Access Policy for Waterways;" Chapter NR 103, "Water Quality Standards for Wetlands;" Chapter NR 107, "Aquatic Plant Management;" and Chapter NR 109, "Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations."*

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Booth Lake is located in U.S. Public Land Survey Sections 13 and 24 of Township 4 North, Range 17 East, Town of Troy, Walworth County, Wisconsin, as shown on Map 1. Booth Lake is a small seepage lake, occupying a depression in pitted outwash glacial deposits. There is neither an inlet nor an outlet to the Lake. Steep slopes largely surround this nearly circular waterbody. Lower level lands and a small wetland exist along a portion of the eastern side of the waterbody in the vicinity of the Memorial Park parking lot. The waterbody provides opportunities for all forms of water-based recreational activities, including swimming, boating, and fishing during the summer months, and ice-skating, cross-country skiing, and ice fishing during the winter months. The Lake is a year-round visual amenity. Walking and jogging, bird watching, and picnicking are popular passive recreational uses of the waterbody. Public access is provided only for Village of East Troy, Town of East Troy, and Town of Troy residents and property owners, and residents and property owners within the East Troy school district in the Towns of LaFayette, LaGrange, and Spring Prairie, through the public Memorial Park, providing a beach and recreational boating access site, located along the southeastern shore of the Lake, pursuant to policies currently in force and administered by the park commission. No provisions are in place for nonresident use of the Memorial Park facilities, other than as guests of the aforementioned property owners and residents.

WATERBODY CHARACTERISTICS

Booth Lake is a 113-acre waterbody, the hydrographical characteristics of which are set forth in Table 1. The Lake is a seepage lake, and, as such, the Lake's water level is dependent upon the regional groundwater table and annual precipitation. Booth Lake is characterized by shallow shoreline areas surrounding a single, deep basin, having little surface inflow, and no defined surface outflow. The Lake is roughly circular in aspect, with an approximately one-acre island in the northeastern portion of the Lake. The waterbody has a maximum depth of approximately 24 feet, a mean depth of 12 feet, and a volume of about 1,380 acre-feet. The bathymetry of the Lake is shown on Map 2.

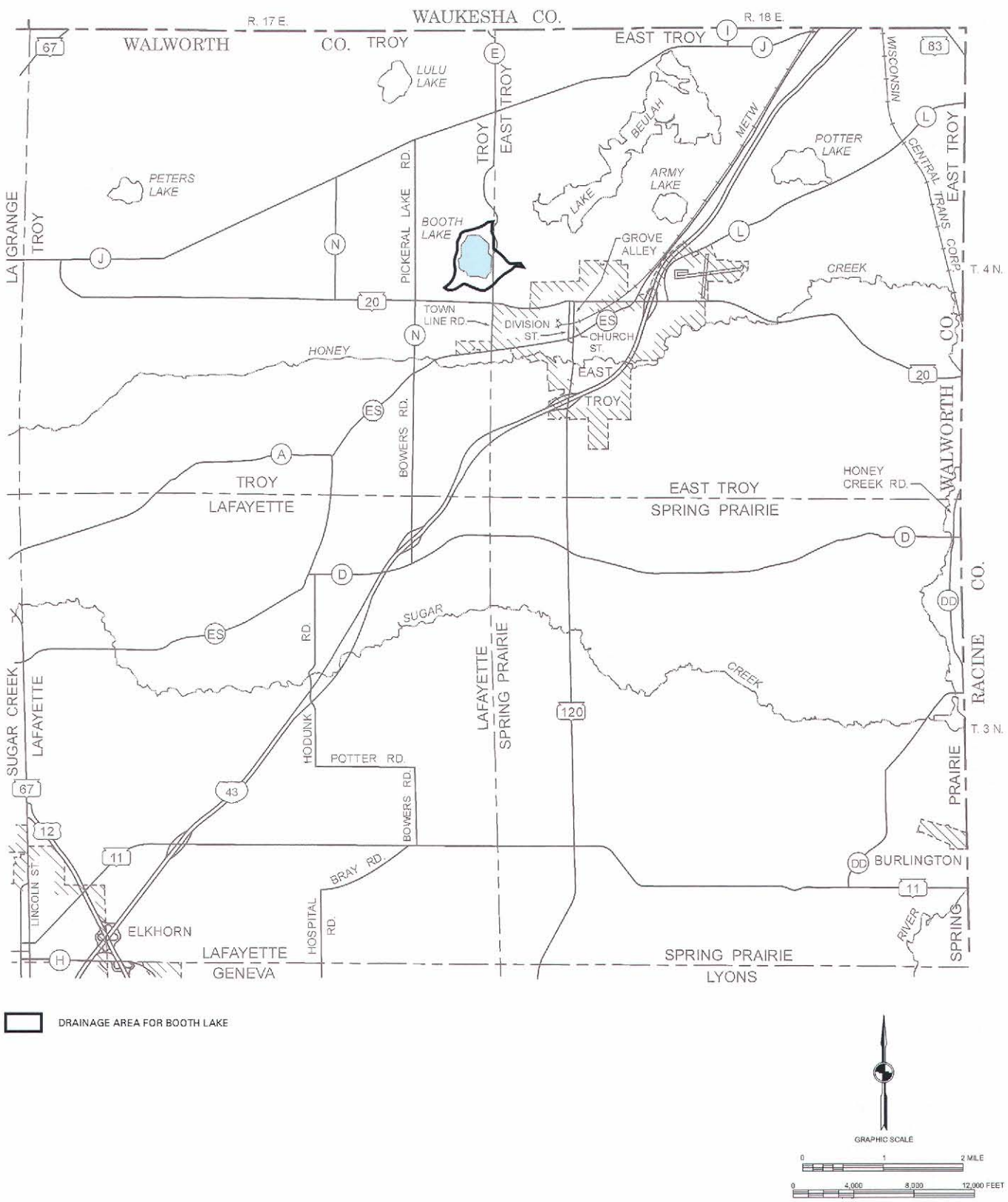
TRIBUTARY DRAINAGE AREA AND LAND USE CHARACTERISTICS

Land Use

The drainage area tributary to Booth Lake is situated predominantly within the Town of Troy, Walworth County, with a small portion of the drainage area extending into the Town of East Troy. The drainage area tributary to Booth Lake is about 274 acres in areal extent. As shown on Map 3, the western shorelands of the Lake were developed for urban residential land uses prior to 1950, with most of the development occurring prior to 1920. Additional development at urban residential densities occurred through the mid-1960s. Additional development at urban residential densities has occurred during the 1990s to the east and southwest of the Lake.

Map 1

LOCATION MAP OF BOOTH LAKE



Source: SEWRPC.

The surrounding land uses within the drainage basin tributary to Booth Lake are primarily urban and open space land uses, being comprised of single-family residential, wetland and woodland, and recreational land uses. Residential and recreational lands are primarily centered on the Lake. Recreational land uses include the Memorial Park on the southeastern shores of the Lake, and a Girl Scouts of America facility located on the northern shoreline of the Lake. Existing land uses as of 1995 are shown on Map 4 and are summarized in Table 2. Changes in land use within the drainage area tributary to the Lake are likely to be minimal,[1] although limited further residential development of platted lots within the drainage area and, possibly, redevelopment of existing properties may be expected to occur. Residential lands currently encompass approximately 75 percent of the shoreline of Booth Lake, with the balance being comprised of recreational lands, as shown on Map 3.

Table 1

HYDROGRAPHIC CHARACTERISTICS OF BOOTH LAKE

Parameter	Measurement
Surface Area	113 acres
Volume	1,356 acre-feet
Shoreline Length	1.79 miles
Shoreline Development Factor[a]	1.08
Maximum Depth	24 feet
Mean Depth	12 feet
Tributary Drainage Area	274 acres

[a]Shoreline Development Factor is the ratio between the actual circumference of the lake and the circumference of a circle with the same radius. A circular lake would have a Shoreline Development Factor of 1.0, while a dendritic lake would have a Shoreline Development Factor in excess of 1.0.

Source: SEWRPC.

WATER QUALITY

Water quality data on Booth Lake were collected during the period from 1992 through 1994 by the U.S. Geological Survey. These data were used to determine water quality condition in Booth Lake. The data are summarized in Table 3, and selected data are shown graphically in Figures 1 and 2. The sampling location used for data collection is shown on Map 2. Additional data collection on Booth Lake by the U.S. Geological Survey was initiated during October 2000 and will continue through September 2003. These data are reported annually by the U.S. Geological Survey.[2] Data for the 2001 hydrological year also are summarized in Table 3 and Figures 1 and 2.

Based upon the data reported during the period from 1992 through 1994, and 2001, by the U.S. Geological Survey,[3] Booth Lake has good water quality. Based upon total phosphorus and chlorophyll-*a* concentrations, the Lake has Wisconsin Trophic State Index (WTSI) values of 45 and 44, respectively, indicating that the Lake is a mesotrophic waterbody.[4] This trophic classification is supported by the data shown in Table 3 and is shown graphically in Figure 3. Mesotrophic lakes are moderately fertile lakes that support abundant aquatic plant

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[1]*SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997.*

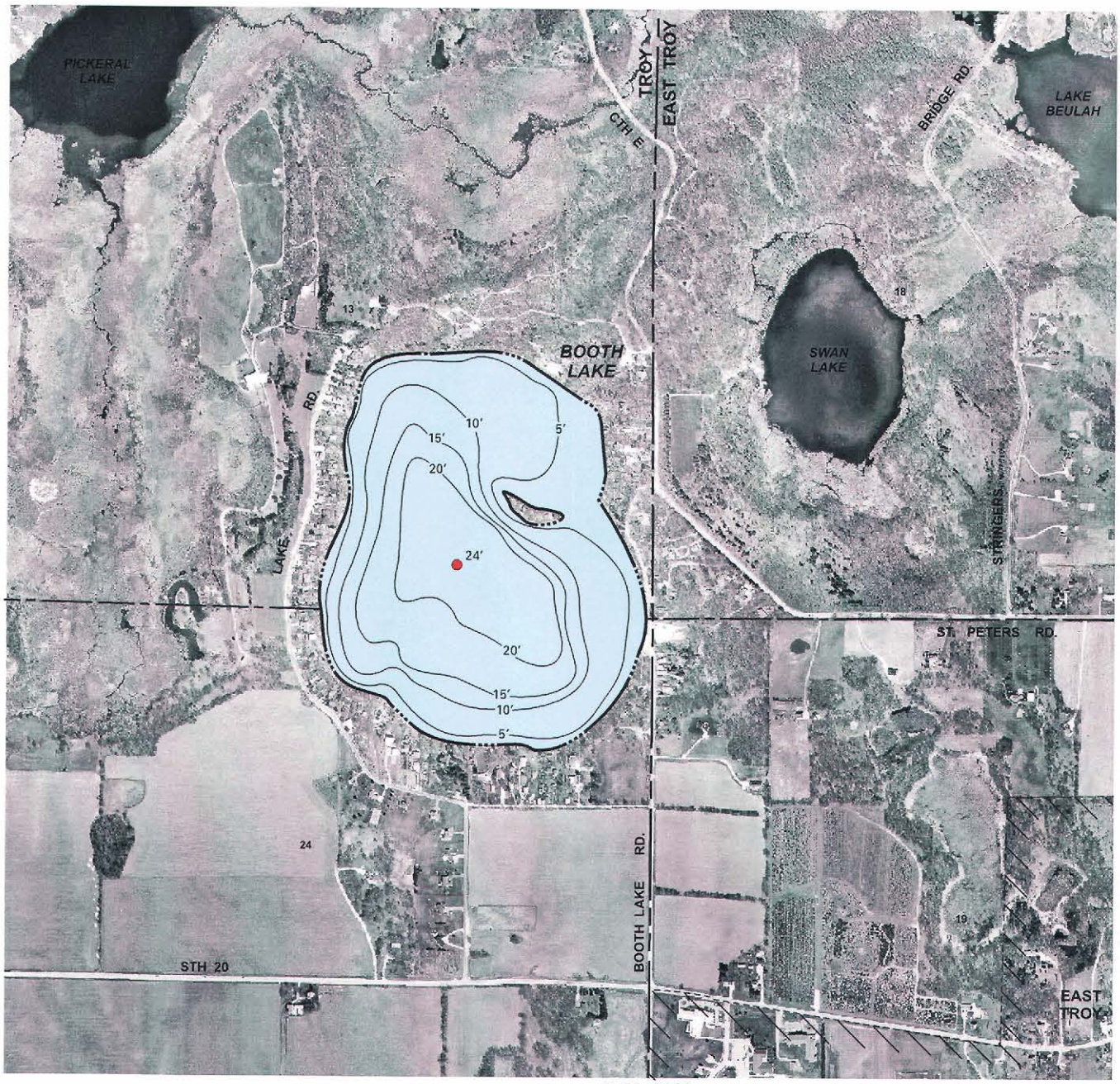
[2]*See U.S. Geological Survey Open File Report No. 95-190,* Water Quality and Lake Stage Data for Wisconsin Lakes: Water Year 1994, *1995, and following years.*

[3]*U.S. Geological Survey Water Data Report No. WI-92-1,* Water Resources Data Wisconsin: Water Year 1992, *1993; U.S. Geological Survey Water Data Report No. WI-92-2,* Water Resources Data Wisconsin: Water Year 1993, *1994; U.S. Geological Survey Open File Report No. 95-190,* Water Quality and Lake Stage Data for Wisconsin Lakes: Water Year 1994, *1995.*

[4]*R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes,"* Research and Management Findings, *Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.*

Map 2

BATHYMETRIC MAP OF BOOTH LAKE



Source: SEWRPC.

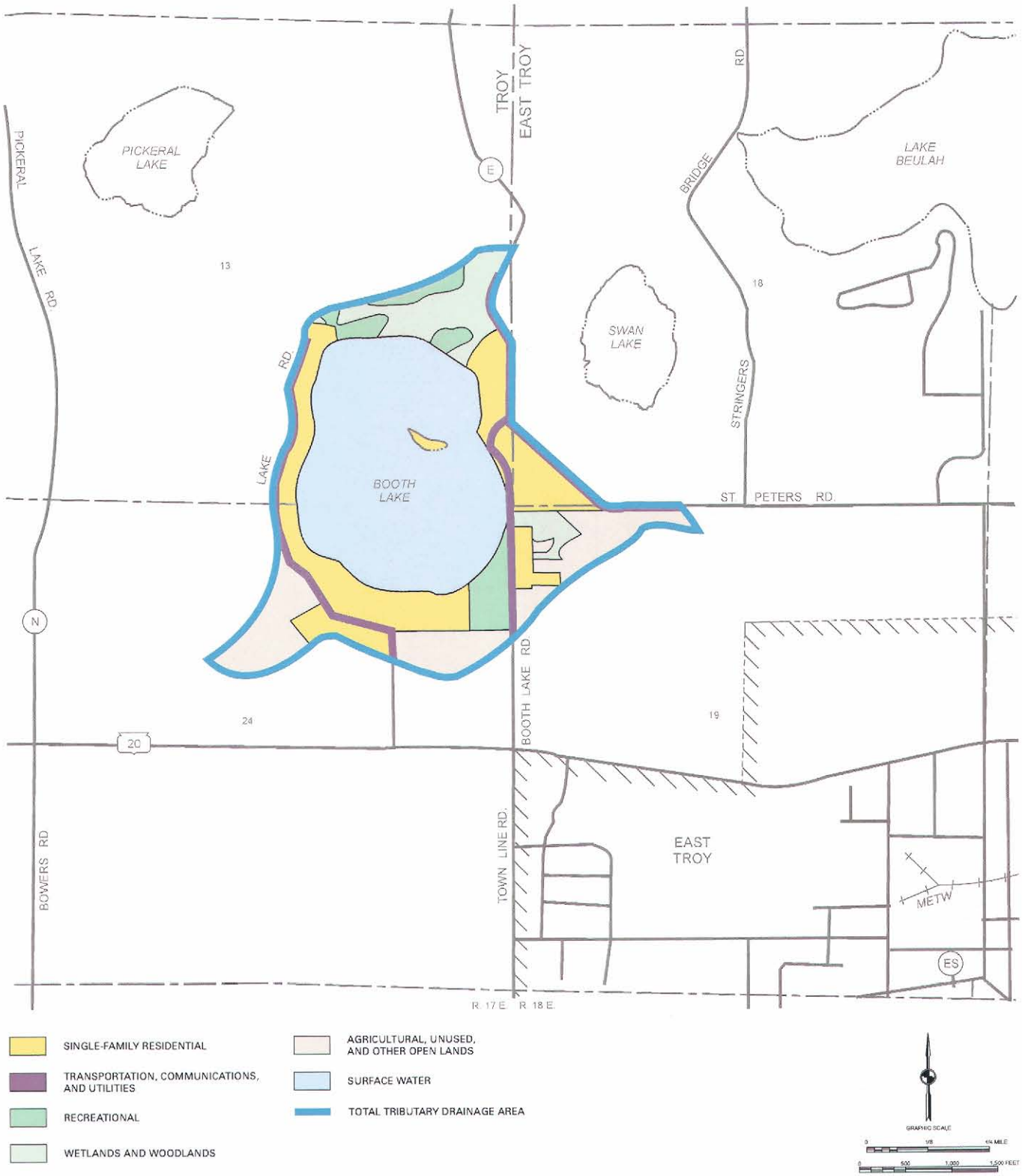
Map 3

HISTORIC URBAN GROWTH WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 1950-1995

Source: SEWRPC.

Map 4

GENERALIZED LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 1995



Source: SEWRPC.

growths and may support productive fisheries. Nuisance growths of algae and plants are usually not exhibited by mesotrophic lakes. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.[5]

The average surface water total phosphorus value for the years 1992 through 1994 and 2001, ranged from seven to 11 micrograms per liter (μg/l), while chlorophyll-*a* concentrations averaged four μg/l for all four years, as shown in Table 3. Surface water total phosphorus concentrations did not exceed 12 μg/l during the four-year sampling period. These concentrations, therefore, were well within the standard of 20 μg/l reported by the Regional Planning Commission as the value below which few water quality problems are likely to occur. Neither the total phosphorus nor chlorophyll-*a* concentrations were indicative of water quality problems.

Table 2

EXISTING LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE

Land Use Categories	1995	
	Acres	Percent of Drainage Area
Urban		
Residential	59.0	21.5
Transportation and Utilities	10.7	3.9
Recreational	16.8	6.1
Unused Urban Lands	0.8	0.3
Subtotal	87.3	31.8
Rural		
Agricultural	37.6	13.7
Wetlands	1.8	0.7
Woodlands	22.7	8.3
Water	119.1	43.4
Other Open Land	5.7	2.1
Subtotal	186.9	68.2
Total	274.2	100.0

Source: SEWRPC.

Despite the high quality of Booth Lake, the Lake waters were subject to some seasonal changes. Figure 4 shows the annual periodicity in surface and deep water temperature and oxygen levels during the period from 1992 through 1994. These data indicate that Booth Lake stratifies annually with respect to the dissolved oxygen concentrations, but has limited thermal stratification. The stratification appears to reflect a chemocline, or area within the Lake where chemical changes occur. Reference to Figure 2 supports this finding insofar as there are observed changes in the conductivity and pH of the Lake below about 15 feet in depth. For example, during August 1992, the lake water temperature ranged from 77°F at the surface to about 70°F at the bottom. However, the dissolved oxygen concentration decreased from about 10 mg/l at the surface to near zero mg/l at the lake bottom, with a significant loss of oxygen from the water column beginning at about 12 feet in depth coincident with an increase in conductivity from about 284 μS/cm to 329 μS/cm and a decrease in pH from about 8.3 units to 7.4 units. Such chemical stratification is unusual in temperate lakes, but may reflect the fact that Booth Lake is a seepage or groundwater-fed waterbody. The importance of this observation lies in the fact that, in the event of a rapid turnover event wherein the anaerobic bottom water of the Lake could be mixed into the surface waters on the order of hours rather than days, the resultant decrease in dissolved oxygen concentrations could induce a fish kill. In addition, added oxygen demand during the winter months as a result of the decomposition under the ice of scenescent aquatic plants could induce a winter kill of fish and other aquatic life. For this reason, changes in the abundance of aquatic plants within the Lake is an issue of concern, as increased plant growth could increase oxygen demand and enhance the anaerobic zone within the Lake. Notwithstanding, however, similar in-lake water quality conditions have been reported since the mid-1960s without any apparent deleterious impact on the ecology of the Lake.[6]

[5]*See R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes, *Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983; also see SEWRPC Memorandum Report No. 93,* A Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995.*

[6]*Wisconsin Department of Natural Resources Lake Use Report No. FX-31,* Booth Lake, Walworth County, Wisconsin, *1969.*

Table 3

BOOTH LAKE WATER QUALITY DATA: 1992-1994

Parameter[a]	02/04/92		04/07/92		06/01/92		07/14/92		08/11/92	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	21.0	1.5	22.0	1.5	21.0	1.5	20.0	1.5	20.0
Specific Conductance (µS/cm)	323	343	307	309	317	326	319	347	284	329
pH (standard units)	7.9	8.0	8.3	8.3	8.5	7.8	8.1	7.4	8.3	7.4
Water Temperature(ºF)	39.2	40.1	45.5	45.5	68.9	61.7	73.4	71.6	77.0	69.8
Turbidity (NTU)	--	--	0.50	<0.50	--	--	--	--	--	--
Secchi Depth (feet)	--	--	17.1	--	8.9	--	5.9	--	3.6	--
Dissolved Oxygen	13.6	7.5	11.7	11.5	10.0	4.8	8.9	0.5	10.3	0.3
Hardness, as $CaCO_3$	--	--	160.0	160.0	--	--	--	--	--	--
Calcium, Dissolved	--	--	30.0	30.0	--	--	--	--	--	--
Magnesium, Dissolved	--	--	20.0	20.0	--	--	--	--	--	--
Sodium, Dissolved	--	--	6.0	6.0	--	--	--	--	--	--
Potassium, Dissolved	--	--	1.0	1.0	--	--	--	--	--	--
Alkalinity, as $CaCO_3$	--	--	130.0	130.0	--	--	--	--	--	--
Sulfate, Dissolved SO_4	--	--	18.0	18.0	--	--	--	--	--	--
Chloride, Dissolved	--	--	12.0	12.0	--	--	--	--	--	--
Fluoride, Dissolved	--	--	0.1	0.1	--	--	--	--	--	--
Silica, Dissolved	--	--	<0.2	<0.2	--	--	--	--	--	--
Solids, Dissolved at 180ºC	--	--	184.0	184.0	--	--	--	--	--	--
Nitrogen, NO_2+NO_3, Dissolved	--	--	0.11	0.12	--	--	--	--	--	--
Nitrogen, Ammonia Dissolved	--	--	0.24	0.25	--	--	--	--	--	--
Nitrogen, Ammonia + Organic, Total	--	--	0.80	0.80	--	--	--	--	--	--
Total Phosphorus	--	--	0.005	0.004	0.010	0.033	0.011	0.020	0.010	<0.020
Ortho-Phosphorus, Dissolved	--	--	0.002	0.002	--	--	--	--	--	--
Iron, Dissolved (µg/l)	--	--	<50	<50	--	--	--	--	--	--
Manganese, Dissolved (µg/l)	--	--	<40	<40	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	--	--	1.0	--	3.0	--	6.2	--	4.4	--

Parameter[a]	02/03/93		04/21/93		06/22/93		07/21/93		08/10/93	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	23.0	1.5	24.0	1.5	22.0	1.5	22.0	1.5	22.0
Specific Conductance (µS/cm)	336	357	310	313	328	337	322	366	228	333
pH (standard units)	8.0	7.8	8.4	8.3	8.3	7.6	8.3	7.4	8.3	8.0
Water Temperature(ºF)	40.1	41.0	44.6	44.6	74.3	64.4	77.9	68.9	75.2	73.4
Turbidity (NTU)	--	--	0.70	0.70	--	--	--	--	--	--
Secchi Depth (feet)	--	--	16.4	--	9.8	--	6.6	--	9.5	--
Dissolved Oxygen	12.1	7.3	10.9	10.5	9.3	3.5	8.7	0.0	8.7	6.2
Hardness, as $CaCO_3$	--	--	150.0	150.0	--	--	--	--	--	--
Calcium, Dissolved	--	--	32.0	32.0	--	--	--	--	--	--
Magnesium, Dissolved	--	--	18.0	18.0	--	--	--	--	--	--
Sodium, Dissolved	--	--	5.6	5.7	--	--	--	--	--	--
Potassium, Dissolved	--	--	1.0	1.0	--	--	--	--	--	--
Alkalinity, as $CaCO_3$	--	--	130.0	130.0	--	--	--	--	--	--
Sulfate, Dissolved SO_4	--	--	18.0	18.0	--	--	--	--	--	--
Chloride, Dissolved	--	--	11.0	11.0	--	--	--	--	--	--
Fluoride, Dissolved	--	--	0.1	0.1	--	--	--	--	--	--
Silica, Dissolved	--	--	0.5	0.4	--	--	--	--	--	--
Solids, Dissolved at 180ºC	--	--	184.0	182.0	--	--	--	--	--	--
Nitrogen, NO_2+NO_3, Dissolved	--	--	0.13	0.19	--	--	--	--	--	--
Nitrogen, Ammonia Dissolved	--	--	0.27	0.26	--	--	--	--	--	--
Nitrogen, Ammonia + Organic, Total	--	--	0.80	0.70	--	--	--	--	--	--
Total Phosphorus	--	--	0.008	0.007	0.006	0.009	0.009	<0.020	0.006	<0.020
Ortho-Phosphorus, Dissolved	--	--	0.002	0.002	--	--	--	--	--	--
Iron, Dissolved (µg/l)	--	--	<50	<50	--	--	--	--	--	--
Manganese, Dissolved (µg/l)	--	--	<40	<40	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	--	--	3.6	--	3.4	--	4.4	--	4.2	--

Table 3 (continued)

Parameter[a]	03/01/94		04/12/94		06/15/94		07/18/94		08/10/94	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	3.0	24.0	1.5	23.0	1.5	22.0	1.5	21.0	1.5	21.0
Specific Conductance (µS/cm)	345	373	328	330	337	370	334	393	333	331
pH (standard units)	8.3	7.6	8.2	8.2	8.1	7.4	8.1	7.2	8.3	8.2
Water Temperature(ºF)	37.4	40.1	48.2	47.3	76.1	64.4	79.7	71.6	73.4	73.4
Turbidity (NTU)	--	--	0.70	1.00	--	--	--	--	--	--
Secchi Depth (feet)	--	--	9.2	--	7.9	--	10.8	--	8.5	--
Dissolved Oxygen	13.3	4.9	12.4	12.1	8.0	0.3	8.6	0.4	8.5	8.4
Hardness, as $CaCO_3$	--	--	160.0	160.0	--	--	--	--	--	--
Calcium, Dissolved	--	--	34.0	34.0	--	--	--	--	--	--
Magnesium, Dissolved	--	--	18.0	18.0	--	--	--	--	--	--
Sodium, Dissolved	--	--	6.3	6.3	--	--	--	--	--	--
Potassium, Dissolved	--	--	1.0	1.0	--	--	--	--	--	--
Alkalinity, as $CaCO_3$	--	--	140.0	140.0	--	--	--	--	--	--
Sulfate, Dissolved SO_4	--	--	16.0	16.0	--	--	--	--	--	--
Chloride, Dissolved	--	--	13.0	13.0	--	--	--	--	--	--
Fluoride, Dissolved	--	--	0.1	0.1	--	--	--	--	--	--
Silica, Dissolved	--	--	<0.2	<0.2	--	--	--	--	--	--
Solids, Dissolved at 180ºC	--	--	190.0	190.0	--	--	--	--	--	--
Nitrogen, NO_2+NO_3, Dissolved	--	--	0.07	0.13	--	--	--	--	--	--
Nitrogen, Ammonia Dissolved	--	--	0.12	0.12	--	--	--	--	--	--
Nitrogen, Ammonia + Organic, Total	--	--	0.70	0.60	--	--	--	--	--	--
Total Phosphorus	--	--	0.006	0.007	0.011	<0.020	0.010	0.021	0.012	0.027
Ortho-Phosphorus, Dissolved	--	--	0.002	0.002	--	--	--	--	--	--
Iron, Dissolved (µg/l)	--	--	<50	<50	--	--	--	--	--	--
Manganese, Dissolved (µg/l)	--	--	<40	<40	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	--	--	4.8	--	2.9	--	2.9	--	6.6	--

Parameter[a]	02/12/01		04/17/01		06/13/01		07/16/01		08/14/01	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	21.5	1.5	21.5	1.5	21.5	1.5	21.5	1.5	21.0
Specific Conductance (µS/cm)	322	339	319	320	301	312	310	353	331	391
pH (standard units)	7.7	7.7	8.0	8.0	8.2	8.1	8.1	7.3	8.1	7.1
Water Temperature(ºF)	37.6	39.4	49.8	49.8	73.4	61.2	79.7	71.6	68.0	44.0
Turbidity (NTU)	--	--	4.7	--	--	--	--	--	--	--
Secchi Depth (feet)	--	--	11.8	--	9.2	--	10.2	--	6.9	--
Dissolved Oxygen	10.0	8.6	12.0	11.2	10.1	8.5	9.2	0.3	8.2	0.3
Hardness, as $CaCO_3$	--	--	142.0	--	--	--	--	--	--	--
Calcium, Dissolved	--	--	29.0	--	--	--	--	--	--	--
Magnesium, Dissolved	--	--	17.0	--	--	--	--	--	--	--
Sodium, Dissolved	--	--	6.7	--	--	--	--	--	--	--
Potassium, Dissolved	--	--	1.0	--	--	--	--	--	--	--
Alkalinity, as $CaCO_3$	--	--	126.0	--	--	--	--	--	--	--
Sulfate, Dissolved SO_4	--	--	13.3	--	--	--	--	--	--	--
Chloride, Dissolved	--	--	12.9	--	--	--	--	--	--	--
Fluoride, Dissolved	--	--	0.1	--	--	--	--	--	--	--
Silica, Dissolved	--	--	<0.2	--	--	--	--	--	--	--
Solids, Dissolved at 180ºC	--	--	172.0	--	--	--	--	--	--	--
Nitrogen, NO_2+NO_3, Dissolved	--	--	0.092	--	--	--	--	--	0.019	--
Nitrogen, Ammonia Dissolved	--	--	0.141	--	--	--	--	--	0.045	--
Nitrogen, Ammonia + Organic, Total	--	--	0.57	--	--	--	--	--	--	--
Total Phosphorus	< 0.005	< 0.005	0.009	--	0.011	0.014	0.011	0.023	0.009	0.024
Ortho-Phosphorus, Dissolved	--	--	< 0.002	--	--	--	--	--	0.004	--
Iron, Dissolved (µg/l)	--	--	< 10	--	--	--	--	--	--	--
Manganese, Dissolved (µg/l)	--	--	< 0.4	--	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	--	--	2.2	--	4.0	--	3.1	--	2.8	--

[a] *Unless otherwise indicated, units are mg/l.*

Source: U.S. Geological Survey and SEWRPC.

Figure 1

TEMPERATURE AND DISSOLVED OXYGEN PROFILES FOR BOOTH LAKE: 1992-2001

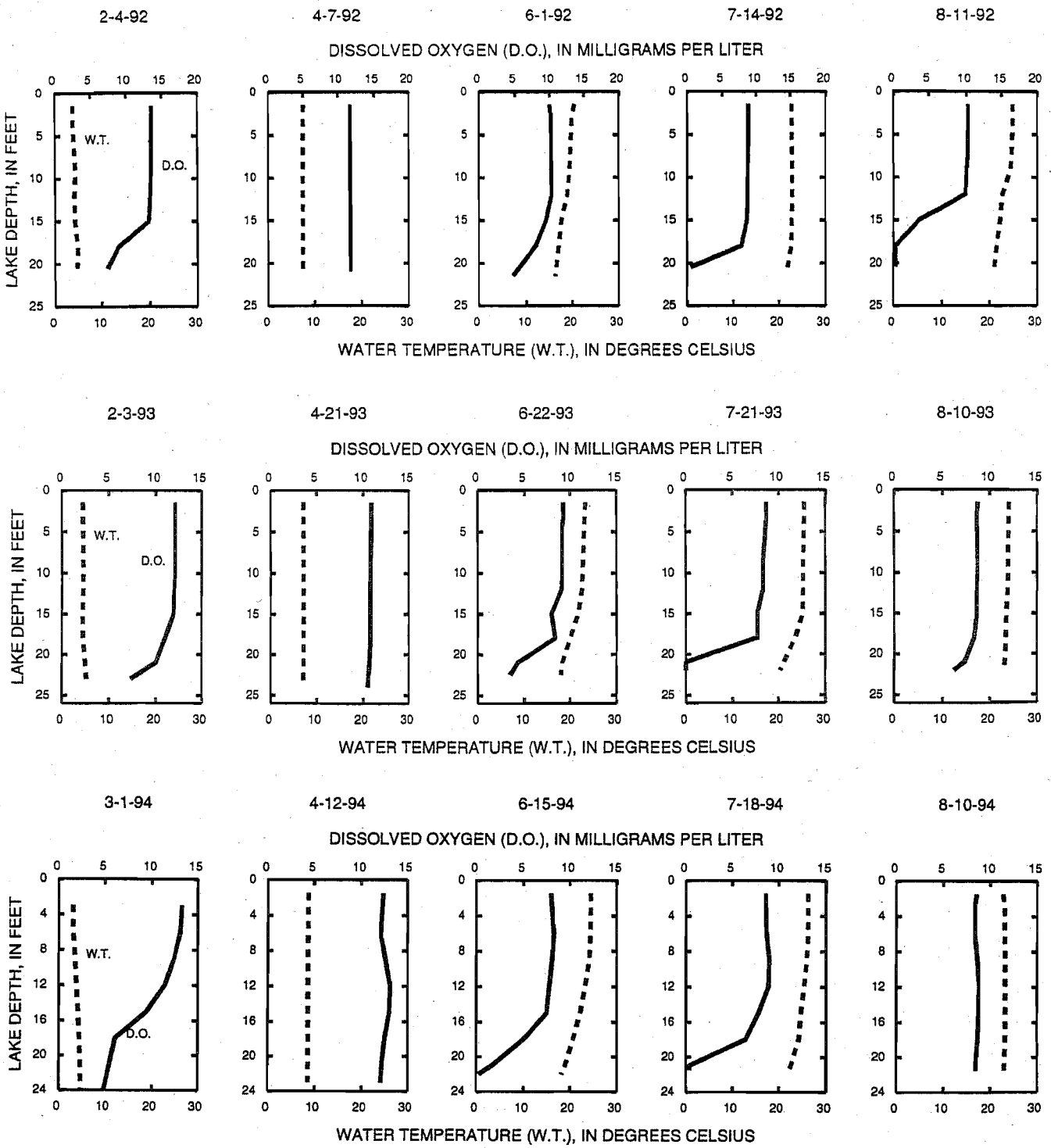
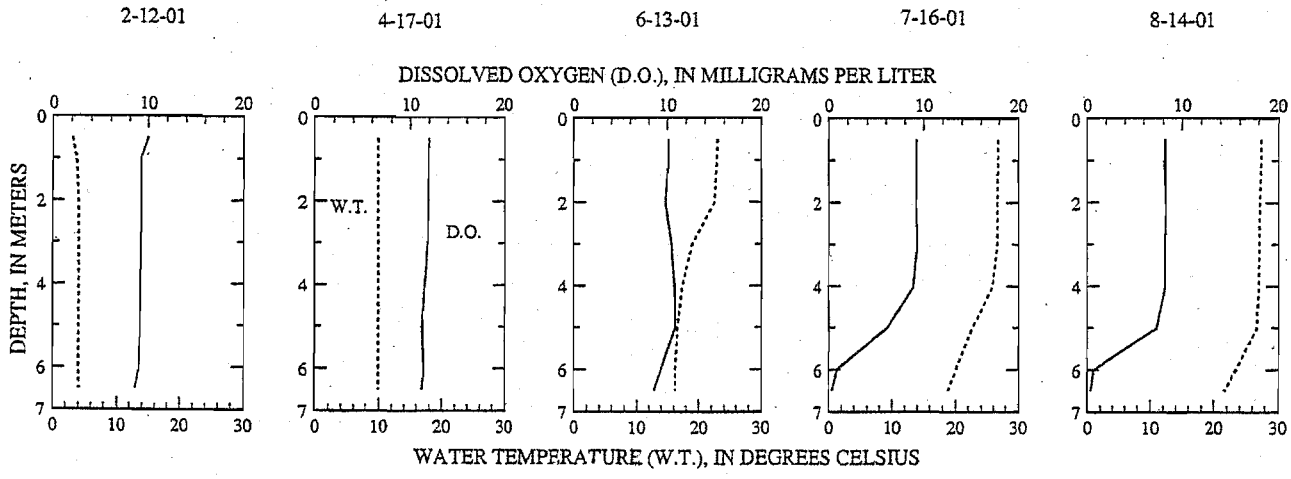


Figure 1 (continued)



Source: U.S. Geological Survey and SEWRPC.

The Wisconsin Trophic State Index (WTSI) values for Booth Lake, calculated based upon water clarity, also demonstrated seasonal fluctuations. However, the seasonality exhibited by the WTSI values is consistent with the typical, cyclical, seasonal growth and senescence of the phytoplankton or algae. The seasonal patterns observed during the years 1992 through 1994 exhibited a similar seasonality, although the data for 1994 showed a less pronounced shift from spring to late-summer than was observed during the previous years, as shown in Figure 3 based upon the data set forth in Table 3. Generally, the Lake waters were clear in the early spring (April), with Secchi-disc transparency values of greater than 10 feet being recorded during each of the three years. As the Lake waters warmed, water clarity decreased in response to increasing levels of chlorophyll-*a*, the green plant pigment. Chlorophyll-*a* concentrations typically increased throughout the summer, peaking at about six µg/l during most years. Concurrently, the resulting water clarity decreased to less than 10 feet. Notwithstanding, water quality in the Lake remains good throughout the year, as shown in Figure 5. This conclusion is generally supported in that few water quality concerns have been reported by electors of the Lake Management District.

POLLUTANT LOADINGS

Pollutant loads to a lake are generated by various natural processes and human activities that take place in the drainage area tributary to a lake. These loads are transported to the lake through the atmosphere or across the land surface. Pollutants transported by the atmosphere are deposited onto the surface of the lake as dry fallout and direct precipitation. Pollutants transported across the land surface enter the lake as direct runoff and, indirectly, as groundwater inflows, including drainage from onsite wastewater treatment systems. Pollutants transported across the land surface can also enter a streamcourse and be carried into a lake as surface inflow. However, in seepage lakes like Booth Lake, the absence of an inlet and outlet means that atmospheric deposition, and direct and indirect runoff from the lands surrounding the waterbody, form the primary pathways through which pollutants enter the Lake.

The absence of identifiable point source discharges from industries or wastewater treatment facilities suggests that nonpoint or diffuse sources of pollutants, generated from human activities within the drainage area directly tributary to the Lake, constitute the primary sources of pollutants to the Lake. Therefore, the discussion that

Figure 2

SPECIFIC CONDUCTANCE AND pH PROFILES FOR BOOTH LAKE: 1992-2001

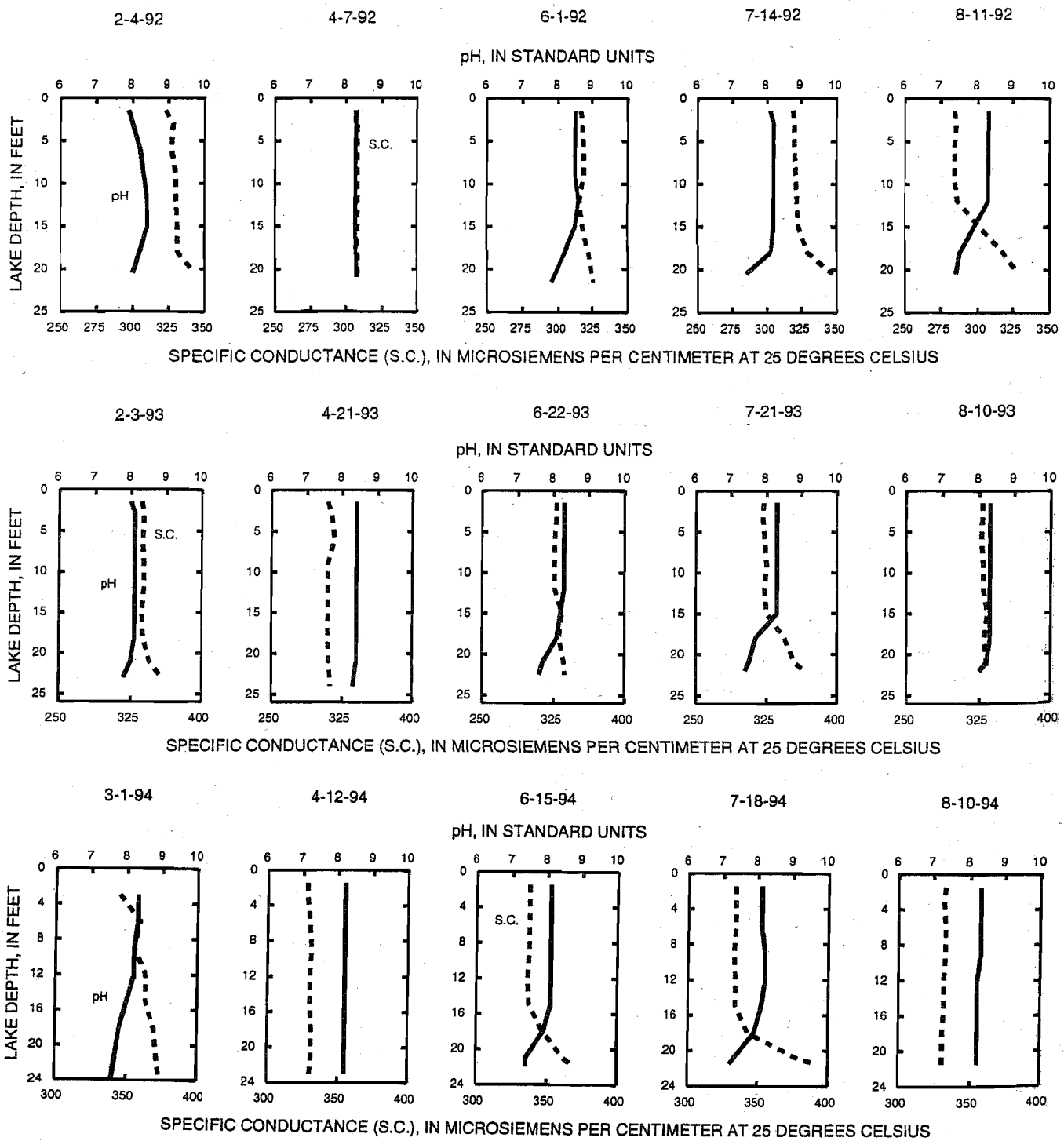
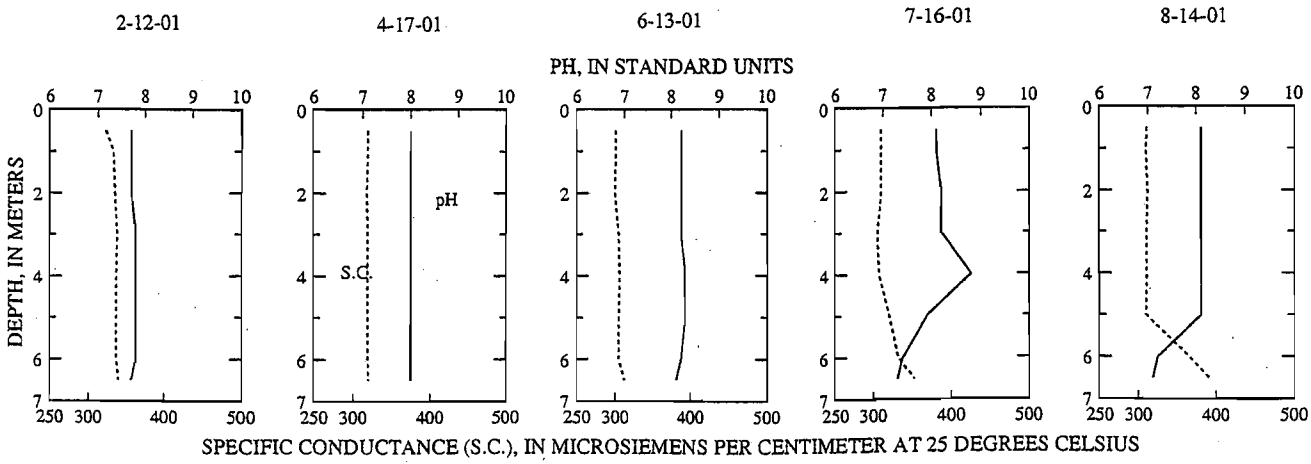


Figure 2 (continued)



Source: U.S. Geological Survey and SEWRPC.

follows is based upon nonpoint source pollutant loadings to Booth Lake. Control of nonpoint-sourced pollutants entering Booth Lake is an issue of concern, given the absence of an outflow or natural means of removing contaminants from the lake basin. Pollutants entering the Lake are likely to remain in the Lake, with potentially negative consequences for lake water quality.

The nonpoint source pollutant loads to Booth Lake were estimated on the basis of land use inventory data and unit area load coefficients determined for southeastern Wisconsin. Total phosphorus loads were estimated using the Wisconsin Lake spreadsheet Model (WILMS),[7] and a unit area load-based algorithm developed for the Southeastern Wisconsin Region. Annual contaminant loads entering Booth Lake were calculated to be approximately 21.4 tons of sediment, 64 pounds of phosphorus, 0.1 pound of cadmium, one pound of copper, and 10 pounds of zinc, as shown in Table 4. Copper and zinc were used in this analysis as surrogates for metals and other pollutants that are contributed primarily from urban sources.

To validate the estimated contaminant loads to Booth Lake, the Commission staff applied the estimated phosphorus load of 64 pounds in the Vollenweider-type OECD phosphorus budget model to estimate an in-lake total phosphorus concentration.[8] This calculation resulted in an estimated annual average total phosphorus concentration of about 12 μg/l, which value is similar to the observed in-lake phosphorus concentration. The forecast chlorophyll-*a* concentration in the Lake was about five μg/l, which is approximately the same as the observed chlorophyll-*a* concentration of about four μg/l.

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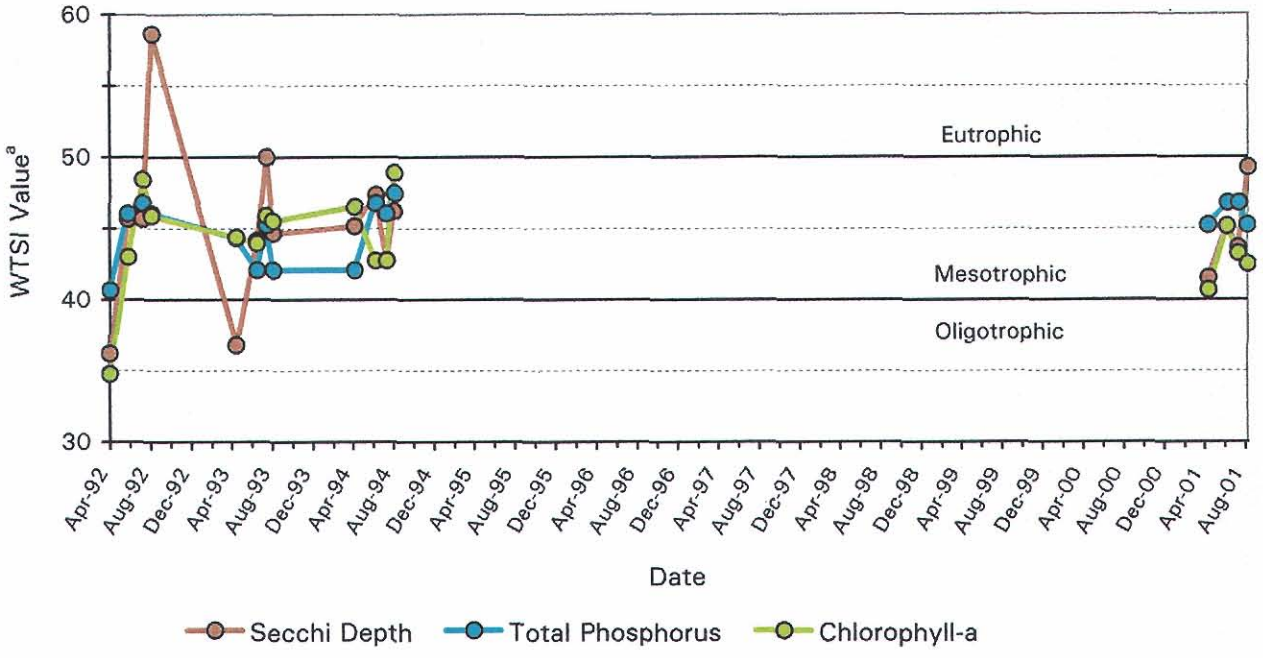
[7]*Wisconsin Department of Natural Resources Report No. PUBL-WR-363 96 REV,* Wisconsin Lake Model Spreadsheet, Version 2.00, User's Manual, *June 1994.*

[8]*S.-O. Ryding and W. Rast,* The Control of Eutrophication in Lakes and Reservoirs, *Unesco Man and the Biosphere Series Vol. 1, Parthenon Press, London, 1989.*

Figure 3

WISCONSIN TROPHIC STATE INDEX FOR BOOTH LAKE: 1992-2001



[a] *R.A. Lillie, S. Graham, and P. Rasmussen, "Trophic State Index Equations and Regional Predictive Equations for Wisconsin Lakes,"* Research and Management Findings, *Wisconsin Department of Natural Resources Publication No. PUBL-RS-735 93, May 1993.*

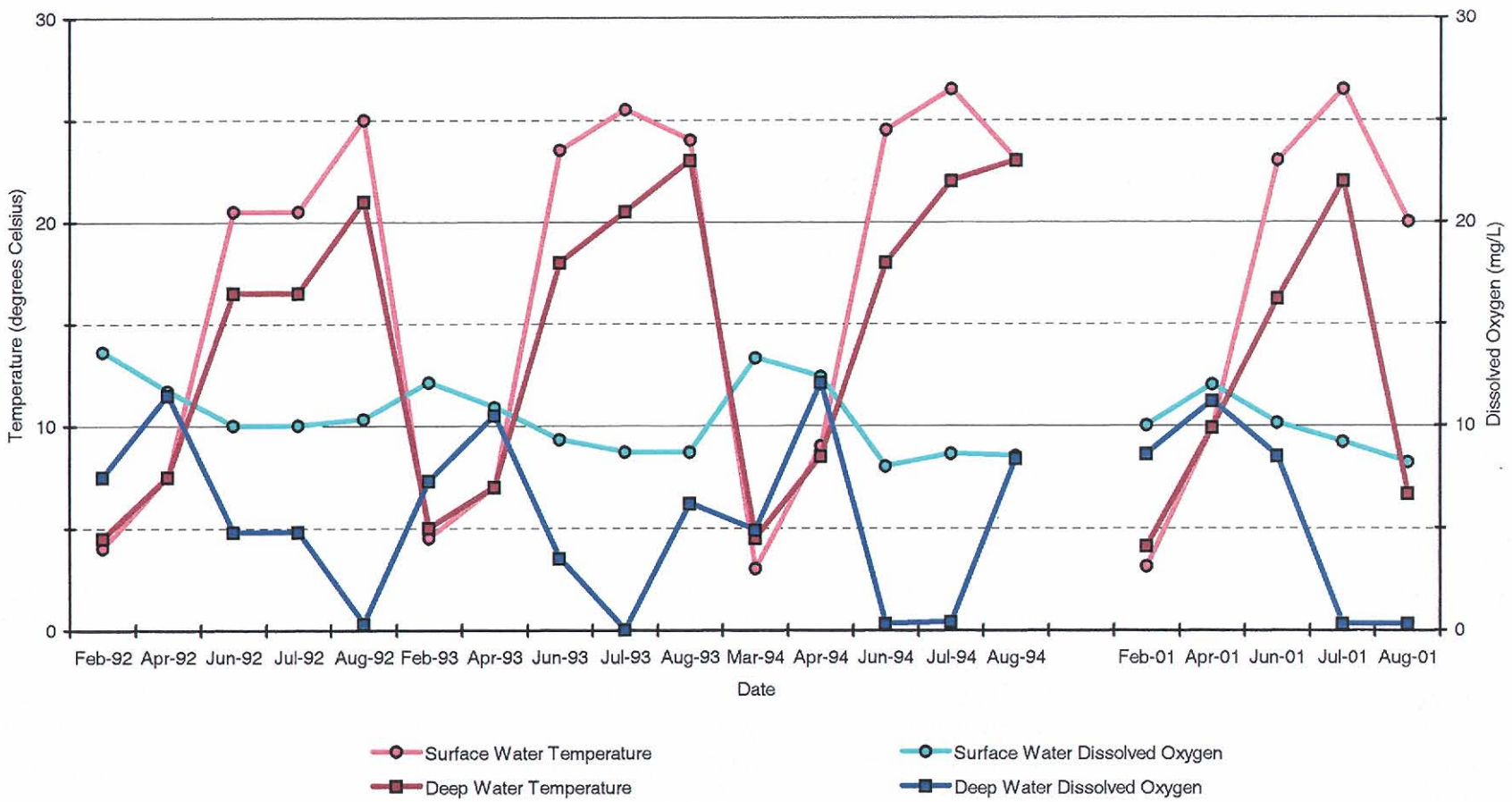
Source: U.S. Geological Survey and SEWRPC.

Table 4 also shows the relative percentage contributions of the various land uses to the pollutant loads to Booth Lake. These data indicate that, based on 1995 land use conditions in the drainage area tributary to Booth Lake, about 30 percent of the annual total phosphorus load to Booth Lake is contributed from agricultural and open lands within the tributary drainage area. Of the remainder, about 50 percent is contributed from residential areas, about 20 percent from other urban sources, and the balance from wetlands, woodlands, and direct deposition onto surface waters. About 40 percent of the sediment load is contributed from agricultural and open lands, about 10 percent from urban sources, and about 50 percent from woodlands, wetlands, and direct deposition onto surface waters. All of the heavy metals delivered to the Lake are estimated to originate in urban areas.

Of the controllable pollutant sources, the most significant sources under existing land use conditions vary with the particular pollutants of concern. Agricultural and other open rural lands are the principal sources of sediment and phosphorus loads to Booth Lake, while urban lands generate the largest percentage of metals loadings. Onsite sewage disposal systems also constitute a potentially significant source of phosphorus from urban areas.

Figure 4

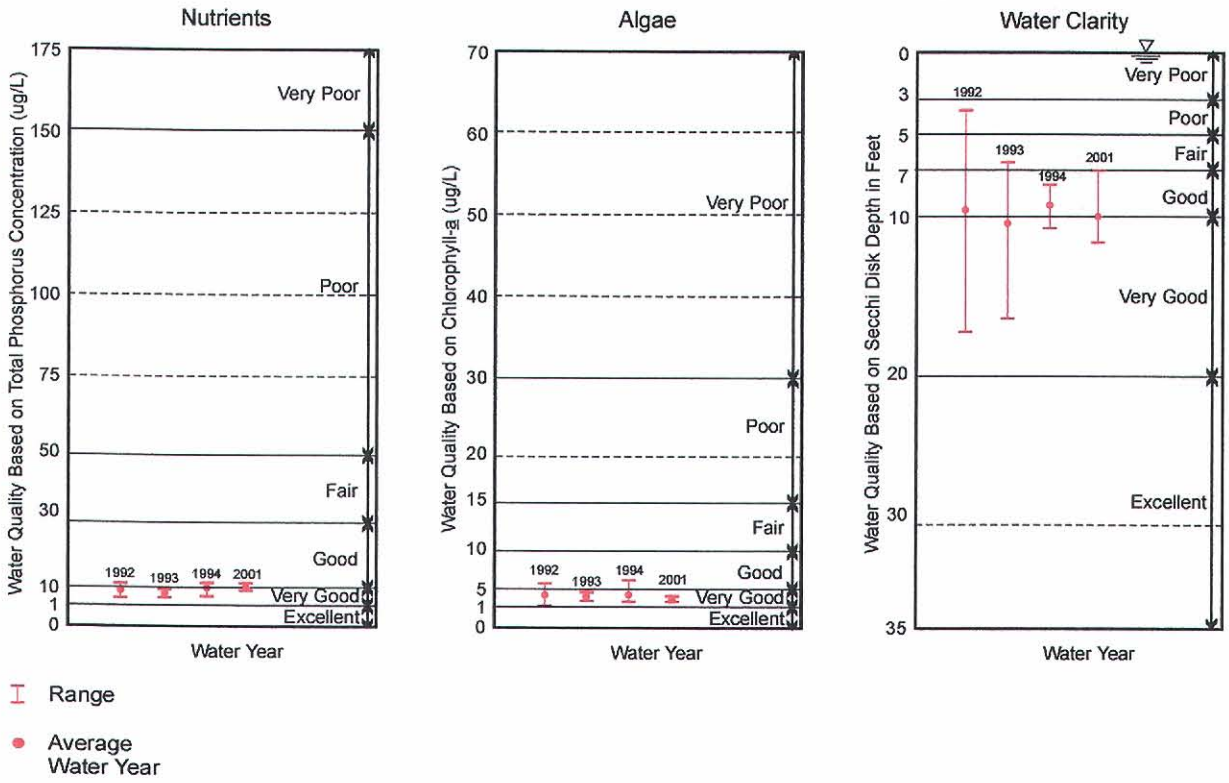
SURFACE AND DEEP WATER TEMPERATURE AND DISSOLVED OXYGEN CONCENTRATIONS AMONG MULTIPLE SEASONS AND YEARS FOR BOOTH LAKE: 1992-2001



Source: U.S. Geological Survey and SEWRPC.

Figure 5

BOOTH LAKE PRIMARY WATER QUALITY INDICATORS: 1992-2001



Source: U.S. Geological Survey and SEWRPC.

GROUNDWATER

Groundwater resources constitute an extremely valuable element of the natural resource base related to Booth Lake, both as a source of water supply and as a component of the surface water system. Groundwater in the vicinity of the Lake moves within two distinct systems: a shallow water table system and deep system. The shallow water table system consists of glacial deposits and the dolomite bedrock nearest the surface. The deep system includes all bedrock, mostly sandstone, above the crystalline Precambrian basement rocks. The shallow sand and gravel aquifer, consisting of water-bearing sand and gravel, extends to well over 200 feet in thickness in the vicinity of Booth Lake, and is the only aquifer which is significant in terms of its relationship with the drainage area hydrology of Booth Lake. The groundwater gradient in the surface aquifer is very flat, indicating limited horizontal movement in the vicinity of the Lake, as shown on Map 5.[9] Groundwater flows from areas to the southwest, west, and northwest toward the Lake. Lake levels are directly related to the surrounding groundwater and there are numerous groundwater discharges, or "springs," within the lake basin. Hence, groundwater can be expected to have a direct affect on lake levels.

As indicated in previous sections of this report, water quality conditions in Booth Lake are currently maintained at a good quality level. Groundwater inflow appears to be an important component of the hydrology contributing to

[9]*SEWRPC Technical Report No. 37,* Groundwater Resources of Southeastern Wisconsin, *June 2002.*

Table 4

ESTIMATED ANNUAL POLLUTANT LOADINGS TO BOOTH LAKE BY LAND USE CATEGORY: 1995

Land Use Category	Pollutant Loads				
	Sediment (tons)	Phosphorus (pounds)	Cadmium (pounds)	Copper (pounds)	Zinc (pounds)
Urban Land					
Residential	0.6	23.2[a]	0.0	0.0	0.6
Transportation and Utilities	0.6	8.8	0.1	1.0	9.2
Recreational	0.2	2.2	0.0	0.0	0.0
Subtotal	1.4	34.2	0.1	1.0	9.8
Rural Land					
Agricultural	8.5	17.7	--	--	--
Wetlands	<0.1	0.1	--	--	--
Woodlands	<0.1	1.0	--	--	--
Water	11.2	11.0	--	--	--
Subtotal	19.7	29.8	--	--	--
Total	21.1	64.0	0.1	1.0	9.8

[a]*Includes the contribution from onsite sewage disposal systems. The contribution from onsite sewage disposal systems, based upon the* per capita *phosphorus contribution contained within wastewater estimated within the WILMS model, could range from approximately 3.5 pounds per year to as much as 80 pounds per year, depending upon soil type, system condition, and system locations. For purposes of this analysis, 3.5 pounds per year were used as that value provided the loading that was best correlated to the measured in-lake phosphorus concentration.*

Source: SEWRPC.

this quality. Thus, management measures to ensure continued good quality groundwater inflows to the Lake also should be considered. Recent observations of elevated nitrate concentrations in groundwater upslope and south of Booth Lake underline the need for ongoing vigilance and care of groundwater resources.

SOIL TYPES AND CONDITIONS

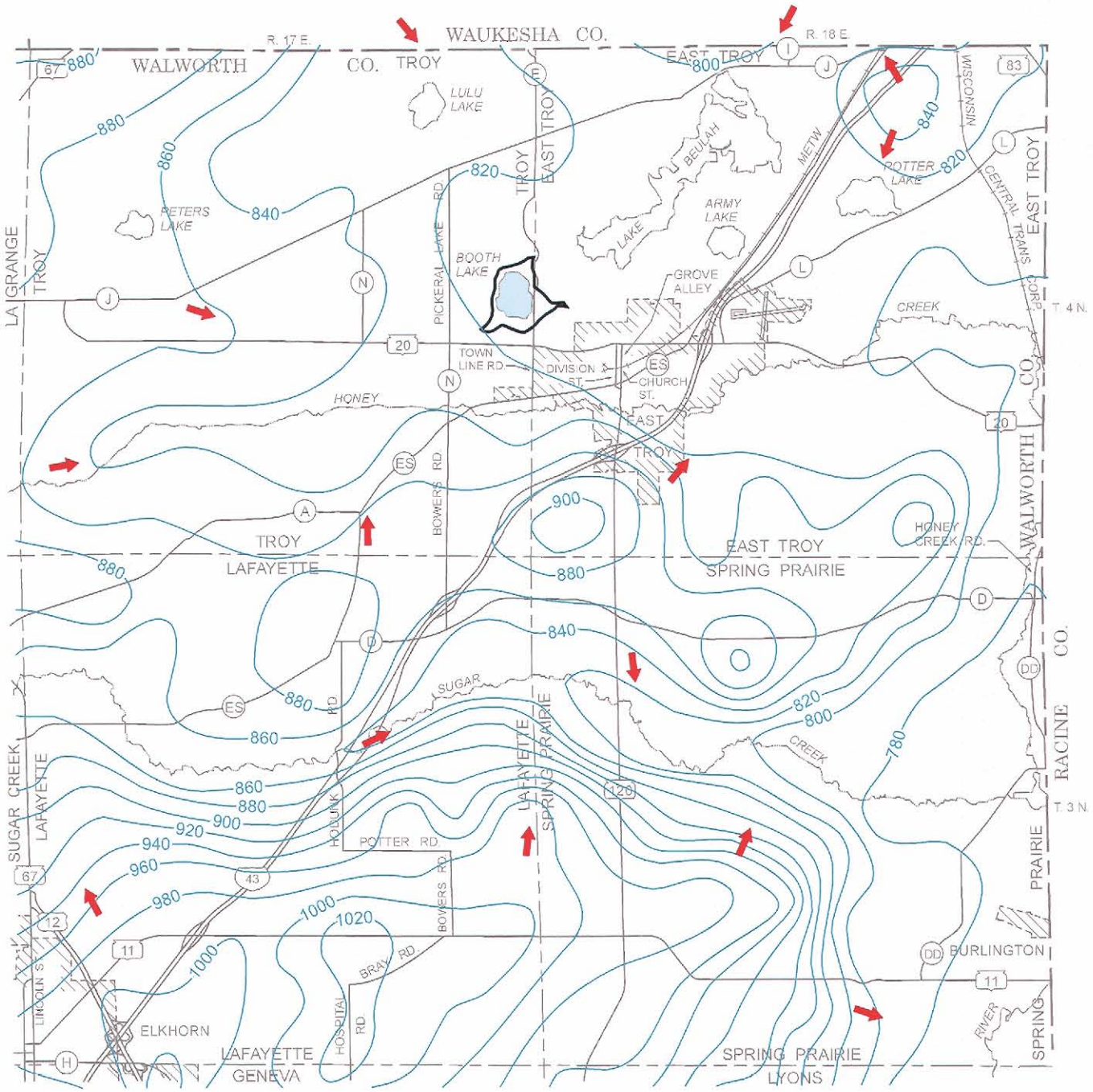
Soil type, land slope, and land use and management practices are among the more important factors determining lake water quality conditions. Soil type, land slope, and vegetative cover are also important factors affecting the rate, amount, and quality of stormwater runoff. The soil texture and soil particle structures influence the permeability, infiltration rate, and erodibility of soils. Land slopes are also important determinants of stormwater runoff rates and of susceptibility to erosion.

The U.S. Natural Resources Conservation Service, under contract to the Southeastern Wisconsin Regional Planning Commission, completed a detailed soil survey of the Booth Lake area in 1966.[10] Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the tributary drainage area to Booth Lake. Soils within the total and direct tributary area to Booth Lake were categorized into four main hydrologic soil groups, as indicated on Map 6. Approximately 55 percent of the total tributary drainage area is covered by moderately drained soils, about 1 percent of the tributary drainage area by very poorly drained soils, and 1 percent with well-drained soils, with the remaining areas of the watershed being surface water.

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

Map 5

DIRECTION OF GROUNDWATER FLOW IN THE BOOTH LAKE AREA



DRAINAGE AREA FOR BOOTH LAKE

DIRECTION OF GROUNDWATER FLOW

960 WATER TABLE CONTOUR (SHOWS ELEVATION OF WATER TABLE ON JANUARY 5 AND 6, 1984. CONTOUR INTERVAL 20 FEET. IN NATIONAL GEODETIC VERTICAL DATUM-1929)

GRAPHIC SCALE

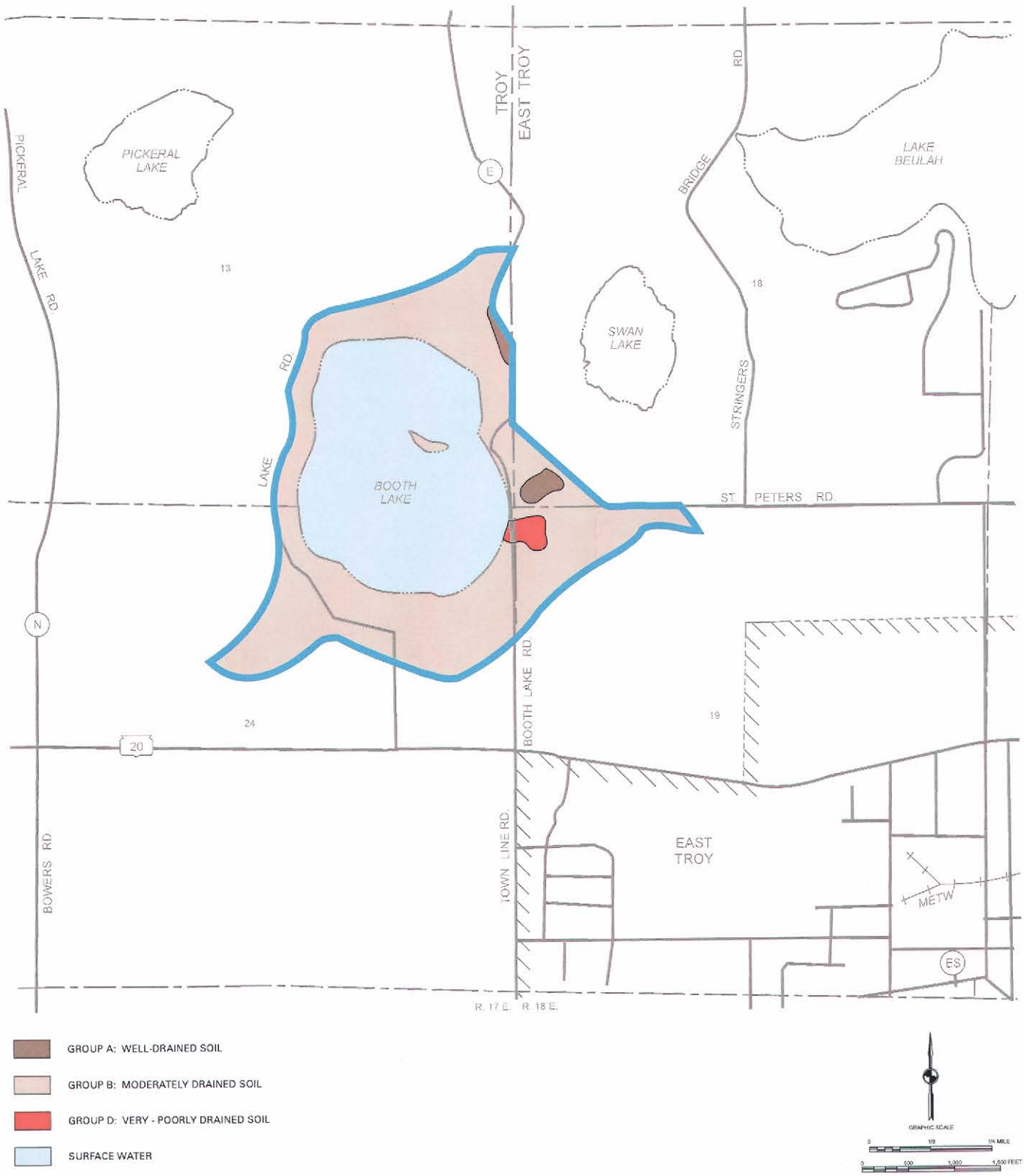
0 1 2 MILE

0 4,000 8,000 12,000 FEET

Source: Wisconsin Geological and Natural History Survey and SEWRPC.

Map 6

HYDROLOGIC SOIL GROUPS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE



Source: SEWRPC.

The regional soil survey also contained interpretations of the suitability of the soils for urban residential development with conventional onsite sewage disposal systems and development with alternative onsite sewage disposal systems. At present, all residential lands in the drainage area tributary to Booth Lake are served by private onsite sewage disposal systems. Those lands are covered by soils that are categorized as having varying suitability for onsite sewage disposal systems. The soil rating for onsite sewage disposal systems, presented on Maps 7 and 8, reflect the requirements of Chapter Comm 83 of the *Wisconsin Administrative Code* governing onsite sewage disposal systems as it existed early in the year 2000. Much of the drainage area tributary to Booth Lake is covered by moderately drained soils, as shown on Map 6. The suitability of these soils for conventional and alternative type onsite sewage disposal systems varies throughout the area. In some areas, the soils are suitable for residential development using onsite sewage treatment systems, as indicated on Maps 7 and 8. In other areas, such as the steeply sloping areas riparian to the Lake indicated on Map 9, the suitability of soils within the shoreland zone for onsite sewage disposal using both conventional and alternative onsite sewage disposal systems is limited due largely to slope.

During 2000, the Wisconsin Legislature amended Chapter Comm 83 and adopted new rules governing onsite sewage disposal systems. These rules, which had an effective date of July 1, 2000, increased the number of types of onsite sewage disposal systems that legally could be used from four to nine. The Wisconsin Department of Commerce envisions that other systems also will be approved in the future. These new rules significantly alter the existing regulatory framework and will increase the area in which onsite sewage disposal systems may be utilized. Although the new rules included a provision that allows counties the option of waiting three years before implementing the new onsite sewage disposal system rules and permitting the use of the new types of systems, in Walworth County, the use of the new technologies was not delayed and the new technologies are currently allowed, where appropriate, in accordance with the new code.

The shorelands of Booth Lake are included within a planned sanitary sewer service area.[11] However, this provision is generally considered to be a long-term future consideration which would provide for connection to the Village of East Troy sewerage system should future conditions dictate. Currently, there is no widespread need or local sentiment for a public system.

AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

Commission staff conducted a survey of aquatic plant species in the lake basin during June of 2000. The results of this survey are presented in Table 5 and graphically depicted on Map 10. Illustrations of the common aquatic plants found in Booth Lake are included in Appendix A.

Nine aquatic plant species were found in Booth Lake, as set forth in Table 5. The flora of the lake basin was extremely sporadic and sparse relative to other lakes in the Region. The flora of the lake basin was dominated by spiny naiad, *Najas marina*, followed by muskgrass, *Chara vulgaris*, in abundance, neither of which pose a problem for most recreational uses of the waterbody. The other plant species present were Eurasian water milfoil, variable pondweed, Illinois pondweed, water celery, and water stargrass, as well as waterweed and water bulrush. The presence of Eurasian water milfoil, as shown in Table 5, is cause for concern, as it is an exotic, or nonnative, species that can exhibit "explosive" growth under suitable conditions. It reproduces by the rooting of plant fragments, and has been known to cause severe recreational use problems in lakes in southeastern Wisconsin. It often outcompetes the native aquatic vegetation of lakes in southeastern Wisconsin, reduces the biodiversity of the lakes, and degrades the quality of fish and wildlife habitats.[12] The distribution of this plant should be

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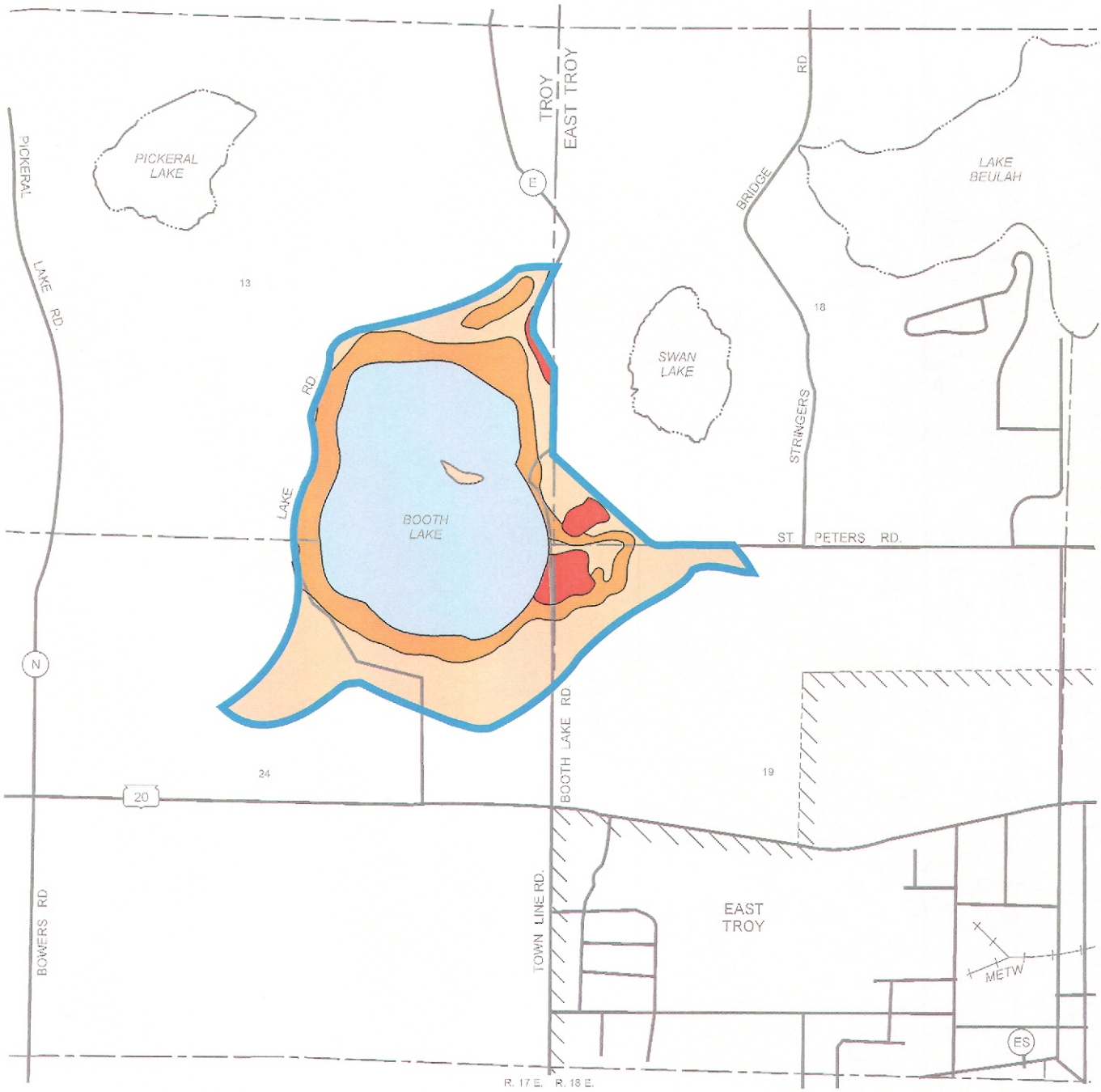
[11] *SEWRPC Community Assistance Planning Report No. 112, 3rd Edition,* Sanitary Sewer Service Area for the Village of East Troy and Environs, Walworth County, Wisconsin, *December 2000.*

[12] *Wisconsin Department of Natural Resources,* Eurasian Water Milfoil in Wisconsin: A Report to the Legislature, *1993.*

Map 7

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE FOR CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS



UNSUITABLE: AREAS COVERED BY SOILS WHICH HAVE A HIGH PROBABILITY OF NOT MEETING THE JUNE 2000 CRITERIA OF CHAPTER COMM 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 JUNE 2000 CRITERIA OF CHAPTER COMM 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 JUNE 2000 CRITERIA OF CHAPTER COMM 83 OF THE *WISCONSIN ADMINISTRATIVE CODE* GOVERNING CONVENTIONAL ONSITE SEWAGE DISPOSAL SYSTEMS

(NONE) OTHER: AREAS CONSISTING FOR THE MOST PART OF DISTURBED LAND FOR WHICH NO INTERPRETIVE DATA ARE AVAILABLE

SURFACE WATER

GRAPHIC SCALE
0 1/8 1/4 MILE
0 500 1,000 1,500 FEET

Source: SEWRPC.

Map 8

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE FOR MOUND - TYPE SEWAGE DISPOSAL SYSTEMS

UNSUITABLE: AREAS COVERED BY SOILS WHICH HAVE A HIGH PROBABILITY OF NOT MEETING THE JUNE 2000 CRITERIA OF CHAPTER COMM 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 JUNE 2000 CRITERIA OF CHAPTER COMM 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 JUNE 2000 CRITERIA OF CHAPTER COMM 83 OF THE *WISCONSIN ADMINISTRATIVE CODE* GOVERNING MOUND SEWAGE DISPOSAL SYSTEMS

(NONE) OTHER: AREAS CONSISTING FOR THE MOST PART OF DISTURBED LAND FOR WHICH NO INTERPRETIVE DATA ARE AVAILABLE

SURFACE WATER

GRAPHIC SCALE
0 1/8 1/4 MILE
0 500 1,000 1,500 FEET

Source: SEWRPC.

Map 9

SOIL SLOPE CLASSIFICATION SUMMARY FOR THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE

Source: SEWRPC.

Table 5

FREQUENCY OF OCCURRENCE AND DENSITY RATINGS OF SUBMERGENT PLANT SPECIES IN BOOTH LAKE: JUNE 2000

Plant Genus and Species	Plant Common Name	Number of Sites Found[a]	Relative Frequency of Occurrence (percent)[b]	Average Density at Sites Found[c]	Average Density in Whole Lake[c]	Ecological Significance[d]
Chara vulgaris	Muskgrass	39	60.9	2.6	1.6	Excellent producer of fish food, especially for young trout, bluegills, small and largemouth bass, stabilizes bottom sediments, and has softening effect on the water by removing lime and carbon dioxide
Elodea canadensis	Waterweed	1	1.6	1.0	<0.1	Provides shelter and support for insects which are valuable as fish food
Myriophyllum spicatum	Eurasian water milfoil[e]	18	28.1	1.3	0.4	Exotic invasive plant species that can lead to a decrease in native aquatic plant community abundance and diversity, but it can provide cover for invertebrates and forage fish species
Najas marina	Spiny naiad	43	67.2	2.8	1.9	Stems, foliage, and seeds are important wildfowl food and produces good food and shelter for fish
Potamogeton gramineus	Variable pondweed	9	14.1	1.3	0.2	Provides habitat for fish and food for waterfowl, in addition to muskrat, beaver, and deer
P. illinoensis	Illinois pondweed	2	3.1	1.0	<0.1	Provides shade and shelter for fish; harbor for insects; seeds are eaten by wildfowl
Scirpus subterminalis	Water bulrush	1	1.6	4.0	0.1	Provides shelter for fish and supports insects
Vallisneria americana	Eel grass	4	6.3	2.8	0.2	Provides good shade and shelter, supports insects, and is valuable fish food
Zosterella dubia	Water stargrass	11	17.2	1.1	0.2	Provides food and shelter for fish, locally important food for waterfowl

[a] *There were a total of 64 sampling point locations along 17 transects.*

[b] *Maximum equals 100 percent.*

[c] *Maximum density achievable equals 4.0 for each species.*

[d] *Information obtained from Norman C. Fassett, A Manual of Aquatic Plants, Wisconsin Department of Natural Resources, Guide to Wisconsin Aquatic Plants, and Wisconsin Lakes Partnership, Through the Looking Glass...A Field Guide to Aquatic Plants, 1997.*

[e] *Section NR 109.07, "Designated Invasive and Nonnative Aquatic Plant."*

Source: SEWRPC.

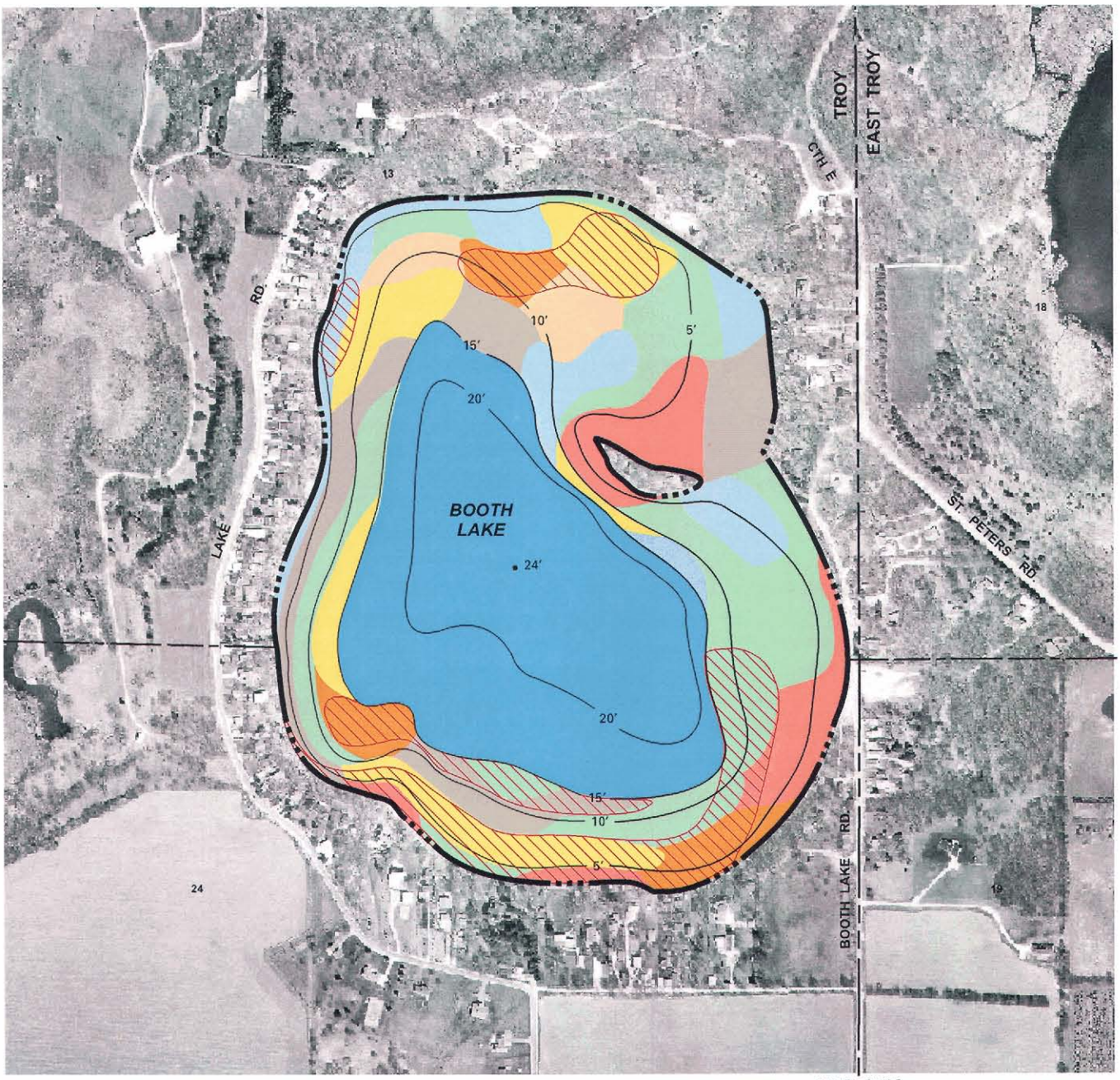
monitored as part of the proposed aquatic plant monitoring program under the Wisconsin Department of Natural Resources Self-Help Monitoring Program. Control of Eurasian water milfoil within Booth Lake is an issue of concern.

CHAPTER NR 107-DELINEATED SENSITIVE AREAS

Chapter NR 107 of the *Wisconsin Administrative Code* authorizes the Wisconsin Department of Natural Resources to restrict the chemical treatment of aquatic plants in sensitive areas of lakes. Sensitive areas are defined within Chapter NR 107 as "areas of aquatic vegetation identified by the Department as offering critical or unique fish and wildlife habitat, including seasonal or life-stage requirements, or offering water quality or erosion control benefits of the body of water." Sensitive areas can be located in and immediately adjacent to bodies of water. Chapter NR 107 also requires that alternatives to chemical treatment of aquatic plants be evaluated for use within identified sensitive areas.

Map 10

AQUATIC PLANT COMMUNITY DISTRIBUTION IN BOOTH LAKE: 2000



20′ WATER DEPTH CONTOUR IN FEET

DEPTH GREATER THAN 15 FEET

NO VEGETATION

EURASIAN WATER MILFOIL

MUSKGRASS

SPINY NAIAD

SPINY NAIAD AND MUSKGRASS

MUSKGRASS AND WATER STAR GRASS

SPINY NAIAD, WATER STAR GRASS, VARIABLE PONDWEED, AND WILD CELERY

SPINY NAIAD, MUSKGRASS, WATER STAR GRASS, WILD CELERY, AND VARIABLE AND ILLINOIS PONDWEEDS

DATE OF PHOTOGRAPHY: MARCH 2000

GRAPHIC SCALE

0 1/16 1/8 MILE

0 600 1200 FEET

Source: SEWRPC.

During 1992, the Wisconsin Department of Natural Resources surveyed Booth Lake to delineate potential sensitive areas. At that time, the entire lake basin was designated as a sensitive area, with the exception of the public beach on the east shore, boat launch on the east shore, and Girl Scout camp along the northeast shore. Restrictions imposed by the Wisconsin Department of Natural Resources within the sensitive area included: restricting chemical treatments to the control of Eurasian water milfoil; restricting aquatic plant screens to the control of Eurasian water milfoil; prohibiting pea gravel, sand blankets, filling, and wetland alterations; and, limiting boardwalks within the wetland area to those permitted on a case-by-case basis. The Wisconsin Department of Natural Resources also recommended that mechanical harvesting not take place without a reassessment of the aquatic vegetation.

FISHERIES

The Wisconsin Department of Natural Resources Publication No. FM-800-95REV, *Wisconsin Lakes*, 1995, indicates that largemouth bass are present, and panfish are common in Booth Lake. Based upon several lake inventories conducted between 1969 and 1979 by the Wisconsin Department of Natural Resources,[13] the fish community is comprised of bluegill, yellow perch, green sunfish, pumpkinseed, bluntnose minnow, blacknose shiner, blacknose dace, largemouth and rock bass, Iowa darter, northern and walleyed pike, common and golden shiner, warmouth, white sucker, yellow, black, and brown bullheads, black crappie, grass pickerel, banded killifish, central mudminnow, and carp. Areas along the less steeply sloping shorelands of the Lake present suitable habitats for the spawning of bass and panfish. Spawning takes place during the spring, from the time of the spring thaw to about mid-June. Based upon these surveys, carp were not considered to present a serious threat to the lake ecosystem, although their numbers should continue to be monitored.

An independent fish survey, conducted during July 2000, confirmed that bluegill, green sunfish, and largemouth bass were the dominant species in the Lake.[14] Northern and walleyed pike were not reported during this survey, and have not been reported to have been caught in the Lake during the recent past. This survey indicated that the largemouth bass population is likely to have preyed upon the yellow perch population, substantially reducing the numbers of perch to be found in the Lake. As a consequence, the largemouth bass population appeared to be in direct competition with the bluegill and green sunfish population for food. Thus, while the bluegill and green sunfish populations were reported to be in excellent condition, the largemouth bass population appeared to be somewhat stunted. For this reason, protection of the lake fishery is an issue of concern.

WILDLIFE AND WATERFOWL

Given the relatively low-density, single-family residential nature of much of the lake shoreline, and the surrounding woodlands, wetlands, and farm fields in the vicinity of the Lake, it is likely that the wildlife community is comprised of small animals. In the upland areas, small game animals, such as rabbit and squirrel; predators, such as fox and raccoon; game birds, such as pheasant; marsh furbearers, such as muskrat; migratory and resident songbirds; and marsh birds, such as redwinged blackbirds and great blue herons, are likely to exist. It is equally likely that the character of wildlife species, along with the nature of the habitat present in the planning area, has undergone significant change since the time of European settlement. Due to the clearing of forests, plowing of the prairie, and filling or draining of wetlands for agricultural purposes, much of the wildlife habitat has been modified. In addition, other modern land management practices can adversely affect wildlife and wildlife habitat. These practices include the excessive use of fertilizers and pesticides, road salting, heavy traffic, the introduction of domestic animals, and the fragmentation and isolation of remaining habitat areas for urban and agricultural uses.

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[13]*D. Fago, Wisconsin Department of Natural Resources Research Report No. 148,* Retrieval and Analysis used in Wisconsin's Statewide Fish Distribution Survey, *Second Edition, December 1988.*

[14]*Randall Atkinson, Aquatic Resources and Glacial Pond Farms,* Booth Lake, Walworth County Fish Survey & Recommendations for Future Management 2000, *2001.*

As shown on Map 11, wildlife habitat areas in the drainage area directly tributary to Booth Lake generally occur in association with existing surface water, wetland, and woodland resources, shown on Map 12. Wildlife habitat areas covered about 55 acres, or about 20 percent of the drainage area. Of this total habitat acreage, about 47 acres, or about 17 percent, were rated as Class II habitat; and about eight acres, or about 3 percent, were rated as Class III habitat.[15]

The habitat areas shown on Map 11 are largely coincident with Commission-delineated environmental corridors in this watershed, as shown on Map 13. Primary environmental corridors extend over 53 acres, or about 19 percent of the drainage area tributary to Booth Lake. The Commission recommends that, to the extent practicable, primary environmental corridor lands should be maintained in essentially natural, open uses.[16]

RECREATIONAL USES AND FACILITIES

Booth Lake is a multi-purpose use waterbody serving all forms of recreation, including swimming, boating, and fishing in the summer months and ice-skating, cross-country skiing, and ice fishing in the winter months. The Lake is used year-round as a visual amenity: walking and jogging, bird watching, and picnicking being popular passive recreational uses of the waterbody. As noted above, the Lake is the site of a public park, beach and recreational boating access site, and a youth camp comprises the northern shorelands of the Lake.

The public park, and attendant beach, pavilion and boat launch site, is located along the southeast shore of the Lake.[17] The park is operated by an independent park commission, the Memorial Park Board, created pursuant to Section 45.05 of the *Wisconsin Statutes* of 1923,[18] and comprised of two representatives from each of the surrounding communities: the Village of East Troy and the Towns of East Troy and Troy. This park and its facilities, including the boat launch site, is operated pursuant to policies established by the commission which limit access only to the residents and property owners of the Village of East Troy and the Towns of East Troy and Troy, and to residents and property owners of the East Troy school district within the Towns of LaFayette, LaGrange, and Spring Prairie, and their accompanied guests.[19] Because the public recreational boating access opportunities are not open to nonresidents of the Village, Towns and school district, Booth Lake currently is deemed not to have adequate public recreational boating access as set forth in Chapter NR 1 of the *Wisconsin Administrative Code*. This limits the access of the Booth Lake Management District and surrounding communities to State lake enhancement funds and services, and, hence, is an issue of concern.

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[15]*For details on these classifications, see SEWRPC Planning Report No. 40,* A Regional Land Use Plan for Southeastern Wisconsin: 2010, *January 1992.*

[16]*SEWRPC Planning Report No. 40,* op. cit., *p. 438.*

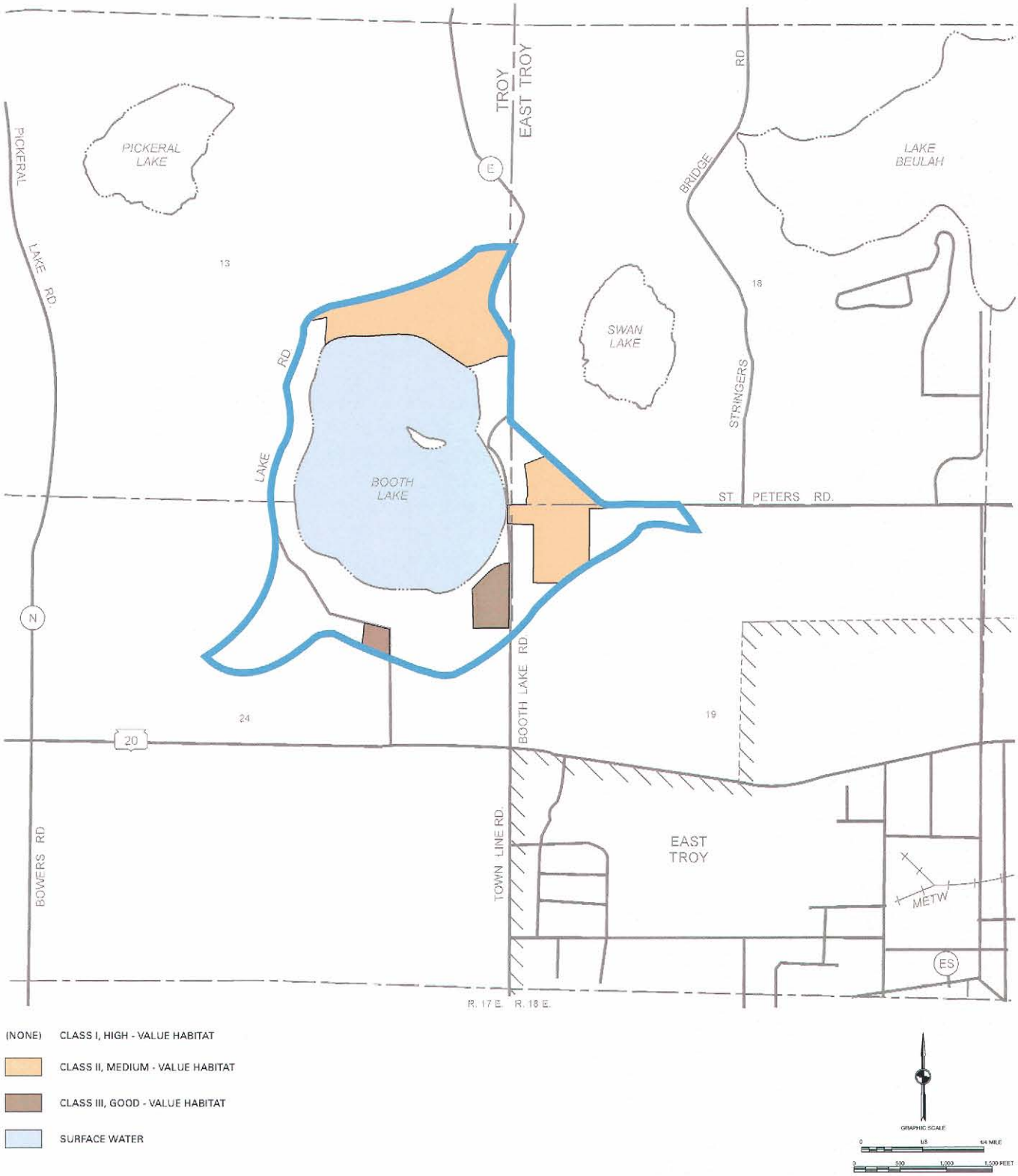
[17]*Lands for the Village of East Troy and Towns of Troy and East Troy veterans memorial park were jointly purchased by the three municipalities by warranty deed dated August 14, 1922, "to be used as a site for a building and other memorial in honor of the Soldiers, Sailors and Marines, residents of the Towns who served in the late War against Germany."*

[18]*Section 45.05 (6) of the* Wisconsin Statutes *provides for the continuation of actions previously taken by any county, city, village or town toward the establishment of a veterans memorial under the* Wisconsin Statutes *of 1943 or prior. Pursuant to this section, and as provided in Sections 45.058 (4) and 45.058 (5) of the* Wisconsin Statutes *of 1923, such a park or memorial "shall be managed, maintained and controlled by a commission consisting of two (2) citizens from each of the municipalities....*[which] *commission shall have full power to make all necessary contracts, rules and regulations for the purchase, maintenance, operation and control of the park...and may enact ordinances for the control and regulation of such memorial having the force and effect, within the limits of the memorial and in the streets and highways adjacent thereto, of city ordinances."*

[19]*Memorial Park Board,* Memorial Park Policies Manual, *May 2001.*

Map 11

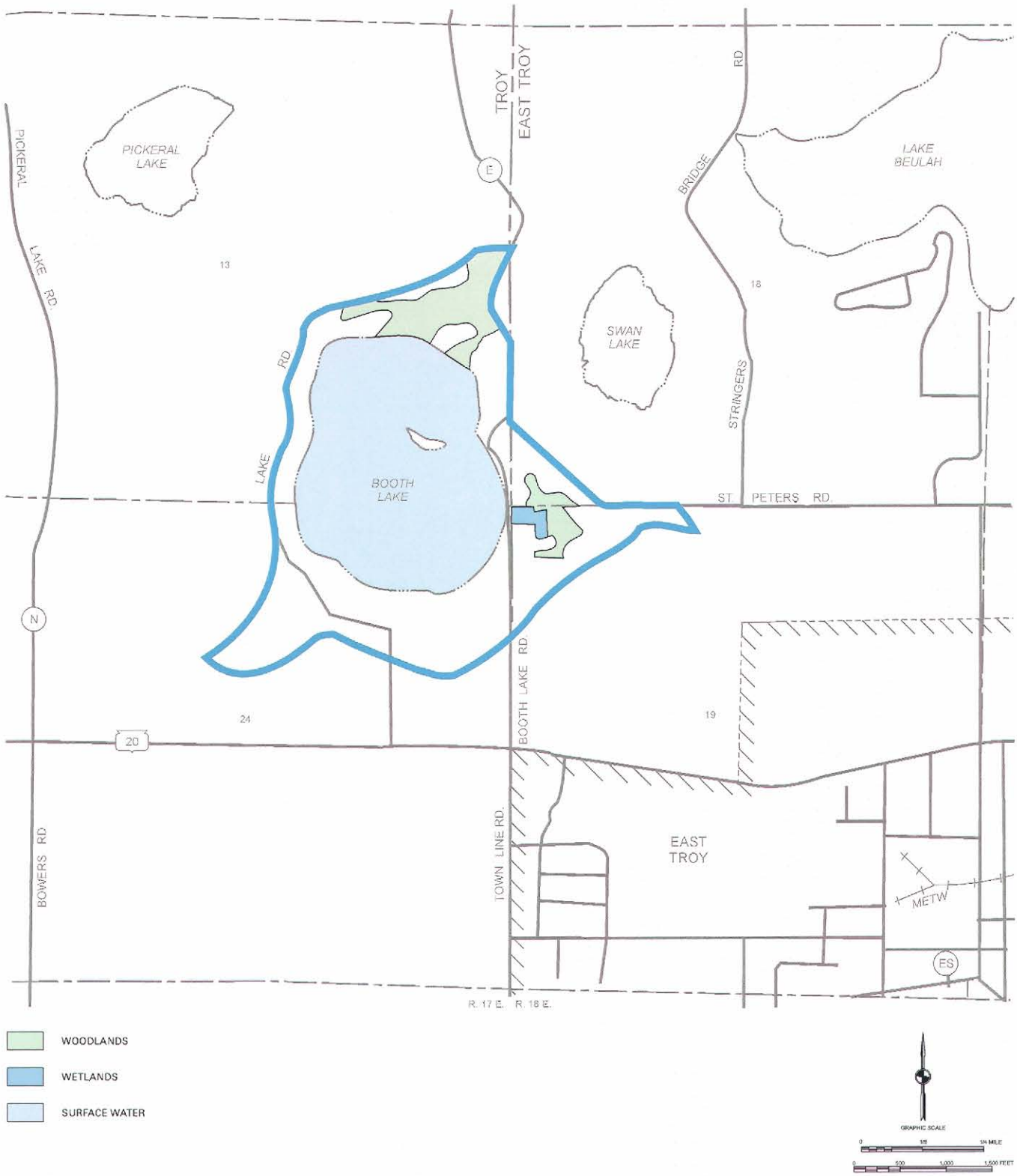
WILDLIFE HABITAT AREAS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 1985



Source: SEWRPC.

Map 12

WOODLANDS AND WETLANDS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 1995



Source: SEWRPC.

Map 13

ENVIRONMENTALLY VALUABLE AREAS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 1995

Source: SEWRPC.

Recreational use surveys were conducted by Commission staff on June 24 and June 29, 2000. These surveys indicated that two to four watercraft of all types were being operated on Booth Lake during the weekday and that eight to 11 watercraft were being operated on Booth Lake on the weekend. Watercraft being operated on Booth Lake included fishing boats and pleasure boats of various types, such as pontoon boats, ski-boats, and personal watercraft. Table 6 summarizes the weekday and weekend boating usage on the Lake.

In addition to the inventory of watercraft being actively used for recreation on the Lake, a boat count was conducted during June 2000. This count indicated that 210 boats were either moored in the water or stored on land adjacent to the Lake. The types of boats included: canoes, fishing boats, paddleboats, pontoon boats, power boats, sailboats, personal watercraft (jetskis), sailboards (wind surfers) and kayaks, as set forth in Table 7.

Other uses observed included extensive use of Booth Lake for swimming, as shown in Table 6. Both the Girl Scouts of America camp and the public beach are venues for swimming lessons and related water-based recreational activities. Since the majority of these occur during the week, the large numbers of campers and learners participating in day camps and lessons suggest a higher level of weekday lake usage than would probably otherwise be the case in the absence of these facilities.

SHORELINE PROTECTION STRUCTURES

Erosion of shorelines results in the loss of land, damage to shoreline infrastructure, and interference with lake access and use. Wind-wave erosion, ice movement, and motorized boat traffic usually cause such erosion. A survey of Booth Lake shoreline, conducted by Commission staff during June 2000, identified approximately one-half of the shoreline in its natural state. The remaining shoreline was determined to be protected by riprap and bulkheads, as shown on Map 14. No obvious, significant erosion-related problems were observed.

COUNTY ORDINANCES

County Zoning Ordinance

Zoning represents one of the most important and significant tools available to local units of government in directing the proper use of lands within their areas of jurisdiction. Local zoning regulations include general, or comprehensive, zoning regulations and special-purpose regulations governing floodland and shoreland areas. General zoning may be adopted as a single ordinance or as a series of separate ordinances; they may or may not be contained in the same document. Any analysis of locally proposed land use must take into consideration the provision of both general and special-purpose zoning. Walworth County has adopted general zoning in the unincorporated portions of the County, including the drainage area tributary to Booth Lake, in accordance with Section 59.69 of the *Wisconsin Statutes.*

The County zoning ordinance provides for conservancy zoning through the C-4 zoning district of the immediate shoreland area and the open water portion of the Lake itself, as shown on Map 15. The lands surrounding the Lake, beyond the C-4 zoning district, are predominately included within an R-1, single-family residential, zoning district. With the exception of the youth camp to the north and the parkland to the southeast of the main lake basin, this zoning provides for low-density, single-family residential development around much of the lakeshore. A small area of land to the south of the Lake is zoned as an R-3, single-family residential, zoning district, which provides for medium-density, single-family residential development. Outside of the residential lands, the major portion of the drainage area tributary to Booth Lake is zoned as C-2, upland resource conservation zoning district, which permits residential development at very low densities, or as C-4, lowland resource conservation district. The lands within the youth camp lie within the C-2, upland resource conservation zoning district. South and southeast of the Lake, small areas of the drainage area tributary to Booth Lake fall within the A-1, prime agricultural, and A-3, agricultural land in holding zoning districts; the latter being those lands southeast of the Lake and adjacent to the Village of East Troy.

Table 6

RECREATION USE SURVEY ON BOOTH LAKE: 2000

Date and Time	Weekend Participants								
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming[a]	Picnicking	Other	Total
June 24, 2000									
10:30 a.m. to 11:30 a.m.	1	2	5	0	0	9	8	0	25
1:15 p.m. to 2:15 p.m.	3	3	4	0	1	35	23	4	73
Total	4	5	9	0	1	44	31	4	98
Mean	2	2	4	0	0	22	15	2	49

Date and Time	Weekday Participants								
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming[a]	Picnicking	Other	Total
June 29, 2000									
10:00 a.m. to 11:00 a.m.	3	0	1	0	0	15	0	0	19
12:00 p.m. to 1:00 p.m.	2	0	0	0	0	110	5	2	119
Total	5	0	1	0	0	125	5	2	138
Mean	2	0	0	0	0	62	2	1	69

[a]*Includes swimmers from the Girl Scout camp and swimming lessons at the Town beach.*

Source: SEWRPC.

Table 7

WATERCRAFT ON BOOTH LAKE: JUNE 2000

Type of Watercraft										
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddle Boat	Sailboat	Kayak	Wind Surf Board	Personal Water Craft	Other	Total
33	54	28	29	20	16	6	4	12	8	210

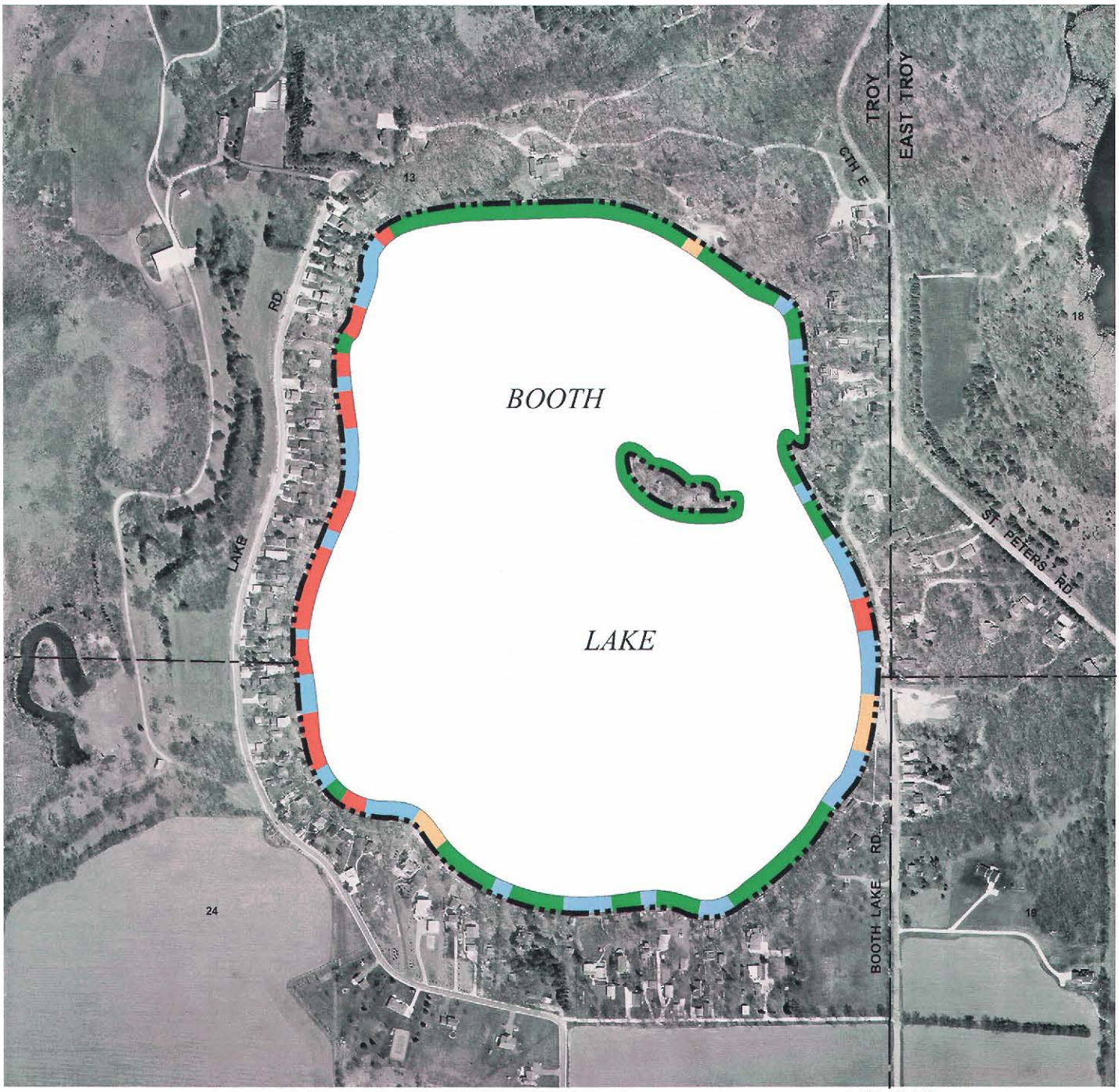
Source: SEWRPC.

The R-1, single-family residential, zoning district permits development on lots with a minimum area of 40,000 square feet, where soil conditions allow placement of onsite sewage disposal systems. The R-3, two-family residential, zoning district permits development on lots with a minimum area of 15,000 square feet. Lands designated as C-2 provide for a minimum lot size of five acres, while those designated as A-1 and A-3 provide for a minimum area of 35 acres.

The Walworth County Private Sewage System and Sanitation Ordinance contains general provision for the design, installation, operation, and maintenance of private water supply systems, septic tanks, effluent disposal systems, holding tanks, and septic sludge disposal systems. This ordinance was adopted in 1982 by the Walworth County Board of Supervisors and has since been amended from time-to-time.

Map 14

SHORELINE PROTECTION STRUCTURES ON BOOTH LAKE: 2000



DATE OF PHOTOGRAPHY: MARCH 2000

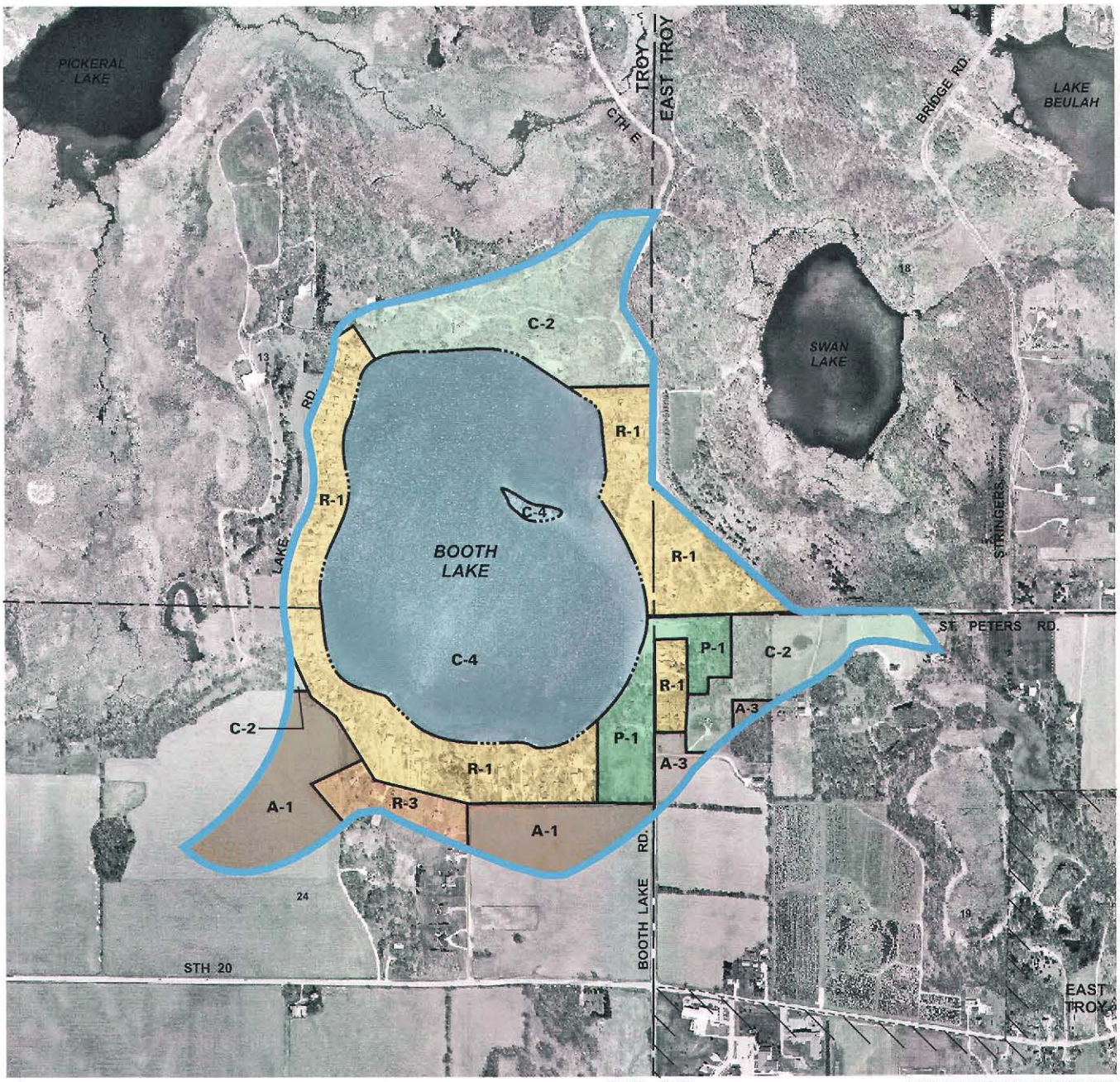
RIPRAP
NATURAL
BEACH
BULKHEAD

GRAPHIC SCALE
0 1/32 1/16 MILE
0 300 600 FEET

Source: SEWRPC.

Map 15

EXISTING ZONING DISTRICTS WITHIN THE DRAINAGE AREA TRIBUTARY TO BOOTH LAKE: 2002



R-1	SINGLE-FAMILY RESIDENTIAL (UNSEWERED 40,000 SQUARE FEET)	C-2	UPLAND RESOURCE CONSERVANCY
R-3	MULTIPLE-FAMILY-RESIDENTIAL (SEWERED OR UNSEWERED 15,000 SQUARE FEET)	A-1	PRIME AGRICULTURAL LAND
P-1	PARK	A-3	AGRICULTURAL LAND HOLDING
C-4	LOWLAND RESOURCE CONSERVANCY (SHORELAND)		

GRAPHIC SCALE

0 1/8 1/4 MILE

0 500 1,000 1,500 FEET

Source: SEWRPC.

Most pertinent to land use planning and development are provisions regulating the location of private water supply and sewage disposal systems. The use of private sewage disposal systems, in particular, is restricted in floodland areas, in areas with steep slopes, and in areas with soils unsuitable for the operation of such systems.

County Stormwater Management and Construction Site Erosion Control Ordinance
In addition to the zoning code, the Walworth County Land Disturbance, Erosion Control and Storm Water Management Ordinance governs the amount of sediment and other pollutants from construction sites and land disturbing activities in the County that occur on platted lots within a subdivision plat; lots developed under a certified survey map; areas of 4,000 square feet or greater; works where fill and/or excavation volumes exceed 400 cubic yards; public streets, roads, or highways; watercourses; and utilities. In addition, the soil erosion control and stormwater management provisions of the Walworth County land division ordinance would apply to residential developments of five acres or more, and other developments of three acres or more. Land disturbing activities associated with the development of one- and two-family dwelling and building sites are controlled under the provisions of the Uniform Dwelling Code (UDC). All control measures are administered and enforced by the Walworth County Land Conservation Department.

The Walworth County Board in 1990 adopted a construction site erosion control ordinance that applies to the unincorporated areas of the County, including the Town of Troy. The ordinance is intended to protect water quality by reducing the amount of sediment and other pollutants leaving construction sites during the land development process. The law requires landowners or tenants to obtain a permit before undertaking the construction of any building or structure; removal of vegetation or ground cover, grading, excavation, or filling affecting 4,000 square feet or more; and construction or reconstruction of roads and bridges.

County Subdivision Control Ordinance
The Walworth County Subdivision Control Ordinance establishes requirements with respect to the design of lots, subdivision access, and necessary internal improvements, such as streets, drainage, and sewerage and water facilities. The ordinance requires the preparation of a subdivision plat for all land divisions that create five or more parcels or building sites each of which is 15 acres or less in size. The ordinance requires the preparation of a certified survey map for a division of land, other than a subdivision, which results in the creation of less than five lots, any one of which is 15 acres or less in size. Most provisions of the ordinance are also applicable to condominium projects. Under the County ordinance, certain improvement requirements, such as those pertaining to road surfacing and to the installation of curbs and gutters, sidewalks, and street lamps, are left to the determination of the town boards of the respective towns.

County Shoreland Zoning Ordinance
Under Section 59.971 of the *Wisconsin Statutes,* counties in Wisconsin are required to adopt zoning regulations within statutorily defined shoreland areas, or, those lands that are within 1,000 feet of a navigable lake, pond, or flowage, or 300 feet of a navigable stream, or, to the landward side of the floodplain, whichever distance is greater, within their unincorporated areas. Minimum standards for county shoreland zoning ordinances are set forth in Chapter NR 115 of the *Wisconsin Administrative Code.* In Walworth County, shoreland and floodland regulations are set forth in the Walworth County Shoreland Zoning Ordinance. This ordinance includes zoning districts and special regulations for shoreland areas, defined as all lands lying within the following distances of the ordinary high water mark of navigable waters: 1,000 feet from a lake, pond, or flowage; or 300 feet from a river or stream or to the landward side of the floodplain, whichever distance is greater. The shoreland regulations include requirements governing the removal of vegetation and earth movements, and structural setbacks, within the shoreland area. Among these requirements are provisions, set forth in Section 2.8 of the Ordinance, that limit tree cutting, shrubbery clearing, and earth movements within the shoreland zone to no more than 30 feet within any 100 feet of shoreline and within an area extending landward 35 feet from the Ordinary High Water Mark, to prevent erosion, minimize sedimentation, and preserve the natural beauty of the County.

The Walworth County Shoreland Zoning Ordinance also includes the County's floodplain regulations, which apply to all lands within the 100-year recurrence interval flood hazard areas. The existing floodplain regulations

prohibit virtually all new structures in the floodplain, including the floodway and flood fringe areas, in accordance with sound floodland management practice.

In addition, counties, pursuant to Chapters 23 and 330 of the *Wisconsin Statutes*, also are required to regulate the use of all wetlands five acres or larger located in the shoreland areas of unincorporated municipalities within 300 feet of a stream and 1,000 feet of a lake, or to the landward side of the floodplain, whichever is greater. Wetland maps for Walworth County were prepared for the Wisconsin Department of Natural Resources by the Regional Planning Commission in 1981.

LOCAL ORDINANCES

Booth Lake is subject to a boating ordinance promulgated by the Town of Troy. This ordinance provides generally applicable rules for all waters within the jurisdiction of the District, as set forth in Appendix B. These rules limit the times during which boats may operate on Booth Lake and allow for the enactment and enforcement of boating restrictions and limitations. The ordinance conforms to State of Wisconsin boating and water safety laws pursuant to Chapter 30, *Wisconsin Statutes*.

FEDERAL WETLAND REGULATIONS

Section 404 of the Federal Clean Water Act requires the U.S. Department of the Army, Corps of Engineers, working in cooperation with the U.S. Environmental Protection Agency, to regulate the discharge of dredged and fill material into waters of the United States, including lakes, rivers, and wetlands. In carrying out this responsibility, the Corps of Engineers determines when permits are required for the discharge of dredged and fill materials. Some silviculture, mining, and agricultural activities in water and wetland areas may be exempt from the individual permit requirement. Certain minor activities, such as boat ramp construction and shore stabilization, may be undertaken under a pre-approved general, or nationwide, permit. Under Section 401 of the Act, the issuance of Federal permits must be consistent with State water quality policies and standards.

Chapter III

ALTERNATIVE AND RECOMMENDED AQUATIC PLANT AND RECREATIONAL USE MANAGEMENT PRACTICES

INTRODUCTION

There are a number of issues of concern that impact the recreational use and water quality of Booth Lake. These issues were identified in Chapter II and include: continuing urban-density residential development in the drainage area tributary to Booth Lake; the provision of adequate public recreational boating access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*; the presence of nuisance growths of Eurasian water milfoil and other aquatic plants, combined with an overall scarcity and lack of diversity of aquatic vegetation in selected areas; and, the apparent decline in the quality of the lake fishery.

In some ways, these issues of concern are interrelated. In those areas of the Lake where Eurasian water milfoil is abundant, certain recreational uses are limited, the aesthetic quality of the Lake is impaired, and in-lake habitat degraded. The plant primarily interferes with recreational boating activities by clogging propellers and cooling water intakes, snagging paddles, and slowing sailboats by wrapping around keels and control surfaces. The plant also causes concern amongst swimmers who can become entangled within the plant stalks. Thus, without control measures, these areas can become problematic to boat navigation, fishing, and swimming. Native aquatic plants, generally found at slightly deeper depths, pose fewer potential problems for navigation, swimming, and fisheries. In addition, many native aquatic plants provide fish habitat and food resources and offer shelter for juvenile fishes and young-of-the-year.

Despite areas in the Lake where nuisance growths of Eurasian water milfoil occur, overall, the Lake is limited in the numbers and diversity of aquatic plants. In particular, the Lake lacks a diverse submergent and floating vegetation community. In turn, this lack of diversity is likely to have contributed to an imbalance in the fisheries community within the Lake. At present, there is not enough forage for fish to utilize as a food source, nor enough cover to limit predation on juvenile fishes. This creates a situation which, over time, has begun to create an imbalance in the fish community that includes limitations on the varieties of species found within the Lake, and a stunting of the largemouth bass population.[1]

In this chapter, alternative and recommended management measures to address the identified issues of concern are presented. These measures include:

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[1]*Rand Atkinson, Aquatic Resources and Glacial Pond Farms,* Booth Lake, Walworth County, Fish Survey & Recommendations for Future Management 2000, *2001.*

1. Land use management measures designed to limit the inputs of contaminants, especially nutrients, to the Lake from its tributary drainage area;

2. Recreational use management measures designed to limit the spread of nuisance conditions between lakes and within Booth Lake;

3. Fisheries management measures designed to mitigate the habitat-related impacts of a changing aquatic flora; and,

4. Aquatic and shoreland plant management measures designed to encourage native plant communities and limit the spread of nonnative, invasive species.

Alternative and recommended management measures to address these concerns are described briefly below. The alternatives and recommendations set forth herein focus on those measures which are applicable to the Booth Lake Management District, with lesser emphasis given to those measures which are applicable to other agencies with jurisdiction within the drainage area tributary to Booth Lake.

PAST AND PRESENT AQUATIC PLANT MANAGEMENT PRACTICES

The Booth Lake Management District and its precursor organization, the Booth Lake Property Owners' Association, historically has taken a largely passive approach to aquatic plant management, having actively managed the aquatic plant populations of the Lake only since 1990. During 1988, an application was made to the Wisconsin Department of Natural Resources (WDNR) for the chemical treatment of aquatic plants in Booth Lake. However, no chemical control actions were taken at that time. During 1990, a similar application was made, and 15.5 gallons of the herbicide 2,4-D were applied to the Lake to control perceived nuisance growths of aquatic vegetation. Likewise, during 1992, three gallons of 2,4-D were applied. Since then, there have been no documented chemical treatments to control nuisance growth of aquatic vegetation until 2000, when limited chemical treatment of Eurasian water milfoil growth using 2,4-D was reintroduced. Notwithstanding, the primary mechanism for the control of Eurasian water milfoil growth in the Lake has been manual control by SCUBA divers. In addition, individual householders are known to have engaged in manual harvesting in the vicinities of their piers and docks, and limited chemical herbicide treatments were applied for the control of Eurasian water milfoil during 2001 and 2002.

LAND USE MANAGEMENT

Array of Management Measures

The recommended future land use condition for the drainage area tributary to Booth Lake is set forth in the adopted regional, County, and Town of Troy land use plans.[2] These plans present alternatives for the preservation of primary environmental corridor lands in essentially natural, open space use. The delineated environmental corridors contain most of the ecologically valuable lands in the vicinity and adjacent to Booth Lake. Alternative protection measures include the placement of these lands in appropriate zoning districts, depending upon the type and character of the natural resource features to be preserved and protected. All lakes, wetlands, and woodlands are recommended to be placed in conservancy protection districts. The existing Walworth County zoning for the lands in the vicinity of Booth Lake and in the drainage area tributary to Booth Lake is consistent with these recommendations.

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[2]*SEWRPC Planning Report No. 45,* A Regional Land Use Plan for Southeastern Wisconsin: 2020, *December 1997; SEWRPC Community Assistance Planning Report No. 252,* A Land Use Plan for Walworth County, Wisconsin: 2020, *April 2001; and SEWRPC Community Assistance Planning Report No. 229,* A Land Use Plan for the Town of Troy: 2020, Walworth County, Wisconsin, *January 1999.*

With respect to the recommended future land use pattern, the adopted County and Town land use plans indicate little new development within the drainage area tributary to Booth Lake. Some limited infilling of existing, platted lots would be expected to occur, and, in addition, the redevelopment and reconstruction of existing single-family homes on lakefront properties may be expected. The existing Walworth County zoning for the lands in the vicinity of Booth Lake and in the drainage area tributary to Booth Lake is consistent with the adopted regional plan. The recommended land use plan for the Town of Troy suggests a potential future increase in low-density-urban residential development to the south of the Lake. Such development would suggest an increase in urban-density land usage beyond that indicated by the current zoning. This potential future change may be expected to result in a very minor increase in the pollutant loadings to the Lake associated with urbanization and could potentially increase the pressure for recreational use of the Lake. In addition, these land use changes have the potential to impact the quantity and quality of groundwater inflows to the Lake. Groundwater inflows to the Lake are an important reason that the Lake water quality is maintained at an high level.

Land use activities associated with urban development within the drainage area tributary to Booth Lake generate nonpoint source pollution loadings that represent a potentially significant threat to the Lake's water quality. Sources of nonpoint source pollutants include both rural and urban land uses, including land disturbing activities associated with construction and redevelopment within the drainage area. As noted, based upon recommendations set forth in the county and town land use plans, future development of open lands within the drainage area tributary to Booth Lake is proposed to be limited with the exception of a potential future increase in low density development on the south side of the Lake on lands now used for agricultural purposes. However, unplanned development, and redevelopment of existing properties, could occur and impacts on lake water quality could potentially result.

The recommended urban measures set forth in the adopted regional and local land use and water quality management plans were directed largely at the urban and urbanizing areas. The recommended urban measures set forth in the adopted regional and local plans were directed at urban nonpoint sources within the drainage area tributary to Booth Lake, and were estimated to achieve about a 25 percent reduction in nonpoint source pollutant loads to the Lake.[3] In the Booth Lake tributary area, these measures included the future provision of public sanitary sewerage services.[4] The future, long-term provision of public sanitary sewerage services within the drainage area tributary to Booth Lake is supported by the phosphorus loading analysis set forth in Table 4 in Chapter II of this report. This analysis shows that the potential phosphorus load from onsite sewage disposal systems serving urban residential development within the drainage area of the Lake could potentially contribute up to 80 pounds of phosphorus per year, or about one-half again as much phosphorus to the Lake as all other sources combined. That maximum loading assumes a large number of nonfunctioning systems. At the present time, the loading from onsite sewage disposal systems is estimated to be less than five pounds of phosphorus per year. This analysis suggests that the majority of onsite sewage disposal systems within the drainage area are functioning within normal operating parameters. As there is likely to be continued reliance on onsite sewage disposal systems for the foreseeable future, continuing efforts to inspect, maintain, and replace as necessary such onsite sewage disposal systems will be required, pursuant to applicable State and County requirements.

In addition, given the steeply sloping topography of portions of the drainage area tributary to Booth Lake, concerns have been expressed by some electors of the District regarding stormwater management within the watershed. Proper design and application of urban stormwater management measures, such as grassed swales and detention basins, requires the preparation of a detailed stormwater management system plan that addresses stormwater drainage problems and controls nonpoint sources of pollution. Based on preliminary evaluation,

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[3]*SEWRPC Community Assistance Planning Report No. 112, 3rd Edition,* Sanitary Sewer Service Area for the Village of East Troy and Environs, Walworth County, Wisconsin, *December 2000; SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995.*

[4]*SEWRPC Community Assistance Planning Report No. 112,* op. cit.

however, it is estimated that few practices would be effective in the areas within the immediate vicinity of Booth Lake. Management measures that can be applied within the Town of Troy in the immediate vicinity of Booth Lake are limited largely to good urban housekeeping practices, grassed swales, and vegetative lakeshore buffers. However, structural measures could be considered for installation as part of the development process in urbanizing areas within those currently undeveloped portions of the drainage area, and in those portions of the watershed along roadways where provision of measures to reduce runoff velocities from the impervious surfaces may be desirable.

The recommended rural measures set forth in the adopted regional and local plans were directed largely at rural nonpoint sources within the drainage area tributary to Booth Lake, and were estimated to achieve a 25 percent reduction in nonpoint source pollutant loads to the Lake.[5]

Recommended Management Measures

Insofar as future land usage reflects these latter recommendations, it is recommended that development proceed with due regard for the management of stormwater and other urban runoff so as not to impair the water quality of the Lake. To wit, it is recommended that:

- Development within the drainage area tributary to Booth Lake should occur at densities consistent with those set forth in the adopted Town and County land use plans;

- Land use development, or redevelopment, proposals around the shoreline of the Lake be carefully reviewed for potential impacts on the Lake;

- Residential developments be placed in conservation development on smaller lots, while preserving portions of the open space on each property or group of properties considered for development and preserving the natural and cultural resources to the extent practicable;[6]

- A regular program of inspection and maintenance, as necessary, be implemented with respect to onsite sewage disposal systems to ensure their continued capacity and functioning, until such time as public sanitary sewerage service is provided; and

- Urban pollution control measures, including wet detention-infiltration basins, grassed swales, and good urban "housekeeping" practices, be encouraged to minimize pollutant loadings while maintaining water loadings to the Lake.

With regard to the onsite sewage disposal system management program, it is recommended that consideration be given to developing a periodic pumping program to ensure that systems are pumped at regular intervals—approximately once per three years. The systems also should be inspected at these times to ensure their continued functioning.

Where new development or redevelopment is proposed, it is recommended that the provisions of the relevant Walworth County land division and construction site erosion control ordinances be strictly enforced within the drainage area tributary to Booth Lake. These control measures are administered and enforced by the Walworth County Land Conservation Department. With respect to conservation development, it is recommended that such development principles be applied on the lands to the south and southeast of Booth Lake which are partially within the drainage area tributary to the Lake at such time as these lands are considered for urban residential development. In these areas, it would be desirable to maintain open space areas within the Lake drainage area and

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[5]*SEWRPC Community Assistance Planning Report No. 112,* op. cit.*; and SEWRPC Memorandum Report No. 93,* op. cit.

[6]*See SEWRPC Planning Guide No. 7,* Rural Cluster Development Guide, *December 1996.*

cluster the development beyond the drainage area tributary to the Lake. It is also recommended that the relevant performance standards set forth in the adopted County land and water resource management plan be enforced as necessary. These practices would be intended to minimize the impact of development on the surface and ground water flows to Booth Lake.

RECREATIONAL USE MANAGEMENT

Current public recreational boating standards as set forth in Sections NR 1.91(4) and NR 1.91(5) of the *Wisconsin Administrative Code*, establish minimum and maximum standards for public boating access development, respectively, to qualify waters for resource enhancement services provided by the Wisconsin Department of Natural Resources. Based upon these standards, Booth Lake would be required to have minimum parking facilities for five vehicles, plus one handicapped accessible unit, for a total of six units, and maximum parking facilities for eight vehicles, plus one handicapped unit, for a total of nine units. These access standards apply to lakes with open water areas of between 100 acres and 499 acres.

As noted in Chapter II, while there is currently one public boating access site at the park on the southeastern shore of Booth Lake, this site lacks adequate parking facilities as defined in Chapter NR 1 of the *Wisconsin Administrative Code*. While the Park provides ample numbers of parking spaces, the restriction of these spaces solely for the use of residents and property owners of the Village of East Troy and Towns of Troy and East Troy, and the residents and property owners of the East Troy school district in the Towns of LaFayette, LaGrange and Spring Prairie, and their accompanied guests, is contrary to the requirements of Chapter NR 1, which requires that a number of parking spaces equivalent to at least the minimum set forth in the *Wisconsin Administrative Code*. In this case, a minimum of parking spaces for five car-trailer units, plus one handicapped space, be provided without restriction to all potential lake users. Thus, while Booth Lake meets the standard with regard to the numbers of access points, the lack of availability to the general public means that the Lake fails to conform to current State public recreational boating access standards. Thus, provision of adequate public recreational boating access to Booth Lake, pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*, is an alternative to be considered for the Lake Management District to retain its eligibility for future grants from the Wisconsin Department of Natural Resources for lake enhancement services.

Array of Management Measures

Given the built nature of the Lake shorelands, there is very limited scope for provision of additional parking and launching opportunities for recreational boating access users within reasonable proximity, defined as within one-quarter of one mile, in Chapter NR 1 of the *Wisconsin Administrative Code*, of the Lake. Likewise, given that the only private access point to the Lake is situated within the youth camp on the northern shores of the Lake, opportunities to develop private provider agreements with existing access facilities on the Lake is limited. Conclusion of such an agreement with the operators of the youth camp is not considered feasible, due to the additional risk that users of such a site may pose to the youth within the campgrounds. Similarly, the purchase of a homestead property for conversion to a public recreational boating access site is constrained by the residential nature of the lakeshore community, which would be severely disrupted by the operation of a public recreational boating access facility. Notwithstanding, and more importantly, the steeply sloping lakeshore topography around much of the Lake generally precludes development of an access site at all but the northern and southern extremes of the Lake. Provision of parking spaces for car-trailer units other than those allocated to Village and Town residents and property owners, residents and property owners of the East Troy school district, and their accompanied guests, at the existing park site, is currently limited by the operating policies of the Memorial Park board of commissioners. However, provision of parking opportunities at this site would satisfy the requirements of Chapter NR 1 of the *Wisconsin Administrative Code* and provide Booth Lake with adequate public recreational boating access.

Recommended Management Measures

The only feasible alternative appears to be that of opening a number of car-trailer unit parking spaces within the existing parking facility, equal to a number of parking spaces between the minimum and maximum required pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*, to persons who currently fail to meet the

Village, Town and school district property ownership and residency criteria. This option would require action by the Chapter 45, *Wisconsin Statutes*, Veterans Memorial Park Commission operating the Memorial Park site, with the view to modifying their operating policies to provide for public recreational boating access opportunities consistent with at least the minimum standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*. If considered, such a change in policy should be reviewed by the legal counsel for the Veterans Memorial Park Commission to confirm the ability of the Commission to make such changes.

The proposed parking facilities should conform to the guidance on accessibility contained in Wisconsin Department of Natural Resources Publication No. PUBL-CA-003 88, *Handbook for Accessibility...A Reference to Help Develop Outdoor Recreation Areas to Include People with Disabilities*. Such access facilities would provide for greater convenience of the residents of Booth Lake, as well as for the convenience and safety of the public at large, by providing an improved public launch site with adequate parking facilities. In addition, Booth Lake would become eligible to receive grant funds from the Wisconsin Department of Natural Resources for future lake improvement projects. Reasonable fees may be charged for the use of the public recreational boating access site.[7]

In addition to the provision of adequate public recreational boating access, it is recommended that boating traffic be minimized in areas of the Lake where Eurasian water milfoil is prevalent, in order to prevent its further spread within the lake basin. Use of appropriate buoyage is suggested.[8] Two general types of buoyage exist: regulatory buoys, such as those used to demarcate slow-no-wake or exclusionary areas; and informational buoys, those used to enhance public awareness. While regulatory markers are enforceable, use of informational buoys is recommended for this purpose. Buoyage has the advantage of being visible to recreational boaters, and affected areas can be clearly demarcated. Buoys placed within the waters of the State of Wisconsin are subject to the requirements set forth in Chapter 30, *Wisconsin Statutes*, and require a Wisconsin Department of Natural Resources permit prior to placement. Appropriate signage at the public recreational boating access site to supplement the buoyage, and inclusion of information on Eurasian water milfoil in the District's informational programming, consistent with the aquatic plant management measures set forth below, is also recommended.

FISHERIES MANAGEMENT

Based upon a recent fisheries reconnaissance,[9] Booth Lake appeared to have a "limited" fishery, although a more rigorous fish population assessment would be required to better determine the nature of the apparent limitation. Notwithstanding, this limitation is reported to be due, in part, to the limited diversity and numbers of aquatic plants within the Lake, especially among submergent vegetation communities and vegetation associated with the nearshore area, that provides less than adequate habitat for the fishes. Some of the principal concerns with the present fishery are the limited species diversity, the lack of a yellow perch fishery that was historically present in the Lake, and an apparent stunting of the largemouth bass population. As noted in Chapter II, the fish population of Booth Lake is presently dominated by panfish and largemouth bass.

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[7]*Reasonable fees are considered to be equivalent to the daily entrance fee for Wisconsin State Parks, with the possibility that surcharges can be considered for provision of additional facilities, such as parking attendants, restrooms, and related amenities.*

[8]*Buoys must be white in color, cylindrical in shape, seven or more inches in diameter, and extend 36 or more inches above the water line. Regulatory buoys include buoys used to demarcate restricted areas, prohibit boating or types of boating activities in specific areas, and control the movements of watercraft. Buoys used to demarcate regulated areas display their instructions in black lettering. Prohibition buoys display an orange diamond with an orange cross inside. Control buoys display an orange circle. Informational buoys are similar in construction to the regulatory buoys, but contain an orange square on the white background. Informational buoys are not enforceable.*

[9]*Rand Atkinson, Aquatic Resources and Glacial Pond Farms,* op. cit.

Array of Management Measures

Booth Lake provides a suitable habitat for a warmwater fishery with adequate water quality and dissolved oxygen levels that can contribute to the maintenance of a fish population that is dominated by desirable sport fish. To this end, a more rigorous fisheries survey should be considered in order to better identify fish population composition, length-weight distributions, community age structure, and related life history information, such as proportion of available spawning habitat, spawning success, and juvenile recruitment, that will be important for making stocking-related decisions. Notwithstanding, however, provision of additional "structure" within the lake basin to provide habitat for fishes is recommended. Potential alternatives for improving the fishery include protecting existing fish spawning sites and establishing additional habitat sites through the development of a desirable aquatic plant community, especially in the shallow water habitat areas of the Lake. These alternatives can be supplemented by regulatory provisions relating to the removal of fishes from the Lake and the addition of fishes to the Lake by stocking. All of these measures appear to be appropriate for use in Booth Lake. However, it should be noted that stocking of fishes by the Wisconsin Department of Natural Resources is considered a lake enhancement service, the provision of which is subject to a lake being deemed to have adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

Habitat Protection

Habitat protection refers to a range of conservation measures designed to maintain existing fish spawning habitat. These measures include restricting recreational and other intrusions into gravel-bottomed shoreline areas during the spawning season (for bass this is spring, mid-April to mid-June), use of natural vegetation in shoreland management zones, and other "soft" shoreline protection options that aid in habitat protection. These latter measures are discussed further below, in respect to their use in shoreline protection and management.

Habitat Creation

In lakes where vegetation is lacking or where plant species diversity is low, artificial habitat may need to be developed. As discussed in Chapter II, the results of the aquatic plant surveys of Booth Lake indicate that there is insufficient habitat for a healthy fish community. Thus, the use of natural shoreline landscaping techniques provides one alternative to enhance available fish and wildlife habitat around lakes. In addition, provision of additional shoreline cover, in the form of deadfalls or other structures to improve fish habitat into the nearshore waters, can add habitat and structure to the lake environment.[10] Such structure would be intended to provide shelter for juvenile fishes and forage fishes, as well as substrate for aquatic invertebrates and algae that serve as their food stocks. It should be noted that placement of such structures may require a Wisconsin Department of Natural Resources permit pursuant to Chapter 30 of the *Wisconsin Statutes*. A copy of WDNR Form 3500-93 (R 3/2002), Application for Fish Cribs, is appended hereto as Appendix C. Examples of various types of fish cribs and similar structures designed to enhance lake fisheries are provided therein. In addition, given the fact that the Lake surface is intensively used for a variety of active water sports, due cognizance must be given to the placement of structures to avoid potential conflicts, including public safety concerns, with other recreational uses.

Modification of Species Composition

Species composition management refers to a group of conservation and restoration measures that include the stocking of desirable species designed to enhance the angling resource value of a lake. The mixture of species is determined by the stocking objectives. These are usually to: supplement an existing population, maintain a population that cannot reproduce itself, add a new species to a vacant niche in the food web, replace species lost to a natural or man-made disaster, or establish a fish population in a depopulated lake. In the case of Booth Lake, smaller fishes that form the food stocks for the bass appears to be underrepresented in the fish community,[11] as are smallmouth bass, which were reported to have historically formed a significant portion of the fish population. While assistance in stocking programs and fisheries management is potentially available through the Wisconsin Department of Natural Resources, the ability of Booth Lake to utilize such assistance is limited by the lack of

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[10]Ibid.

[11]Ibid.

adequate public recreational boating access, pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*; however, assistance may be privately available from local commercial hatcheries. Fish stocking may require a Wisconsin Department of Natural Resources permit.

Regulations and Public Information

The open season, size limits, and bag limits for the fish species of Booth Lake are given in Table 8. Enforcement of these regulations is important to the success of any sound fish management program. Such requirements provide an opportunity for both game and forage fish population to reach a sustainable level.

In addition, the conduct of periodic creel surveys using volunteer monitors can provide a cost-effective means of obtaining additional data on the fish populations and fisheries in Booth Lake. Alternative approaches to the conduct of this type of survey could include creel census-takers stationed at the boat access site, the distribution of questionnaires to riparian households, and similar voluntary reporting mechanisms. Examples of available resources for the conduct of such citizen-based surveys are provided in Appendix D.

Recommended Management Measures

Based upon the results of the fishery survey conducted in parallel with this planning program,[12] the following fisheries management measures, designed to improve and enhance the Lake fishery, are recommended to be considered:

- Encourage the use of natural vegetation and other "soft" shoreline protection options in shoreland management zones to aid in habitat protection;
- Promote the creation of fish habitat within Booth Lake through the provision of additional shoreline and in-lake structure as appropriate:[13]
  - — Deadfalls or other constructs are recommended to be placed into the nearshore waters at approximately 300- to 400-feet intervals along the shoreline, providing cover for minnows and other predatory fish, such as largemouth bass;
  - — Brush bundles and other similar structures are recommended to be placed to a depth of 10 feet; and,
  - — Fish cribs, placed in groups of three, are recommended to be placed to a depth of 15 feet, providing habitat and cover for bass;
- Consider the stocking of fishes:[14]
  - — Initially, smaller fishes that form the food stocks for the predatory fishes, such as bass, are recommended to be stocked;

[12]Ibid.

[13]Ibid.

[14]Ibid.

Table 8

WISCONSIN STATE FISHING REGULATIONS: 2002-2003

Species	Open Season	Daily Limit	Minimum Size
Northern Pike	May 4 to March 1	2	26 inches
Walleyed Pike	May 4 to March 1	5	15 inches
Largemouth and Smallmouth Bass	May 4 to March 1	5	14 inches
Bluegill, Pumpkinseed (sunfish), Crappie, and Yellow Perch	Open all year	25	None
Bullhead and Rough Fish	Open all year	None	None

Source: Wisconsin Department of Natural Resources Publication No. PUB-FH-301 2002, Guide to Wisconsin Hook and Line Fishing Regulations 2002-2003, *January 2002, and SEWRPC.*

  - — Secondly, periodic monitoring of fish populations is recommended to be conducted to determine when adequate food stock populations for predatory fishes have been established and are stable; and,

  - — Finally, stocking of smallmouth bass and yellow perch could be considered to restore historic populations of these species in the Lake that are underrepresented in the current fish population;

- Continue monitoring and stocking until habitat improvements are fully in place, with appropriate monitoring to determine if and when these populations become self-sustaining; and,

- Utilize fishing regulations to protect stocked fishes to improve the opportunity for their populations to become self-sustaining—it is recommended that residents participate in volunteer creel surveys so that an ongoing monitoring of the fish population in Booth Lake can be carried out.

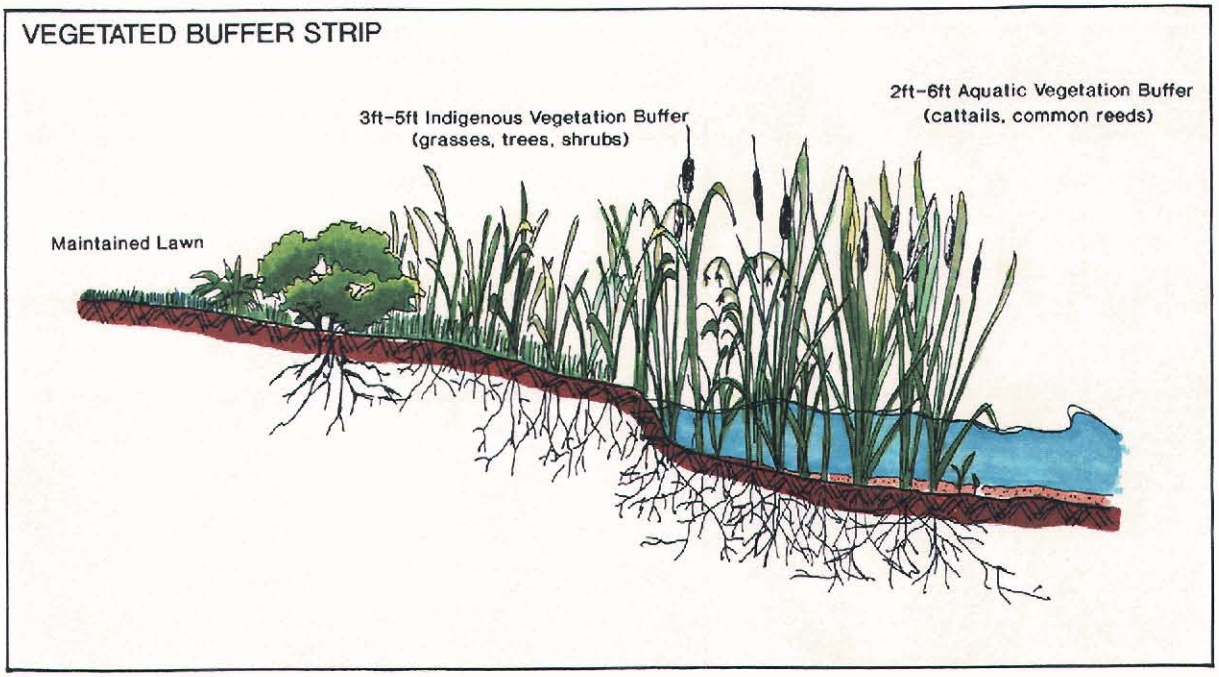
SHORELAND AND IN-LAKE AQUATIC PLANT MANAGEMENT

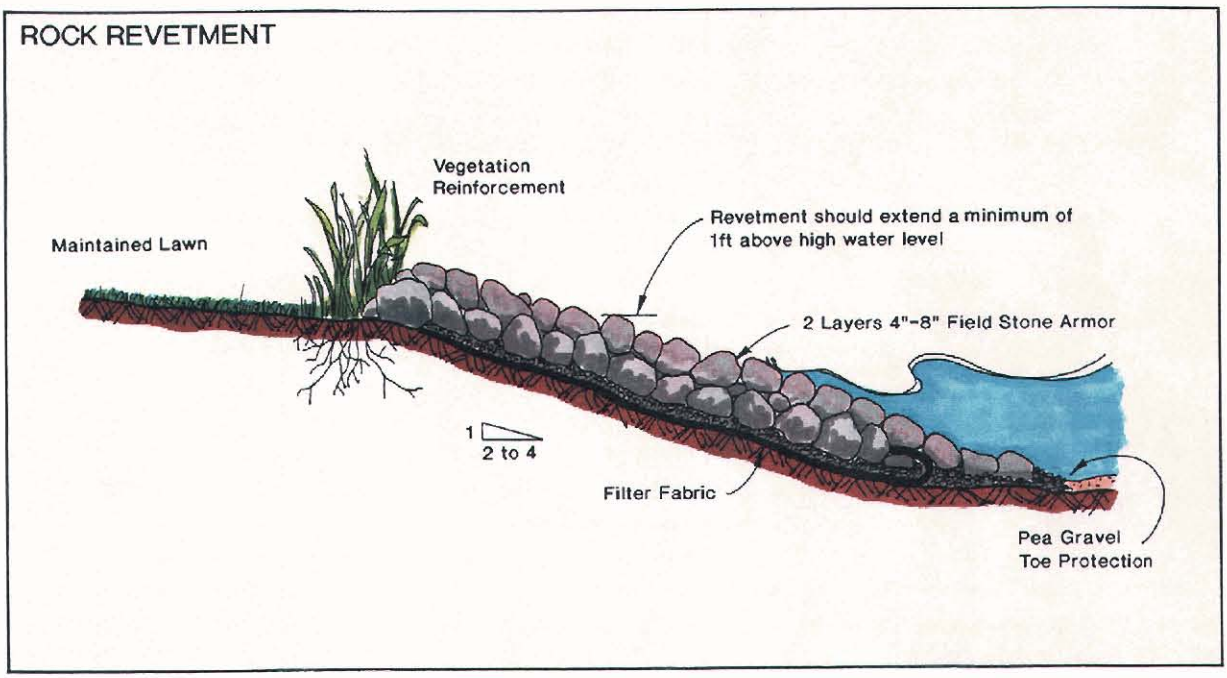
The shoreland and aquatic macrophyte management elements of this plan consider alternative management measures consistent with the provisions of Chapters NR 103 and NR 107 of the *Wisconsin Administrative Code.* Further, the alternative aquatic plant management measures are consistent with the requirements of Chapter NR 7 of the *Wisconsin Administrative Code,* and with the public recreational boating access requirements relating to the grant program, set forth under Chapter NR 1 of the *Wisconsin Administrative Code.*

Shoreline management measures refer to a group of measures designed to reduce and minimize shoreline loss due to erosion by waves, ice, or related action of the water. Currently, about one-half of the shoreline of Booth Lake is protected by some type of structural measure, including bulkheads and areas where riprap had been used to stabilize the shoreline. Most of the observed shoreline protection measures were in a good state of repair. Shoreline erosion was found to exist only at isolated locations on Booth Lake and no serious problems were identified. Alternative shoreline protection structures to be considered include measures such as vegetative buffer strips and riprap, as shown in Figure 6. These alternatives were selected because they can be constructed, at least partially, by local residents; because most of the construction materials involved are readily available; because the measures 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.

Figure 6

PLAN ALTERNATIVES FOR SHORELINE EROSION CONTROL





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

Source: SEWRPC.

Array of Management Measures

Aquatic plant management measures are classed into four groups: physical measures, which include lake bottom coverings and water level management; mechanical removal measures, which include harvesting and manual removal; chemical measures, which include the use of aquatic herbicides; and biological control measures, which include the use of various organisms, including insects. All control measures are stringently regulated and require a State of Wisconsin permit pursuant to Chapters NR 107 and NR 109 of the *Wisconsin Administrative Code*. Placement of bottom covers also requires a Wisconsin Department of Natural Resources permit under Chapter 30 of the *Wisconsin Statutes*.

Physical Control Measures

Lake bottom covers and light screens provide limited control of rooted plants by creating a physical barrier which reduces or eliminates 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 areas so covered in about a year. Synthetic material, such as polyethylene, polypropylene, fiberglass, and nylon can provide relief from rooted plants for several years. However, because of the need to encourage aquatic plant growth, while simultaneously controlling the growth of Eurasian water milfoil, the placement of lake bottom covers as a method to control aquatic plant growth does not appear to be warranted and is not recommended for Booth Lake.

Manual Control Measures

The physical removal of specific types of vegetation by selective harvesting of plants provides a highly selective means of controlling the growths of nuisance aquatic plant species, including purple loosestrife and Eurasian water milfoil. Pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*, manual harvesting of aquatic plants within a 30-foot-wide corridor along a 100-foot length of shoreline would be allowed without a Wisconsin Department of Natural Resources permit, provided the plant material is removed from the Lake. Any other manual harvesting would require a State permit, unless employed in the control of designated nonnative invasive species, such as Eurasian water milfoil or curly-leaf pondweed.

In the shoreland area, where purple loosestrife may be expected to occur, bagging and cutting loosestrife plants, for example, prior to the application of chemical herbicides to the cut stems, can be an effective control measure for small infestations of this plant. Loosestrife management programs, however, should be followed by an annual monitoring and control program for up to 10 years following the initial control program to manage the regrowth of the plant from seeds. Manual removal of such plants is recommended for isolated stands of purple loosestrife when and where they occur.

In the nearshore area, specially designed rakes are available to assist in the removal of nuisance aquatic plants, such as Eurasian water milfoil. The use of such rakes also provides a safe and convenient method of controlling aquatic plants in deeper nearshore waters around piers and docks. Should the Booth Lake Management District acquire a number of these specially designed rakes, they could be made available for the riparian owners to use on a trial basis to test their operability before purchasing them. The advantage of the rake is that it is easy and quick to use, immediately removing the plants.

Hand pulling of stems, where they occur in isolated stands, provides an alternative means of controlling plants, such as Eurasian water milfoil in the Lake and purple loosestrife on the lakeshore. Because this is a more selective measure, and given the need to enhance the native aquatic plant community in the Lake, the rakes being nonselective in their harvesting, manual removal of Eurasian water milfoil is recommended in Booth Lake where practicable and feasible. This technique has been used extensively in the Lake, with SCUBA divers and property owners removing the milfoil plants, and continues to be a feasible option. Likewise, manual removal of isolated stands of purple loosestrife along the lakeshore, if and when such growths occur, continues to be a feasible option.

Chemical Control Measures and Aquatic Herbicides

Chemical treatment with herbicides is a short-term method of controlling heavy growths of nuisance plants. The use of herbicides can potentially damage or destroy nontarget plant species that provide habitat for fishes and other wildlife. Widespread chemical treatments can also provide an advantage to less desirable, invasive, introduced plant species to the extent that they may outcompete the more beneficial, native species. Hence, this is seldom a feasible management option to be used on a large scale. Nevertheless, limited chemical control is often a viable technique for the control of the relatively small-scale infestations of aquatic plants, such as Eurasian water milfoil, or shoreland plants, such as purple loosestrife. Chemicals are generally applied to the growing plants in liquid form. Chemical treatment can be administered at a relatively low cost and is, therefore, considered to be a viable management option in conjunction with manual removal, in this specific situation. Chemical control applications are stringently regulated and require a Wisconsin Department of Natural Resources permit.

Biological Control Measures

Classical biological control has been successfully used to control both weeds and herbivorous insects.[15] Recent evidence shows that *Galerucella pucilla* and *Galerucella calmariensis*, beetle species, and *Hylobius transversovittatus* and *Nanophyes brevis*, weevil species, have potential as biological control agents for purple loosestrife, while *Eurhychiopsis lecontei*, an aquatic weevil species, has potential as a biological control agent for Eurasian water milfoil.[16] Extensive field trials conducted by the Wisconsin Department of Natural Resources in the Southeastern Wisconsin Region during 1999 and 2000 have indicated that these insects can provide effective management of large infestations of purple loosestrife. In contrast, very few studies have been completed using *Eurhychiopsis lecontei* as a means of aquatic plant management control. Thus, while the use of insects as a means of wetland plant management is considered to be viable, the use of *Eurhychiopsis lecontei* as a means of aquatic plant management control is not recommended for use on Booth Lake at this time. Grass carp, *Ctenopharyngodon idella*, an alternative biological control used elsewhere in the United States, are not permitted in Wisconsin.

Few lakes in Southeastern Wisconsin lack aquatic plant growth. Booth Lake is one of a limited number of lakes that would benefit from a greater density and diversity of aquatic plants. Low-growing plants, such as spiny naiad and muskgrass, which provide food and shelter for fish and waterfowl, do occur in the Lake. However, because of their low-growing height, these species are often outcompeted by Eurasian water milfoil. Eurasian water milfoil grows rapidly to the lake surface, capturing the available sunlight and shading out the native species. Thus, control of the Eurasian water milfoil, using manual and chemical means as noted above, is one means of promoting the growth of native plants, and is recommended for Booth Lake.

While there have been some attempts, notably in Lac La Belle in Waukesha County, to transplant native aquatic plants between Lakes within the Region, these largely have proven less than successful. Transplantation of aquatic plants is extremely labor-intensive, and may require a State of Wisconsin permit. Therefore, it is not recommended for use in Booth Lake. Note, however, that creation of additional aquatic habitat in shoreland areas through the use of vegetated buffer strips and provision of structure through deadfalls or placement of other structures into the Lake is recommended for fisheries management purposes.

Public Informational and Educational Programming

As part of the overall citizen informational and educational programming to be conducted in the Booth Lake community, residents and visitors in the vicinity of Booth Lake should be made aware of the value of the ecologically significant areas in the overall structure and functioning of the ecosystems of Booth Lake. Specifically, informational programming related to the protection of ecologically valuable areas in and around

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[15]*B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* LakeLine, *Vol. 17, No. 3, September 1997, pp. 20-21, 34-37.*

[16]*Sally P. Sheldon, "The Potential for Biological Control of Eurasian Water Milfoil (*Myriophyllum spicatum*) 1990-1995 Final Report," Department of Biology Middlebury College, February 1995.*

Booth Lake should focus on need to minimize the spread of nuisance aquatic species, such as purple loosestrife and Eurasian water milfoil.

Educational and informational brochures and pamphlets, of interest to homeowners and supportive of the lake management program, are available from the University of Wisconsin-Extension, the Wisconsin Department of Natural Resources, the Walworth County Offices, and many Federal government agencies. These brochures could be provided to homeowners through local media, direct distribution, or targeted library/civic center displays. Alternately, they could be incorporated into the newsletters produced and distributed by the Booth Lake Management District. Many of the ideas contained in these publications can be integrated into ongoing, larger-scale activities, such as anti-littering campaigns, recycling drives and similar pro-environment activities.

Other informational programming offered by the Booth Lake Management District, the Wisconsin Department of Natural Resources, Walworth County, and the University of Wisconsin-Extension, such as the Adopt-A-Lake program and Project WET (Water Education Training) curriculum, can contribute to an informed public, actively involved in the protection of ecologically valuable areas within the drainage area tributary to Booth Lake. Citizen monitoring and awareness of the positive value of native aquatic plant communities are important opportunities for public informational programming and participation that are recommended for Booth Lake.

Recommended Management Measures

Maintenance of existing shoreline protection structures is recommended. Where appropriate or necessary, replacement of existing structures with more natural shoreland protection measures is recommended. If additional shore protection is installed, it is recommended that consideration be given to the visual aesthetics of blending various types of construction along the shore. This will not only enhance the visual appeal of the shoreline, but will also minimize the edge effects that can occur as the result of two dissimilar abutting styles of construction. Vegetative buffer strips may also desirable be for selected areas in this Lake.

In the case of Booth Lake, two differing aquatic plant management actions are recommended. In the first case, control of the Eurasian water milfoil populations present within the Lake is required to limit the spread of this invasive, nonnative species using primarily manual, and, to a lesser degree, chemical, means. In the second case, as noted in the aforereferenced fisheries survey,[17] actions are required to encourage the growth of native aquatic plants within the lake basin, through the control of Eurasian water milfoil, as a means of providing and enhancing fish habitat. Other options for the protection and establishment of aquatic vegetation in the Lake are limited to biological means, such as the dropping of deadfalls or placement of fish cribs into the nearshore area of the Lake to provide fish habitat. Placement of structures of the bed of a lake or other navigable water is subject to permitting by the WDNR, pursuant to Chapter 30 of the *Wisconsin Statutes*. The relevant application form for the placement of fish cribs to enhance fisheries habitat is appended hereto as Appendix C.

In addition, it is recommended that ecologically valuable areas be excluded from aquatic plant management activities, especially during fish spawning seasons in early summer and autumn. Only herbicides that selectively control Eurasian water milfoil, such as 2,4-D, should be used. Chemical applications, if required, should be made in early spring to maximize their effectiveness on nonnative plant species, while minimizing impacts on native plant species and acting as a preventative measure to reduce the development of nuisance conditions. Extensive use of chemical herbicides, however, is not recommended.

Public informational programming is a common element in all of these cases and ongoing public informational programming is recommended.

[17]Ibid.

ANCILLARY PLAN RECOMMENDATIONS

Lake Water Quality Monitoring

The participation of Booth Lake in the Wisconsin Department of Natural Resources Self-Help Monitoring Program, which involves citizen volunteers taking Secchi-disc transparency readings in the Lake at regular intervals, should be continued. Data gathered as part of this program should be presented annually by the volunteers at the annual meeting of the Booth Lake Management District, where the citizen monitors could be given some recognition for their work. The Lake Coordinator of the Wisconsin Department of Natural Resources, Southeast Region, could assist in enlisting more volunteers in this program. The information gained at first hand by the public from participation in this program can increase the credibility of the proposed changes in the nature and intensity of use to which the Lake is subjected.

Public Informational Programming

With respect to informational programming, distribution of posters and pamphlets, available from the University of Wisconsin-Extension and Wisconsin Department of Natural Resources, that provide information and illustrations of aquatic plants, their importance in providing habitat and food resources in aquatic environments, and the need to control the spread of undesirable and nuisance plant species is recommended. Currently, many lake residents seem to view all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering their environmental impact. Inclusion of specific public informational and educational programming within the activities of the Booth Lake Management District is recommended. These programs should focus on the value of and the impacts of these plants on water quality, fish, and on wildlife; and on alternative methods for controlling existing nuisance plants, including the positive and negative aspects of each method. These programs can be incorporated into the comprehensive informational and educational programs that also would include information on related topics, such as water quality, recreational use, fisheries, and onsite sewage disposal systems.

Lastly, it is recommended that aquatic plant surveys be conducted at about five-year intervals, depending upon the observed degree of change in the aquatic plant communities. In addition, information on the aquatic plant control program should be recorded and should include descriptions of major areas of nuisance plant growth and areas chemically treated.

SUMMARY

This plan, which documents the findings and recommendations of a study requested by the Booth Lake Management District, examines existing and anticipated conditions, potential aquatic plant management problems, and recreational use problems on Booth Lake. The plan sets forth recommended actions and management measures for the resolution of those problems. The recommended plan is summarized in Table 9 and shown on Map 16.

Booth Lake was found to be a mesotrophic waterbody of average to above average water quality. Groundwater inflows to the Lake are an important factor in maintaining high-quality lake water. Preservation of environmental corridor lands, and especially within the shoreland and nearshore areas situated immediately adjacent to the Lake, is recommended. Walworth County, the Towns of Troy and East Troy, together with the Booth Lake Management District, should support appropriate land management practices designed to reduce nonpoint source pollutant discharges in stormwater runoff and maintain the current inflow of high-quality groundwater to the Lake. These recommendations also include the provision for clustering any new development south of the Lake that, while not draining directly to the Lake, may impact the groundwater recharge and inflows to the Lake. Further, the Lake Management District should promote appropriate shoreline management practices, including the use of vegetative buffer strips, where applicable.

The Booth Lake shoreland and aquatic plant management plan recommends actions be taken to reduce human impacts on ecologically valuable areas in and adjacent to the Lake, and reduce human impacts on the in-lake

Table 9

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN ELEMENTS FOR BOOTH LAKE

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Land Use Management[a]	Land use zoning	Entire Watershed	Observe guidelines set forth in the regional and local land use plans, and Walworth County land and water resource management plan; maintain historic lakefront residential dwelling densities to the extent practicable; protect environmentally sensitive lands as recommended in the regional natural areas and critical species habitat protection and management plan; encourage conservation development practices providing for the clustering of any new development beyond the lake drainage area to minimize nonpoint pollution impacts on, and potential losses of, groundwater recharge	Walworth County, Village of East Troy, Town of East Troy, Town of Troy
	Onsite sewage disposal system management	Entire Watershed	Develop and implement a regular system of inspection, maintenance, and pumping for onsite sewage disposal systems within the drainage area tributary to Booth Lake pending the long-term provision of public sanitary sewerage services as set forth in the adopted regional plans	Walworth County, Booth Lake Management District
	Ordinance enforcement	Entire Watershed	Enforce construction site erosion control, stormwater management, development control, and onsite sewage disposal system inspection and maintenance ordinances and programs as necessary	Walworth County
Fisheries Management[a]	Develop a fishery enhancement program based upon recent fisheries survey	Booth Lake	Review survey data and habitat protection measures for improved fisheries as needed; continue to enforce fishing regulations and review as necessary Enhance existing shoreline and nearshore structure through native aquatic and shoreland vegetation plantings and control of nuisance aquatic plants to improve the fishery forage base Increase fish habitat using natural and artificial structures Consider fish stocking Monitor fish populations through fish surveys; consider developing a Lake resident volunteer creel census program	Booth Lake Management District in cooperation with the Wisconsin Department of Natural Resources, and/or private firm if needed
Recreational Use Management	Public Boating Access	Booth Lake	Provide adequate, unrestricted parking facilities to meet Chapter NR 1 public recreational boating access standards	Memorial Park Board, Booth Lake Management District
	Nonnative aquatic plant management program	Eurasian water milfoil control zone	Limit recreational boating through Eurasian water milfoil areas to minimize the spread of the plant throughout the Lake; limited use of herbicides in spring, and manual removal during summer and fall recommended	Booth Lake Management District

Table 9 (continued)

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Aquatic and Shoreland Plant Management	Manual harvesting[b]	Areas of nuisance growth around piers, docks, and beaches	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers especially during summer and fall; collect plant fragments arising from boating and harvesting activities	Booth Lake Management District, private lakeshore homeowners
	Chemical control of nonnative plants	Eurasian water milfoil control zone and areas containing purple loosestrife	Consider limited use of herbicides in spring	Booth Lake Management District
	Native aquatic plant community establishment	Areas lacking native aquatic plant diversity and numbers of plants	Encourage shoreland management practices that promote native plant growth in and adjacent to the Lake	Booth Lake Management District and private lakeshore home owners
Ancillary Management Measures	Monitoring programs[c,d]	Booth Lake	Continue to participate in the WDNR Self-Help monitoring program; conduct an aquatic plant survey every 3 to 5 years; periodically monitor fish populations to measure stocking success	Booth lake Management District, Wisconsin Department of Natural Resources
	Public informational programming	Direct drainage area tributary to Booth Lake	Continue public awareness and informational programming	Walworth County, Booth Lake Management District

[a]*Land use recommendations are those set forth in the regional land use, water quality management, and natural areas and critical species habitat protection and management plans. No specific cost allocation for the Booth Lake Management District. Fisheries management recommendations are those set forth in the report of Rand Atkinson, Aquatic Resources and Glacial Pond Farms,* Booth Lake, Walworth County Fish Survey & Recommendations for Future Management 2000, *2001. Costs include the costs of providing additional in-lake habitat, shoreline structure, and selective stocking of specific fishes.*

[b]*Measures recommended generally involve low or no cost and would be borne by private property owners. Cost is included under public informational and educational component.*

[c]*Partial funding available through the Wisconsin Department of Natural Resources grant programs.*

[d]*Periodic additional surveys are recommended annually for water clarity, and at three- to five-year intervals for aquatic plant communities, and five- to 10-year intervals for fish communities.*

Source: SEWRPC.

macrophyte beds, especially those beds dominated by Eurasian water milfoil, to limit the spread of nonnative invasive plant species. The plan recommends that boating traffic be restricted where Eurasian water milfoil is prevalent. The plan recommends limited aquatic plant management measures, associated with manual harvesting of Eurasian water milfoil and purple loosestrife. Use of chemical herbicides is recommended to be limited, mainly to areas where nonnative invasive species are present. The plan also recommends establishing nearshore native aquatic floating and emergent vegetation to increase species diversity and numbers, primarily through the control of nonnative, invasive species, such as Eurasian water milfoil and purple loosestrife.

The recommended plan includes continuation of an ongoing program of public information and education, focussing on providing riparian residents and lake users with an improved understanding of the lake ecosystem. For example, additional options regarding household chemical usage, lawn and garden care, onsite sewage disposal system operation and maintenance, shoreland protection and maintenance, and recreational usage of the Lake should be made available to riparian property owners, thereby providing riparian residents with alternatives to traditional activities.

Map 16

RECOMMENDED LAKE MANAGEMENT PLAN FOR BOOTH LAKE

—20'— WATER DEPTH CONTOUR IN FEET

LAND USE MANAGEMENT

- PRESERVE ENVIRONMENTAL CORRIDORS
- PROMOTE GOOD HOUSEKEEPING PRACTICES IN URBAN AREAS

FISHERIES MANAGEMENT

- PROVIDE SHORELINE AND IN-LAKE STRUCTURE AS FISH HABITAT (In addition this measure is applicable in other selected areas)

RECREATIONAL USE MANAGEMENT

- PUBLIC RECREATIONAL BOATING ACCESS SITE - PROVIDE ADEQUATE PARKING PER NR 1

AQUATIC PLANT AND SHORELINE MANAGEMENT

- EURASIAN WATER MILFOIL CONTROL AREA
- LIMIT BOATING TRAFFIC TO MINIMIZE SPREAD
- LIMITED AQUATIC HERBICIDE USE
- MANUAL HARVESTING OF PLANTS

WATER QUALITY MANAGEMENT

- CONTINUE PARTICIPATION IN WISCONSIN DEPARTMENT OF NATURAL RESOURCES SELF-HELP MONITORING PROGRAM
- CONTINUE PUBLIC AWARENESS PROGRAM

DATE OF PHOTOGRAPHY: MARCH 2000

GRAPHIC SCALE

0 1/32 1/16 MILE

0 300 600 FEET

Source: SEWRPC.

Finally, the recommended plan seeks to balance the demand for high-quality residential and recreational opportunities at Booth Lake with the requirements for environmental protection. To this end, the plan emphasizes expanding the parking facilities at the existing boat access site on the southeastern portion of the Lake so that they are consistent with the requirements of Chapter NR 1.91 of the *Wisconsin Administrative Code.* The plan also recommends improving the present lake fishery by developing nearshore and deeper-water habitat sites that provide cover and structure, stocking the lake with forage fish and game fish, and improving the aquatic plant community by encouraging the growth of native floating and emergent vegetation, especially in the nearshore areas, and by controlling nonnative invasive plant species, such as Eurasian water milfoil.

APPENDICES

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Appendix A

ILLUSTRATIONS OF COMMON AQUATIC PLANTS FOUND IN BOOTH LAKE

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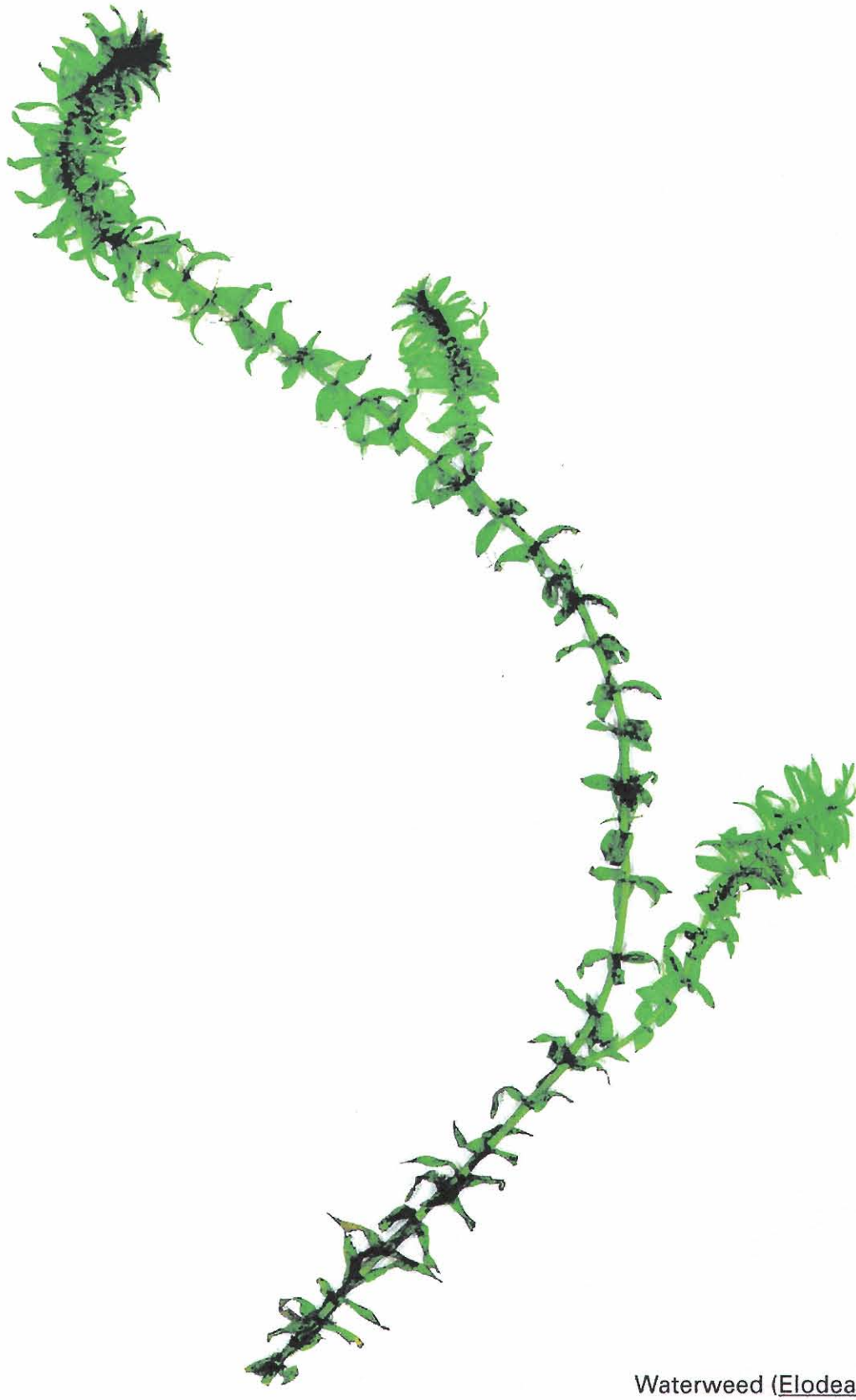
Muskgrass (Chara vulgaris)



Waterweed (Elodea canadensis)

Eurasian Water Milfoil (Myriophyllum spicatum)

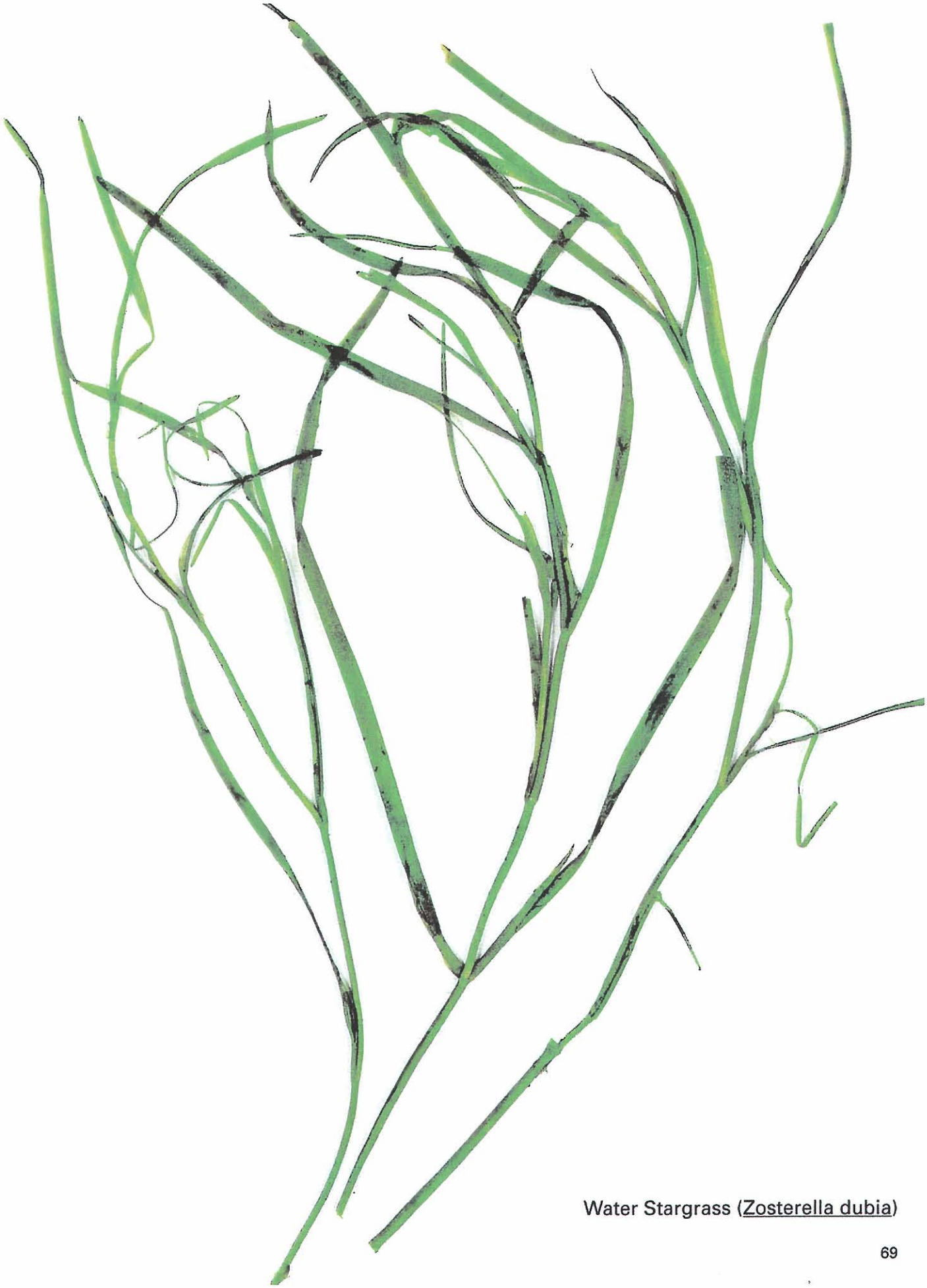
Spiny Naiad (Najas marina)

Variable Pondweed (Potamogeton gramineus)

Illinois Pondweed (Potamogeton illinoensis)

Water Bulrush (Scirpus subterminalis)

Eel Grass / Wild Celery (Valisneria americana)



Water Stargrass (Zosterella dubia)

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Appendix B

RECREATIONAL BOATING ORDINANCES APPLICABLE TO BOOTH LAKE

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CHAPTER 14 –

ENVIRONMENTAL PROTECTION

ORDINANCE- 2001-04

A. WATER TRAFFIC ORDINANCE:

This ordinance is entitled the "Town of Troy Water Traffic Ordinance". The purpose of this ordinance is as follows: An Ordinance to regulate water traffic, boating and water sports upon the waters of Booth Lake and Lulu Lake, and prescribing penalties for violation thereof. The Town Board of the Town of Troy, Walworth County, Wisconsin do ordain as follows:

Section 1. **Intent.** The intent of this ordinance is to provide safe and healthful conditions for the enjoyment of aquatic recreation consistent with public rights and interest and the capability of the water resource.

Section 2. **Applicability.** The provisions of this ordinance shall apply to the waters of Booth Lake and Lulu Lake, within the jurisdiction of the Town of Troy.

Section 3. **Enforcement.** The provisions of this ordinance shall be enforced by all duly constituted peace officers of the Town of Troy.

Section 4. **State Boating and Water Safety Law Adopted.** The statutory provision describing and defining regulations with respect to water traffic, boats and related activities and safety in the following enumerated sections of the Wisconsin Statues, exclusive of any provisions therein relating to the penalties to be imposed or the punishment for violation of said statues, are hereby adopted and by reference made a part of this ordinance.

30.50 Definitions
30.51 Operation of unnumbered motorboats prohibited.
30.52 Certificates of number
30.53 Identification number to be displayed on boat, certificate to be carried.
30.54 Transfer of ownership of numbered boat
30.55 Notice of abandonment or destruction of boat or change of address
30.60 Classification of motorboats
30.61 Lighting equipment
30.62 Other equipment
30.63 Motorboat prohibition
30.64 Patrol boats exempt from certain traffic regulations
30.65 Traffic rules
30.66 Speed restrictions
30.67 Accidents and accident reports
30.68 Prohibited operation
30.69 Water Skiing
30.70 Skin Diving
30.80 Inclusive

Section 5. **Additional Definitions.** In this ordinance:

(a) "Person" means an individual, firm, partnership, corporation or any other association or individuals organized together for any purpose whatsoever.

(b) "Slow-no-wake" is defined as the slowest speed required to maintain steerage.

(c) "Traffic Lane" means that part of a lake lying more than 150 feet from the shore, or from any dock, raft, pier.

(d) "Commercial passenger boat" means any boat for hire to carry farepaying passengers.

Section 6. **Additional Speed Restrictions.** In addition to the speed restrictions on Section 4 (30.66), above, no person shall operate a motorboat at a speed in excess of the following:

(a) From 7:00 p.m. to 10:00 a.m.-slow-no-wake
(b) Except in the traffic lane, slow-no-wake
(c) On all of Lulu Lake, slow-no-wake
(d) All motor traffic traveling faster than slow-no-wake shall operate in a counterclockwise direction.

Section 7. **Water Skiing.**

(a) No motor boat operator shall tow more than one water skier nor shall any water skier allow himself to be towed by any motor boat already towing one water skier, except however, the towing of two skiers shall be allowed on Mondays through Fridays, excepting legal holidays.
(b) In water skiing, both boat and skier shall at all times remain in the traffic lane.
(c) No person shall operate a boat for the purpose of towing a water skier, aquaplane or similar device, or engage in water skiing or aquaplaning at any time between the hours of 7:00 p.m. and 10:00 a.m.

(d) No person shall water ski or aquaplane in a marked weedbed or fish spawning area.

Section 8. "Any person violating section 6 or section 7 of the Town of Troy boating ordinance shall forfeit not more than $50.00 (plus court cost) for the first offense and shall forfeit no more that $100.00 (plus court cost) upon conviction of the same offense a 2nd or subsequent time within one year."

Section 9. **Severability.** The provisions of this ordinance shall be deemed severable and it is expressly declared that the Town Board would have passed the other provisions of this ordinance irrespective of whether one or more provisions of this ordinance or the application thereof to any person or circumstances is held invalid, the remainder of the ordinance and the application of such provisions to other persons or circumstances shall not be affected thereby.

Section 10. **Wisconsin Statues Defined.** Wherever used in this ordinance the term "Wisconsin Statues" shall mean the Wisconsin Statues of 2000 with all subsequent amendments.

Section 11.**Effective Date: Clerk's Duty.**

(a) This ordinance shall take effect and be in force from and after passage, publication and posting as provided by law.

(b) The Clerk of the Town of Troy is directed to file a copy of this ordinance with the Department of Natural Resources, State Capital, Madison, Wisconsin.

(c) Adopted by the Town of Troy this 9th day of May 2001.

TOWN BOARD OF THE TOWN OF TROY

Samual L. Murdock, Chairman

John Kendall, Supervisor

Allen Curler, Supervisor

Attest: Ruth Polinski, Clerk

Appendix C

WISCONSIN DEPARTMENT OF NATURAL RESOURCES PERMIT APPLICATION FORM FOR PLACEMENT OF IN-LAKE STRUCTURES

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State of Wisconsin
Department of Natural Resources

APPLICATION FOR FISH CRIBS
Form 3500-93 (R 3/2002)

Thank you for contacting the Wisconsin Department of Natural Resources
Enclosed are the project application materials you have requested.

Fish Crib Information Requirements

The following information is required on all applications for a permit to place a fish crib on the bed of a lake. Please submit:

1. A completed application form #3500-93 dated and signed.

2. In the "proposed materials" box, indicate the type of material which will be used to construct the fish habitat structure(s).

NOTE: Any nails, staples, wire, etc. used to build cribs must be **GALVANIZED OR STAINLESS STEEL**

3. In the "location sketch" box draw in a map of your property and the waterway and attach a lake survey map or hydrographic map. On the maps indicate the following:
   a. Location of applicant's property showing the nearest town road or county/state highway.
   b. Fire number of your property.

4. Under "project plans", a top view and side view of the fish crib as shown in the sample drawing. Indicate the scale or dimensions on the drawing.

   The top view should include:

   a. Location of fish habitat structure(s) and distance from the shoreline. Also show the distance between structures if you propose to place more than one structure.

   The side view should include:

   a. The length, width and height of the structure(s).
   b. How the structures(s) will be anchored to the lakebed.
   c. Water depth at the location of the structure(s). For impoundments or flowages show depth of the water during low water periods.

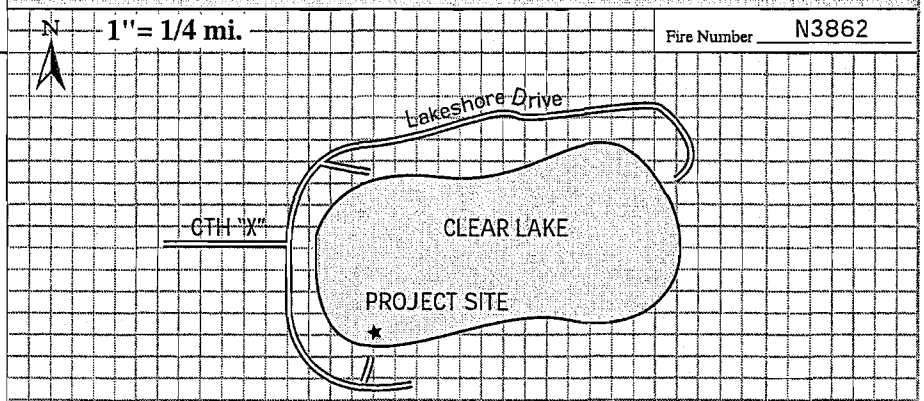
Please send the completed application to the Water Management Specialist for the county where your project is located (A complete listing of addresses by county can be found on the Waterway and Wetland Permits web page link below).

http://www.dnr.state.wi.us/org/water/fhp/waterway/wmscoun.htm

DRAWINGS OF PROPOSED ACTIVITY SHOULD BE PREPARED IN ACCORDANCE WITH SAMPLE DRAWING

Location Sketch (Indicate scale.) Show route to project site: include nearest main road and crossroad.

FISH CRIBS 1 of 2
SAMPLE DRAWING



Fire Number N3862

Proposed Materials

40-6" to 8" diameter 8' green hardwood logs

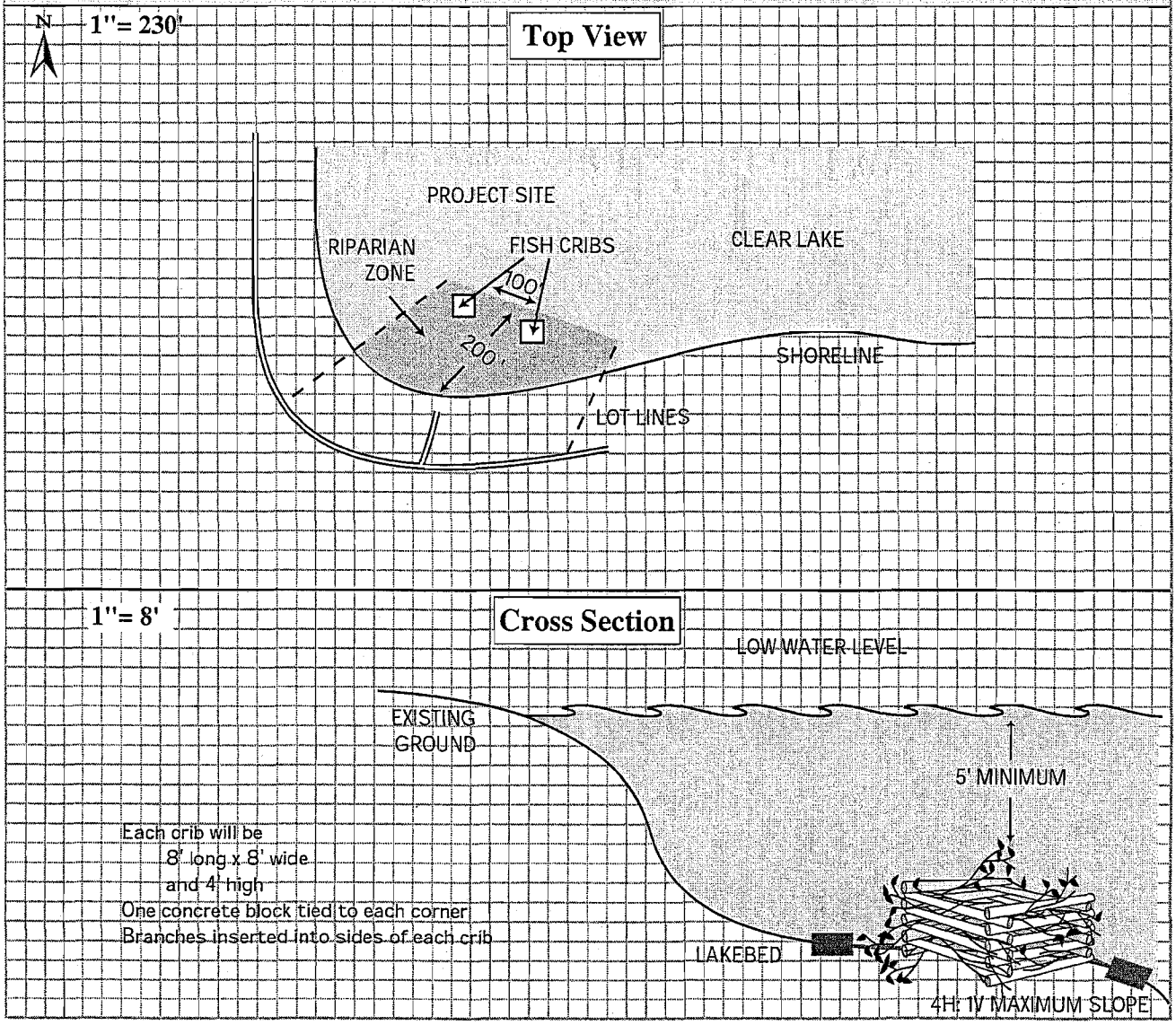
8-1/2" x 8" polyethelene rods

40 maple branches

8 concrete blocks

Nylon rope

Project Plans. (Include top view and typical cross sections. Clearly identify features and dimensions or indicate scale.) Use additional sheets if necessary.



State of Wisconsin
Department of Natural Resources

APPLICATION FOR FISH CRIBS
Form 3500-93 (R 3/2002)
PAGE 1 of 2

This form is required under Section 30.12(3), Wis. Stats. Refusal to provide this information may result in the dismissal of your application. Personally identifiable information on this form will be used for no other purpose.

Landowner's Name	Project Address	Project Location
Street or Route		_____ 1/4, _____1/4, Section_____, T_____N, R_____ (E) (W)
City, State, Zip Code	( ) City ( ) Town ( ) Village of	

Home Telephone No. ( )	Work Telephone No. ( )	Fire Number	Tax Parcel No.	County	Name of Waterway

I hereby certify that the information contained herein is true and accurate. I am the owner of the riparian property or am the duly authorized representative and may sign this application on behalf of the owner(s) of said property. I have read and understand all of the conditions of this permit and attached pages and will construct the above-mentioned project in compliance with all such conditions. I understand that failure to comply with any or all of the provisions of the permit renders the authorization contained herein null and void and may result in a fine and/or imprisonment under the provisions of s. 30.12(5), Wis. Stats. or forfeiture under s. 30.15, Wis. Stats.

Printed or Typed Full Name of Applicant	Signature of Applicant	Date signed

Printed or Typed Full Name of Contractor	Address	Phone Number

ATTENTION! YOU MUST COMPLY WITH THE ATTACHED PERMIT CONDITIONS

FINDINGS OF FACT

1. The Department and the applicant have completed all procedural requirements and the project as permitted will comply with all applicable requirements of Wisconsin Administrative Code and Wisconsin Statutes.
2. The proposed project will not impact wetlands, materially obstruct navigation, is not detrimental to the public interest, and will not adversely affect water quality if the project is constructed in accordance with this permit.
3. The Department has determined that the granting of this permit would not be a major state action significantly affecting the quality of the human environment.

CONCLUSIONS OF LAW

1. The Department has authority under s. 30.12(3), Wis. Stats., and applicable Wisconsin Administrative Codes.
2. The Department has complied with s. 1.11, Wis. Stats.

NOTICE OF APPEAL RIGHTS

If you believe that you have a right to challenge this decision, you should know that the Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed. To request a contested case hearing pursuant to s. 227.42, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. All requests for contested case hearings must be made in accordance with section NR 2.05 (5), Wis. Adm. Code. This section of the code requires that the grounds for the petition for hearing be identified and that the desired changes be described. Pursuant to section NR 2.05 (5), Wis, Adm. Code, and section 227.42, Wis. Stats., you are required to include specific information demonstrating all four of the following:

1. The substantial interest of the petitioner which is injured in fact or threatened with injury by the Department's action or inaction;
2. That there is no evidence of legislative intent that this interest is not to be protected;
3. That the injury to the petitioner is different in kind or degree from the injury to the general public caused by the Department's action or inaction ; and
4. That there is a dispute of material fact (you must specify the disputed facts).

This notice is provided pursuant to s. 227.48(2), Wis. Stats.

LEAVE BLANK - DEPARTMENT OF NATURAL RESOURCE USE ONLY

STATE OF WISCONSIN - DEPARTMENT OF NATURAL RESOURCES
For the Secretary

Issued By _____ Date Signed _____

Title _____ Fee Received $_____

FISH CRIB PERMIT CONDITIONS

1. Your accepting this permit and beginning to construct the project means that you have read, understand and agree to follow all conditions of this permit.

2. A written statement certifying that the project was completed according to the conditions of the permit shall be submitted to the Department within 10 days of project completion.

3. This permit is not valid unless you have obtained all required approvals from other LOCAL, STATE and FEDERAL jurisdictions.

4. The fish crib must:
   a. Not materially obstruct navigation or cause injury to other public rights and interests including fish and game habitat or to private riparian rights.
   b. Be constructed of untreated oak, maple or yellow birch logs or timber not less than 4" in diameter and securely fastened together. No other materials shall be used unless specifically approved under condition 8 below.
   c. Be located so that the top of the structure is no less than five (5) feet below the normal low water level.
   d. Not be placed outside your own riparian zone of interest (usually within the waterward extension of your property's lot lines).
   e. Be placed in areas where the bottom slope is no steeper than 4' horizontal to 1' vertical and the bottom materials are sufficient to support the structure and prevent it from sinking into the bottom.
   f. Not be marked by any buoy or other marking device.
   g. Be weighted to provide firm anchorage to the lake bottom.

5. If the structures are installed through the ice, the resulting open water hole(s) must be fenced as required under Section 167.26, Wisconsin Statutes.

6. If necessary the Department may:
   Amend this permit by changing or adding conditions to ensure that the project is in compliance with all applicable legal requirements and revoke this permit to protect the public interest or prevent material impairment of navigation.

7. This permit expires on November 1 of the calendar year following the date of issuance. No construction may take place after that date unless you obtain a written extension of this permit from the Department before the date the permit expires.

8. Other conditions _____

_____

_____

Copies of this permit sent to:
Conservation Warden
U.S. Army Corps of Engineers
Fisheries Biologist
Water Management Specialist

DRAWINGS OF PROPOSED ACTIVITY SHOULD BE PREPARED IN ACCORDANCE WITH SAMPLE DRAWING

Proposed Materials

Location Sketch (Indicate scale.) Show route to project site: include nearest main road and crossroad.

N 1"= _____ ft.

Fire Number _____

Project Plans. (Include top view and typical cross sections. Clearly identify features and dimensions or indicate scale.) Use additional sheets if necessary.

N 1"= _____ ft.

Top View

Cross Section

Log Fish Crib Design Advice

Fish cribs are designed to attract and concentrate fish for easier harvest by anglers. They may also benefit small fish by providing protection from predators where natural cover is scarce. Fish cribs are not effective in or near natural cover such as aquatic vegetation or stumps. They are intended for use in lakes that lack sufficient natural cover.

Panfish and bass are most readily attracted to fish cribs. Panfish are found in and around the cribs while large and smallmouth bass seek cover along the projecting log ends. When walleyes are present they have been observed underneath the structure or lying alongside the base logs during daylight hours. A number of fish cribs have been evaluated by anglers and the Department of Natural Resources skin-divers. The log fish crib described in this brochure is the basic design considered most suitable for installation in Wisconsin waters.

Fish cribs can be a hazard to navigation if not installed in sufficient water depth, or if they are poorly or improperly constructed. The individuals placing such structures in public waters may be legally liable for injuries or damages resulting from improper construction or installation of cribs.

Green oak, hard maple, yellow birch, beech or iron wood are the only types of wood recommended for use in log crib construction. When green they are dense and heavy enough to sink in water without the addition of other weight. The tops of hardwoods also provide the best material for use in filling the interior of the crib, thereby utilizing the entire tree. Larger hardwood branches are tough and long lasting in water. The crooked nature of these branches prevents tight packing and provides numerous openings for small fish within the crib. Hardwood saplings of sufficient diameter may also be used. Old christmas trees, conifer tops and other small diameter brush should not be used as they pack too tightly and do not last for more than a few years. **DRY LOGS WILL NOT SINK READILY AND SHOULD NOT BE USED.** Concrete blocks can be wired to the crib to ensure sinking.

Materials Required For Construction of One Fish Crib

Four (4) 6-foot by 1/2" solid polyethylene rods [or four (4) 6-foot by 1/2" or 3/4" lengths of nylon or polyethylene rope]

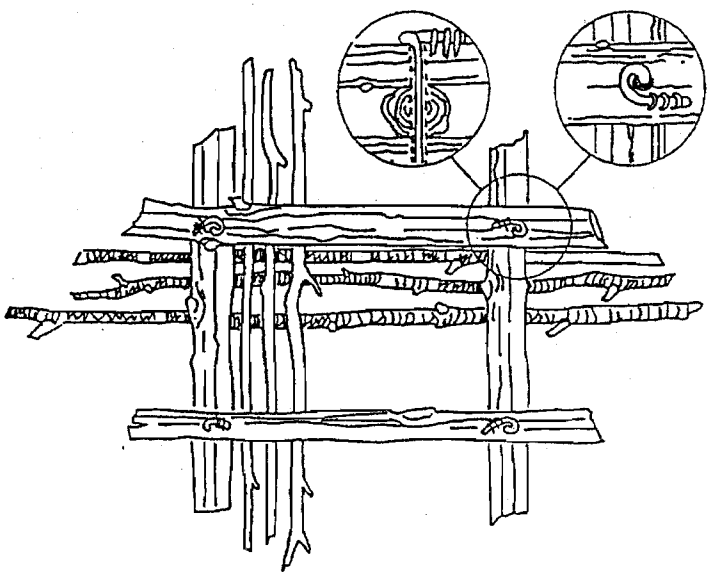
Eighteen (18) 8-foot logs with 6" top
Twenty-four (24) 1-3/4 inch fence staples
A sufficient number of 15' long by 1" to 3" diameter hardwood tops, to line each tier of the log crib.

Construction

The basic log fish crib is constructed with eighteen 8 - foot logs having 4 to 8 inch tops. Logs larger than 8 inches in diameter should be split. All branches (1" to 3" diameter) from the cut trees should be cut in 15 foot lengths for lining each log tier. Four 1/2 inch diameter, 6 foot long solid polyethylene rods are used to secure the log corners. A secondary option is 6-foot lengths of 1/2 or 3/4 inch polyethylene or nylon rope. Steel reinforcing rod is not recommended because it will rust and the crib will eventually deteriorate. Drill 3/4 inch holes in each 8 foot log approximately 15 inches from each butt. All holes should be spaced evenly apart on all logs. The plastic rod will then line up straight vertically through each log allowing for a tighter and more secure crib.

Log Fish Crib Design Advice (continued)

Select the two largest logs for your base logs. Insert the plastic rod through each hole. Heat each rod approximately 8 inches from the end with a propane torch to the point where the rod becomes pliable. Bend the rod 90 degrees with a rotating motion to form a whorled L shaped piece. By creating this whorl it adds strength to the bend. Secure the short portion of the L (approximately 6") to the bottom of the two base logs with 3 - 1 3/4 inch fencing staples. Stapling provides added security from the rod pulling through the logs while transporting the crib to the installation site.



When using lengths of rope, tight knots should be tied and ends stapled to secure the log corners. Place the next largest diameter logs through the rods over the base logs to form a square. Line this tier with a single parallel layer of the 15' long cut tops. These tops should be fairly close to one another with butt ends protruding at an equal distance from each side of the base logs. The cut tops portion of the crib supplies the internal cover for smaller fish. Continue this procedure with the remaining logs and cut tops in log cabin fashion to a height of 4 to 5 feet. Complete the crib by securing the corners. Again, create a whorled L-shaped bend with the torch on the top logs and staple.

Installation Procedures

Fish cribs are usually installed in open-water with a boat and outboard motor. If constructed during the winter, cribs should be constructed on the ice over shallow water of about 4 to 5 feet. They will sink to the bottom as the ice leaves. Just as soon as the ice leaves the lake, the crib must be moved to the permanent site. DO NOT LEAVE THE CRIB IN SHALLOW WATER.

When towing fish cribs to designated open-water sites the ideal equipment to use is a 16' flat bottom boat powered by a 25 hp outboard motor. Cribs should be towed to about six feet of water or a sufficient depth to permit moving over the top of the crib with a boat. Run a 25' X 1/2" rope under the top logs on each side of the boat and loop around the approximate center of the boat. Pull the crib up tight to the bottom of the boat and secure the ropes with an easily untied hitch. Move the crib to the designated site, untie the ropes and slowly lower the structure in place making sure it sinks evenly in an upright position. Once on the bottom pull the ropes through.

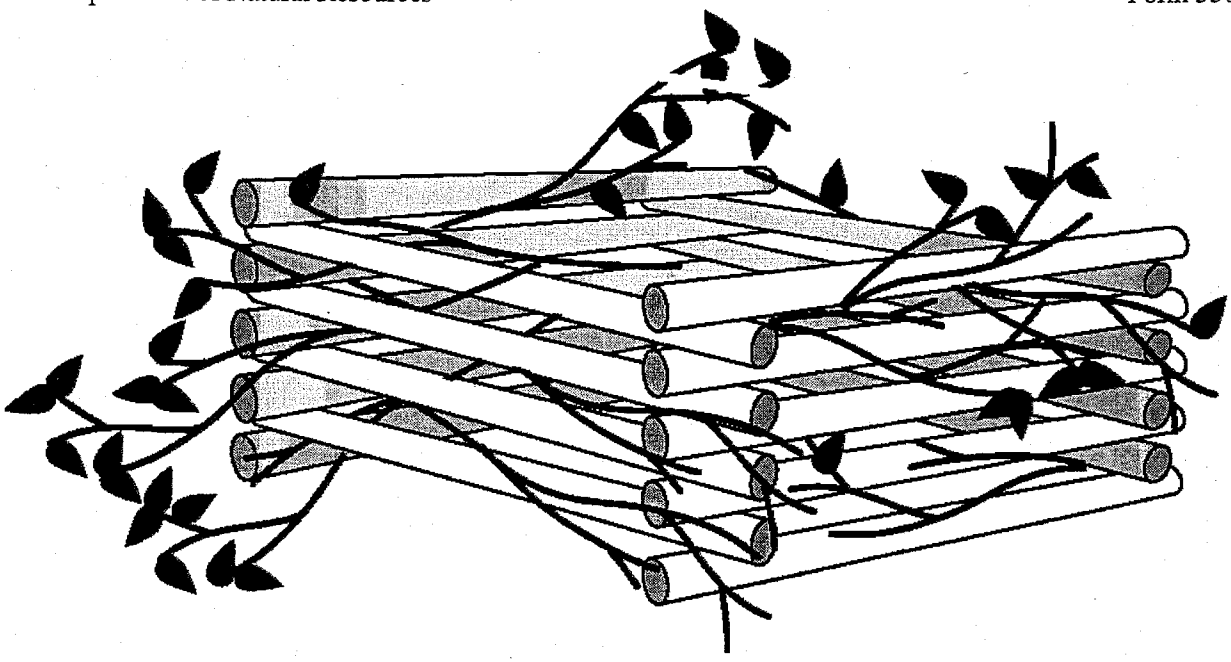
Site Location For Fish Cribs

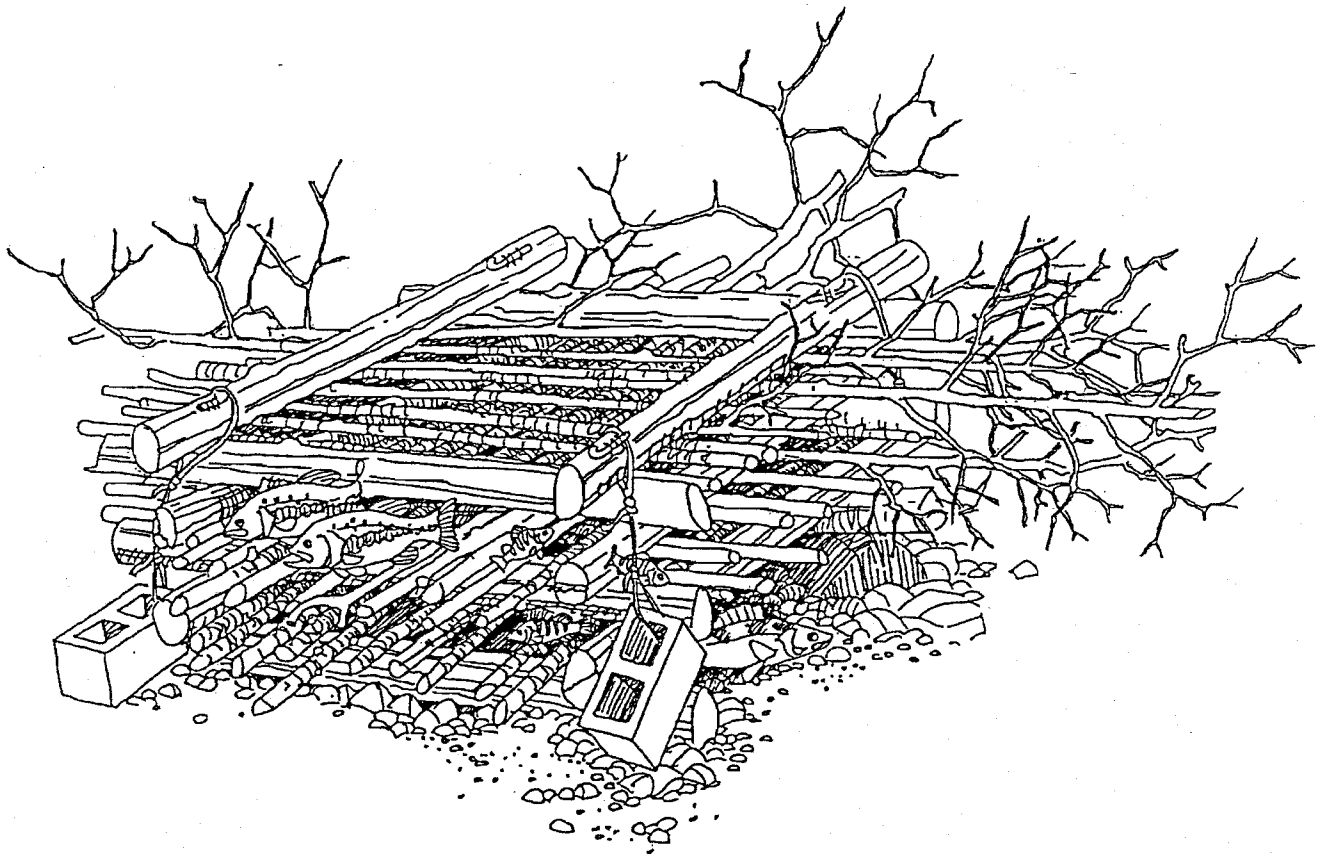
Fish cribs are to be placed so that the top of the structure is no less than five (5) feet below the low water level. No crib is to be placed in less than 10 feet of water to avoid navigational hazards. In lakes with fluctuating water levels, place cribs so they will be in at least 10 feet of water during low water.

Cribs should not be installed near bathing beaches, diving rafts or natural cover. Determine the proper depth and mark the site with a temporary buoy prior to transporting the crib. Select a weed-free, hard bottom site. Do not place cribs on a soft bottom as they will settle and be poorly utilized by fish.

Cribs should be spaced 100 to 200 feet apart. If more than one crib is installed at a time, leave a temporary buoy on the first crib until the second is installed. This will insure proper spacing between cribs.

Be certain the crib locations are accurately plotted on a lake map. All crib locations must be in conformance with your permit.





Appendix D

PROTOCOL FOR THE CONDUCT OF A CITIZEN-BASED CREEL CENSUS OF BOOTH LAKE

INTRODUCTION

Creel surveys are records of the types and conditions of fishes caught in a lake, and may include records of fishes kept or released back into the lake.[1] Such records are compiled from anglers, and generally include information on the species of fishes caught, their length, weight, and condition. Location information may also be collected as part of such a census. These records provide fisheries managers with data on the abundance, angling pressures, and condition of fishes in a lake. A group of records from a waterbody comprise a census and serve a similar purpose to the federal census conducted on a decadal basis by the U.S. Census Bureau in that fisheries managers can determine the essential characteristics of a fishery and develop management plans based upon these specific characteristics. For example, using these data, fisheries managers can create and/or modify stocking and harvesting programs to best reflect prevailing conditions at a specific lake.

DATA ACQUISITION AND REPORTING

Data are typically gathered and entered onto a form by either the individual angler or a volunteer monitor who interviews individual anglers, say, at the recreational boating access site or along the lakeshore. A typical data entry form that could be used in the conduct of a creel census on Booth Lake is shown in Figure D-1. The data form provides space for the monitor or angler to enter a variety of information about the Lake and its fishery. The initial data to be entered describe the type of fishing experience and weather conditions at the time of the fishing experience. The date and times of the fishing experience are entered onto the form, together with the type of fishing—boat fishing, shore fishing, open-ice fishing, ice shanty fishing, or wading fishing—and the numbers of persons in the fishing party. The time data allow calculation of the rate of catch per unit of effort, or time, devoted to the catch. If known, the air and water temperatures, and the water clarity based upon a Secchi disc measurement, are also entered on the form. These data provide insights into light conditions and other water quality conditions that may be influencing the fishery at the time of the survey.

The body of the form, shown in Figure D-1, provides space for recording data on individual fishes caught during the angling experience. The major fish species present in Booth Lake are listed in the right hand column, together with a numeric code that represents that fish species. Not all fish species reported from the Lake are listed, however. Fishes not listed can be added in the blank spaces provided. Some species, such as the bullheads, have a

---

[1] *Bradley T. Eggold and Matthew Coffaro,* A Manual for Creel Clerks and Contest Monitors, *Wisconsin Department of Natural Resources, undated.*

Figure D-1

CREEL SURVEY FORM

Lake Name: BOOTH LAKE
Date: _____ (Month/Day/Year)
Weather: _____
Air Temperature (°F): _____
Water Temperature (°F): _____
Secchi Depth (ft): _____

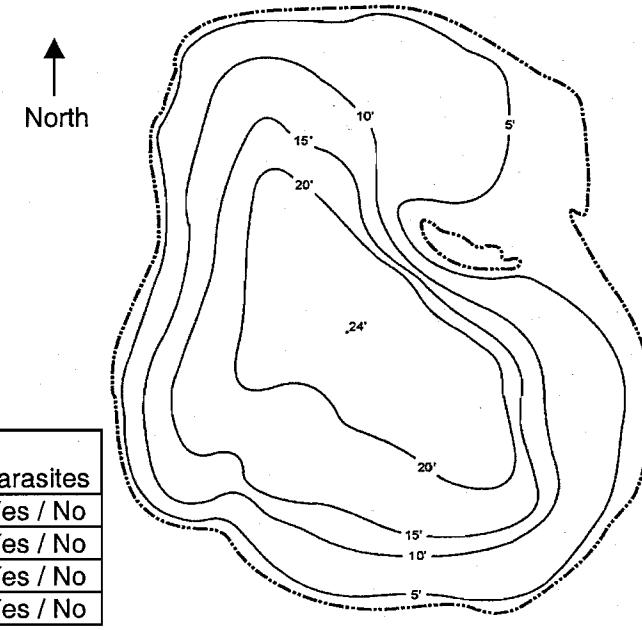
Interviewer/person submitting report: _____
Type of Fishing: (1) Boat fishing (2) Shore Fishing (3)Open-ice fishing (4) Ice shanty (5) Wading
Number in Fishing Party: _____
Start Fish Time: _____ : _____ am/pm
End Fish Time: _____ : _____ am/pm
Total Fish Time (hour): _____ hrs. _____ min.

Measurements for all Fish Caught

Species Code	Total Length (in)	Weight (lbs)

Species	Code	% of Time Fished For	# Caught	# Kept
Bluegill	1			
Yellow Perch	2			
Green Sunfish	3			
Pumpkinseed	4			
Rock Bass	5			
Largemouth Bass	6			
Smallmouth Bass	7			
Northern Pike	8			
Walleye	9			
Warmouth	10			
White Sucker	11			
Bullhead	12			
Carp	13			
	14			
	15			
	16			
	17			

Show location of area fished on map below:



Fish Condition Observations

Species Code	Deformities	Eroded Fins	Lesions/ Tumors	Parasites
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No	Yes / No

number of variants—e.g., yellow bullheads, brown bullheads, and black bullheads—that have been reported in the Lake as documented in Chapter II. There are specific taxonomic difficulties in distinguishing these varietals, and, from a fisheries management point of view, little difference between their habitat, feeding, and reproductory requirements. However, should the census taker have access to an appropriate taxonomic key and be able to determine these varietals, each could be listed in the spaces provided. Aides to taxonomic identification of fishes are available either on-line or in book form;[2] an example of a taxonomic key to distinguish green sunfish from bluegill, pumpkinseed, orange spotted sunfish, longear sunfish, and warmouth is shown as Figure D-2.

Against each fish species, spaces are provided for the respondent, whether the angler or census taker, to indicate the percentage of time spent fishing for a specific species of fish, the numbers caught, and the numbers kept. These latter numbers could reflect strikes by fishes that may be smaller than the regulatory limit, or fishes captured during a "catch-and-release" fishing experience. As noted above, the total time spent fishing is recorded in the header of the survey form, and the percentage of time spent angling for the various target species is reflected in the right hand column.

The left hand column provides additional spaces for recording specific details about individual fishes captured. Using the code number provided in the right hand column for the specific type of fish, the angler or census taker should enter the appropriate information on each fish captured in the spaces provided. Total length is measured as the distance, in inches, between the tip of the snout to the tip of the tail. For those species having flexible tail fins, the recommended method of estimating total length is to group or bunch the tail fin and record the overall length. This dimension is shown in Figure D-3. Length is commonly reported in inches and tenths of inches.

In addition, the left hand column provides space to enter the weight of the individual fishes next to the overall length. As with length, weight is indicated in pounds and tenths of pounds using the following conversions:

1 to 2 ounces	=	0.1 pound	9 to 10 ounces	=	0.6 pound
3 ounces	=	0.2 pound	11 ounces	=	0.7 pound
4 to 5 ounces	=	0.3 pound	12 to 13 ounces	=	0.8 pound
6 to 7 ounces	=	0.4 pound	14 to 15 ounces	=	0.9 pound
8 ounces	=	0.5 pound	16 ounces	=	1.0 pound.

By examining length and weight data, the fisheries manager can make an estimate of the condition factor of the fishes.

The lower left hand portion of the form provides additional space for the angler or census taker to note any abnormalities observed, including deformities, damaged or eroded fins, lesions and tumors, and any visible parasites. Space is also provided for the observer to record the species of fish affected.

Finally, the lower right hand side of the form provides a bathymetric map of Booth Lake that can be used by the angler or census taker to record locations of fishing efforts. Because this survey is based upon catches made by casual anglers, it is not subject to the potential bias introduced to sampling by more formalized sampling techniques. This is beneficial for assessment purposes as it results in a truly random sample of fishes and fisheries conditions within the Lake over time.

Data acquired should be reported on forms similar to that shown in Figure D-1 to the Secretary of the Booth Lake Management District. Data should be compiled in spreadsheets using standard statistical programs for personal computers. This will facilitate sharing the data with Wisconsin Department of Natural Resources fisheries staff or other fisheries professionals using electronic media.

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[2]*George C. Becker,* Fishes of Wisconsin, *The University of Wisconsin Press, 1983; see also http:// limnology.wisc.edu/, then select Great Lakes, On-line System for Identifying Wisconsin Fishes, for an electronic version of this taxonomic key.*

Figure D-2

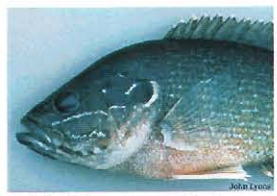
PICTORAL IDENTIFICATION KEY FOR SUNFISHES

Green Sunfish

Adult

Mouth reaches to or beyond the middle of the eye

2 dorsal fins that appear as one



Light blue to whitish streaks emanating from the head

No tooth patch on the tongue

Relatively elongated gill rakers

Adult

Breeding male

Similar Species

Bluegill
The bluegill is somewhat similar to the green sunfish. The green sunfish has a somewhat larger mouth reaching the middle of the eye), a more elongated body,a rounded pectoral fin, and an opercular tab fringed with white. The bluegill has a smaller mouth (reaching the front of the eye), a more rounded body, an elongated and pointed pectoral fin, and a solid dark blue opercular tab.

Pumpkinseed
The pumpkinseed is somewhat similar to the green sunfish. The pumpkinseed has a red dot at the back of its dorsal tab, and it has short and knobby gill rakers. The green sunfish has an opercular tan fringed with white, and its gill rakers are relatively elongated.

Orangespotted sunfish
The orangespotted sunfish is somewhat similar to the green sunfish. The orangespotted sunfish has 8 or 9 soft rays in its anal fin, conspicuous orange spots, and an overall lighter body color. The green sunfish has 10-12 soft rays in its anal fin, lacks orange spots, and has an overall darker body color.

Warmouth
The warmouth is somewhat similar to the green sunfish. The warmouth has a tooth patch on its tongue; the green sunfish does not.

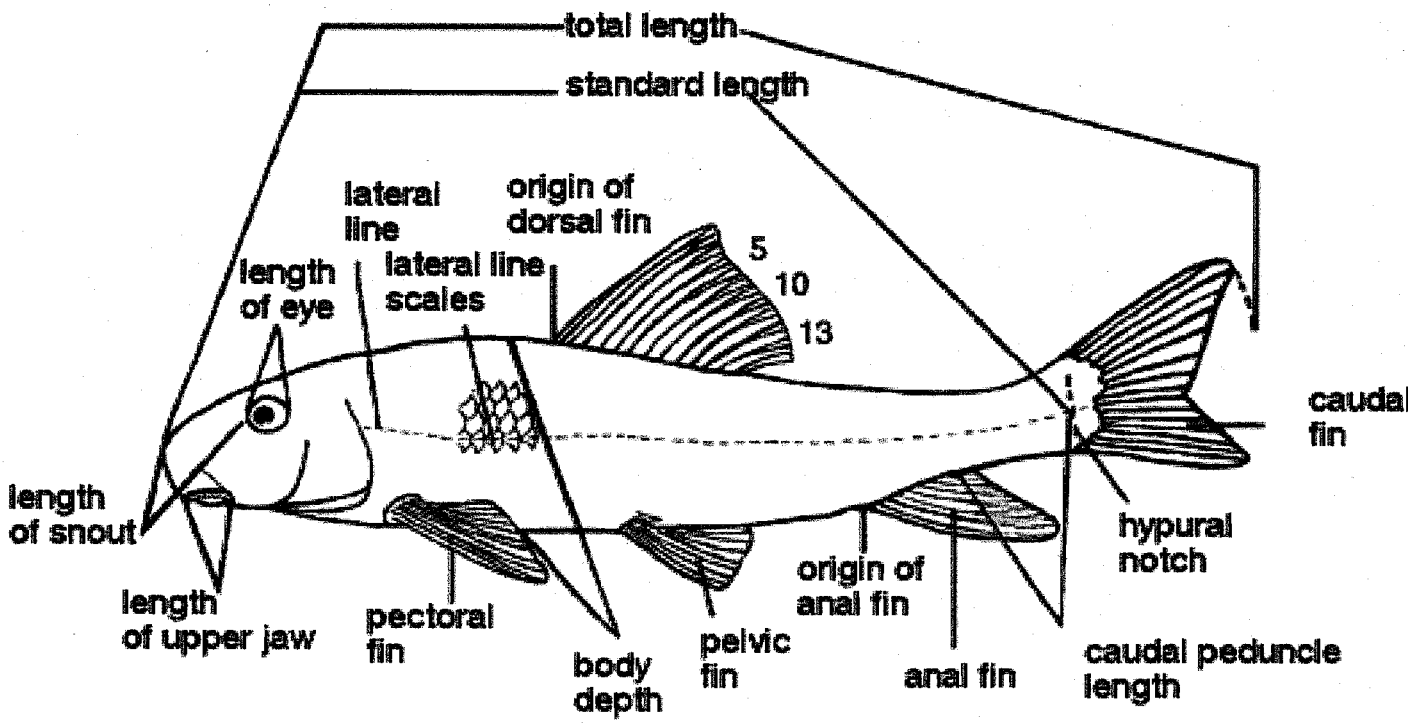
Longear sunfish
The longear sunfish is somewhat similar to the green sunfish. The longear sunfish has a reddish margin around its opercular tab (which is elongated in large specimens but not in small ones) and 34-38 lateral line scales. The green sunfish has a white to yellow margin around its opercular tab and 44-51 lateral line scales.

NOTE: The above information can be found at http://limnology.wisc.edu/research/newresearch.htm

Source: Wisconsin Department of Natural Resources, University of Wisconsin Center for Limnology and Sea Grant Institute and SEWRPC.

Figure D-3

EXTERIOR ANATOMY FEATURES OF WHITE SUCKERS GENERALLY USED IN IDENTIFICATION OF FISHES



Source: Wisconsin Department of Natural Resources, University of Wisconsin Center for Limnology and Sea Grant Institute, and SEWRPC.

DATA ANALYSIS AND INTERPRETATION

As noted above, the data gathered through the creel census process can be compiled and analyzed in a number of ways. While some of the more complex interpretations of the data should be undertaken by persons trained to conduct such an analysis, there are some basic facts that the census takers can glean from the data that will be of interest to the electors and property owners of the Booth Lake Management District. These analyses are briefly described below.[3]

Species Caught

The most basic piece of information that can be gleaned from the census data is the numbers and types of fishes being caught from the Lake. Tabulating information on the types of fishes from year to year will provide information of how the fish communities may be changing over time. Data need not be compiled on an annual basis, but can also be assessed by comparing similar months or other periods of time—see analysis of catch per unit effort below. Simply listing the types of fishes and the numbers caught, and calculating the percentage of the catch represented by each species, can provide useful information on the dominance of specific types of fishes. Major changes in the percentage represented by specific fishes can provide an indication of an ecosystem level

[3]*See Richard C. Lathrop, Susan B. Nehls, Clifford L. Brynildson, and Karen R. Plass, Wisconsin Department of Natural Resources Technical Bulletin No. 181,* The Fishery of the Yahara Lakes, *1992.*

change that should be investigated further. The percentage of the catch represented by a species, P, is calculated as:

P = number of species A caught / total number of fishes caught x 100 (1)

The data used to calculate these percentages can be found on the data sheet, shown as Figure D-1, using the numbers reported in the "# Caught" column in the right hand column in the body of the form (= number of species A caught), and the sum of the numbers shown in the "# Caught" column. Calculating this latter figure will require adding up the total of the numbers shown in the "# Caught" column.

Catch per Unit Effort

Catch per unit effort, or CPUE as it is often referred to, represents the dividend of the numbers of fishes of a particular species captured during a fishing excursion. This number is calculated using the data from the header box in combination with the numbers of fishes shown in the "# Caught" column. This number is calculated for individual fish species. Multiple forms can be added to provide estimates of catches of specific fishes per angler per hour (or day).

To calculate the number of hours fished, or "Total Fish Time," data shown in the header block as "Start Fish Time" and "End Fish Time" will allow determination of the numbers of hours fished:

Total Fish Time = End Fish Time – Start Fish Time (2)

Using a 24-hour clock (also known as "military time") will help in calculating the hours fished, although the hours fished can be calculated using the more traditional a.m. and p.m. time format. If more than one person is shown in the "Number in Fishing Party" block, the hours fished must be adjusted accordingly to produce a number of hours fished per angler. This statistic can be determined as:

Hours per Angler = Total Fish Time / Number in Fishing Party (3)

To calculate the catch per unit effort for a particular species, the numbers of fishes caught is divided by the time spent fishing:

CPUE = # Caught of species A / Hours per Angler (4)

The catch per unit effort is most often expressed in terms of the number of fishes of a particular species per angler-hour.

Average Total Length and Average Weight

Another statistic that is easily calculated, and which has value in determining the age and quality of the fishery, is the average total length and average weight for each species of fish. Using the data presented in the left hand column of the creel survey form shown in Figure D-1, data for each species can be totaled and averaged to generate these average values:

Average Total Length = Σ (Total Length for species A) / total number of fishes of species A caught (5)

Average Weight = Σ (Weight for species A) / total number of fishes of species A caught (6)

In a lake where conditions are not changing dramatically, these average total length and average weight values would be likely to remain somewhat similar over time. This similarity is due to the fact that anglers are as likely to catch young fishes as well as older fishes in a random manner. Provided all of these data are recorded, the numbers of younger and older fish would tend to remain somewhat constant over time. Dramatic changes in these numbers would suggest that a summer kill or winter kill may have occurred, or that a particular species of fish had had a poor breeding season where few young survived. Dramatic changes could also indicate a change in angling pressure, such as would be expected in the case where anglers capture larger (or smaller) numbers of fishes in a

given year, altering the make up of the fish community. These latter changes can be evaluated using total length and weight data "classes," since the length and weight of fishes is proportionate to their age. By plotting the data in the form of bar graphs or histograms, missing or abnormal age classes (see below) can be identified. Such instances should be reported to the Wisconsin Department of Natural Resources fisheries managers or other trained individuals for further investigation.

Age Classes

This statistic is analogous to the average growth curves many parents are familiar with through visits to their child's pediatrician. Statistically, over a large enough population, average body sizes can be determined and used to assess the progress of children as they mature. These same statistics can be employed in fisheries management to determine if recruitment, or the addition of new fishes to a population, is occurring, and the degree of breeding success. Successive years generally result in large numbers of young fish, distinguished by greater number of shorter, lighter fishes, that mature into fewer numbers of older fish, distinguished by longer, heavier fishes. The numbers of fishes decline due to natural mortality, angling pressures, and predation by piscivorous fishes and birds. These losses are normal and natural, and result in a relatively smooth transition from large numbers of young fishes to fewer numbers of older fishes over time. Gaps or major changes in this transition would indicate some traumatic occurrence, such as a year in which there was poor breeding success or a loss of the necessary habitat that would promote successful breeding, among other impacts. In Booth Lake, preliminary age-growth data were compiled from the fish survey completed during this planning project for three fish species:[4]

Bluegill	6.2 – 6.9 inches	Three-year old fishes
	7.0 – 7.7 inches	Four-year old fishes
	7.7 – 7.75 inches	Five-year old fishes
	7.9 – 9.1 inches	Six-year old fishes
Green Sunfish	4.75 inches	Two-year old fishes
	6.2 inches	Three-year old fishes
	6.7 inches	Four-year old fishes
	7.25 – 7.5 inches	Five-year old fishes
	7.6 – 7.7 inches	Six-year old fishes
Largemouth Bass	11.25-11.75 inches	Three-year old fishes
	12.25 inches	Four-year old fishes
	13.25 inches	Five-year old fishes

These data can be refined and further developed over time as additional creel census data are added to the data set, and the District citizen monitors should seek the assistance of the Wisconsin Department of Natural Resources fisheries managers or other trained individuals in the determination and interpretation of the age classes and age class data.

Condition Factor

The information compiled from the creel survey form shown in Figure D-1 can also be used to estimate the condition factor of the fish species in the Lake. In like manner to the age classes based upon length or size of fishes, information on both the length and weight can be used to estimate the "condition" of the fishes captured. These data are also analogous to those compiled by physicians who record a patient's height and weight. Condition factor, CF, is determined as:

$$CF = \text{Total Length} / \text{Weight} \qquad (7)$$

[4] *Rand Atkinson, Aquatic Resources and Glacial Pond Farms,* Booth Lake, Walworth County Fish Survey & Recommendations for Future Management 2000, *2001.*

The ratio between length and weight would be expected to remain relatively constant in a healthy population, length increasing in proportion to the increased weight attained with age. Graphing this relationship would result in a straight-line graph, beginning at zero and increasing steadily over time. Changes in this ratio, or deviations from the straight line graph, would provide warning of a change in the fishery, such as stunting of the population, that should be evaluated further by Wisconsin Department of Natural Resources fisheries managers or other trained individuals.

Miscellaneous Information

The creel survey form shown in Figure D-1 also includes a block for the census taker or angler to record any abnormalities observed in the fishes captured. Consistent notations of deformities, eroded fins, lesions and tumors, and parasites should be reported to the Wisconsin Department of Natural Resources fisheries managers or other trained individuals for further investigations.

PUBLIC INFORMATIONAL PROGRAMMING

The data gathered, compiled, and analyzed through the conduct of the foregoing citizen-based volunteer fisheries survey could be presented annually at the annual meeting of the Booth Lake Management District in like manner to the Wisconsin Department of Natural Resources Self-Help volunteer monitoring program data. Information on the fishery combined with water quality information gathered through the volunteer water quality monitoring program can provide an early warning to the District and Booth Lake community of changes in the lake ecosystem. These changes should ultimately encourage the District to initiate further investigations into the causes and nature of the changes underlying the observed conditions and can help to correct undesirable conditions before they become critical. In this way, programs such as the volunteer monitoring programs can help to protect and maintain the water quality and appeal of Booth Lake.