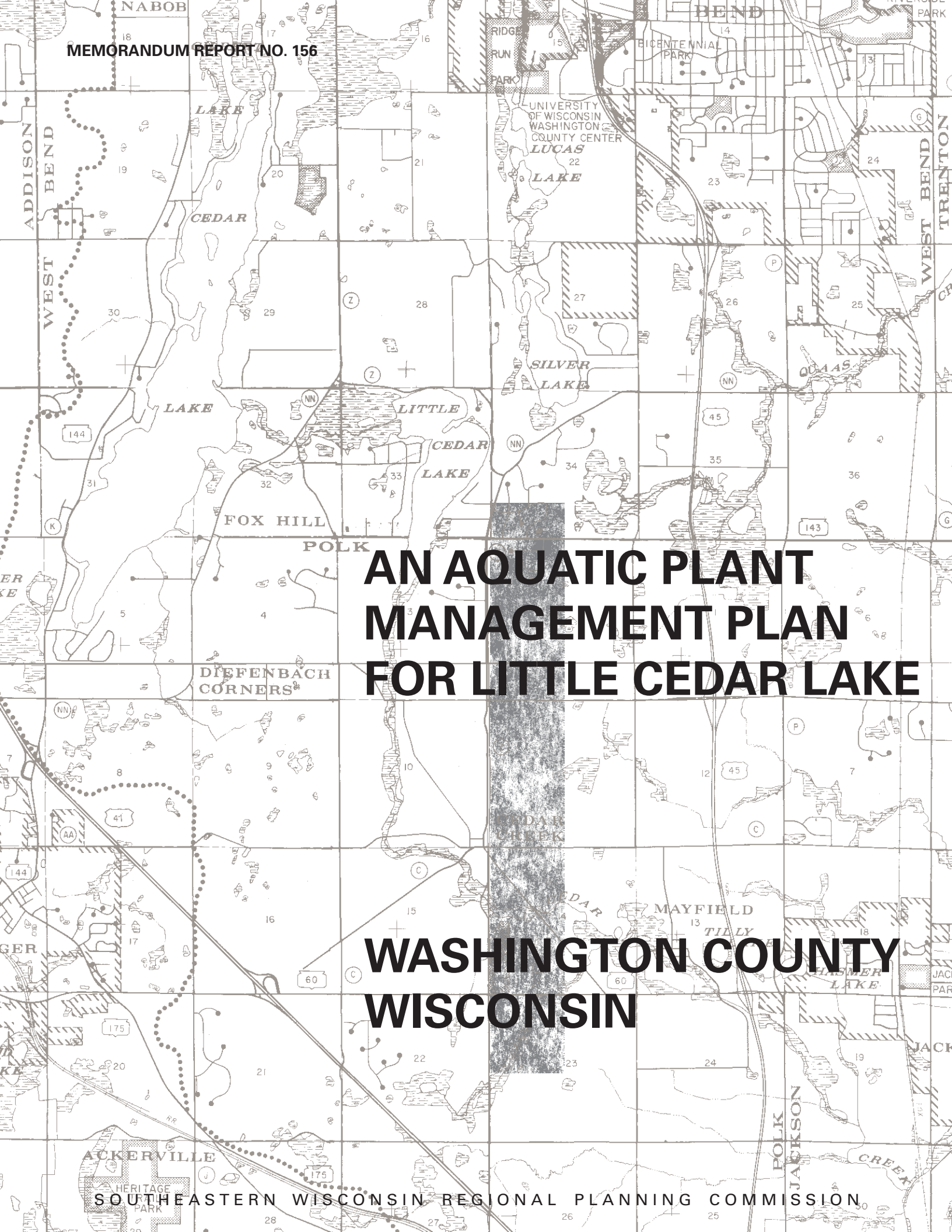

MEMORANDUM REPORT NO. 156

AN AQUATIC PLANT MANAGEMENT PLAN FOR LITTLE CEDAR LAKE

WASHINGTON COUNTY WISCONSIN

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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MEMORANDUM REPORT
NUMBER 146

AN AQUATIC PLANT MANAGEMENT PLAN FOR LITTLE CEDAR LAKE WASHINGTON COUNTY, WISCONSIN

Prepared by the

Southeastern Wisconsin Regional Planning Commission
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Chapter I

INTRODUCTION

Little Cedar Lake is located on Cedar Creek, downstream of Big Cedar Lake, in the Towns of Polk and West Bend in Washington County, Wisconsin. The Lake is a drainage lake with Cedar Creek, a tributary stream to the Milwaukee River system, forming both the inflow and outflow of the Lake. Little Cedar Lake 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, with a county park providing recreational use opportunities to visitors from the greater West Bend area of Washington County and elsewhere in Southeastern Wisconsin.

A perception of changing conditions within the Lake, likely to adversely affect the recreational and aesthetic value of the Lake, led to the formation of the Little Cedar Lake Protection and Rehabilitation District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district. The District seeks to undertake a lake-oriented program of community involvement, education, and management. Pursuant to this mandate, and seeking to improve the usability and prevent the deterioration of the natural assets and recreation potential of Little Cedar Lake, the District has contracted with the U.S. Geological Survey for water quality monitoring services and with the Southeastern Wisconsin Regional Planning Commission for the preparation of an aquatic plant management plan for Little Cedar Lake.

This report sets forth an inventory of the aquatic plant communities present within Little Cedar Lake, data on land use within the drainage area tributary to Little Cedar Lake, water quality data, and related information, and represents part of the ongoing commitment of the Little Cedar Lake Protection and Rehabilitation District, in cooperation with the Towns of Polk and West Bend, to sound planning with respect to the Lake. The inventory data presented herein were prepared by the Southeastern Wisconsin Regional Planning Commission, with the assistance of the Little Cedar Lake Protection and Rehabilitation District, during the period 2000 through 2002.

The aquatic plant survey of Little Cedar Lake was conducted during the year 2000 by Commission staff with the assistance of the Little Cedar Lake Protection and Rehabilitation District. The survey was completed using the modified Jesson and Lound[1] transect-based aquatic plant survey method employed by the Wisconsin Department of Natural Resources for aquatic plant surveys throughout the State. Wetland plant inventories were compiled by Commission staff using the wetland inventory maps prepared for the Wisconsin Department of Natural Resources by the Regional Planning Commission and field inventory data gathered by Commission staff using assessment techniques summarized in the adopted regional natural areas and critical species habitat protection and manage-

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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.*

ment plan.[2] Fisheries data, gathered by the Wisconsin Department of Natural Resources, and water quality data, gathered under the auspices of the U.S. Geological Survey, are also incorporated into this plan as appropriate. In addition, data on Little Cedar Lake also were abstracted from the Wisconsin Department of Natural Resources nonpoint source pollution control plan for the Cedar Creek Priority Watershed.[3] This planning program was funded in part by a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Little Cedar Lake Protection and Rehabilitation District under the Chapter NR 190 Lake Management Planning Grant Program.

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

This plan is intended to address the recreational lake use goals and objectives for Little Cedar Lake developed in consultation with the Little Cedar Lake Protection and Rehabilitation District. These 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 vegetation, fishery, and wildlife populations, in and around Little Cedar Lake;

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

3. To effectively manage the water quality of Little Cedar Lake to maintain healthy aquatic and riparian wetland plant communities 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 and plan element, which conforms to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes*,[4] should serve as an initial step in achieving these objectives over time.

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[2]*SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

[3]*Wisconsin Department of Natural Resources Publication No. PUBL-WR-336-93,* A Nonpoint Source Control Plan for the Cedar Creek Priority Watershed Project, *August 1993*.

[4]*This plan has been prepared pursuant to the standards and requirements set forth in 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 and Mechanical Control Regulations."*

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Little Cedar Lake is located in the east central portion of Washington County, Wisconsin, as shown on Map 1. The Lake is a flow-through or drainage lake, comprised of two principal basins. Cedar Creek comprises the primary inflow to, and outflow from, the Lake, entering the Lake from the northwest and draining the Lake to the south. Cedar Creek ultimately forms a tributary to the Milwaukee River system draining to the Laurentian Great Lakes at Milwaukee Harbor.

Little Cedar Lake is located in the Towns of Polk and West Bend, in Washington County. The Lake is the third in a chain of lakes and millponds formed along Cedar Creek in the West Bend metropolitan area.[1] It lies in a north-south depression within the terminal moraine formed approximately 12,500 years ago by the Lake Michigan Lobe of the continental glacier. The glacier scoured the Lake basin from the Niagara dolomite bedrock, and formed a low terrace of outwash sand and gravel, which, currently, supports the extensive wetland areas in the vicinity of the Lake. The outflow from Little Cedar Lake is controlled by a low-head, concrete dam on the south side of the Lake. The structure is owned and operated by the Little Cedar Lake Advancement Association, with a maximum water surface elevation of 1,014.15 feet above National Geodetic Vertical Datum of 1929. From this outlet, Cedar Creek continues to drain south and east to its confluence with the main branch of the Milwaukee River, just south of the Village of Grafton in Ozaukee County. The hydrologic connection between Big Cedar and Little Cedar Lakes by Cedar Creek is shown on the 1892 plat map, reproduced as Map 2. Recent studies by the U.S. Geological Survey also indicate a geohydrological connection between Big Cedar Lake, Little Cedar Lake, and Silver Lake as shown on Map 3.[2] As a consequence of this groundwater connection, waters from a portion of the watershed tributary to Little Cedar Lake also flow to Silver Lake and are discharged to the Milwaukee River system through the Silver Creek tributary, which flows northward out of Silver Lake. The estimated groundwater time of travel between Little Cedar Lake and Silver Lake is 20 years, as shown in Figure 1.

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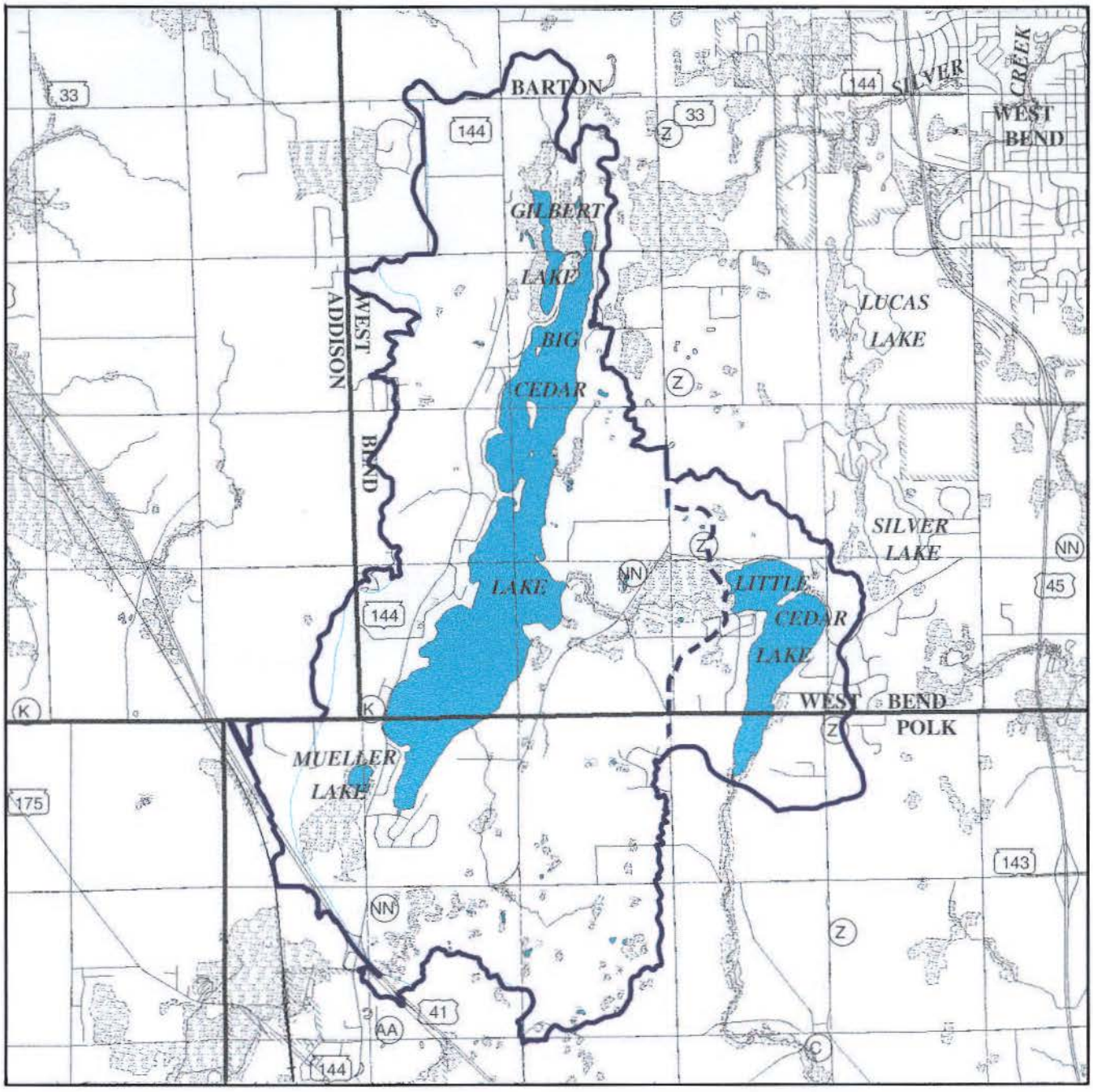
[1] *From upstream to downstream, within Washington County, these waterbodies include Gilbert Lake, Big Cedar Lake, Little Cedar Lake, Lent Lake, and Mayfield Pond. See SEWRPC Memorandum Report No. 139,* Surface Water Resources of Washington County, Wisconsin, Lake and Stream Classification Project: 2000*, September 2001.*

[2] *U.S. Geological Survey Water-Resources Investigations Report 02-4204,* Simulation of the Shallow Aquifer in the Vicinity of Silver Lake, Washington County, Wisconsin, Using Analytic Elements*, 2003.*

Map 1

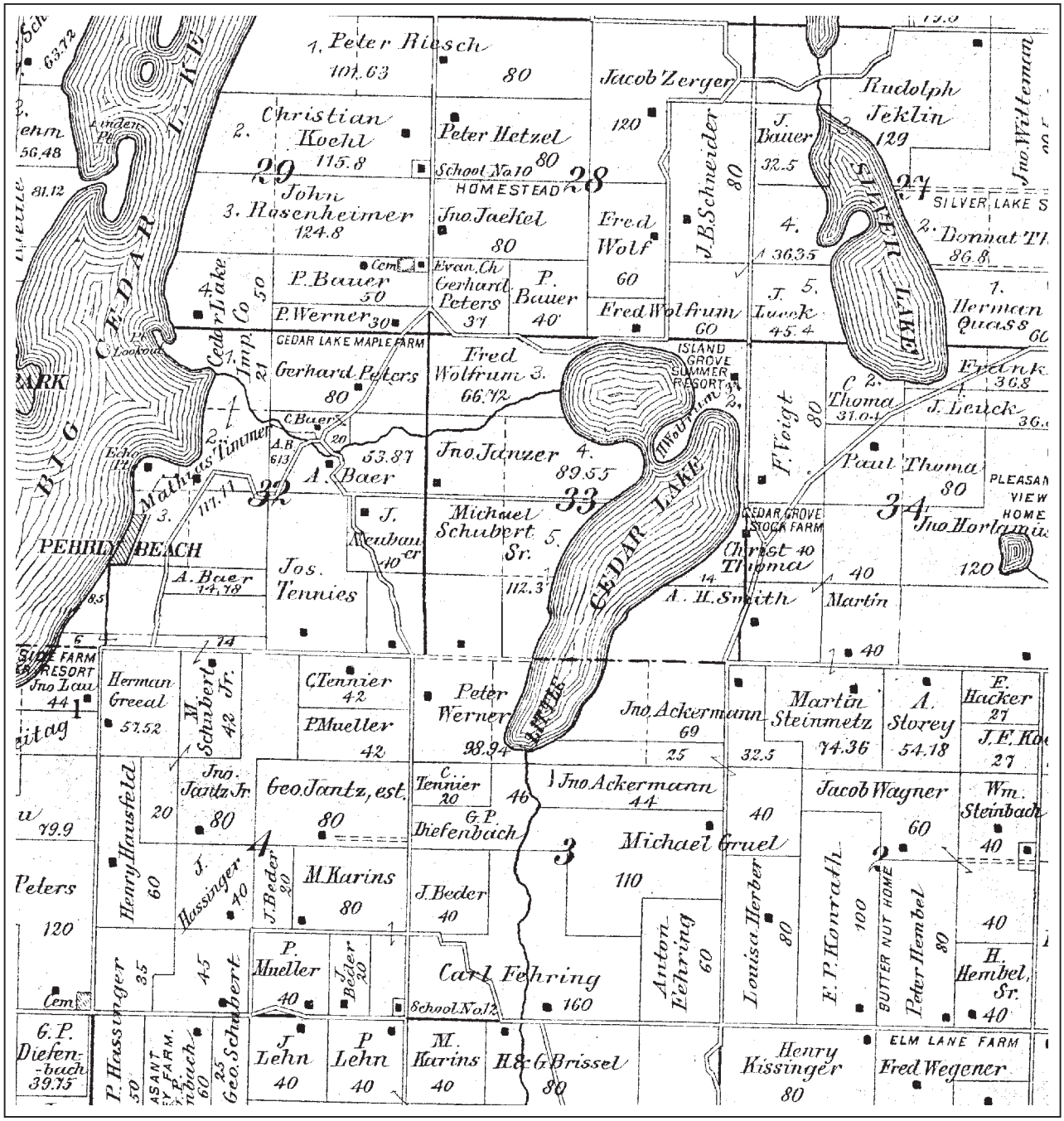
LOCATION MAP OF LITTLE CEDAR LAKE



Source: SEWRPC.

Map 2

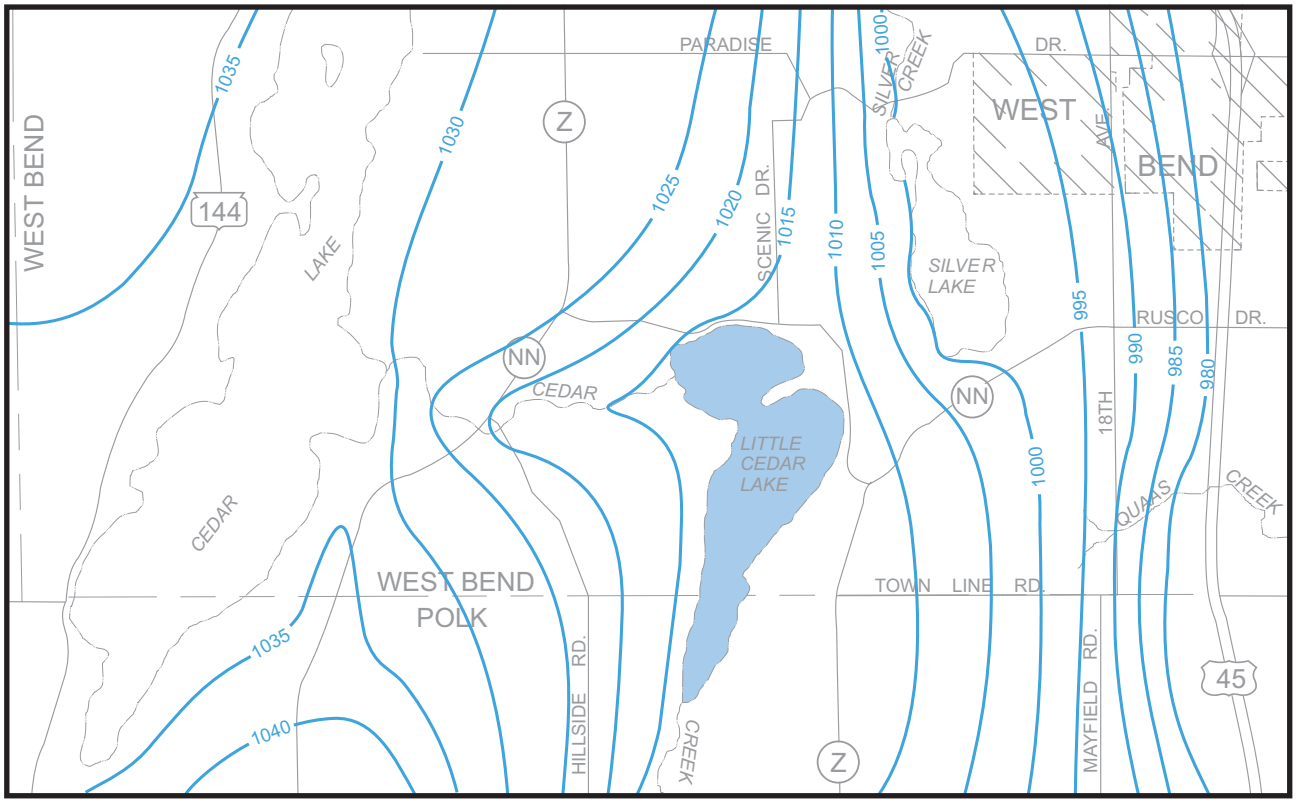
HISTORIC PLAT MAP FOR THE LITTLE CEDAR LAKE AREA: 1892



Source: C.M. Foote & Company, Minneapolis, Minnesota.

Map 3

DIRECTION OF GROUNDWATER FLOW IN THE LITTLE CEDAR LAKE AREA



985 WATER TABLE CONTOUR (SHOWS ELEVATION OF WATER TABLE ON JANUARY 5 AND 6, 1984. CONTOUR INTERVAL FIVE FOOT CONTOURS ABOVE THE NATIONAL GEODETIC VERTICAL DATUM-1929)

Source: U.S. Geological Survey.

WATERBODY CHARACTERISTICS

Little Cedar Lake is a 246-acre waterbody, the hydrographical characteristics of which are set forth in Table 1. The Lake has a maximum depth of 56 feet, a mean depth of 13 feet, and a volume of 3,153 acre-feet. The bathymetry of the Lake is shown on Map 4. The Lake is comprised of two principle basins: the northern basin, at the inlet, being oval in shape and locally known as “the Kettle,” and a shallower, southern basin that forms the main lake basin of Little Cedar Lake. This latter basin is characterized as a narrow basin, elongated in a north-south direction, confined within steep slopes along much of the eastern and western shorelines. Lake depths quickly drop to more than 30 feet. The basin is connected to a large wetland complex located to the west.

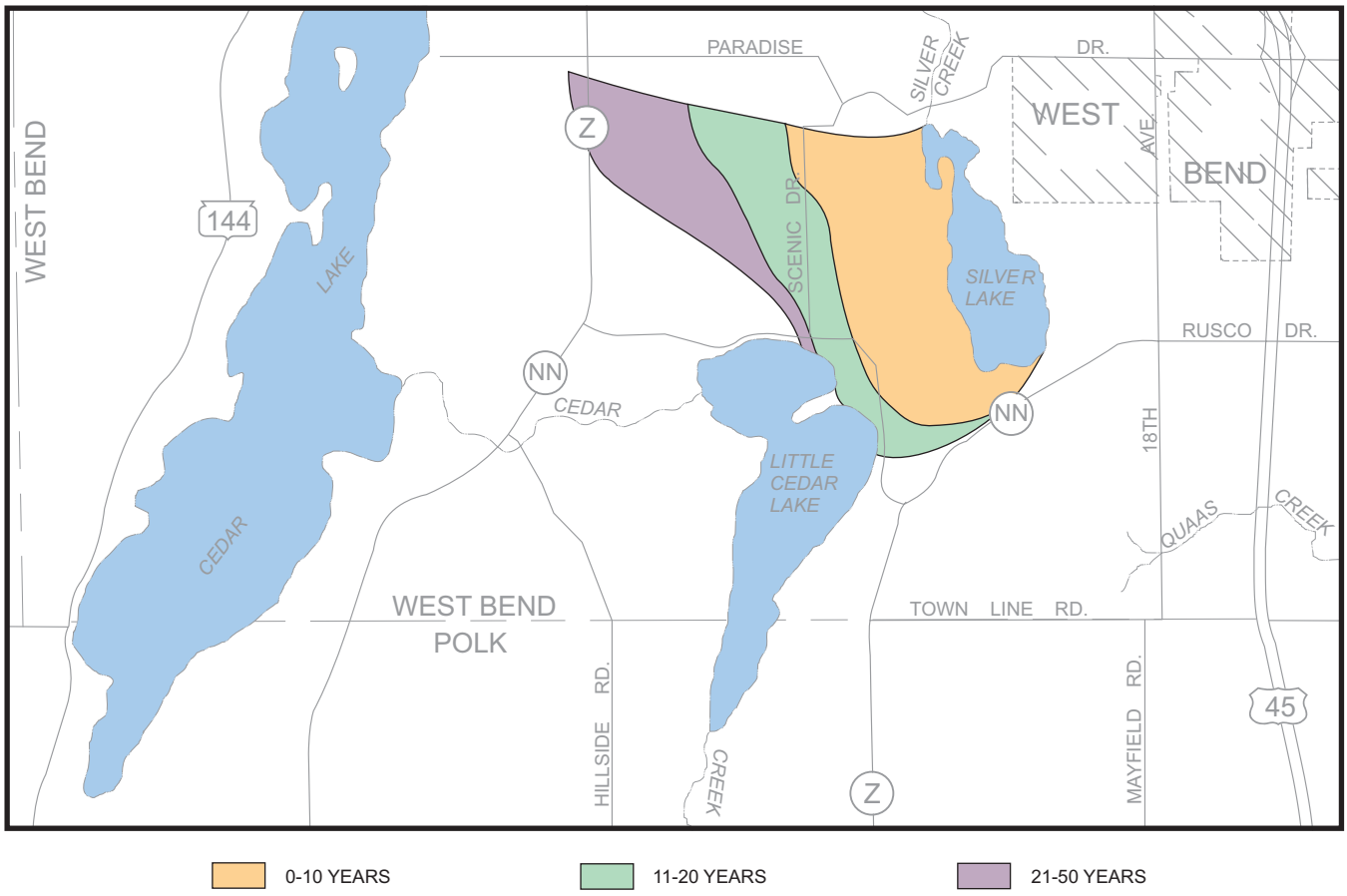
WATERSHED CHARACTERISTICS

Population and Land Use

As of 1995, there were approximately 670 persons residing within the drainage area directly tributary to Little Cedar Lake. There were approximately 320 housing units located within this drainage area.

Figure 1

GROUNDWATER RECHARGE AREAS AND TIMES OF TRAVEL TO SILVER LAKE, WASHINGTON COUNTY, WISCONSIN



Source: U.S. Geological Survey.

Urban development in the drainage area directly tributary to Little Cedar Lake consists primarily of urban density residential development that has largely occurred between 1950 and 1980, as shown on Map 5. Residential lands surround the shores of Little Cedar Lake, with exception to the western shore of the northern lobe and the southeastern shore of the southern lobe of the Lake which are comprised of undeveloped wetlands and County-owned parkland.

As of 1995, woodlands, wetlands and agricultural lands occupied the majority of the lands within the total tributary drainage area, as shown on Map 6 and quantified in Table 2. Of the approximately 6,850 acres of rural lands within the drainage area tributary to Little Cedar Lake, about 3,280 acres, or about 39 percent of the rural area, were in agricultural uses, with about the same area being comprised of woodlands, wetlands, and surface waters. About 1,540 acres, or about 18 percent, of the tributary drainage area, were devoted to urban land uses as of 1995, with the dominant urban land use being comprised of residential lands, encompassing about 1,020 acres.

The existing 1995 land use pattern within the drainage area directly tributary to Little Cedar Lake also is quantified in Table 2. Within this portion of the watershed, about 280 acres, or about 23 percent of the drainage area directly tributary to the Lake, were devoted to urban land uses. The dominant urban land use was residential,

Table 1

HYDROGRAPHIC CHARACTERISTICS OF LITTLE CEDAR LAKE

Parameter	Measurement
Surface Area	246 acres
Volume	3,153 acre-feet
Shoreline Length	4.35 miles
Maximum Depth	56 feet
Mean Depth	13 feet
Tributary Drainage Area	8,393 acres

Source: Wisconsin Department of Natural Resources and SEWRPC.

encompassing 220 acres. Notwithstanding, the majority of the lands within the drainage area directly tributary to Little Cedar Lake, or about 920 acres, were devoted to rural land uses. About 330 acres, or about 27 percent of the rural area, were in agricultural use, with woodlands, wetlands, and surface waters comprising the balance.

Few changes in land use within either the direct drainage area tributary to Little Cedar Lake or the total drainage area are anticipated. Such changes are expected to be limited to infilling of already platted lots and the possible redevelopment of existing properties.[3] Only minor, additional large-lot residential development is envisioned for the drainage area.

Public Recreational Boating Access

Public recreational boating access to the Lake is provided through the County-owned parkland located along the southeastern shoreline of the southern basin, which has an improved public boat landing. This access site, shown on Map 4, provides public recreational boating access opportunities that are consistent with the standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code.*

WATER QUALITY

Little Cedar Lake is a mesotrophic or moderately enriched waterbody. Mesotrophic lakes, while relatively fertile, support abundant aquatic plant growths and productive fisheries, but generally do not exhibit nuisance growths of algae and plants. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.[4]

Water quality investigations of Little Cedar Lake were conducted by CDM/Limnetics Environmental Consultants during 1976,[5] and by the U.S. Geological Survey during the period from February 1997 through August 1999.[6] Based upon these data, water quality conditions within Little Cedar Lake appear to have improved since the 1970s. CDM/Limnetics reported an annual average surface water total phosphorus concentration of about 0.124 milligrams per liter (mg/l) and a corresponding chlorophyll-*a* concentration of about 20 micrograms per liter (µg/l) from the northern basin of the Lake, which would indicate a highly eutrophic waterbody. Secchi-disc transparencies during the 1976 study were consistent with this degraded water quality condition, and ranged from 1.0 to 1.8 meters. In the southern basin, slightly better water quality conditions were reported, with an annual average chlorophyll-*a* concentration of about eight µg/l, and a Secchi-disc transparency of between 1.0 and 3.0 meters.

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

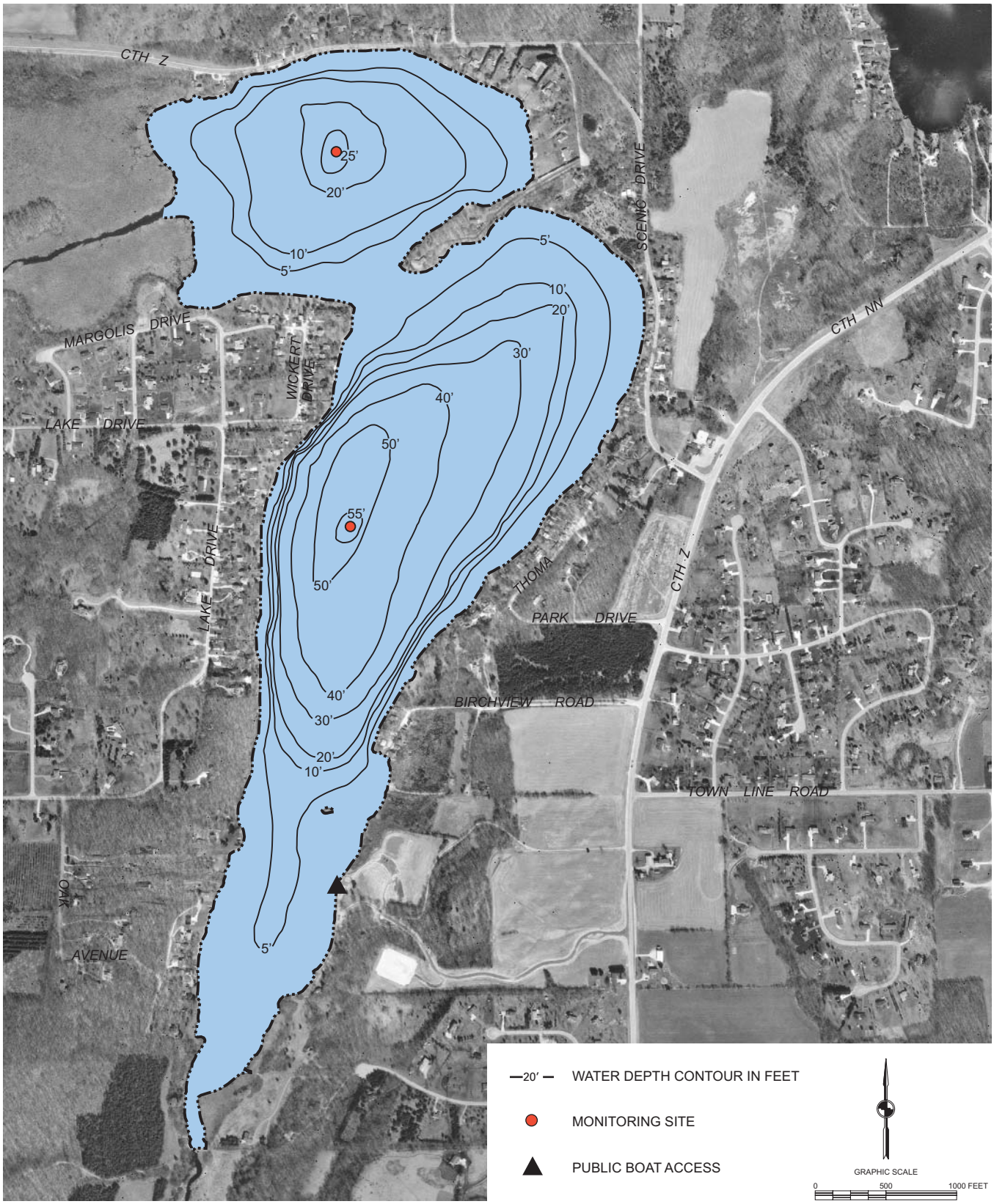
[4]*See R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes, *Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983; also see SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report,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

[5]*CMD/Limnetics Environmental Consultant,* An Environmental Study of Little Cedar Lake and the Hydrological and Water Quality Characteristics of Its Associated Watershed for the Inland Lake Protection and Rehabilitation District of Little Cedar Lake, Washington County, Wisconsin, *March 1977.*

[6]*See U.S. Geological Survey Open-File Report 02-135,* Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 2001, *2002. These reports have been published annually since 1994.*

Map 4

BATHYMETRIC MAP OF LITTLE CEDAR LAKE

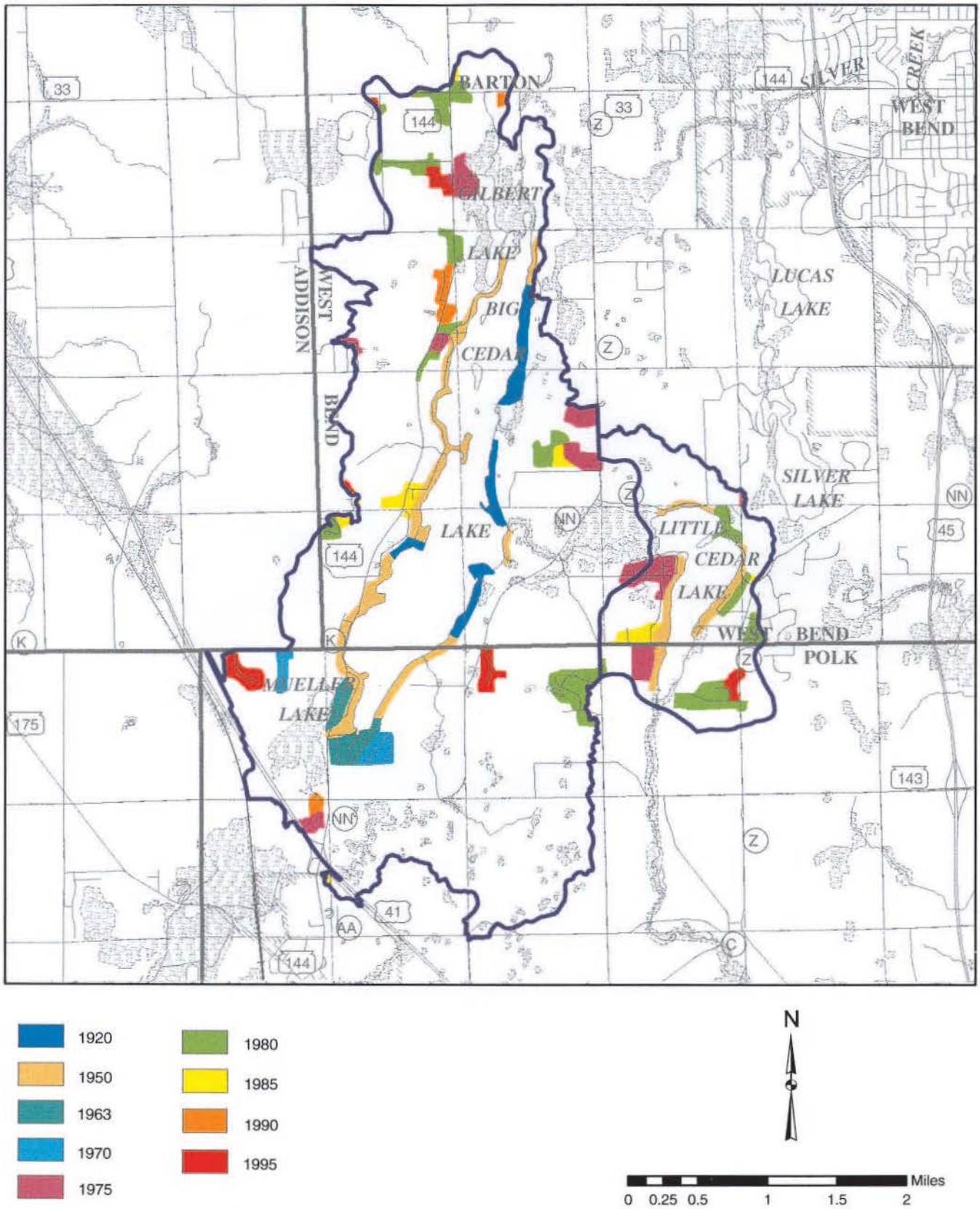


DATE OF PHOTOGRAPHY: MARCH 2000

Source: U.S. Geological Survey and SEWRPC.

Map 5

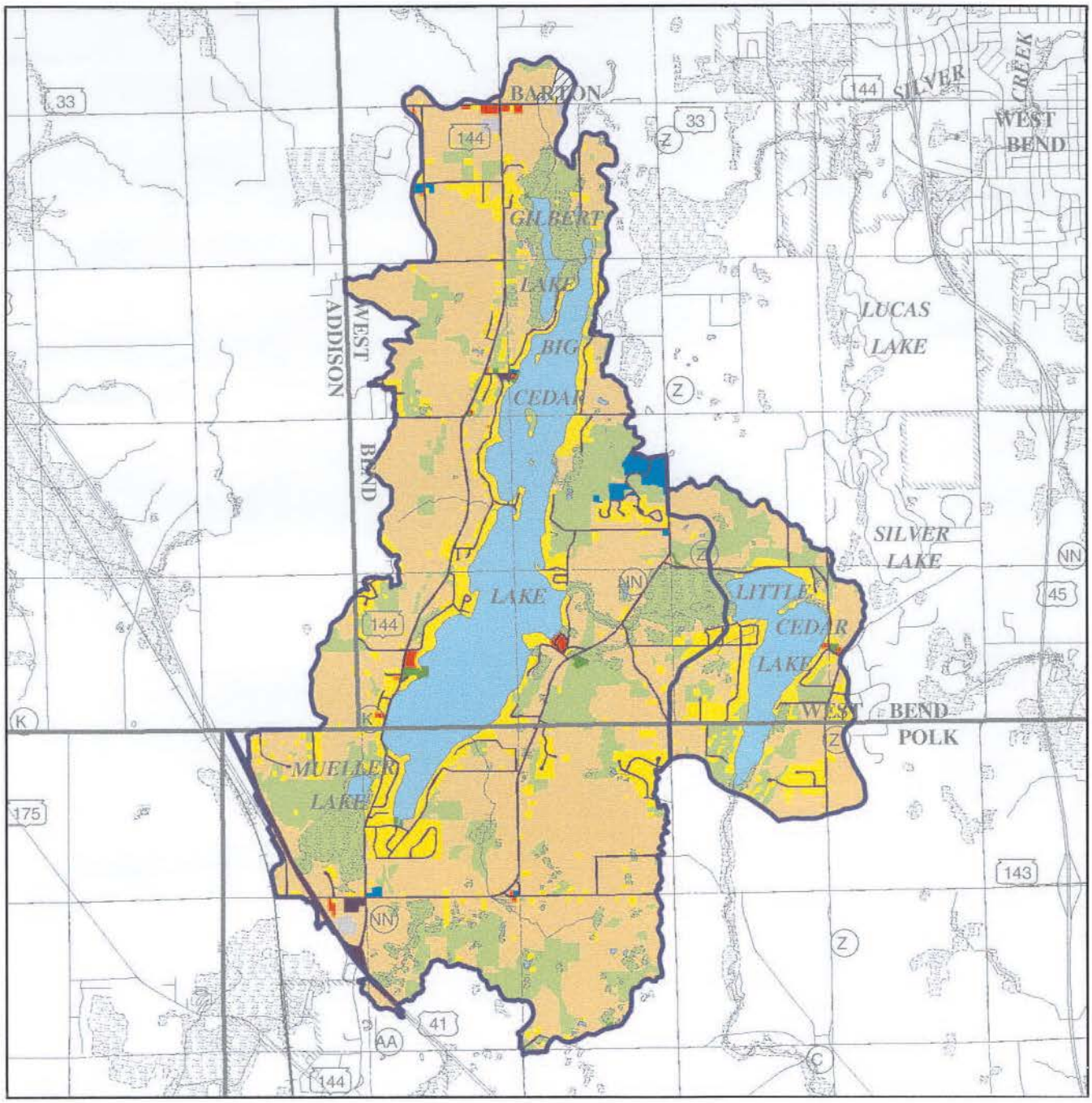
HISTORIC URBAN GROWTH WITHIN THE LITTLE CEDAR LAKE TRIBUTARY DRAINAGE AREA



Source: SEWRPC.

Map 6

EXISTING LAND USE WITHIN THE LITTLE CEDAR LAKE TRIBUTARY DRAINAGE AREA: 1995



Single-Family Residential
Multi-Family Residential
Commercial
Industrial
Transportation, Communications, and Utilities
Governmental and Institutional
Recreation
Surface Water
Wetlands and Woodlands
Agricultural, Unused, and Other Open Lands
Extractive and Landfill

N

0 0.25 0.5 1 1.5 2 Miles

Source: SEWRPC.

Table 2

EXISTING LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO LITTLE CEDAR LAKE: 1995

Land Use Categories	Direct Drainage Area		Total Drainage Area	
	Acres	Percent of Direct Drainage Area	Acres	Percent of Total Drainage Area
Urban				
Residential	221	18	1,018	12
Commercial	2	<1	23	<1
Industrial	- -	- -	29	<1
Governmental and Institutional	- -	- -	39	1
Transportation, Communication, and Utilities	57	5	417	5
Recreation	2	<1	18	<1
Subtotal	282	23	1,544	18
Rural				
Agricultural	329	27	3,281	39
Wetlands	38	3	556	7
Woodlands	210	18	1,259	15
Water	262	22	1,273	15
Other Open Land	81	7	480	6
Subtotal	920	77	6,849	82
Total	1,202	100	8,393	100

Source: SEWRPC.

In contrast, the annual average surface water total phosphorus concentration in the northern basin of Little Cedar Lake, reported by the U.S. Geological Survey for the years 1997 through 1999, was approximately 0.020 mg/l, with an annual average chlorophyll-*a* concentration of about 12 µg/l, as shown in Table 3. Secchi-disc transparency values ranged from 2.0 meters to 4.3 meters. The spring surface water total phosphorus concentration in the northern basin of the Lake was slightly higher at about 0.03 mg/l, with a range of about 0.010 to 0.037 mg/l. In the southern or main basin of Little Cedar Lake, the U.S. Geological Survey reported an average surface water total phosphorus concentration of about 0.014 mg/l, and an average chlorophyll-*a* concentration of about three µg/l, as shown in Table 4. Secchi-disc transparency values for this basin ranged from 4.1 meters to 4.5 meters. The sampling locations used by U.S. Geological Survey, between 1997 and 1999, are shown on Map 4.

The observed chlorophyll-*a* and total phosphorus concentrations are indicative of good water quality. The spring average surface water total phosphorus concentrations in the Lake's south or main basin was below the standard of 0.02 mg/l recommended by the Regional Planning Commission as the value below which few water quality problems are likely to occur.

Data obtained by the U.S. Geological Survey from two sites within Little Cedar Lake, between 1997 and 1999, indicated that the Lake stratifies during the summer months, as shown in Figure 2, exhibiting both thermal and dissolved oxygen stratification with depth during the months of June through September. Winter stratification also was suggested by the data reported by the U.S. Geological Survey for the month of February during the period between 1997 and 1999. These data are typical of dimictic lakes in the temperate zone. The depletion of dissolved oxygen in the hypolimnion or bottom waters of a lake is common in mesotrophic and eutrophic waterbodies.[7]

[7] *R.G. Wetzel*, Limnology, *Saunders, Philadelphia, 1975.*

Table 3

SEASONAL WATER QUALITY CONDITIONS IN THE NORTH BASIN OF LITTLE CEDAR LAKE: 1997-1999

Parameter[a]	1997		1998		1999	
	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]
Physical Properties						
Dissolved Oxygen						
Range	8.6 – 11.4	0.0 – 10.4	7.1 – 13.9	0.2 – 7.0	7.6 – 15.3	0.0 – 9.0
Mean	10.2	2.3	10.2	2.2	10.6	3.5
Standard Deviation	1.4	4.5	2.5	3.0	3.2	4.5
Number of Samples	5	5	5	5	5	5
pH (units)						
Range	8.0 – 8.5	7.1 – 8.4	8.0 – 8.5	7.2 – 7.8	7.8 – 8.6	7.2 – 7.8
Mean	8.3	7.5	8.3	7.5	8.2	7.5
Standard Deviation	0.2	0.5	0.2	0.3	0.3	0.3
Number of Samples	5	5	5	5	5	5
Secchi Depth (feet)						
Range	8.5 – 19.7	- -	5.6 – 10.2	- -	3.6 – 14.1	- -
Mean	11.8	- -	7.0	- -	8.3	- -
Standard Deviation	5.3	- -	2.2	- -	4.4	- -
Number of Samples	4	- -	4	- -	4	- -
Specific Conductance (µS/cm)						
Range	486 – 514	487 – 574	481 – 503	506 – 559	450 – 507	510 – 551
Mean	497	537	494	526	482	530
Standard Deviation	11	34	10	21	23	20
Number of Samples	5	5	5	5	5	5
Temperature (°C)						
Range	1.5 – 24.0	4.5 – 17.0	2.1 – 26.6	4.2 – 19.0	3.0 – 25.6	3.6 – 15.3
Mean	15.5	12.3	17.4	13.1	16.6	10.9
Standard Deviation	0.3	5.1	10.4	6.6	9.4	5.0
Number of Samples	5	5	5	5	5	5
Nutrients						
Dissolved Nitrogen, Ammonia						
Range	- -	- -	- -	- -	0.008	- -
Mean	- -	- -	- -	- -	0.008	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	- -	- -	- -	- -	1	- -
Dissolved Nitrogen, NO_2+NO_3						
Range	- -	- -	- -	- -	0.010	- -
Mean	- -	- -	- -	- -	0.010	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	- -	- -	- -	- -	1	- -
Total Nitrogen, Organic						
Range	- -	- -	- -	- -	0.600	- -
Mean	- -	- -	- -	- -	0.600	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	- -	- -	- -	- -	1	- -
Dissolved Orthophosphorus						
Range	- -	- -	- -	- -	0.004	- -
Mean	- -	- -	- -	- -	0.004	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	- -	- -	- -	- -	1	- -
Total Phosphorus						
Range	0.006 – 0.037	0.036 – 0.505	0.010 – 0.027	0.020 -0.186	0.011 – 0.040	0.023 – 0.361
Mean	0.018	0.227	0.020	0.097	0.021	0.127
Standard Deviation	0.012	0.200	0.009	0.069	0.012	0.135
Number of Samples	5	5	5	5	5	5

Table 3 (continued)

Parameter[a]	1997		1998		1999	
	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]
Biological						
Chlorophyll-*a* (µg/l)						
Range	1.4 – 9.7	- -	1.9 – 34.1	- -	1.5 – 43.0	- -
Mean	6.0	- -	15.4	- -	14.0	- -
Standard Deviation	3.7	- -	13.5	- -	19.5	- -
Number of Samples	4	- -	4	- -	4	- -

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

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

[c]*Depth of sample greater than 45 feet.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Associated with these periods of hypolimnetic anoxia is increased conductivity levels in the hypolimnion of Little Cedar Lake, as shown in Figure 3. This phenomenon is indicative of internal loading occurring within the Lake. Internal loading is the result of the release of phosphorus and other elements from the lake sediments as a result of changes in oxidation state of the multivalent cations such as iron, calcium, and aluminum which releases previously-bound elements back into the water column.[8] The impact of this internal loading on lake trophic state is related to the rate at which the Lake mixes from top to bottom during the spring and fall overturn events. In spring and fall, differential warming and cooling of the lake surface waters, respectively, alters the density of the lake waters in such a manner as to promote the mixing of lake water. When the mixing process is relatively slow, on the order of days to weeks, minerals and nutrients released from the lake sediments into the hypolimnion of the lake tend to recombine with the multivalent cations in the lake sediments and precipitate out of the water column. Conversely, if the mixing process is relatively rapid, on the order of hours or days, as may occur due to the passage of an intense storm, the minerals and nutrients may be mixed upward into the epilimnion or surface waters where they are available for plant growth. In Little Cedar Lake, the former process seems to be the dominant process. This hypothesis is supported by the fact that the predicted total phosphorus concentrations exceeded the observed total phosphorus concentrations in the Lake, as would be anticipated in a groundwater-fed Lake where phosphorus loads are attenuated by retention of phosphorus within the soil profile prior to discharge of the groundwater into the Lake.[9]

Based on the total phosphorus data, Little Cedar Lake has a Wisconsin Trophic State Index (WTSI) value of 51 indicating that the Lake is a mesotrophic waterbody, which status is supported by data shown in Figure 4.[10] Mesotrophic lakes are moderately fertile lakes that support abundant aquatic plant growths and may support

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[8]*Werner Stumm and James J. Morgan,* Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters*, Wiley-Interscience, New York, 1970.*

[9]*Estimates of the long-term annual average total phosphorus concentration Little Cedar Lake were derived from the WILMS model, described in Wisconsin Department of Natural Resources Publication No. PUBL-WR-363-96 REV,* Wisconsin Lake Model Spreadsheet, Version 2.00, User's Manual*, June 1994; observed in-lake total phosphorus concentrations in Little Cedar Lake for the period February 1996 through August 2001 are reported in the annual U.S. Geological Survey Open-File Reports,* Water-Quality and Lake-Stage Data for Wisconsin Lakes*, for each water year.*

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

Table 4

SEASONAL WATER QUALITY CONDITIONS IN THE SOUTH BASIN OF LITTLE CEDAR LAKE: 1997-1999

Parameter[a]	1997		1998		1999	
	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]
Physical Properties						
Alkalinity, as $CaCO_3$						
Range	200	200	192	194	185	- -
Mean	200	200	192	194	185	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Color						
Range	10.0	5.0	10.0	15.0	10.0	- -
Mean	10.0	5.0	10.0	15.0	10.0	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Oxygen						
Range	8.5 – 11.5	0.0 – 10.3	8.3 – 11.1	0.0 – 6.8	8.5 – 15.2	0.0 – 9.0
Mean	10.1	2.1	9.6	1.5	10.7	3.5
Standard Deviation	1.4	4.6	1.1	3.0	2.8	4.5
Number of Samples	5	5	5	5	5	5
Hardness, as $CaCO_3$						
Range	220	220	220	220	210	- -
Mean	220	220	220	220	210	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
pH (units)						
Range	8.3 – 8.4	7.4 – 8.1	8.0 – 8.4	7.4 – 7.8	7.9 – 8.2	7.4 – 8.0
Mean	8.3	7.6	8.2	7.5	8.1	7.6
Standard Deviation	0.1	0.3	0.2	0.2	0.1	0.2
Number of Samples	5	5	5	5	5	5
Secchi Depth (feet)						
Range	12.8 – 25.9	- -	9.2 – 27.6	- -	5.2 – 14.8	- -
Mean	17.8	- -	16.8	- -	11.7	- -
Standard Deviation	5.6	- -	9.0	- -	4.3	- -
Number of Samples	4	- -	4	- -	4	- -
Dissolved Solids at 180°C						
Range	274	276	286	292	286	- -
Mean	274	276	286	292	286	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Specific Conductance (µS/cm)						
Range	480 – 510	481 – 560	463 – 500	499 – 536	435 – 498	504 – 532
Mean	491	521	481	518	463	517
Standard Deviation	12	30	16.3	15	23	12
Number of Samples	5	5	5	5	5	5
Temperature (°C)						
Range	1.0 – 24.5	3.5 – 9.0	3.0 – 26.5	2.7 – 8.0	2.4 – 25.5	3.6 – 8.8
Mean	15.2	7.0	17.8	7.4	16.7	7.5
Standard Deviation	7.7	2.2	10.4	2.6	9.7	2.2
Number of Samples	5	5	5	5	5	5
Turbidity (NTU)						
Range	0.7	0.5	0.7	0.9	6.6	- -
Mean	0.7	0.5	0.7	0.9	6.6	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Metals/Salts						
Dissolved Calcium						
Range	38	38	36	37	34	- -
Mean	38	38	36	37	34	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -

Table 4 (continued)

Parameter[a]	1997		1998		1999	
	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]
Metals/Salts (continued)						
Dissolved Chloride						
Range	37	- -	38	38	41	- -
Mean	37	- -	38	38	41	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	- -	1	1	1	- -
Dissolved Iron (µg/l)						
Range	10.0	10.0	10.0	10.0	10.0	- -
Mean	10.0	10.0	10.0	10.0	10.0	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Magnesium						
Range	31	31	31	31	31	- -
Mean	31	31	31	31	31	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Manganese (µg/l)						
Range	2.0	5.0	5.3	5.2	9.4	- -
Mean	2.0	5.0	5.3	5.2	9.4	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Potassium						
Range	2.0	2.0	1.6	1.8	1.7	- -
Mean	2.0	2.0	1.6	1.8	1.7	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Silica						
Range	11.0	11.0	0.7	2.3	0.3	- -
Mean	11.0	11.0	0.7	2.3	0.3	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Sodium						
Range	17	17	18	18	18	- -
Mean	17	17	18	18	18	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Dissolved Sulfate SO_4						
Range	11.0	11.0	12.0	5.6	20.0	- -
Mean	11.0	11.0	12.0	5.6	20.0	- -
Standard Deviation	- -	- -	- -	- -	- -	- -
Number of Samples	1	1	1	1	1	- -
Nutrients						
Dissolved Nitrogen, Ammonia						
Range	0.050	0.100	0.091	0.262	0.013 – 0.073	- -
Mean	0.050	0.100	0.091	0.262	0.043	- -
Standard Deviation	- -	- -	- -	- -	0.042	- -
Number of Samples	1	1	1	1	2	- -
Dissolved Nitrogen, NO_2+NO_3						
Range	0.090	0.120	0.094	0.059	0.012 – 0.071	- -
Mean	0.090	0.120	0.094	0.059	0.041	- -
Standard Deviation	- -	- -	- -	- -	0.042	- -
Number of Samples	1	1	1	1	2	- -
Total Nitrogen, Organic						
Range	0.600	0.500	0.530	0.740	0.520 – 0.670	- -
Mean	0.600	0.500	0.530	0.740	0.595	- -
Standard Deviation	- -	- -	- -	- -	0.148	- -
Number of Samples	1	1	1	1	2	- -

Table 4 (continued)

Parameter[a]	1997		1998		1999	
	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]	Shallow[b]	Deep[c]
Nutrients (continued)						
Dissolved Orthophosphorus						
Range	0.002	0.003	0.007	0.059	0.003 – 0.005	- -
Mean	0.002	0.003	0.007	0.059	0.004	- -
Standard Deviation	- -	- -	- -	- -	0.001	- -
Number of Samples	1	1	1	1	2	- -
Total Phosphorus						
Range	0.007 – 0.020	0.014 – 0.432	0.012 – 0.019	0.069 – 0.378	0.009 – 0.019	0.038 – 0.251
Mean	0.012	0.225	0.015	0.249	0.013	0.166
Standard Deviation	0.005	0.163	0.003	0.155	0.004	0.090
Number of Samples	5	5	5	5	5	5
Biological						
Chlorophyll-*a* (µg/l)						
Range	0.9 – 6.6	- -	1.4 – 4.2	- -	0.0 – 4.7	- -
Mean	3.1	- -	2.5	- -	2.1	- -
Standard Deviation	2.5	- -	1.2	- -	1.9	- -
Number of Samples	4	- -	4	- -	4	- -

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

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

[c]*Depth of sample greater than 20 feet.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

productive fisheries. Nuisance growths of algae and plants are usually not exhibited by mesotrophic lakes, but may occur in meso-eutrophic lakes. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.

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, across the land surface, and by way of inflowing streams. Pollutants transported by the atmosphere are deposited onto the surface of the lake as dry fallout and direct precipitation. Pollutants transported by streams enter a lake as surface water inflows. In a drainage lake, like Little Cedar Lake, pollutants loadings transported by inflowing streams and across the land surface directly tributary to a lake, in the absence of identifiable or point source discharges from industries or wastewater treatment facilities, comprise the principal routes by which contaminants enter a waterbody.[11] There are no known point sources of water pollutants within the Little Cedar Lake tributary drainage area.[12] All of the residential lands within the tributary drainage area are served by onsite sewage disposal systems. For this reason, the discussion that follows is based upon nonpoint source pollutant loadings.

The nonpoint source pollutant loads to Little Cedar Lake were estimated on the basis of land use inventory data and unit area load coefficients determined for Southeastern Wisconsin. Based upon these mathematical models, annual contaminant loads entering Little Cedar Lake were calculated to be approximately 905 tons of sediment;

[11]*S.-O. Ryding and W. Rast,* The Control of Eutrophication in Lake and Reservoirs, *Unesco Man and the Biosphere Series Vol. 1, 1989.*

[12]*SEWRPC Memorandum Report No. 93,* op. cit.

Figure 2

DISSOLVED OXYGEN AND TEMPERATURE PROFILES FOR LITTLE CEDAR LAKE: 1997-1999

NORTH SAMPLING SITE

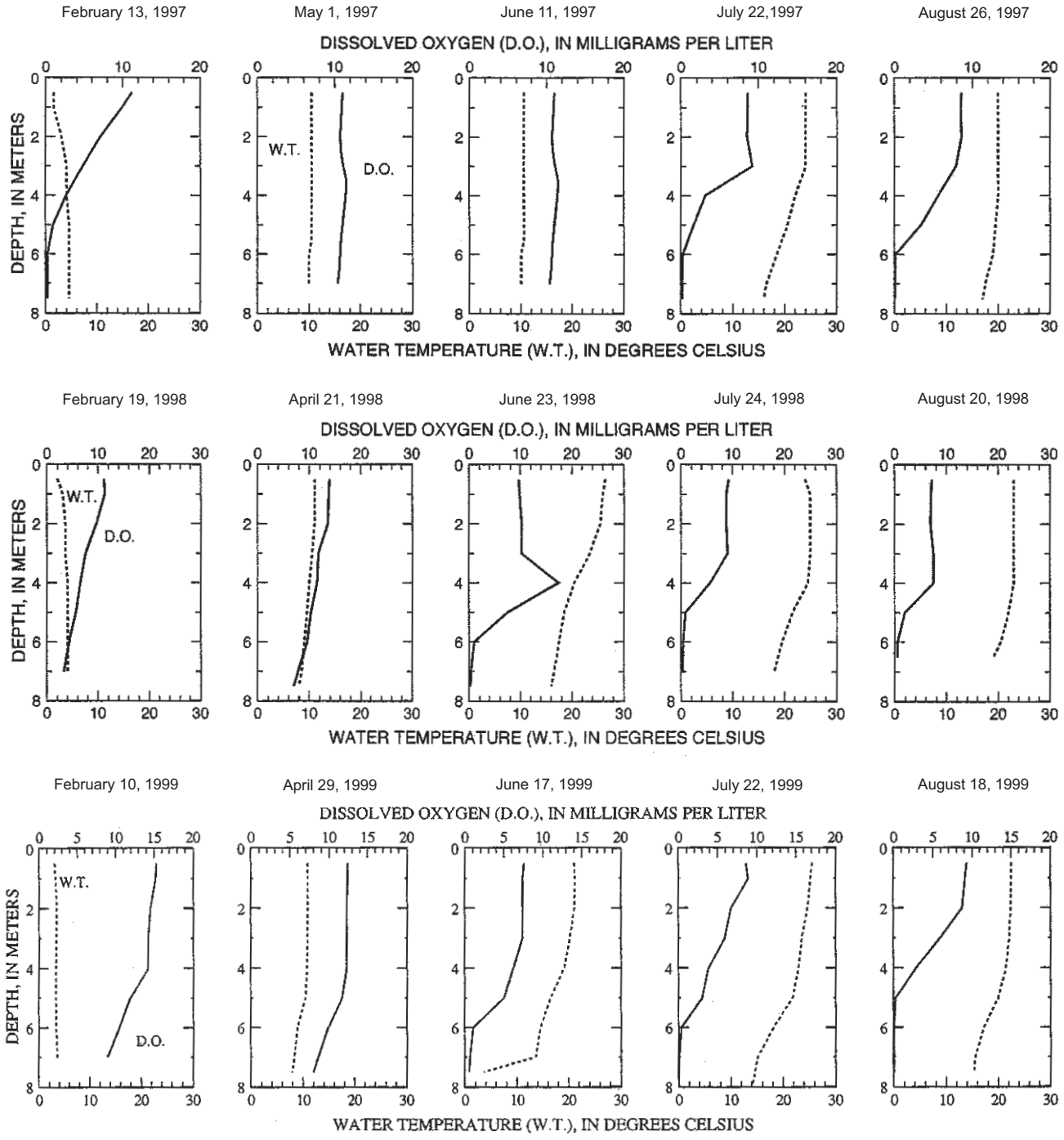
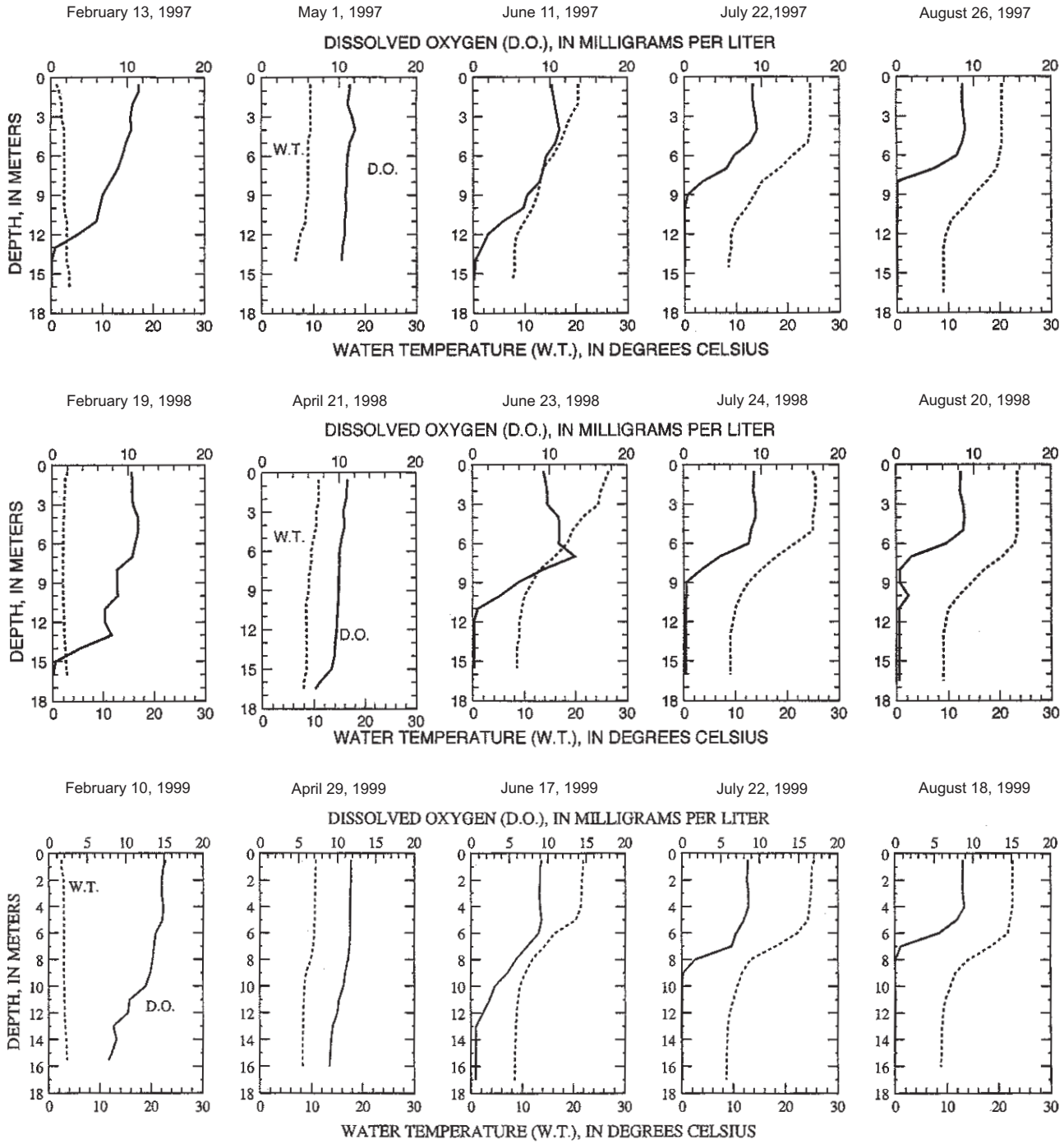


Figure 2 (continued)

SOUTH SAMPLING SITE



Source: U.S. Geological Survey.

Figure 3

SPECIFIC CONDUCTANCE AND pH PROFILES FOR LITTLE CEDAR LAKE: 1997-1999

NORTH SAMPLING SITE

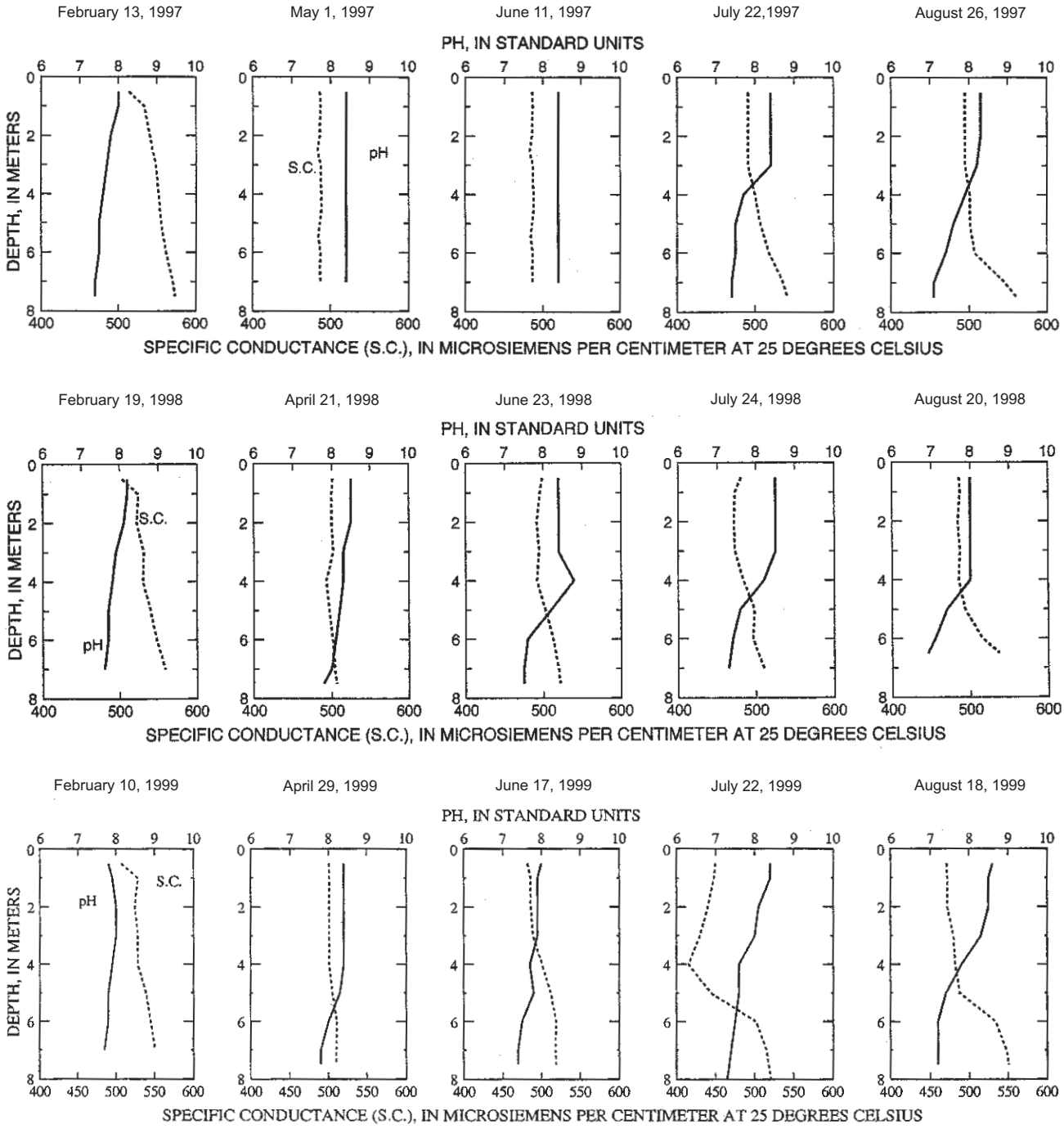
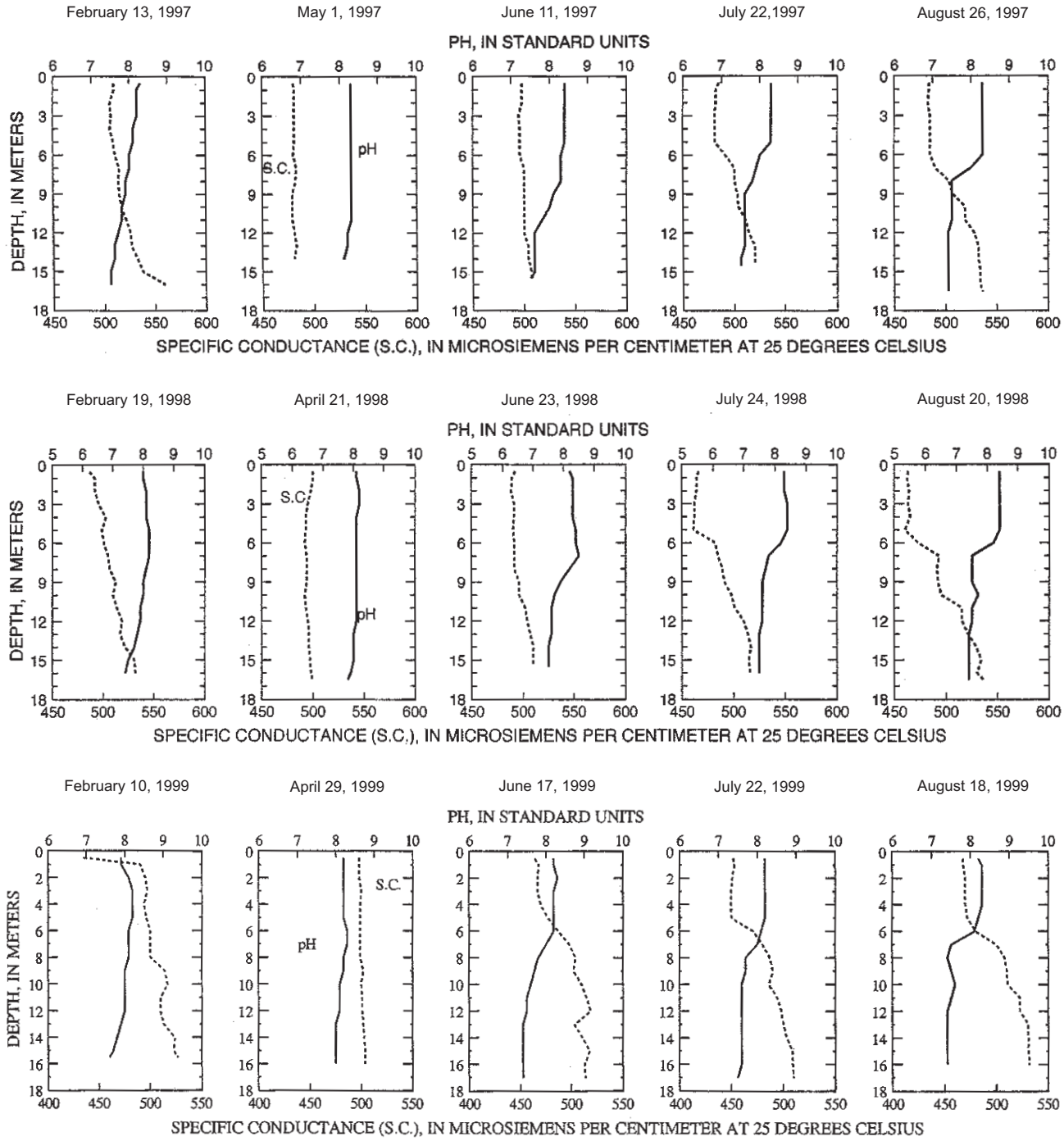


Figure 3 (continued)

SOUTH SAMPLING SITE



Source: U.S. Geological Survey.

Figure 4

SURFACE TOTAL PHOSPHORUS, CHLOROPHYLL-a CONCENTRATIONS, SECCHI DEPTHS, AND TROPHIC STATE INDEX DATA FOR LITTLE CEDAR LAKE

NORTH SAMPLING SITE

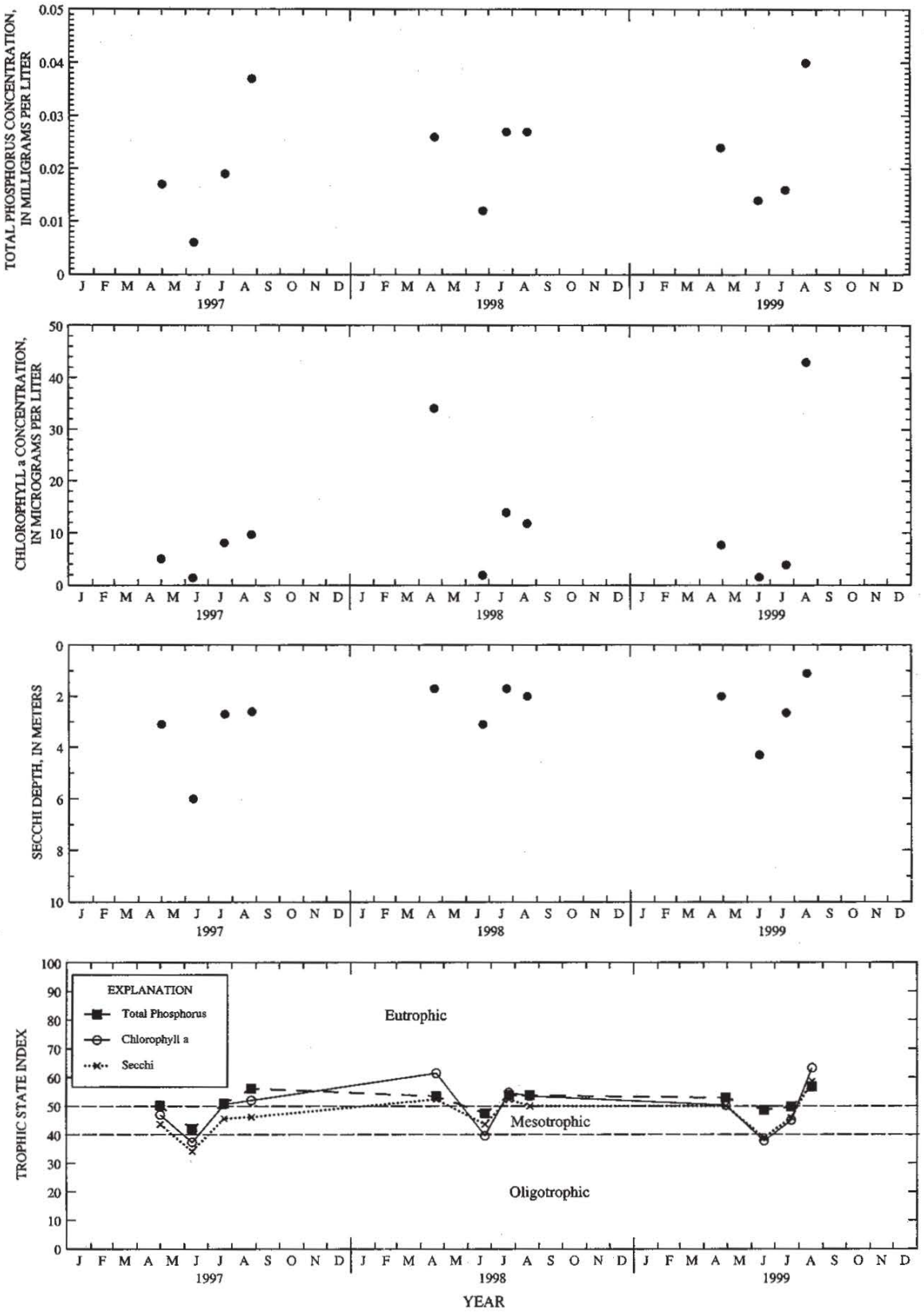
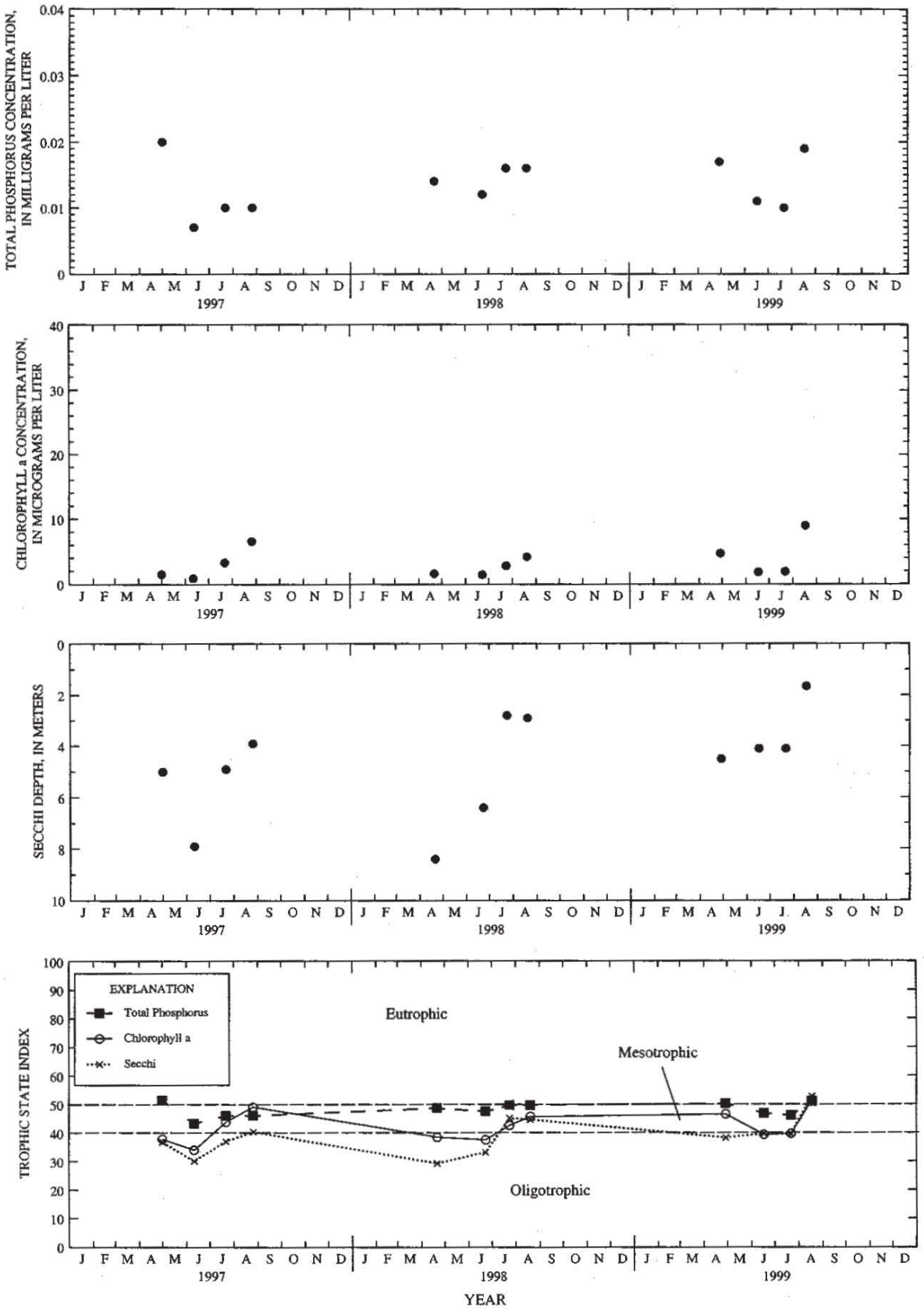


Figure 4 (continued)

SOUTH SAMPLING SITE



Source: U.S. Geological Survey.

3,500 pounds of phosphorus;[13] and 14 pounds, 119 pounds and 0.5 pound of copper, zinc and cadmium, respectively, as shown in Table 5. Copper, zinc and cadmium were used in this analysis as surrogates for metals and other pollutants that are contributed primarily from urban sources.

Table 5 also shows the relative percentage contributions of the various land uses to the pollutant loads to Little Cedar Lake. The data indicate that, based on 1995 land use conditions in the Little Cedar watershed, 82 percent of the phosphorus load and 82 percent of the sediment load, respectively, to Little Cedar Lake is estimated to be contributed from agricultural and open lands within the tributary drainage area; 7 percent and 14 percent, respectively, from woodlands, wetlands, and direct deposition onto surface waters; and, 11 percent and 4 percent, respectively, from urban areas. Residential areas are estimated to have contributed 6 percent of the phosphorus load and 1 percent of the sediment load, respectively.[14] The entirety of the heavy metals loads is considered to be generated from urban sources, as shown in Table 5.

To validate the estimated phosphorus load to Little Cedar Lake, Commission staff applied the estimated phosphorus load of 2,100 pounds in the Vollenweider-type OECD phosphorus budget model to estimate an in-lake total phosphorus concentration. This calculation resulted in an estimated annual average phosphorus concentration of 0.020 mg/l. This concentration corresponds well to the observed range in in-lake total phosphorus concentrations reported from the Lake of between 0.010 mg/l and 0.037 mg/l during the period from 1997 through 1999. This agreement would suggest that the estimated phosphorus load is a reasonable representation of the loads entering Little Cedar Lake, and that other pollution sources, including internal, atmospheric, groundwater, and onsite sewage disposal system sources, are relatively small compared to the loading from external sources.

Of the controllable pollutant sources, the most significant sources under existing land use condition are urban lands, which generate the largest percentage of sediment, nutrient, and metal loadings. Control of contaminants from these various sources can be effected through a variety of measures, as set forth in Chapter IV.

GROUNDWATER RESOURCES

Groundwater resources constitute an extremely valuable element of the natural resources base related to Little Cedar Lake, both as a source of water, and as a component of the surface water system. Groundwater in the vicinity of Little Cedar Lake occurs in three aquifers.[15] From the land surface downward, they are the sand and gravel aquifer, which ranges from approximately 100 feet to 300 feet in thickness in the vicinity of Little Cedar Lake; the dolomite aquifer, which ranges from approximately 100 feet to 200 feet in thickness; and the sandstone

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[13]*The annual phosphorus loads to Little Cedar Lake were estimated utilizing a unit area load (UAL) model to forecast nonpoint source pollutant loads to lakes in Southeastern Wisconsin, as well as the Wisconsin Lake Model Spreadsheet (WILMS)(see Table 6). The UAL model forecast a phosphorus load of about 3,500 pounds, while the WILMS model indicated a phosphorus load within the range of 2,100 pounds to 11,000 pounds. Based upon a comparison of predicted in-lake phosphorus concentrations based on these forecast loads to observed in-lake phosphorus concentrations, as discussed, the lower loading estimate appears to be the most reasonable estimate of the annual total phosphorus load to Little Cedar Lake.*

[14]*The contribution of phosphorus to Little Cedar Lake from urban sources is likely to increase with increased urbanization in the watershed. Studies within the Southeastern Wisconsin Region indicate that urban residential lands fertilized with a phosphorus-based fertilizer can contribute up to two-times more dissolved phosphorus to a lake than lawns fertilized with a phosphorus-free fertilizer or not fertilized at all. See U.S. Geological Survey Water-Resources Investigations Report No. 02-4130,* Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lakes, Wisconsin*, July 2002.*

[15]*An aquifer is a water-bearing stratum of rock, sand, or gravel.*

Table 5

ESTIMATED CONTAMINANT LOADS TO LITTLE CEDAR LAKE: 1995

Land Use	1995					
	Area (acres)	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)	Cadmium (pounds)
Residential	1,018	9.9	203.5	0.0	10.2	0.0
Commercial	23	8.9	27.2	5.0	33.8	0.2
Industrial	29	11.0	34.3	6.5	43.7	0.3
Communications and Utilities	417	2.0	45.8	0.0	0.1	0.0
Governmental	39	9.9	52.6	2.7	31.2	0.0
Recreational	18	0.3	4.8	- -	- -	- -
Water	1,273	119.6	165.4	- -	- -	- -
Wetlands	556	1.0	22.3	- -	- -	- -
Woodlands	1,259	2.3	50.4	- -	- -	- -
Agricultural	3,281	738.4	2,821.8	- -	- -	- -
Other Open Lands	480	2.3	53.0	- -	- -	- -
Total	8,393	905.6	3,481.1	14.2	119.0	0.5

Source: SEWRPC.

Table 6

ESTIMATED EXTERNAL SOURCES OF PHOSPHORUS TO LITTLE CEDAR LAKE: 1995

Source	1995	
	Pounds[a]	Percentage[a]
Urban		
Single-Family and Suburban-Density Residential, Commercial and Industrial, and Institutional	544[b]	26
Rural		
Agricultural	1,345	64
Pasture/Grass	49	2
Wetlands	51	2
Woodlands	55	3
Water	66	3
Subtotal	1,566	74
Total	2,110	100

[a]*Percentages estimated from WILMS model results.*

[b]*Includes the contribution from onsite sewage disposal systems that within the tributary drainage area to Little Cedar Lake, estimated within the WILMS model as ranging from approximately six pounds per year to as much as 236 pounds per year, depending upon soil type, system condition, and system location. For purposes of this analysis, 74 pounds per year were used as the contribution from onsite sewage disposal systems as that value provided the loading that was best correlated to the measured in-lake phosphorus concentrations.*

Source: SEWRPC.

aquifer, which ranges from approximately 300 feet to 400 feet in thickness, comprising the deep artesian system. Of these, the sand and gravel aquifer is intimately connected with the surface waters of Little Cedar Lake and Cedar Creek, and, as noted previously, comprise a hydrologic connection between Little Cedar Lake and Silver Lake to the east.[16] While Silver Lake is a net recipient of the groundwater outflow from Little Cedar Lake, the hydrogeological study suggested that Little Cedar Lake, itself, was a recipient of groundwater inflows from Big Cedar Lake and its tributary watershed. The net groundwater inflow to and outflow from Little Cedar Lake may be considered approximately equal and of negligible net import to the water budget of this Lake relative to the surface water flows of the Cedar Creek and surrounding watershed.

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 Little Cedar Lake area in 1966.[17] Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the drainage area tributary to Little Cedar Lake. Soils within the tributary drainage area to Little Cedar Lake were categorized into four main hydrologic soil groups, as indicated on Map 7. Less than 1 percent of the tributary drainage area was covered by well drained soils, about 74 percent of the tributary drainage area by moderately drained soils, less than about 1 percent of the tributary drainage area by poorly drained soils, and about 3 percent of the tributary drainage area by very poorly drained soils, with the remaining 21 percent of the watershed being surface water.

The regional soil survey also contained interpretations of the suitability of soils for urban development with conventional onsite sewage disposal systems and with alternative onsite sewage disposal systems. At present, all residential lands in the drainage area tributary to Little Cedar Lake are served by private onsite sewage disposal systems. The soil ratings for onsite sewage disposal systems, set forth in the regional soil survey and presented on Map 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. At that time, much of the drainage area tributary to Little Cedar Lake was covered by soils having an undetermined suitability for conventional onsite sewage disposal systems. With respect to lakefront properties dependent upon onsite sewage disposal systems, an unsuitable rating can potentially identify a significant phosphorus source to a lake. In the case of Little Cedar Lake, however, the undetermined nature of the soils, and the good agreement between forecast and observed phosphorus concentrations in the Lake, would suggest that the majority of existing onsite sewage treatment systems is functioning correctly and not contributing significant amounts of phosphorus to the Lake.

It should further be noted, however, that, 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. While these new rules significantly altered the existing regulatory framework and have potentially increased the area in which onsite sewage disposal systems may be utilized, the presence of properly functioning onsite sewage treatment systems around Little Cedar Lake does not appear to be a significant cause of concern with respect to Lake water quality.

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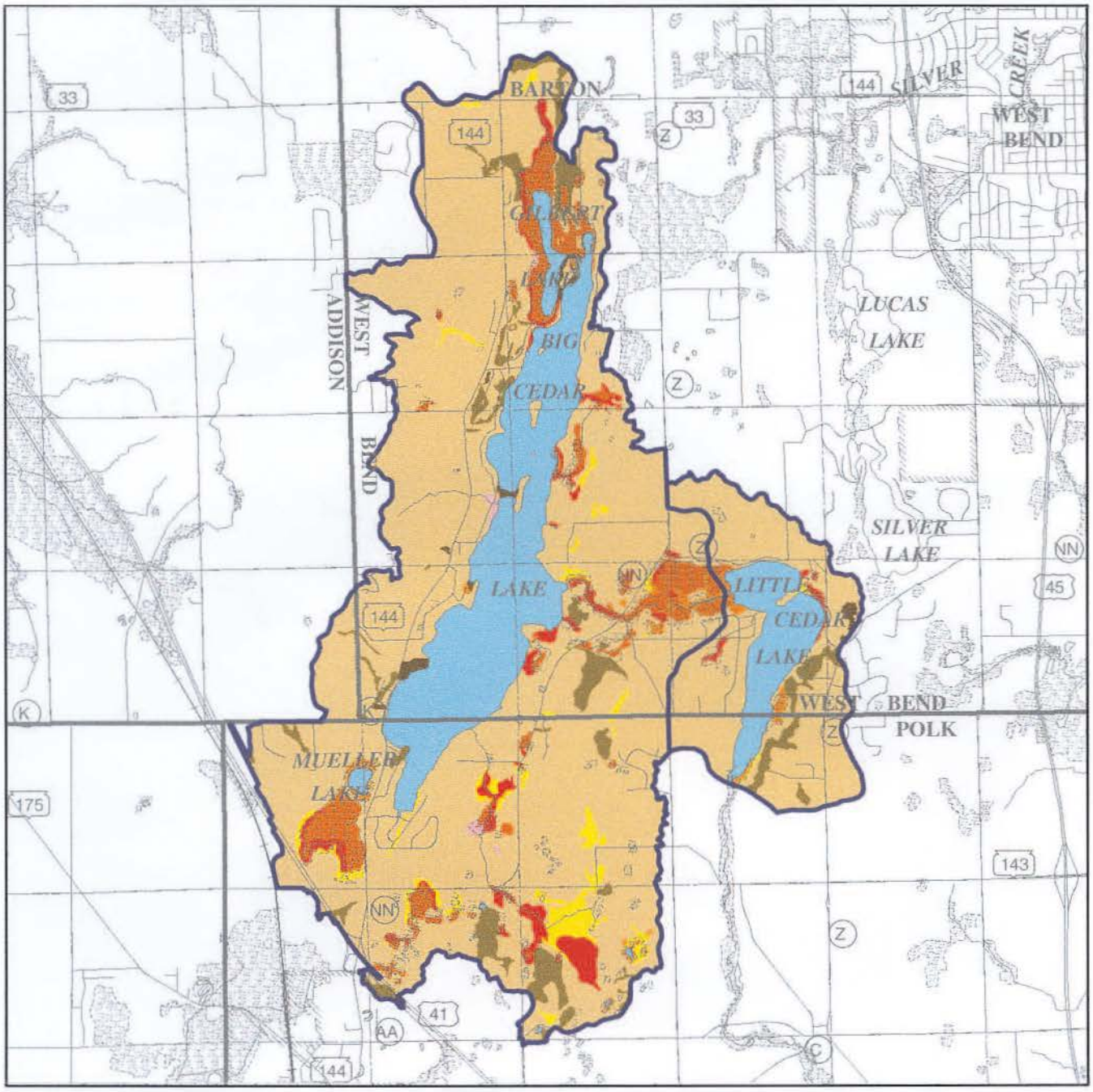
[16] *U.S. Geological Survey Water-Resources Investigations Report 02-4204*, op. cit.

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

Map 7

HYDROLOGIC SOIL GROUPS WITHIN THE DRAINAGE AREA TRIBUTARY TO LITTLE CEDAR LAKE



- GROUP A: Well-drained
- GROUP A/B: Well-drained soils/Moderately drained [1]
- GROUP A/D: Well-drained soil/Very poorly drained soil [2]
- GROUP B: Moderately drained soil
- GROUP B/D: Moderately drained soil/Very poorly drained soil [3]
- GROUP C: Poorly drained soil
- GROUP C/D: Poorly drained soil/Very poorly drained soil [4]
- GROUP D: Very poorly drained soil
- Surface Water

1 Well-drained soil if water table is lowered through provision of a drainage system. Moderately drained soil if water table is not lowered.

2 Well-drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.

3 Moderately drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.

4 Poorly drained soil if water table is lowered through provision of a drainage system. Very poorly drained soil if water table is not lowered.

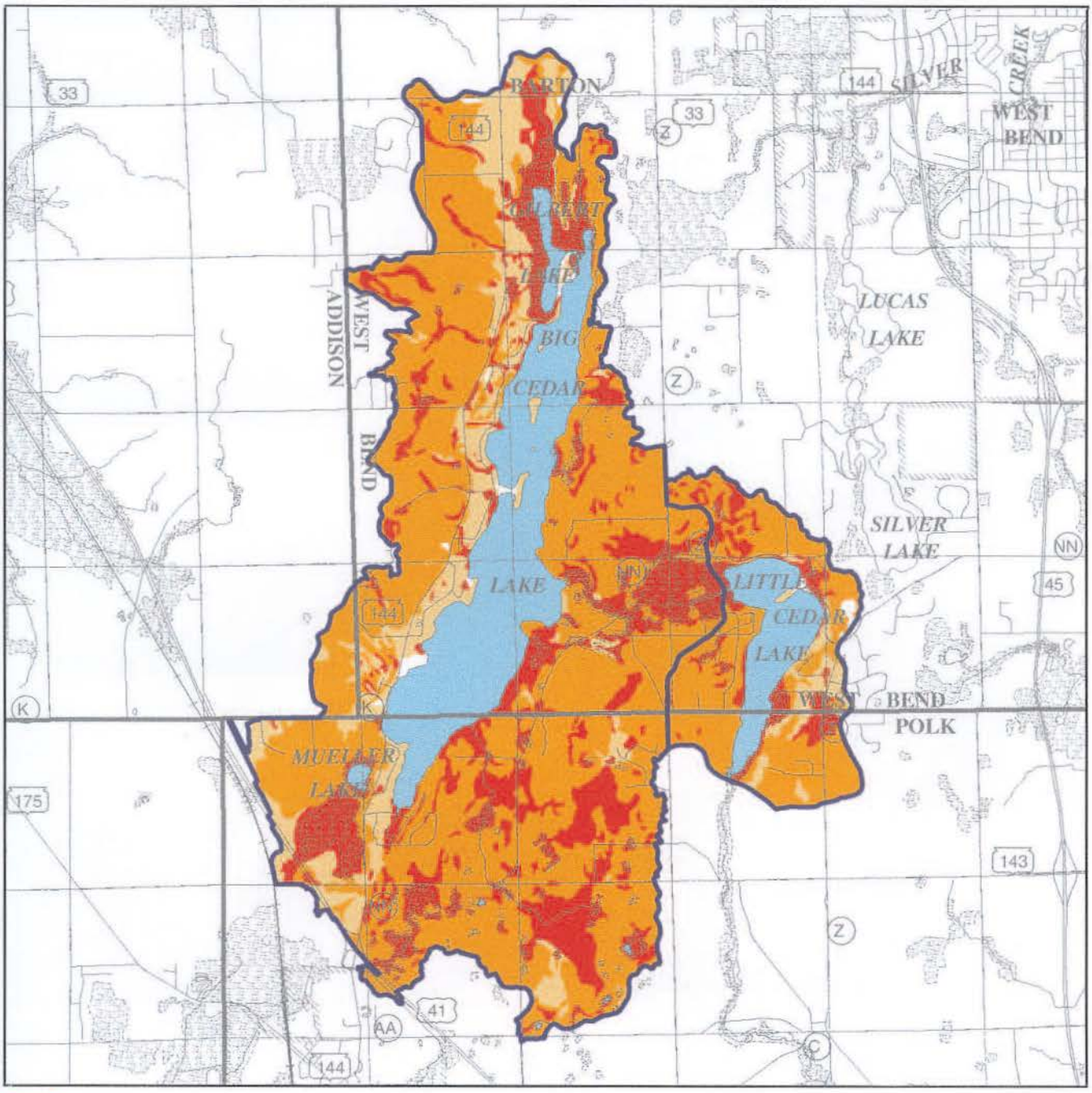
N

0 0.25 0.5 1 1.5 2 Miles

Source: SEWRPC.

Map 8

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO LITTLE CEDAR 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

OTHER: Areas consisting for the most part of disturbed land for which no interpretive data are available

SURFACE WATER

N

0 0.25 0.5 1 1.5 2 Miles

Source: SEWRPC.

AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

An aquatic plant survey was conducted in Little Cedar Lake by the Wisconsin Department of Natural Resources during 1968.[18] This survey indicated that the dominant aquatic plant species were muskgrass, *Chara vulgaris;* water stargrass, *Zosterella dubia;* water milfoil, *Myriophyllum* sp.; yellow water lily, *Nuphar* sp.; white water lily, *Nymphaea* sp.; pondweeds, *Potamogeton* spp.; large-leaf pondweed, *P. amplifolius;* Sago pondweed, *P. pectinatus;* and cattails, *Typha* spp. The southern end of the main lake basin and the western end of the northern lake basin were identified as unique areas of aquatic vegetation to be preserved and protected.

More recently, a survey of aquatic plant community within Little Cedar Lake was conducted by Commission staff during June 2000. The results of this survey are presented in Table 7, and graphically depicted on Map 9. Illustrations of the common aquatic plants found in Little Cedar Lake are included in Appendix A. Twenty-six aquatic plant species were found in Little Cedar Lake during 2000. The Lake had an high floral diversity, which included aquatic plant species designated as having important ecological value. However, Eurasian water milfoil, a declared nuisance species in Wisconsin, also was found throughout the Lake. Eurasian water milfoil was found at its highest densities in the east and west portions of the north basin and the northeast portion of the south basin of the Lake, as shown on Map 10. In addition to Eurasian water milfoil, aquatic plant species occurring at high frequencies were muskgrass, *Chara vulgaris;* coontail, *Ceratophyllum demersum*; water celery, *Vallisneria americana;* waterweed, *Elodea canadensis;* flat-stemmed pondweed, *Potamogeton zosteriformis;* and curly-leaf pondweed, *Potamogeton crispus*. Aquatic plant species dominance is shown in Table 7. The abundance of Eurasian water milfoil is also cause for much concern in Little Cedar Lake, given the increasing recreational usage and shallow depths in the northeast and southern portions of the south basin. The north basin or "kettle" is at considerable risk for the continued spread of Eurasian water milfoil due to its organic substrates and sedimentation at the debouchment of Cedar Creek.

The dominance of Eurasian water milfoil in Little Cedar Lake is cause for concern because this species is an exotic, or nonnative, plant that can exhibit "explosive" growth under suitable conditions, such as in the presence of organic-rich sediments or where lake bottom has been disturbed. It reproduces by the rooting of plant fragments, which can be caused by wind-induced turbulence, fragmentation by boat motor propellers, or action of humans and wildlife, 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, reducing the biodiversity of the lake and degrading the quality of fish and wildlife habitats.[19] Eurasian water milfoil, together with curly-leaf pondweed which is also known to occur in Little Cedar Lake, is a designated nonnative, invasive species.

WETLAND PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

In addition to the aquatic plant survey, a shoreline vegetation and wetland survey was conducted by the Commission staff during June and July 2000. A more detailed list, for each wetland plant community area inventoried, is included in Appendix B. The ecological significance of the major aquatic and wetland plants is included in Table 8. Wetland community types found in the Little Cedar Lake area comprised a range of hydrologic conditions from open water; deep marsh; shallow marsh; southern sedge meadow; fresh (wet) meadow; and wet- and wet-mesic hardwood.

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[18]*Wisconsin Department of Natural Resources Lake Use Report No. 69,* Little Cedar Lake, Washington County, Wisconsin, *1973.*

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

Table 7

AQUATIC PLANT SPECIES PRESENT IN LITTLE CEDAR LAKE AND THEIR ECOLOGICAL SIGNIFICANCE: JUNE 2000

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)[a]	Relative Density at Sites Found[b]	Importance Value[b]	Ecological Significance[c]
Ceratophyllum demersum (coontail)	28	31.1	2.2	0.68	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings
Chara vulgaris (muskgrass)	57	63.3	2.9	1.83	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)	17	18.9	2.4	0.44	Provides shelter and support for insects which are valuable as fish food
Lemna minor (lesser duckweed)	--[d]	--[d]	--[d]	--[d]	A nutritious food source for ducks and geese, also provides food for muskrat, beaver, and fish, while rafts of duckweed provide shade and cover for insects; in addition, extensive mats of duckweed can inhibit mosquito breeding
Lemna trisulc (forked duckweed)	--[d]	--[d]	--[d]	--[d]	Good food for ducks and geese; provides cover for fish and insects
Myriophyllum sp. (native water milfoil)	12	13.3	1.7	0.22	Provides valuable food and shelter for fish; fruits eaten by many waterfowl
Myriophyllum spicatum (Eurasian water milfoil)[g]	73	81.1	3.1	2.49	None known
Najas flexilis (bushy pondweed)	11	12.2	1.3	0.16	Stems, foliage, and seeds important wildfowl food and produces good food and shelter for fish
Najas marina (spiny naiad)	9	10.0	1.2	0.12	Provides good food and shelter for fish and food for ducks
Nuphar sp. (yellow water lily)	--[d]	--[d]	--[d]	--[d]	Leaves, stems, and flowers are eaten by deer; roots eaten by beaver; seeds eaten by wildfowl; leaves provide harbor to insects, in addition to shade and shelter for fish
Nymphaea odorata (white water lily)	--[d]	--[d]	--[d]	--[d]	Provides shade and shelter for fish; seeds eaten by wildfowl; rootstocks and stalks eaten by muskrat; roots eaten by beaver, deer, moose, and porcupine
Potamogeton amplifolius (large-leaf pondweed)	5	5.6	1.4	0.08	Provides food, shelter, and shade for some fish and food for some wildfowl. Provides shelter and support for insects, which are valuable as fish food
Potamogeton crispus (curly-leaf pondweed)[g]	12	13.3	1.4	0.19	Provides food, shelter and shade for some fish and food for wildfowl
Potamogeton gramineus (variable pondweed)	5	5.6	1.8	0.10	Provides habitat for fish and food for waterfowl, in addition to muskrat, beaver, deer, and moose

Table 7 (continued)

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)[a]	Relative Density at Sites Found[b]	Importance Value[b]	Ecological Significance[c]
Potamogeton pectinatus (Sago pondweed)[f]	8	8.9	2.1	0.19	This plant is the most important pondweed for ducks, in addition to providing food and shelter for young fish
Potamogeton richardsonii (clasping-leaf pondweed)	3	3.3	1.0	0.03	Provides food, shelter, and shade for some fish, food for some wildfowl, and food for muskrat. Provides shelter and support for insects, which are valuable as fish food
Potamogeton robbinsii (Robbins pondweed)	1	1.1	2.0	0.02	Provides habitat for invertebrates, in addition to providing food and shelter for young fish
Potamogeton zosteriformis (flat-stemmed pondweed)	20	22.2	2.1	0.46	Provides some food for ducks
Ranunculus longirostris (stiff water crowfoot)	7	7.8	2.1	0.17	Provides food for trout, upland game birds, and wildfowl
Scirpus subterminalis	2	2.2	1.0	0.02	Supports insects; provides food for a variety of ducks and muskrats and provides cover for wildfowl
Spirodella polyrhiza (great duckweed)	--[d]	--[d]	--[d]	--[d]	Good food for ducks and geese; also eaten by muskrat and some fish; provides cover for fish and insects
Vallisneria americana (water celery/eel grass)[f]	15	16.7	2.2	0.37	Provides good shade and shelter, supports insects, and is valuable fish food
Zosterella dubia (water stargrass)	17	18.9	1.7	0.32	Provides food and shelter for fish, locally important food for waterfowl

NOTE: There were 90 sites sampled during the June 2000 survey.

[a]*Maximum equals 100 percent.*

[b]*Maximum density equals 4.0.*

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

[d]*Emergent and floating-leafed aquatic plants are not included in the analysis of density and frequency of occurrence of submerged macrophytes.*

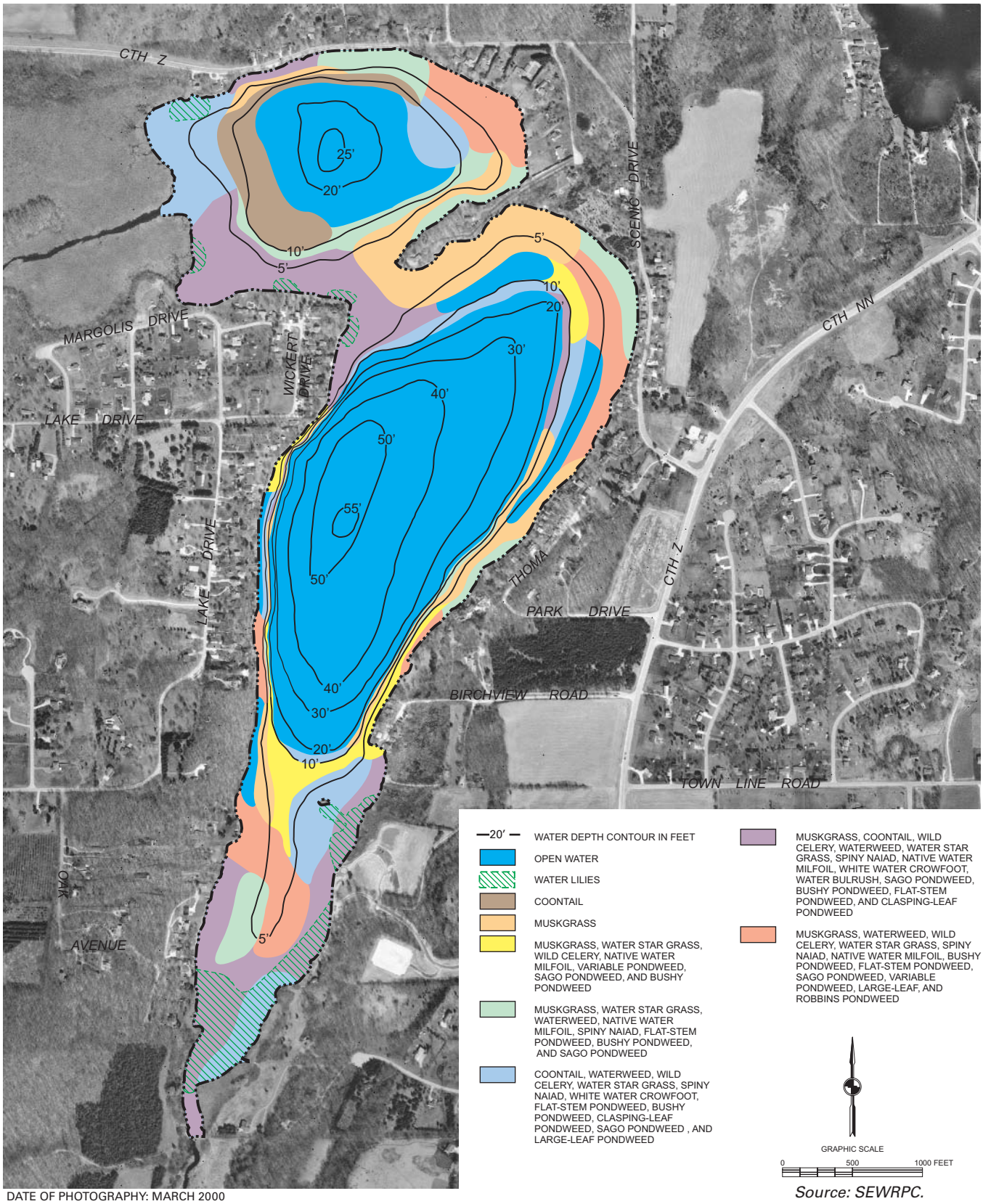
[f]*Considered a high-value aquatic plant species known to offer important values in specific aquatic ecosystems under Section NR 107.08 (4) of the* Wisconsin Administrative Code*.*

[g]*Considered an invasive and nonnative aquatic plant species known to cause significant adverse change in specific aquatic ecosystems under Section NR 109.07 (2) of the* Wisconsin Administrative Code*.*

Source: SEWRPC.

Map 9

DISTRIBUTION OF AQUATIC PLANT COMMUNITIES IN LITTLE CEDAR LAKE: 2000

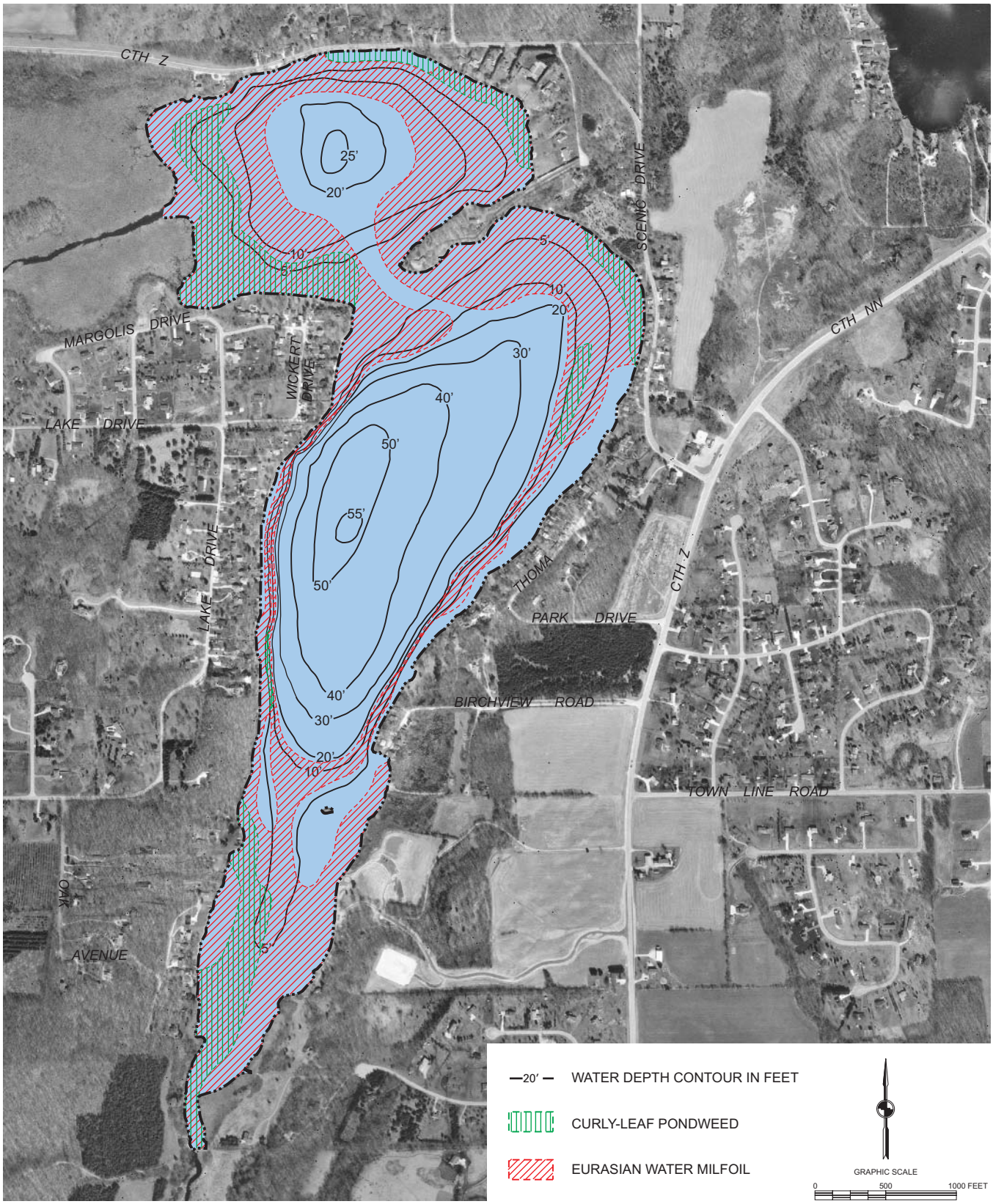


DATE OF PHOTOGRAPHY: MARCH 2000

Source: SEWRPC.

Map 10

DISTRIBUTION OF NONNATIVE AQUATIC PLANT SPECIES IN LITTLE CEDAR LAKE: 2000



DATE OF PHOTOGRAPHY: MARCH 2000

Source: SEWRPC.

Table 8

MAJOR EMERGENT SHORELINE AND WETLAND PLANT SPECIES PRESENT IN THE LITTLE CEDAR LAKE AREA AND THEIR POSITIVE ECOLOGICAL IMPORTANCE

Emergent Wetland Plant Species Present	Ecological Significance[a]
Asclepias incarnata (marsh milkweed)	Seeds provide food for ducks, roots may be eaten by muskrats, and plant fiber are used by birds for nesting materials, used as a host plant for Monarch butterfly caterpillars
Aster simplex (marsh aster)	Flowers attract insects
Carex lacustris (lake sedge)	Nutlets are eaten by waterfowl while the dense growth form of the plant provides valuable shoreline stabilization, and in shallow water the plant provides spawning habitat
Carex stricta (tussock sedge)	Sedges are an essential food source for wildfowl and marsh birds; large sedge meadows provide nesting for Sandhill cranes
Cornus amomum (silky dogwood) and *Cornus stolonifera* (red-osier dogwood)	Berries are eaten by upland game birds, songbirds, waterfowl, deer and beaver; shrub provides habitat and nesting for songbirds
Eleocharis sp. (spikerush)[b]	Plant consumed by waterfowl and submersed plants provide spawning habitat and shelter for invertebrates
Eupatorium maculatum (Joe-pye weed)	Fruits and leaves provide food for mallards and ruffed grouse
Impatiens capensis (jewelweed)	Flowers attract hummingbirds and insects; plants may be eaten by grazers
Iris versicolor (blue-flag iris)	Provides food for waterfowl and muskrats; and persists as good cover for wildlife and waterfowl
Lycopus americanus (cut-leaf bugleweed)	Used by upland game birds, waterfowl and muskrats
Lythrum salicaria (purple loosestrife)[c]	Provides minimal value for wildlife; flowers attract insects; crowds out valuable native vegetation
Phalaris arundinacea (reed canary grass)[c]	Low food value for grazers; offers some summer shelter to waterfowl in disturbed areas; crowds out valuable native vegetation
Polygonum amphibium (pinkweed)	Nutlets eaten by wildfowl, upland game birds, shorebirds, deer and muskrats, leaves offer shade and shelter for fish and invertebrates
Rumex orbiculatus (great water dock)	Nutlets eaten by waterfowl; grazed by deer and muskrats
Salix spp. (willows)	Attracts marsh birds, wildfowl, songbirds and upland game birds, leaves eaten by muskrats, browsed by deer, and important for beaver
Sagittaria latifolia (common arrowhead)	Provides food for ducks, muskrats, beavers and fish, and provides shelter for young fish
Sambucus canadensis (elderberry)	Thickets provide shelter; berries are eaten by songbirds and ruffed grouse
Scirpus acutus (hard-stem bulrush)[b] and *Scirpus validus* (soft-stemmed bulrush)[b]	Provides shelter for young fish, seeds provide food for waterfowl, stems and rhizomes provide food for geese and muskrats, in addition the plant material provides nesting materials and cover for wildfowl and muskrats
Scirpus atrovirens (green bulrush)[b]	Nutlets and tubers are eaten by ducks, plants and roots eaten by geese and swans; attracts marsh birds, waterfowl and songbirds
Sparganium eurycarpum (common bur-reed)	Plants help anchor sediments and provide nesting cover for waterfowl and shorebirds, and grazed on by muskrat and deer
Typha latifolia (broad-leaf cattail)	Supports insects; stalks and roots important food for muskrats and beavers; attracts marsh birds, wildfowl, and songbirds, in addition to being used as spawning grounds by sunfish and shelter for young fish

Table 8 Footnotes

[a]*Information obtained from* Wetland Plants and Plant Communities of Minnesota and Wisconsin*, Second Edition, by Steve D. Eggers and Donald M. Reed;* A Manual of Aquatic Plants *by Norman C. Fassett; and* Through the Looking Glass…A Field Guide to Aquatic Plants*, by Wisconsin Lake Partnership.*

[b]*Considered a high-value aquatic plant species known to offer important values in specific aquatic ecosystems under Section NR 107.08 (4) of the* Wisconsin Administrative Code.

[c]*Nonnative plant species.*

Source: SEWRPC.

Wetlands, shown on Map 11, are defined by the Regional Planning Commission as, "areas that have a predominance of hydric soils and that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions." This definition is also used by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, and is essentially the same as the definition used by the U.S. Natural Resource Conservation Service.[20] The Wisconsin Department of Natural Resources, pursuant to Chapter 23 of the *Wisconsin Statutes*, defines a wetland as "an area where water is at or near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation, and which has soils indicative of wet conditions." This latter definition may include some very poorly drained, poorly drained, or somewhat poorly drained soils[21] as wetland soils that meet the Department's "wet condition" criterion; the Regional Planning Commission would consider only very poorly drained and poorly drained soils as meeting the "hydric soil" criterion. Notwithstanding, as a practical matter, experience has shown that the application of all of these definitions produce reasonably consistent wetland identifications and delineations in a majority of situations within the Southeastern Wisconsin Region. This consistency is due in large part to the provision in the Federal wetland delineation manual which allows for the application of professional judgment in cases where the degree to which the three criteria for wetland identification is satisfied is unclear.

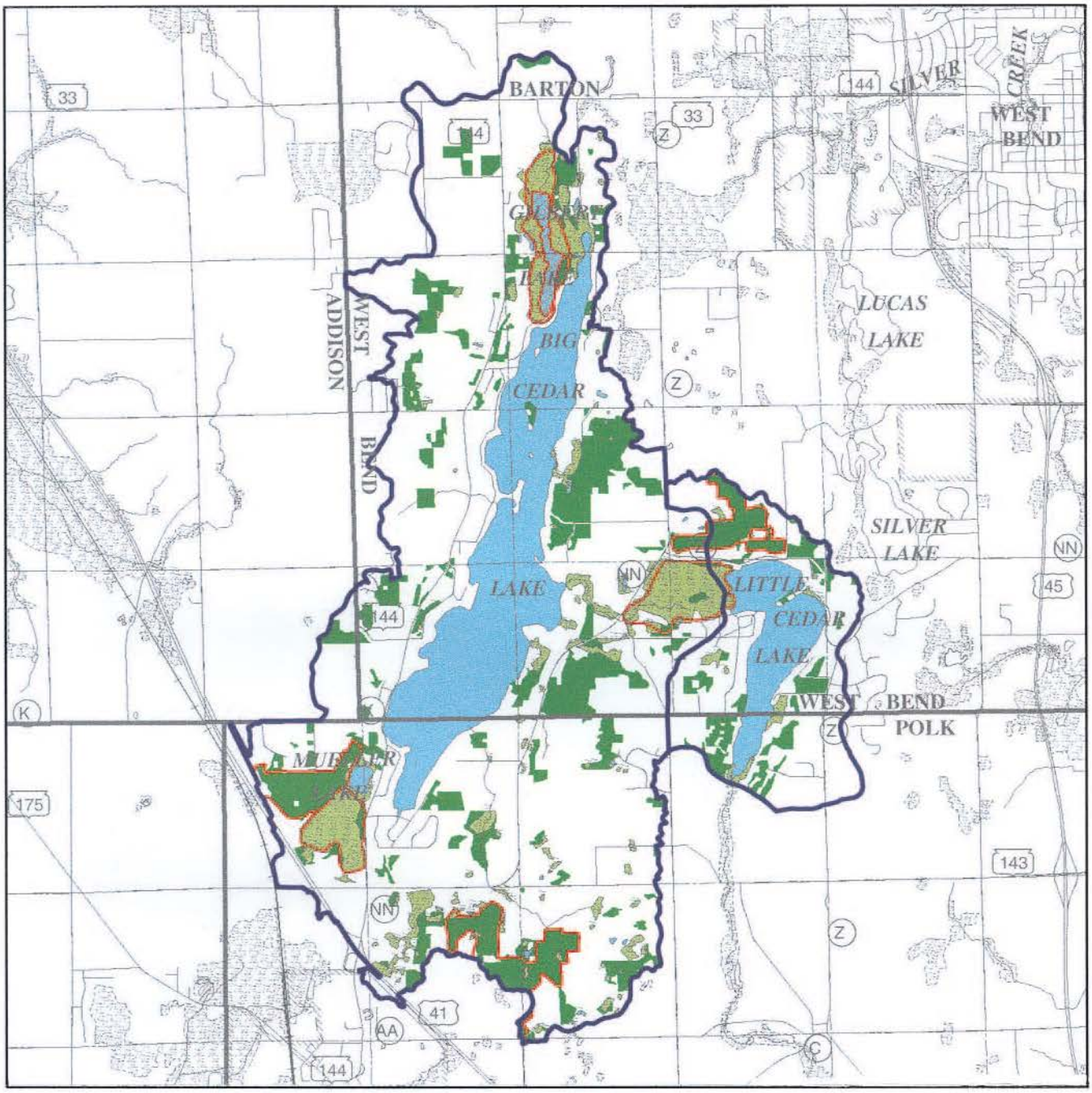
Wetlands affect the quality of water by acting as a filter or a buffer zone allowing silt and sediments to settle out. They also influence the quality of water by providing water during periods of drought and holding it back during periods of floods. When located along shorelines of lake and streams, wetlands help protect those shorelines from erosion. Wetlands may also serve as groundwater discharge and recharge areas in addition to being important resources for overall ecological health and diversity by providing essential breeding and feeding grounds, shelter, and escape cover for many forms of fish and wildlife. However, wetlands are poorly suited to urban use. This is

[20]*Lands designated as prior converted cropland, that is, lands that were cleared, drained, filled, or otherwise manipulated make them capable of supporting a commodity crop prior to December 23, 1985, may meet the criteria of the U.S. Natural Resource Conservation Service wetland definition, but they would not be regulated under Federal wetland programs. If such lands are not cropped, managed, or maintained for agricultural production, for five consecutive years, and in that time the land reverts back to wetland, the land would then be subject to Federal wetland regulations.*

[21]*Although prior converted cropland is not subject to Federal wetland regulations unless cropping ceases for five consecutive years and the land reverts to a wetland condition, the State may consider prior converted cropland to be subject to State wetland regulations if the land meets the criteria set forth in the State wetland definition before it has been cropped for five consecutive years.*

Map 11

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



Source: SEWRPC.

due to the high soil compressibility and instability, high water table, low load-bearing capacity, and high shrink-swell potential of wetland soils, and, in some cases, to the potential for flooding. In addition, metal conduits placed in some types of wetland soils may be subject to rapid corrosion. These constraints, if ignored, may result in flooding, wet basements and excessive operation of sump pumps, unstable foundations, failing pavements, broken sewer lines, and excessive infiltration of clear water into sanitary sewerage systems. In addition, there are significant onsite preparations and maintenance costs associated with the development of wetlands, particularly as they relate to roads, foundations, and public utilities.

PAST AND PRESENT AQUATIC PLANT MANAGEMENT ACTIONS

The Little Cedar Lake Management District has undertaken an active program of aquatic plant management within the Lake basins. An aquatic plant management program has been carried out on Little Cedar Lake in a documented manner since 1950, when records of aquatic plant management efforts were first maintained by the Wisconsin Department of Natural Resources. Prior to 1950, aquatic plant management interventions are likely, but were not recorded. Since 1950, and prior to the development of an aquatic plant management plan for the Lake, the aquatic plant management control program could be characterized as a chemical control program designed to minimize nuisance growths of aquatic macrophytes and algae. Chemical applications for aquatic plant control between 1950 and 2000 are summarized in Table 9. There are no records of the application of sodium arsenite in the Lake during this period. In recent years, the aquatic plant management program conducted on Little Cedar Lake has been modified to include an emphasis on aquatic plant harvesting as a major element of the aquatic plant management strategy. Currently, aquatic plant harvesting is the preferred method of managing nuisance growths of aquatic plants within Little Cedar Lake.

Chapter NR 107-Delineated Sensitive Areas

Chapter NR 107 of the *Wisconsin Administrative Code* authorizes the Wisconsin Department of Natural Resources to restrict chemical treatment of aquatic plants in sensitive areas on lakes. Section NR 107.05(3)i.1 defines such areas 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, as well as immediately adjacent to, bodies of water. Four sensitive areas were designated on Little Cedar Lake by the Wisconsin Department of Natural Resources during August 1991, and are shown on Map 12. Pursuant to their Chapter NR 107 authority, and authorities set forth pursuant to Chapter 30 of the *Wisconsin Statutes*, the Wisconsin Department of Natural Resources has prohibited chemical treatments, filling, alteration of shoreland wetlands, and placing of aquatic plant screens and boardwalks within the delineated sensitive areas. In addition, dredging and depositing sand blankets or pea gravel on the lakebed within certain of these areas is prohibited or restricted. Mechanical harvesting of aquatic plants also is limited or prohibited in the sensitive areas.

FISHERIES

The Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2001, *Wisconsin Lakes*, 2001 indicates that largemouth bass are abundant, that walleyed pike and panfish are common, and that northern pike are present in Little Cedar Lake.[22] In addition, previous fisheries surveys conducted by the Wisconsin Department of Natural Resources provide a more detailed inventory of the fish species within the Lake. The 1968 fisheries inventory[23] indicated that walleyed and northern pike, and largemouth bass, were the primary game fish in the Lake; black crappie, white bass, and yellow perch were the primary panfish. Bluegill and pumpkinseed also were reported very abundant, but stunted, in the Lake. Other fish inventoried included white sucker; yellow and brown

[22] *Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 99 Rev,* Wisconsin Lake, *1999.*

[23] *Wisconsin Department of Natural Resources Lake Use Report No. 69,* op. cit.

Table 9

CHEMICAL CONTROLS ON LITTLE CEDAR LAKE: 1950-2000

Year	Macrophyte Control						Algal Control	
	Sodium Arsenite (pounds)	Diquat (gallons)	Aquathol-K		2,4-D		Cutrine-Plus (gallons)	Copper Sulfate (pounds)
			Gallons	Pounds	Gallons	Pounds		
1950-1969	- -	- -	- -	- -	- -	- -	- -	700
1970	- -	5.00	- -	- -	- -	- -	- -	- -
1971[a]	- -	- -	- -	- -	- -	- -	- -	- -
1972	- -	- -	100.0	- -	- -	- -	- -	- -
1973[a]	- -	- -	- -	- -	- -	- -	- -	- -
1974[a]	- -	- -	- -	- -	- -	- -	- -	- -
1975[a]	- -	- -	- -	- -	- -	- -	- -	- -
1976[a]	- -	- -	- -	- -	- -	- -	- -	- -
1977	- -	- -	- -	50	- -	- -	- -	- -
1978[a]	- -	- -	- -	- -	- -	- -	- -	- -
1979[a]	- -	- -	- -	- -	- -	- -	- -	- -
1980[a]	- -	- -	- -	- -	- -	- -	- -	- -
1981[a]	- -	- -	- -	- -	- -	- -	- -	- -
1982[a]	- -	- -	- -	- -	- -	- -	- -	- -
1983[a]	- -	- -	- -	- -	- -	- -	- -	- -
1984	- -	- -	4.0	- -	61	- -	37.00	- -
1985	- -	- -	105.0	- -	44	- -	11.00	- -
1986[a]	- -	- -	- -	- -	- -	- -	- -	- -
1987	- -	6.50	1.5	- -	- -	- -	8.00	- -
1988	- -	- -	- -	- -	- -	5	- -	- -
1989	- -	1.50	4.3	- -	15	- -	6.00	- -
1990	- -	6.78	- -	- -	53	- -	9.53	- -
1991	- -	59.00	1.5	- -	16	- -	5.75	- -
1992	- -	- -	- -	- -	- -	- -	- -	- -
1993-2000[a]	- -	- -	- -	- -	- -	- -	- -	- -
Total	- -	78.78	216.3	50	189	5	77.28	700

[a]No chemical controls were reported during these years.

Source: Wisconsin Department of Natural Resources and SEWRPC.

bullheads; emerald and golden shiners; bluntnose minnows; and common carp. A 1978 fisheries inventory[24] indicated that the fish community in Little Cedar Lake was comprised of bluntnose minnow; tadpole madtom; common carp; bluegill; largemouth, rock, and white bass; pumpkinseed; green sunfish; black crappie; golden shiner; northern pike; yellow and black bullheads; yellow perch; and walleyed pike.

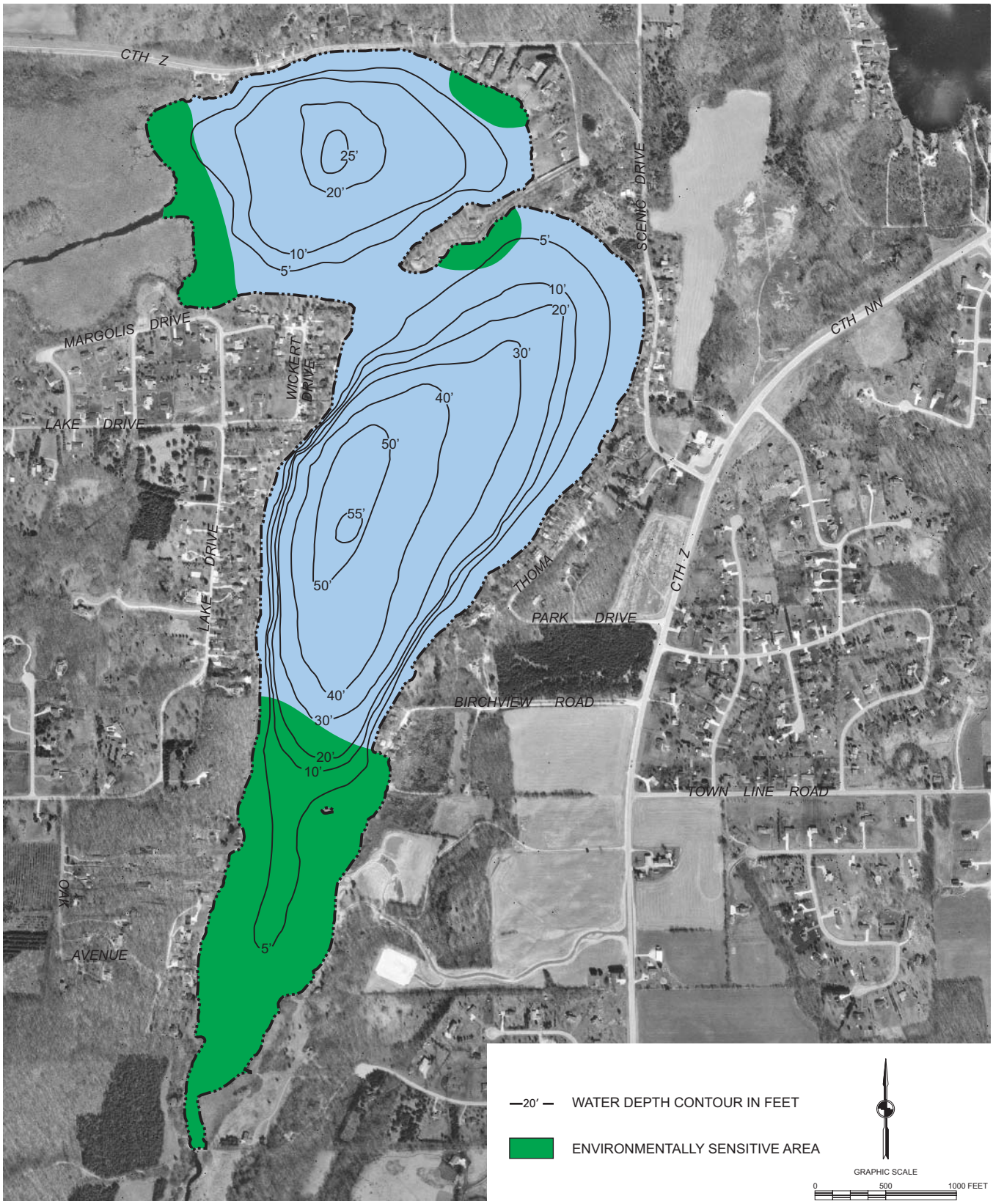
The most recent, comprehensive fisheries survey conducted by Wisconsin Department of Natural Resources staff on Little Cedar Lake was completed during 1999. This survey identified a predominantly northern pike, largemouth bass and bluegill fishery.[25] The 1999 survey results indicated that largemouth bass was the dominant

[24]*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.*

[25]*J.E. Nelson, Wisconsin Department of Natural Resources Unpublished Report,* Comprehensive Fish Community Survey Little Cedar Lake, Washington County, *1999.*

Map 12

WISCONSIN DEPARTMENT OF NATURAL RESOURCES-DELINEATED SENSITIVE AREAS IN LITTLE CEDAR LAKE: 1991



DATE OF PHOTOGRAPHY: MARCH 2000

Source: Wisconsin Department of Natural Resources and SEWRPC.

species, and that the density and growth rates of both northern pike and largemouth bass were at or above the target range. The 1999 survey further indicated that bluegill were abundant, but small in size. Other fish species identified included yellow perch; rock and white bass; green sunfish; pumpkinseed; black crappie; lake chubsucker; yellow bullhead; bluntnose minnow; sand and golden shiners; and common carp. Of these species, the adopted regional natural areas and critical species habitat protection and management plan notes the lake chubsucker as a State species of special concern,[26] while the continued presence of the common carp is an issue of potential concerns that may require management action at some time in the future.

The fish populations of Little Cedar Lake have been augmented by periodic stocking of the Lake.

WILDLIFE AND WATERFOWL

Given the low- and moderate-density, single-family residential nature of much of the Lake's shoreline, and the surrounding woodlands and wetlands in the vicinity, it is likely that the wildlife community is comprised of small upland 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; marsh birds, such as red-winged blackbirds and great blue herons; and waterfowl. 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 and the subsequent clearing of forests, plowing of the prairie, and filling or draining of wetlands for agricultural purposes. Modern practices that adversely affect wildlife and wildlife habitat 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.

As shown on Map 13, wildlife habitat areas in the drainage area tributary to Little Cedar Lake generally occur in association with existing surface water, wetland, and woodland resources. These woodlands and wetlands are principally located along Cedar Creek, shown on Map 11. Wildlife habitat covered approximately 420 acres, or about 35 percent, of the drainage area directly tributary to Little Cedar Lake, and about 2,630 acres, or about 30 percent of the total tributary drainage area. About 154 acres of the direct tributary drainage area and about 1,310 acres of the total tributary drainage area were rated as Class I, high-value habitat; about 180 acres of the direct tributary drainage area and about 660 acres of the total tributary drainage area as Class II, moderate-value habitat; and about 85 acres of the direct tributary drainage area and 660 acres of the total tributary drainage area as Class III, good-value habitat.[27]

The wildlife habitat areas shown on Map 13 are also largely coincident with Commission-delineated environmental corridors within this watershed, as shown on Map 14. Environmental corridors and isolated natural resource area features extended over about 575 acres of the drainage area directly tributary to Little Cedar Lake, and about 3,455 acres of the total tributary drainage area. Primary environmental corridors extend over 290 acres of the drainage area tributary directly to Little Cedar Lake, and over about 1,850 acres of the total drainage area. Secondary environmental corridors were also present within the total drainage area tributary to Little Cedar Lake, extending over about 55 acres. Isolated natural resource area features covered a further 25 acres of the direct drainage area, and about 280 acres of the total drainage area tributary to Little Cedar Lake. The Commission recommends that, to the extent practicable, environmental corridor lands be maintained in essentially natural, open space uses.[28]

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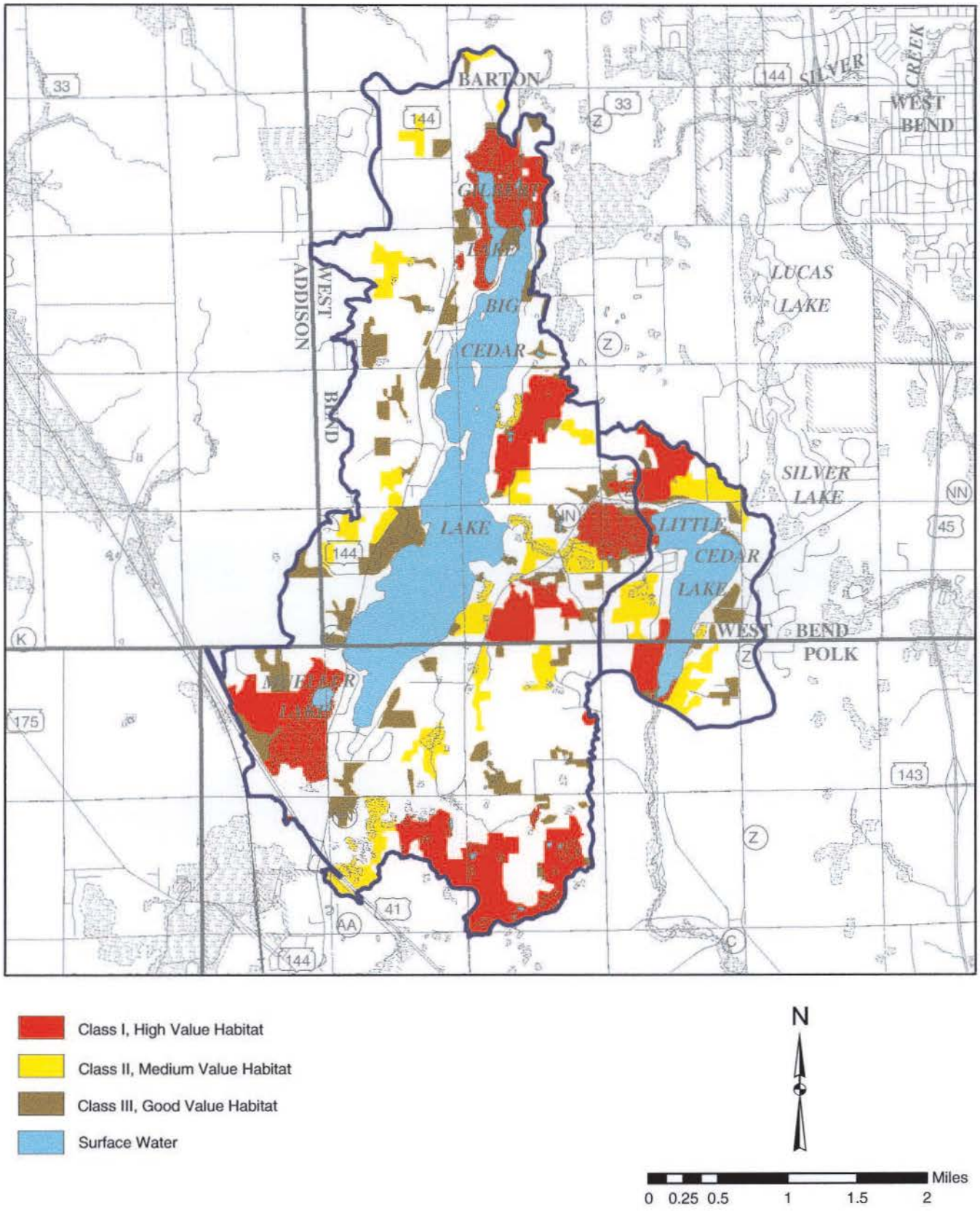
[26]*SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997.*

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

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

Map 13

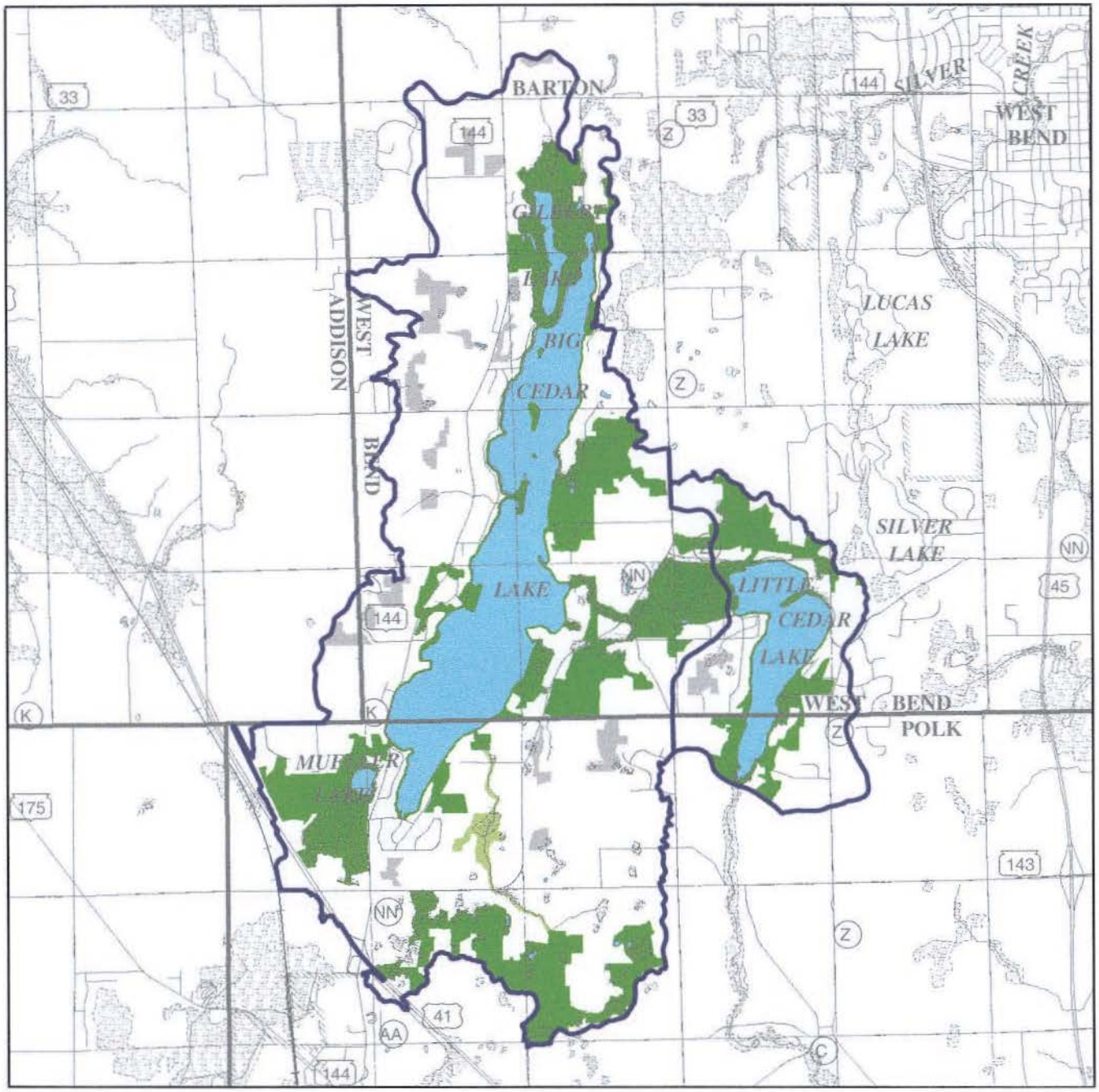
WILDLIFE HABITAT AREAS WITHIN THE DRAINAGE AREA TRIBUTARY TO LITTLE CEDAR LAKE: 1985



Source: SEWRPC.

Map 14

ENVIRONMENTAL CORRIDORS AND NATURAL AREAS WITHIN THE DRAINAGE AREA TRIBUTARY TO LITTLE CEDAR LAKE: 1995



Primary Environmental Corridor

Secondary Environmental Corridor

Isolated Natural Resource Area

Surface Water

N

0 0.25 0.5 1 1.5 2 Miles

Source: SEWRPC.

RECREATIONAL USES AND FACILITIES

Little Cedar Lake is a multi-purpose use waterbody serving all forms of water-based and water-related recreation, 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 used year-round as a visual amenity, and for walking and jogging, bird watching, and picnicking.

Recreational use surveys, conducted by Commission staff on Little Cedar Lake between July 12 and 15, 2000, indicated that between 10 and 33 watercraft of various types were being operated on Little Cedar Lake during either weekday morning or weekend afternoons. Watercraft being operated on the Lake included fishing boats, pleasure boats such as pontoon boats, skiboats, sailing vessels, and personal watercraft ("jetskis"®). Table 10 summarizes the weekday and weekend boating usage on the Lake.

A survey of recreational watercraft moored on, or trailered near, the Lake also was conducted during July 2000. A total of approximately 300 watercraft were observed. Of these, the majority were powered boats of various types, as shown in Table 11. These included about 70 skiboats, 75 fishing boats, 50 pontoon boats, and 15 personal watercraft. In addition, about 30 canoes, 45 paddleboats, and 15 sailboats were recorded. Some of these watercraft were in operation at the time of the survey.

Little Cedar Lake has adequate public recreational boating access pursuant to the public recreational boating access standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*. Public recreational boating access is provided at the Lake. The access site on Little Cedar Lake is located on the southeastern shore at the Ackerman's Grove County Park, formerly Ackerman's Resort. In addition, private boating access and boat rental is provided at Knight's Boat Landing on the north shore of the northern basin of the Lake.

SHORELINE PROTECTION STRUCTURES

Shoreline protection structures are designed to minimize shoreland erosion and to protect the structure and functioning of the aquatic ecosystem, especially, in the nearshore areas. Such protection structures also can contribute to preserving and enhancing water quality and habitat for fishes and other aquatic life. Certain shoreland landscaping practices have been shown to be effective deterrents to resident waterfowl populations, as well as attractive means of preserving and providing habitat for desirable aquatic species. Commission staff conducted a survey of the Little Cedar Lake shoreline during June and July of 2000. This survey identified the shoreline as being comprised of a mixture of riprap, bulkheads, and natural shoreline, with small, scattered areas of beach, as shown on Map 15. No obvious erosion-related problems were observed, although some areas of natural shoreline, especially those with steep slopes, appeared to be potentially susceptible to minor to moderate erosion events.

LOCAL ORDINANCES

Little Cedar Lake is subject to boating regulations promulgated by the Little Cedar Lake Protection and Rehabilitation District. These regulations provide generally applicable rules for all waters within the jurisdiction of the District, as set forth in Appendix C. These rules limit the times during which boats may operate on Little Cedar Lake and the speeds at which boats may operate. These rules also allow for the enactment and enforcement of other boating restrictions and limitations. The regulations conform to State of Wisconsin boating and water safety laws pursuant to Chapter 30, *Wisconsin Statutes.*

Table 10

RECREATIONAL USE SURVEY ON LITTLE CEDAR LAKE: 2000

Date and Time	Weekday Participants							
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	Total
July 12, 2000								
10:15 a.m. to 11:15 a.m.	9	1	0	0	0	0	0	10
1:15 p.m. to 2:15 p.m.	8	1	0	0	0	1	0	10
Total	17	2	0	0	0	1	0	20
Percent	85	10	0	0	0	5	0	100

Date and Time	Weekend Participants							
	Fishing	Pleasure Boating	Skiing	Sailing	Jetskiing	Swimming	Other	Total
July 15, 2000								
10:30 a.m. to 11:30 a.m.	24	5	2	0	0	10	3	44
1:15 p.m. to 2:15 p.m.	14	11	1	0	2	21	5	54
Total	38	16	3	0	2	31	8	98
Percent	39	16	3	0	2	32	8	100

Source: SEWRPC.

Table 11

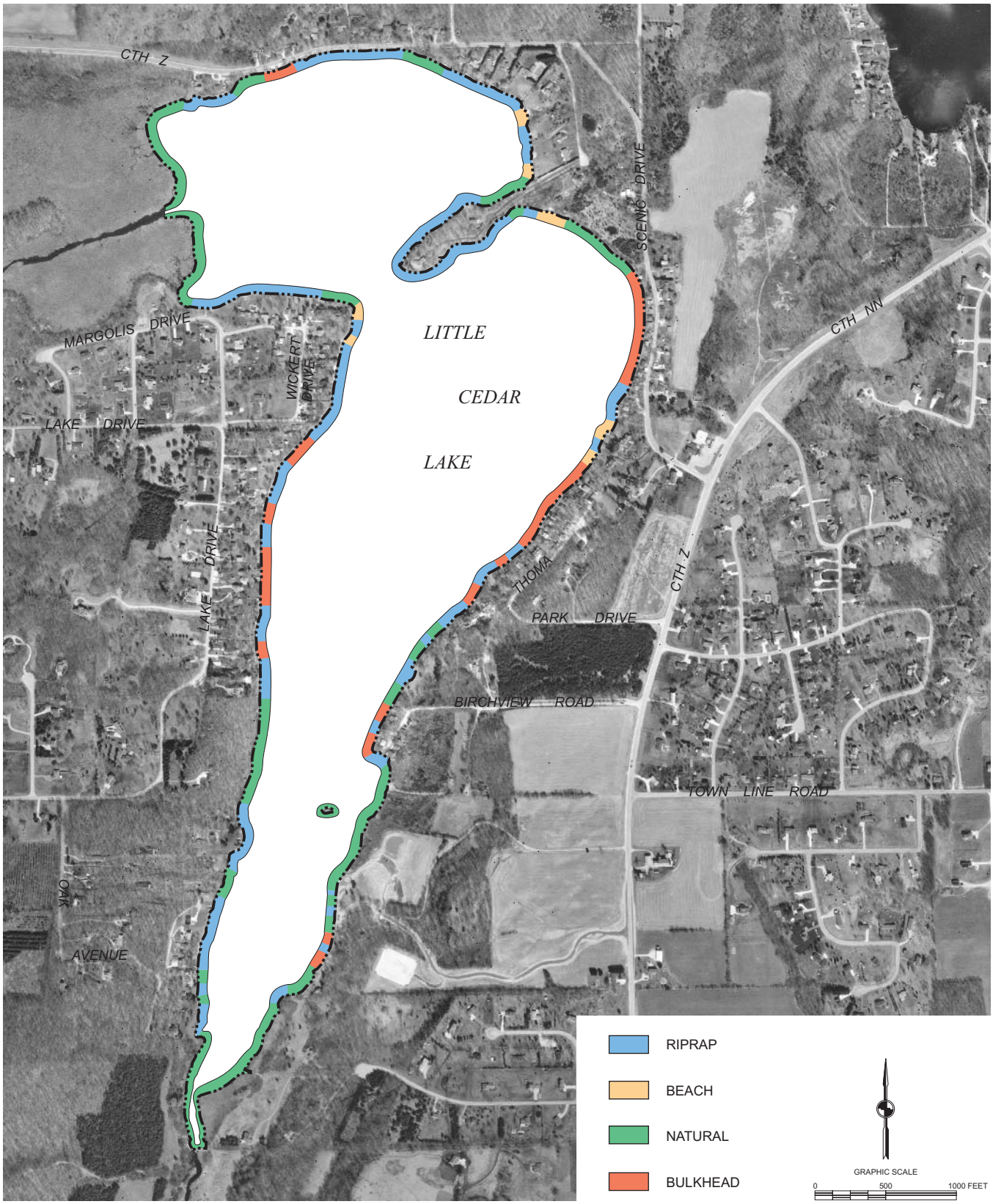
WATERCRAFT ON, AND IN THE VICINITY OF, LITTLE CEDAR LAKE: 2000

Type of Watercraft								
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddle Boat	Sailboat	Personal Watercraft	Other	Total
69	73	50	29	46	17	16	1	301

Source: SEWRPC.

Map 15

SHORELINE PROTECTION STRUCTURES ON LITTLE CEDAR LAKE: 2000



DATE OF PHOTOGRAPHY: MARCH 2000

Source: SEWRPC.

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Chapter III

ISSUES OF CONCERN

INTRODUCTION

Little Cedar Lake is a good-quality waterbody that is capable of supporting a variety of recreational water uses. Notwithstanding, there are a number of existing and potential future problems and issues of concern that should be addressed in this plan. These concerns include potential changes in aquatic plant communities and ecologically valuable areas; land use and its potential impact on water quality; and, recreational usage of the Lake.

AQUATIC PLANT COMMUNITIES

The abundance of aquatic plants, including Eurasian water milfoil, continues to be perceived as a nuisance by users of Little Cedar Lake. In addition, there are other localized recreational use problems experienced in various areas of the Lake. These problems depend on the uses in those portions of the Lake, but generally involve the abundant growths of aquatic plants, especially coontail and Eurasian water milfoil. These plants often grow to the surface of the Lake, limiting certain recreational uses in those areas of the Lake, in addition to impairing the aesthetic quality of the Lake and limiting habitat for fish and other aquatic life within and adjacent to the Lake.

The abundant growths of aquatic plants within Little Cedar Lake can interfere with the recreational uses, aesthetic enjoyment, and the ecological health of the waterbody. Recreational boating activities are impaired by clogging of propellers and cooling water intakes, slowing boating activities, and limiting the ability of lake users to navigate in certain areas of the Lake. Without control measures, these areas could become impassable for recreational navigation. In addition, however, fishing and swimming activities on the Lake are also adversely affected by aquatic plant growth. This is especially of concern in those areas of the Lake where Eurasian water milfoil occurs at swimming depths. Fishing areas are similarly affected by growths of Eurasian water milfoil in the Lake. Native aquatic plants, generally found at slightly deeper depths, pose less severe potential problems for swimming and provide positive ecological benefit to the Lake, as noted in Table 7. In contrast, the abundance and virtually exclusive, monospecific stands of Eurasian water milfoil limit fish habitat, providing few food resources and little shelter, while the density of such stands creates concerns for the safety of swimmers in the Lake. In general, therefore, the abundance of aquatic plants throughout the lake basin is perceived as adversely affecting the aesthetic enjoyment of lake residents and visitors to the Lake. Thus, aquatic plant management is an important issue to be considered.

ECOLOGICALLY VALUABLE AREAS

Little Cedar Lake and its tributary drainage area also contains ecologically valuable areas, including significant areas of diverse, native aquatic vegetation suitable for fish spawning and wildlife habitat, which are located within, and immediately adjacent to, the Lake. The Little Cedar Lake community has expressed concern over the

perceived degradation of these resources. Two potential concerns associated with ecologically valuable areas in and near Little Cedar Lake have been identified. These include: the potential loss of wetlands and other ecologically valuable areas due to urbanization or other encroachments; and the degradation of wetlands and aquatic habitat due to the presence of invasive species, primarily Eurasian water milfoil and purple loosestrife. Thus, management of ecologically valuable areas in and adjacent to the Lake is an important issue to be considered.

Woodlands and Wetlands

The ecologically valuable areas within the drainage area tributary to Little Cedar Lake, as documented in Chapter II, include wetlands, woodlands, and wildlife habitat. Most of these areas are included in the lands designated as environmental corridors by the Regional Planning Commission. Riparian wetland areas and aquatic macrophyte beds also are generally included within sensitive areas delineated by the Wisconsin Department of Natural Resources pursuant to authorities set forth in Chapter NR 107 of the Wisconsin Administrative Code. These critical sites include prime fish spawning habitat and macrophyte beds containing a diverse native flora within the Lake, as well as shoreline areas supporting productive aquatic and wetland habitat. As noted above, in Little Cedar Lake, these areas generally lie along the eastern and western shorelines of the northern basin of the Lake, and the northwestern and southern shorelines of the southern Lake basin. Protection of these areas is an important issue to be considered.

Natural Areas and Environmental Corridors

Important areas of high-quality woodland and wetland have been designated within the adopted regional natural areas and critical species habitat protection and management plan.[1] These areas are shown on Map 11. The Little Cedar Lake Wetlands, an 137-acre sedge meadow and shallow marsh complex located adjacent to the northern basin of Little Cedar Lake along a portion of Cedar Creek downstream of Big Cedar Lake, has been designated a natural area of regional or countywide significance. This good-quality sedge meadow is associated with a shallow marsh complex and contains a variety of calciphilic plant species. About 128 acres of the wetland are currently under private and protective ownership through the Cedar Lakes Conservation Foundation, with the balance of this complex being recommended for similar acquisition and protection in the regional natural areas and critical species habitat protection and management plan. Northeast of these wetlands is the 170-acre Zeigler Woods recommended for acquisition by the Wisconsin Department of Natural Resources. The Woods include a large tract of southern mesic to dry-mesic hardwoods dominated by sugar maple and red oak on irregular, glacial terrain that form a natural area of local significance. The protection of such resources from intrusion by incompatible land uses that can degrade and destroy their environmental values, and the preservation of environmental corridors in an essentially open and natural state, are important issues to be considered.

Shorelands

Most of the shoreline of Little Cedar Lake is protected and no major areas of erosion, which are likely to require additional protection against wind, wave, and wake erosion, were identified during the planning effort. Wherever practical, vegetated buffer strips should be used in lakeshore areas in order to maintain habitat value and the natural ambience of the shoreland area.

LAND USE AND WATER QUALITY

Nonpoint Source Pollution

Nonpoint source pollutants in the drainage area tributary to Little Cedar Lake represents a potentially significant threat to the Lake's water quality. Based upon recommendations set forth in the regional land use plan,[2] and the

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[1] *SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

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

county land and water resource management plan,[3] future development of open lands within the drainage area tributary to Little Cedar Lake is expected to occur as development of existing platted lots or redevelopment of current sites within the drainage area that could have concomitant impacts on lake water quality.

In addition, such development may influence the quality and quantity of stormwater runoff being conveyed to the Lake or available for infiltration into the groundwater. As impervious surface is added to the drainage area tributary to Little Cedar Lake, the ability of rainwater to percolate into the surfacial aquifer is reduced. Greater volumes of rainfall and snowmelt are conveyed through stormwater conveyance systems to the Lake and its tributary streams. While current stormwater management ordinance provisions limit the magnitude of such alterations in runoff volume, increased runoff has the capacity to carry greater loads of potential contaminants to the Lake. Consequently, increased heavy metals, sediment, and nutrient loadings may be expected to occur as land uses change, although these loads may decrease or stabilize once more urban land use conditions stabilize within the drainage area. Nevertheless, construction activities within the watershed have the potential to mobilize significant quantities of soil from the land surface unless mitigation measures are applied and maintained. For these reasons, the control of construction site erosion and of stormwater-borne, nonpoint-sourced pollutants remains an important issue to be considered.

Water Quality

As of 2000, surface water quality in Little Cedar Lake was reported by the U.S. Geological Survey to be very good. As described in Chapter II, the Lake was well within the mesotrophic range, indicating that few water quality problems would be expected. Nevertheless, the citizens within the Little Cedar Lake Protection and Rehabilitation District have expressed concern regarding surface water quality over the longer term, especially as urban density development occurs within the drainage area and groundwatershed tributary to Little Cedar Lake.

Because domestic water supplies to households at Little Cedar Lake are drawn from the Regional groundwater aquifer system, contamination of this aquifer by pollutants leaching into the groundwater from the land surface, and from onsite sewage disposal systems, is an issue of widespread concern within the Region. This concern is shared by the Little Cedar Lake community, who are dependent upon private wells and onsite sewage disposal systems for their water supply and wastewater treatment, respectively. While the soils surrounding the Lake generally appear to be such as to minimize concerns with respect to the transfer of contaminants to the Lake from onsite sewage disposal systems, the management and maintenance of these systems is an issue of concern that relates not only to lake water quality but also to the security of the potable water supply. Thus, while the measures taken to minimize water quality degradation in the surface drainage area tributary to Little Cedar Lake should also serve to protect the groundwater resources of the watershed from contamination, the potential for groundwater contamination remains an issue of concern.

RECREATIONAL USAGE

Overcrowding and excessive recreational boating use is perceived to create problems in many lakes in the Southeastern Wisconsin Region, especially those offering high-quality recreational opportunities within a one- to two-hour drive of the Chicago-Milwaukee metropolitan area. Given the surface area of Little Cedar Lake, and the nature of the access site, the potential for the occurrence of problems due to increased or inappropriate boating pressure is considered to be slight. Nevertheless, local use of the Lake for water-based recreation could result in potentially significant boating pressure should the location of the Lake become better known or the nature of watercraft in common use on the Lake change. Thus, recreational water usage is an issue to be considered.

[3]*Washington County*, Washington County Land and Water Resource Management Plan: 2000-2005, *September 2000.*

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Chapter IV

ALTERNATIVE AND RECOMMENDED LAKE PROTECTION MEASURES

INTRODUCTION

Chapter III described three issues of concern to be considered as part of this lake protection and recreational use plan. These issues are related to: 1) ecologically valuable areas and aquatic plants; 2) nonpoint source pollution and water quality; and 3) recreational use. Following a brief summary of the ongoing lake management program activities, alternatives and recommended measures to address each of these issues and concerns are described in this chapter. The alternatives set forth herein focus on those measures which are applicable to the Little Cedar Lake Protection and Rehabilitation District, and to the Towns of Polk and West Bend, with lesser emphasis given to measures which are applicable to other organizations with jurisdiction within the drainage area tributary to the Little Cedar Lake.

PAST AND PRESENT LAKE MANAGEMENT ACTIONS

The residents of Little Cedar Lake, in conjunction with the Towns of Polk and West Bend, have long recognized the importance of informed and timely action in the management of Little Cedar Lake. The action in this regard resulted in the formation of the Little Cedar Lake Protection and Rehabilitation District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district, which provided the forum for many of the lake management activities undertaken by the residents of Little Cedar Lake. Subsequently, the District has contracted with the U.S. Geological Survey for the conduct of a Trophic State Index (TSI) water quality monitoring investigation between 1997 and 1999, with support of funds provided under the Chapter NR 190 Lake Management Planning Grant Program. These water quality data, in conjunction with the aquatic plant, fisheries, recreational use, and land use data collected during this planning program and summarized in Chapter II, form the basis for the development of the recommended aquatic plant management plan for Little Cedar Lake set forth herein.

ECOLOGICALLY VALUABLE AREAS AND AQUATIC PLANTS

Little Cedar Lake and its tributary drainage area contain ecologically valuable areas, including diverse aquatic and wetland vegetation and substrates suitable for fish spawning, located within and immediately adjacent to the Lake. As described in Chapter III, the potential problems associated with ecologically valuable areas in and near Little Cedar Lake include the potential loss of wetlands and other important ecologically valuable areas due to urbanization or other encroachments; and the degradation of wetlands and aquatic habitat due to the presence of invasive species, including Eurasian water milfoil and purple loosestrife.

Array of Protection Measures

Four measures to protect and maintain the biodiversity of Little Cedar Lake and the tributary drainage area have been identified as potentially viable: 1) wetland management measures, 2) shoreland management measures, 3) in-lake management measures, and 4) citizen informational and educational measures.

Wetland Management Alternatives

Wetland plant management refers to a group of management and restoration measures aimed at both removal of nuisance vegetation and manipulation of species composition in order to enhance and provide for the protection and maintenance of the biodiversity of Little Cedar Lake and its tributary drainage area. Protection of ecologically valuable areas and wetlands is generally best accomplished through land use control measures, public acquisition, or acquisition of conservation easements. In addition, certain in-lake management measures could be used to moderate deleterious changes in the aquatic plant and animal communities that comprise the lakeward portions of the ecologically valuable areas within the Lake basin. Citizen informational and educational programming also forms an important element of the management of environmentally valuable areas within and riparian to Little Cedar Lake by encouraging actions on the part of riparian residents and residents within the drainage area tributary to Little Cedar Lake that would benefit the maintenance of ecologically valuable areas within the Lake.

The recommended future land use condition within the drainage area tributary to Little Cedar Lake is set forth in the adopted regional land use plan,[1] and the Town of West Bend land use plan.[2] These plans recommend the preservation of primary environmental corridor lands in essentially natural, open space use. The delineated environmental corridors contain most of the wetlands and other ecologically valuable lands within the Region, including the environmentally valuable lands adjacent to Little Cedar Lake and within the drainage area tributary to Little Cedar Lake. Recommended protection measures to be considered 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, and enforcement of existing land use regulations within the drainage area, including the County shoreland and floodland ordinance. Cedar Creek and Little Cedar Lake are designated as Class III waterbodies pursuant to this ordinance, which classification applies statewide minimum criteria to lands proposed for development within this watershed.

The aforementioned land use plans recommend that all lakes, rivers, streams, wetlands, and associated undeveloped floodlands and shorelands be placed into conservancy or floodplain protection districts. The existing Washington County zoning for the lands in the vicinity of Little Cedar Lake and in the drainage area tributary to Little Cedar Lake is generally consistent with the recommended future land use pattern set forth in the aforereferenced land use plans. The zoning for the drainage area tributary to Little Cedar Lake includes the wetlands and floodlands within the C-1 conservancy overlay district within the Town of West Bend. These districts prohibit residential and commercial developments. The upland portions of the drainage area within the Town of West Bend are zoned R-4, single family residential. The R-4 single-family residential zoning district permits development of homestead property on lots with a minimum area of 1.5 acres for shoreline residential, 2.5 acres for neighborhood residential, and 3.5 acres for rural residential zoning. In the Town of Polk, however, the upland portions of the drainage area are predominantly included in the R-1, single-family residential, zoning district, which provides for low-density, single-family residential development, and within the A-1, agricultural, zoning district. The R-1 single-family residential zoning district permits development of homestead properties on lots with a minimum area of 60,000 square feet, where soil conditions allow placement of onsite sewage disposal systems. Similar requirements apply to lands identified as agricultural, rural residential lands. Lands designated as A-1 provide for a minimum lot size of five acres. Portions of these upland areas include lands identified in the regional natural areas and critical species habitat protection and management plan as upland areas of specific concern.

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

[2] *Town of West Bend,* Official Land Use Plan: The Town of West Bend*, July 1998.*

Where wetlands and other environmentally valuable lands are threatened by encroachment or degradation, the adopted regional land use plan recommends that these lands be considered for purchase or for acquisition of conservation easements. Land acquisition, as a means of protecting environmentally valuable lands from encroachment or further degradation, or as a means of facilitating their rehabilitation and restoration, is possible with funds provided through the Chapters NR 50/51 Stewardship Grant Program and Chapter NR 191 Lake Protection Grant Program as set forth in the *Wisconsin Administrative Code*. Outright purchase or the purchase of conservation easements are both possible options under these programs. Lands proposed for purchase must be appraised using standard governmental land acquisition procedures as established by the Wisconsin Department of Natural Resources, and must be subject to a land management plan setting forth the processes and procedures for their long-term maintenance and development. The Chapter NR 191 grant program provides State cost-share funding for the purchase up to a maximum State share of $200,000 at up to a 75 percent State cost-share. The Chapter NR 50/51 grant program provides State cost-share funding up to a maximum State share of $100,000 at up to a 50 percent cost-share.

Shoreland and Nearshore Management Alternatives

There is significant overlap between lands designated as wetland under current State definitions and shoreland areas with aquatic plant communities. These areas include shallow nearshore areas within the shoreland zone of a lake. While the management of in-lake aquatic plant communities is discussed below, various potential in-lake management actions may be considered complementary to the management of environmentally valuable wetland areas within the shoreland zone. In addition, citizen informational and educational programming should be considered as an essential aspect of the management of environmentally valuable lands within the drainage area tributary to Little Cedar Lake.

As has been noted above, much of the shoreline of Little Cedar Lake is protected and no major areas of erosion, which are likely to require additional protection against wind, wave, and wake erosion, were identified in the planning effort. Adoption of the vegetated buffer strip method is recommended to be used in lakeshore areas wherever practical in order to maintain habitat value and the natural ambience of the shoreland area. Continued maintenance of existing revetments and other protection structures also is recommended. Conversion of bulk-heads to riprap or naturally vegetated shoreline or combinations thereof, as shown in Figure 5, is recommended to be considered where potentially viable at such time as major repairs are found necessary. Naturally vegetated buffer strips should also be considered for all other shorelines, where practical.

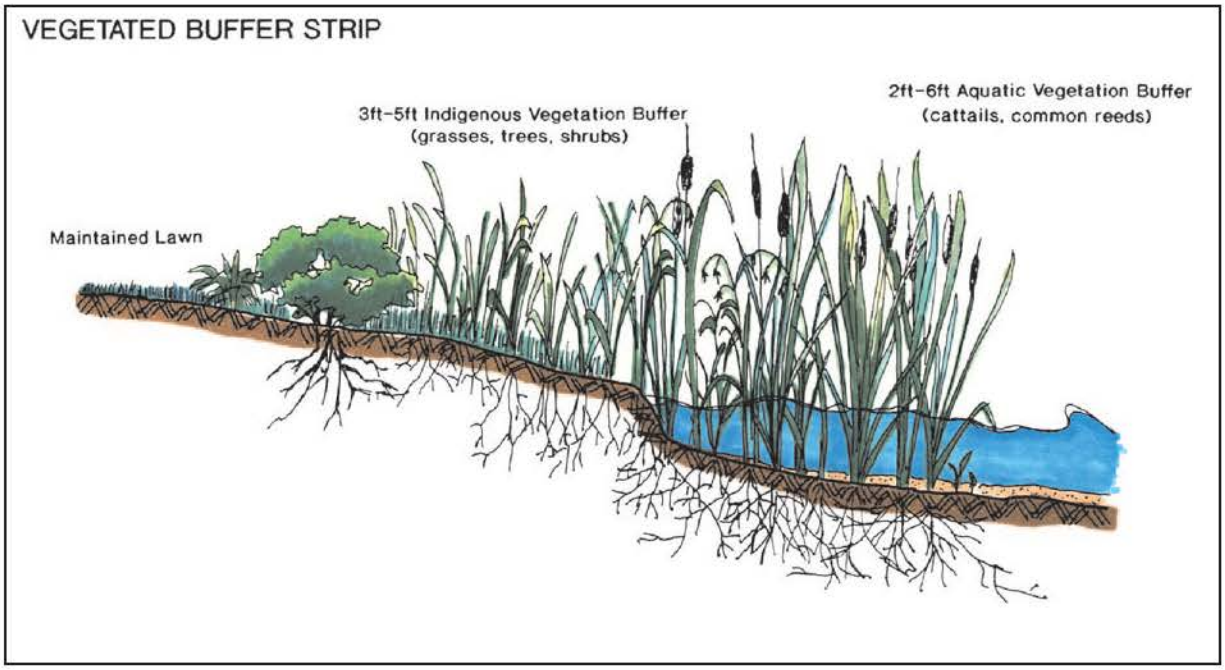
Potential management measures to control nuisance vegetation or to manage shoreland vegetation include physical, chemical and biological controls. Many of these controls, such as the use of chemical herbicides, require permits from the Wisconsin Department of Natural Resources if they extend below the Ordinary High Water Mark into the bed of the Lake. In addition, a County permit also may be required for removal of trees and other vegetation from within the shoreland zone.

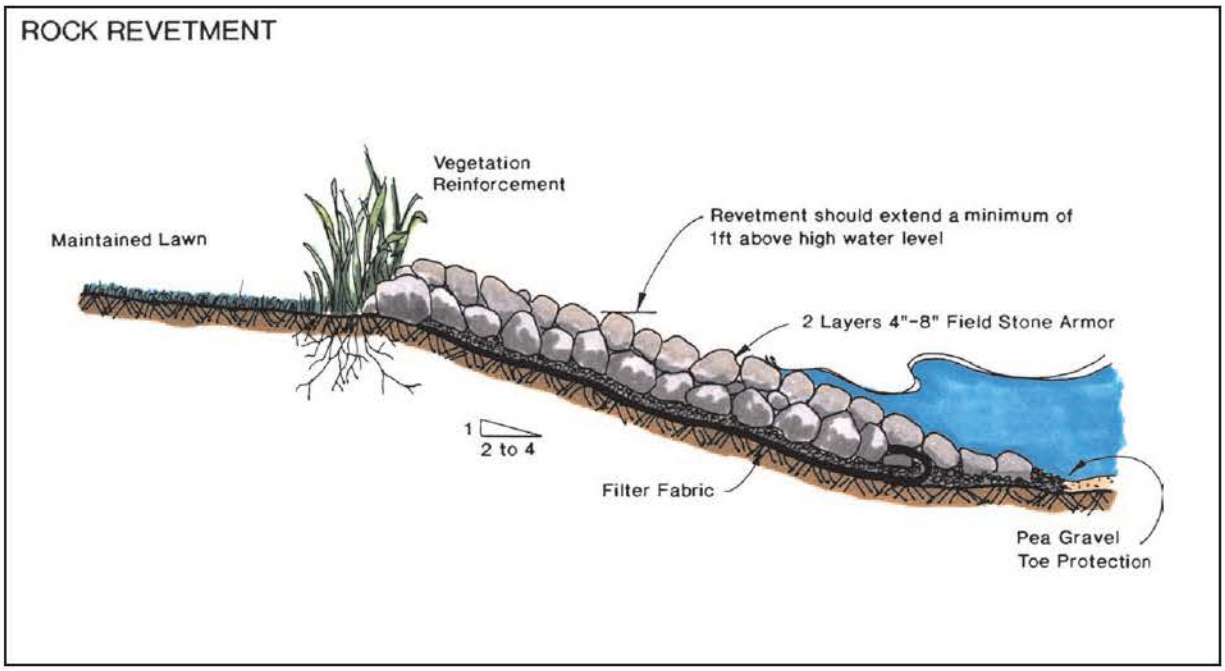
Manual Harvesting

The physical removal of specific types of vegetation by selective harvesting of plants provides a highly selective means of controlling the growths of nuisance upland and wetland plant species, including purple loosestrife, reed canary grass, buckthorn and other invasive, nonnative plants. 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, limiting shedding of seeds that will promote regrowth in future years. Loosestrife management programs, however, should be followed by an annual monitoring and control program for up to 10 years (or more) following the initial control program to manage the regrowth of the plant from seeds that may have been set prior to the application of the control measures. For other nonnative invasive plant species, selective cutting of shrubs and small trees, as in the case of buckthorn, can likewise remove nuisance species from the midst of native plants without causing significant disruption of the habitat area. This procedure may require the limited application of an herbicide to the remaining plant materials for effective long-term control.

Figure 5

RECOMMENDED ALTERNATIVES FOR SHORELINE EROSION CONTROL FOR LITTLE CEDAR LAKE





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.

In the nearshore area, specially designed rakes are available to assist in the removal of nuisance aquatic plants from the shoreline area. 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 Little Cedar Lake Protection and Rehabilitation 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.

In larger areas, repeated mowing or occasional burning can be effective means of managing larger prairie areas, although prairie burns require trained personnel and would be likely to require local permits prior to this measure being used. Manual control of nuisance species in shoreland wetland areas of Little Cedar Lake is considered to be a viable management option.

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 wildlife and other shoreland organisms. 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 not a feasible management option to be used on a large scale. However, chemical control is often a viable technique for the control of the relatively small-scale infestations of purple loosestrife and certain other plants. 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 the control of purple loosestrife and buckthorn, for example, chemical treatments combined with manual control measures can be extremely effective, as noted above. Thus, the use of chemical control measures may be considered a viable alternative in specific situations.

Biological Controls

An alternative approach to controlling nuisance weed conditions, particularly in the case of purple loosestrife, is biological control. Classical biological control has been successfully used to control both weeds and herbivorous insects.[3] Recent evidence shows that the beetles, *Galerucella pucilla* and *Galerucella calmariensis*, and the weevils, *Hylobius transversovittatus* and *Nanophyes brevis*, have potential as biological control agents for purple loosestrife. Extensive field trials conducted by the Wisconsin Department of Natural Resources in the South-eastern Wisconsin Region during 1999 and 2000 indicated that these insects can provide effective management of larger-scale infestations of purple loosestrife. Therefore, the use of these insects as a means of wetland plant management is considered to be viable.

Shoreline Structures

The shorelines of Little Cedar Lake present a largely natural aspect to lake users and residents. As described in Chapter II, the shorelines of Little Cedar Lake did not appear to be subject to any significant erosion. However, residents did express concerns about the presence of waterfowl and the consequent aesthetic degradation arising from the activities of these waterfowl along the shorelands of the Lake. These concerns indicated the need for an altered shoreland management regimen on certain riparian lands. The maintenance of shorelands is important in order to avoid erosion, preserve the nearshore and wetland aquatic vegetation in and around the Lake, and, especially, protect the structure and functioning of the aquatic ecosystem of the Lake. Such protections also contribute to preserving and enhancing water quality as well as providing habitat for fishes and other aquatic life. In addition, certain shoreland landscaping practices have been shown to be effective deterrents to resident waterfowl populations and an attractive means of preserving and providing habitat for desirable aquatic species, while satisfying the aesthetic requirements of shoreland landowners.

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[3] *B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* LakeLine, *Volume 17, Number 3, September 1997, pp. 20-21, 34-37.*

Two options are generally recommended for shoreland protection; namely, the use of riprap to protect lands along active shorelines where erosion by wind waves, wakes of watercraft, and ice movement are anticipated; and the use of natural vegetation along less active shorelines.[4] These options also should be considered in the repair or replacement of existing protection structures. These measures can be constructed or implemented, at least in part, by local residents using readily available construction materials. In addition, these measures would, in most cases, enable the continued use of the immediate shoreline, and create a visually "natural" or "semi-natural" aspect that would enhance the aesthetic qualities of the lake shoreline. The use of taller, native grasses and plants would also discourage waterfowl and address, in part, the concerns expressed by lakeshore residents, while at the same time contributing to the preservation of the shoreland flora.

In addition to the foregoing structural measures, there are also a number of other control measures which can be considered to manage resident waterfowl populations. These measures include limitations on feeding of waterfowl by incorporating a component into the citizen information and education program, or through adoption of appropriate local ordinances. The Wisconsin Department of Natural Resources and the U.S. Department of Agriculture have educational materials which describe these management measures. Other management measures include:

- Modifying landscaping to allow grass to grow longer, so that the waterfowl will feel less safe when accessing shoreland areas, and planting vegetation which is less palatable to birds than grass;
- Installing barriers to limit access from water to adjacent grassy areas;
- Harassing the birds using decoys, noise generators or other devices, or, in selected cases, trained dogs;
- Preventing nesting or disturbing nesting sites; and/or,
- Relocating birds, or, in extreme cases, hunting or culling the birds through permitted wildlife management programs.

These latter measures are not generally recommended and should be considered only if the problems associated with resident waterfowl persist and become severe enough to warrant coordinated actions. In such a situation, the Little Cedar Lake Protection and Rehabilitation District should seek assistance in evaluating alternative control measures from the Wisconsin Department of Natural Resources and the U.S. Department of Agriculture Fish and Wildlife Service.

Citizen Information and Education

As part of the overall citizen informational and educational programming to be conducted within the Little Cedar Lake community, residents and visitors should be made aware of the value of the ecologically significant areas in the overall structure and functioning of the ecosystems of Little Cedar Lake and Cedar Creek. Specifically, informational programming related to the protection of ecologically valuable areas in and around Little Cedar Lake should focus on need to minimize the spread of nuisance aquatic species, such as purple loosestrife in the wetlands and Eurasian water milfoil in the Lake. Other informational programming offered by the Little Cedar Lake Protection and Rehabilitation District, the Wisconsin Department of Natural Resources, University of Wisconsin-Washington County, and University of Wisconsin-Extension (UWEX), as well as other agencies such

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[4]*Chapter 326 of the* Wisconsin Administrative Code, *currently being considered for adoption by the Wisconsin Legislature would impose more rigorous standards upon shoreland landowners so as to promote the use of shoreline protection structures only in those areas where wind wave action or boating traffic create a risk of shoreline erosion. Landowners considering placement of shoreline protection structures should contact the Wisconsin Department of Natural Resources for information on applicable State and County permit requirements when considering placement of such structures adjacent to, or along, the lakeshore.*

as the Wisconsin Association of Lakes, can contribute to an informed public, actively involved in the protection of ecologically valuable areas within the drainage area tributary to Little Cedar Lake. As noted above, the information and education program could include a component related to waterfowl and shoreland management.

In-Lake Aquatic Plant Management Alternatives

Aquatic plant management[5] refers to a group of management and restoration measures aimed at both removal of nuisance vegetation and manipulation of species composition in order to enhance and provide for recreational water use. Generally, aquatic plant management measures are classed into four groups; namely, physical measures which include water level management; manual and mechanical measures which include harvesting and removal; chemical measures which include using aquatic herbicides; and biological controls which include the use of various organisms, including insects. All of these are regulated and require a State permit, chemical aquatic plant controls are regulated under Chapter NR 107 of the *Wisconsin Administrative Code* and all other aquatic plant management practices are regulated under Chapter NR 109 of the *Wisconsin Administrative Code*. Costs range from minimal for manual removal of plants using rakes and hand-pulling to upwards of $100,000 for the purchase of a mechanical plant harvester and associated equipment, the operational costs for which can approach $10,000 to $25,000 per year, depending on staffing and operating policies. Harvesting is probably the measure best applicable to large areas, while chemical controls may be best suited to confined areas and initial control of invasive plants. Planting of native plant species and control of Eurasian water milfoil by the weevil, *Eurhychiopsis lecontei*, are largely experimental in lakes, but can be considered in specialized shoreland areas. In addition, good housekeeping practices implemented in shoreland areas, on riparian properties, and within the drainage area tributary to Little Cedar Lake, encouraged through an active public informational and educational program, should be considered essential elements in any aquatic plant management plan. These options are discussed further below.

Aquatic Herbicides

Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. The use of herbicides can contribute to an ongoing aquatic plant problem by increasing the natural rates of accumulation of decaying organic matter, in turn contributing to an increased oxygen demand which may cause anoxia. The use of herbicides can also potentially damage or destroy nontarget plant species that provide needed habitat for fish and other aquatic organisms. As a result, less desirable, invasive, introduced plant species may outcompete the more beneficial, native species. Hence, this is not a feasible management option to be used on a large scale. However, chemical control is often a viable technique for the control of the relatively small-scale infestations of milfoil and certain other plants. Chemicals are applied to the growing plants in either liquid or granular form. Chemical treatment can be administered at a relatively low cost and is, therefore, considered a viable management option to continue. This measure is considered to be viable for selected areas in Little Cedar Lake.

Mechanical Harvesting

On the basis of the ongoing use of a mechanical harvester on Little Cedar Lake, and the success of harvesting as an aquatic plant management technique in other major Lakes within the Southeastern Wisconsin Region, mechanical harvesting of aquatic plants appears to continue to be a practical and efficient means of controlling plant growth. Harvesting also has the added advantage of removing the plant biomass and its associated nutrients from Little Cedar Lake. Aquatic macrophytes are mechanically harvested with specialized equipment consisting of a cutting apparatus which cuts up to five feet below the water surface and a conveyor system that picks up the cut plants and hauls them to shore. Harvesting leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms and to stabilize sediments. Mechanical harvesting does have some potentially negative impacts to fish and other aquatic life, may cause fragmentation and spread of some plants, and could disturb loosely consolidated bottom sediments. However, if done correctly and carefully, it has shown to be of

[5]*U.S. Environmental Protection Agency Report No. EPA-440/4-90-006,* The Lake and Reservoir Restoration Guidance Manual, *August 1990.*

benefit in ultimately reducing the regrowth of nuisance plants. Mechanical harvesting is a recommended method to continue as a control of aquatic plants in Little Cedar Lake.

Manual Harvesting

Due to limitations imposed by the depth of water within the littoral or nearshore zone, it is not always possible for harvesters to reach the shoreline of every property. Within such areas, especially adjacent to piers and docks where there is significant potential for damage to property and the lakebed, the use of specially designed rakes to manually remove aquatic plants from the shoreline area should be considered. The rakes may be purchased by the Little Cedar Lake Management District and made available to riparian owners for use on a trial basis to test their operability before the homeowners purchase their own equipment. The advantage of the rake is that it is easy and quick to use, immediately removing the plants from these shallow water areas. While aquatic herbicides are also an option for aquatic plant management within these areas, the advantage of manual control methods is immediate relief; chemical treatment involves a waiting period wherein the plant adsorbs the herbicide and the herbicide induces mortality in the plant. Using this method also removes the plants from the lake, avoiding the accumulation of organic matter on the lake bottom adding to the nutrients that favor more plant growth. This method also gives the harvester more time to cover larger areas of the lake as maneuvering between the piers takes time and skill.

Biological Controls

Biological controls provide another alternative approach to controlling nuisance aquatic plant growths, particularly in the case of Eurasian water milfoil. Classical biological control has been successfully used to control both nuisance plants and herbivorous insects.[6] Recent documentation states that *Eurhychiopsis lecontei*, an aquatic weevil species, has potential as a biological control agent for Eurasian water milfoil.[7] However, as the studies that have been completed using *Eurhychiopsis lecontei* as a means of aquatic plant management control, suggest that this control measure is extremely sensitive to disturbances such as those created by recreational boating activity, it is not recommended for use on Little Cedar Lake at this time. The Wisconsin Department of Natural Resources is continuing to conduct evaluations of this measure on several Wisconsin lakes on an experimental basis, however, and the findings of that program may be considered in the future to evaluate the viability of this measure to Little Cedar Lake. Grass carp, *Ctenopharyngodon idella*, an alternative biological control used elsewhere in the United States, are not permitted in Wisconsin.

Lake Bottom Covering

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. Because of the limitations involved, lake bottom covering as a method to control aquatic plant growth are not recommended for Little Cedar Lake.

Boating Ordinances

The promulgation of more stringent controls on the use of powered watercraft within Little Cedar Lake is one means of regulating the conduct of recreational boating traffic that could be harmful to the most important ecologically valuable areas in the Lake (see also Recreational Use Management, below). These areas include the eastern and western shores of the northern basin and the northwestern and southern portions of the south basin,

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[6] *C.B. Huffacker, D.L. Dahlsen, D.H. Janzen, and G.G. Kennedy,* Insect Influences in the Regulation of Plant Population and Communities*, 1984, pp. 659-696; C.B. Huffacker and R.L. Rabb, editors,* Ecological Entomology, *John Wiley, New York, New York, USA.*

[7] *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.*

where the greatest diversity of native aquatic plant species occur. Controls on recreational boating traffic, for example, could limit boating activity within these specific areas of the Lake to defined traffic lanes to minimize the disturbance and propagation of nuisance plant species by the operation of watercraft. Boating ordinances enacted in conformity with State law must be clearly posted at public landings in accordance with the requirements of Section 30.77(4) of the *Wisconsin Statutes*. Placement of regulatory markers must conform to Section NR 5.09 of the *Wisconsin Administrative Code*. Only regulatory markers are enforceable; informational buoys are not enforceable. Creation of recreational boating access lanes is considered to be a viable alternative.

Public Informational and Educational Programming

Aquatic plant management usually centers on the eradication of nuisance aquatic plants for the improvement of recreational lake use. The majority of the public views all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering their environmental impacts. Thus, public information is an important component of an aquatic plant management program. Posters and pamphlets are 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.

Recommended Protection Measures

The following actions are recommended for the management of ecologically valuable areas and aquatic plants:

1. The Little Cedar Lake Protection and Rehabilitation District should support the preservation of the primary environmental corridor lands, and isolated natural resource area features in the Little Cedar Lake tributary drainage area. These lands, and especially their associated wetland areas, are recommended to be protected and preserved to the extent practicable through protective zoning; their incorporation into the stormwater management system and related drainageways; their inclusion within site plans as local parks, recreational trails, or open spaces; and the restoration of their natural structure and functions within the landscape.[8] Such preservation should be promoted through the existing regulations and programs intended to protect such natural resources.

2. The Little Cedar Lake Protection and Rehabilitation District should monitor the Lake and surrounding wetlands for the presence or spread of nuisance plant species such as Eurasian water milfoil and purple loosestrife. Manual harvesting of plants around piers and docks is the recommended means of controlling milfoil and other nuisance species of plants in those areas given the small size of the Lake. In this regard, the District could consider purchasing several specialty rakes designed for the removal of vegetation from shoreline property and make these available to riparian owners. This would allow the riparian owners to use the rakes on a trial basis before purchasing their own. The rakes cost approximately $90 each, and do not require a permit for use within a 30-feet-wide portion of the shoreline; permits are required for manual harvesting outside of this area.

3. Should the growth of Eurasian water milfoil be determined to reach nuisance proportions in the Lake, the Little Cedar Lake Protection and Rehabilitation District should consider the use of chemical herbicides, but should limit the use of such herbicides to the control of Eurasian water milfoil within small areas of the Lake. Early spring or late fall treatments to control the growth of Eurasian water milfoil have proven effective in other lakes in Southeastern Wisconsin and are recommended. Early spring herbicide treatments reduce the biomass subject to decomposition and limit the accumulation of organic materials on the Lake bottom. Late fall treatments risk exacerbating problems of decomposing vegetation depleting dissolved oxygen concentrations under the ice, and associated potentials for winterkill of fishes.

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

4. The Little Cedar Lake Protection and Rehabilitation District should continue its program of selective harvesting of boating access lanes, especially in the vicinity of the public recreational boating access site to maintain navigational access to the deeper water areas of the Lake. Such harvesting is recommended to minimize disturbances to water lily communities to the extent possible, while maintaining navigational access. Mechanical harvesting around piers and docks is not recommended; management of aquatic plants in these shallow water areas, with water depths of less than two to three feet, should be accomplished using manual harvesting or limited chemical herbicide treatments as noted above. Collection of aquatic plant fragments from shorelines and pierheads is recommended to limit the potential for the spread of nonnative invasive species such as Eurasian water milfoil in the Lake.

5. It is recommended that an aquatic plant survey be conducted every three to five years in order to track the success of the current aquatic plant management program, as well as any other changes in the tributary drainage area that may affect Little Cedar Lake.

6. The Little Cedar Lake Protection and Rehabilitation District, through an educational and informational program, should promote awareness among Lake residents, visitors, and watershed residents of good urban housekeeping practices, and the invasive nature of such exotic, nonnative species as Eurasian water milfoil and purple loosestrife. Participation in citizen-based control programs coordinated by the Wisconsin Department of Natural Resources and University of Wisconsin-Extension should be encouraged.

NONPOINT SOURCE POLLUTION AND WATER QUALITY

Little Cedar Lake is a mesotrophic waterbody. As such, it may be considered, by definition, to be in need of protection to maintain and enhance its current aesthetic and recreational uses. As described in Chapter II, the primary sources of pollutant loadings to Little Cedar Lake are nonpoint sources generated within the drainage area tributary to the Lake. While the adopted regional land use plan envisions only limited infilling of existing platted lots or redevelopment of existing lots within the drainage area tributary to Little Cedar Lake, such development still has the potential to result in increased loadings of some pollutants associated with urban development and construction sites. Recent U.S. Geological Survey findings[9] regarding the potential impacts of suburban lawn care practices on stormwater runoff in urbanized watersheds in Wisconsin have heightened concern among lakeshore residents that the water quality of the Lakes may deteriorate, even under relatively stable land use conditions. Consequently, the nonpoint source pollution abatement plan element for the Cedar Creek watershed, set forth within the adopted regional water quality management plan, generally recommends the implementation of both urban and rural nonpoint source pollution control practices designed to reduce the pollutant loadings from nonpoint sources by about 25 percent.[10] The initial regional plan also recommended that local agencies charged with responsibility for nonpoint source pollution control prepare refined and detailed local-level stormwater management and nonpoint source pollution control plans. Thus, consideration is given in this section to those actions that will protect water quality and potentially reduce contaminant loads to the Lake and groundwater systems.

Watershed management measures may be used to reduce nonpoint source pollutant loadings from such rural sources as runoff from cropland and pastureland; from such urban sources as runoff from residential, commercial, transportation, and recreational land uses; and from construction activities. The alternative, nonpoint source

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[9]*U.S. Geological Survey Water-Resources Investigations Report,* Sources of Phosphorus in Stormwater from Two Residential Urban Basins in Madison, Wisconsin: 1994-95*, in press.*

[10]*SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000*, Volume One,* Inventory Findings*, September 1978; Volume Two,* Alternative Plans*, February 1979; and Volume Three,* Recommended Plan*, June 1979.*

pollution control measures considered in this report are based upon recommendations set forth in the regional water quality management plan,[11] the Washington County land and water management plan,[12] the Wisconsin Department of Natural Resources nonpoint source pollution control plan for the Cedar Creek Priority Watershed Project,[13] and information presented by the U.S. Environmental Protection Agency.[14]

In addition, Big Cedar Lake, which is situated upstream from Little Cedar Lake and forms the headwaters of Cedar Creek, provides the main source of inflow to Little Cedar Lake.[15] The application of nonpoint source pollution control measures within the total drainage area tributary to Little Cedar Lake, therefore, would benefit both waterbodies, as well as the downstream portions of the Cedar Creek and Milwaukee River drainage systems.

Array of Control Measures

To control nonpoint source pollution to Little Cedar Lake and its tributary drainage area, application of both urban and rural nonpoint source controls is considered a viable option. In addition, options to control nonpoint source pollution loading during land development activities are discussed.

Urban Nonpoint Source Controls

Potentially applicable urban nonpoint source control measures include wet detention basins, stormwater infiltration basins, grassed swales, and good urban housekeeping practices. Generally, the application of low-cost urban housekeeping practices may be expected to reduce nonpoint source loadings from urban lands by about 25 percent.

Public informational programs can be developed to encourage good urban housekeeping practices, to promote the selection of building and construction materials which reduce the runoff contribution of metals and other toxic pollutants, and to promote the acceptance and understanding of the proposed pollution abatement measures and the importance of lake water quality protection. Good urban housekeeping practices and source controls include restricted use of fertilizers and pesticides; improved pet waste and litter control; the substitution of plastic for galvanized steel and copper roofing materials and gutters; proper disposal of motor vehicle fluids; increased leaf collection; street sweeping; and reduced use of street deicing salt.

Proper design and application of urban nonpoint source control measures such as grassed swales, detention basins, and infiltration basins requires the preparation of a detailed stormwater management system plan that addresses stormwater drainage problems and controls nonpoint sources of pollution. Based upon preliminary evaluation, however, it is estimated that few practices would be effective in the areas within the immediate vicinity of Little

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[11]*SEWRPC Planning Report No. 30,* op. cit.*; and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995.*

[12]*Washington County,* Washington County Land & Water Resource Management Plan: 2000-2005, *September 2000; see also SEWRPC Community Assistance Planning Report No. 170,* Washington County Agricultural Soil Erosion Control Plan, *March 1989, and SEWRPC Planning Report No. 45,* op. cit.

[13]*Wisconsin Department of Natural Resources PUBL-WR-336-93,* A Nonpoint Source Control Plan for the Cedar Creek Priority Watershed Project, *August 1993.*

[14]*U.S. Environmental Protection Agency, Report No. EPA-440/4-90-006,* The Lake and Reservoir Restoration Guidance Manual, *2nd Edition, August 1990; and its technical supplement, U.S. Environmental Protection Agency, Report No. EPA-841/ R-93-002,* Fish and Fisheries Management in Lakes and Reservoirs: Technical Supplement to the Lake and Reservoirs Restoration Guidance Manual, *May 1993.*

[15]*SEWRPC Memorandum Report No. 137,* A Water Quality Protection and Stormwater Management Plan for Big Cedar Lake, Washington County, Wisconsin, *Volume One, August 2001.*

Cedar Lake. Management measures that can be applied within the Towns of Polk and West Bend in the immediate vicinity of Little Cedar Lake are limited largely to good urban housekeeping practices and grassed swales.

In addition, developing areas can generate significantly higher pollutant loadings than established areas of similar size. These areas include a wide array of activities, including individual site development within the existing urban area, and new land subdivision development. As previously noted, while limited additional urban development is presently occurring or planned within the drainage area tributary to Little Cedar Lake, redevelopment of existing platted lots is anticipated. These construction sites may be expected to produce suspended solids and phosphorus loadings at rates several times higher than established urban lands, and control of sediment loss from construction sites is recommended.

Washington County has adopted a construction site erosion control ordinance which is administered and enforced by the County in shoreland areas and in the unincorporated areas of the Little Cedar Lake study area. The provisions of this ordinance apply to all development except single- and two-family residential construction. Single- and two-family construction erosion control measures are to be specified as part of the building permit process.

The Towns of Polk and West Bend apply construction site erosion controls as currently provided in Section Comm 21.125, Erosion Control Procedures of Uniform Dwellings, of the *Wisconsin Administrative Code*. These controls include temporary measures taken to reduce pollutant loadings from construction sites during stormwater runoff events, in a manner consistent with the provisions set forth in the construction site management handbook developed by the Wisconsin Department of Natural Resources.[16]

Construction erosion controls are important pollution control measures that can minimize localized loadings of phosphorus and sediment from the drainage area, and minimize the cumulative impacts of such loadings. The control measures include such revegetation practices as temporary seeding, mulching, and sodding; such runoff control measures as placement of filter fabric fences, straw bale barriers, storm sewer inlet protection devices, diversion swales, sediment traps, and sedimentation basins; and such site management practices as placement of tracking pads to limit the movement of soils from work sites. Construction site erosion controls may be expected to reduce pollutant loadings from construction sites by about 75 percent.

Rural Nonpoint Source Controls

Upland erosion from agricultural and other rural lands currently is a contributor of sediment and other contaminants within the tributary drainage area to Little Cedar Lake. Estimated phosphorus and sediment loadings from croplands, woodlots, pastures, and grasslands in the drainage area tributary to Little Cedar Lake were presented in Chapter II. These loadings are recommended to be reduced to the target level of agricultural erosion control of three tons per acre per year identified in the Washington County agricultural soil erosion control plan and adopted Washington County land and water resource management plan as the tolerable levels that can be sustained without impairing productivity.[17] As set forth in Chapter II, much of the remaining agricultural lands within the drainage area tributary to Little Cedar Lake will be replaced, over time, with urban density development. While such development could potentially reduce the agro-chemical loadings to Little Cedar Lake, this benefit could be offset by the fact that urban lands contribute a wider range of contaminants to surface waters and generally result in increased rates of surface runoff.

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[16]*Wisconsin Department of Natural Resources,* Wisconsin Construction Site Best Management Practices Handbook, *November 1993.*

[17]*Washington County*, op. cit.

Public Informational Programming

Additional actions can be undertaken to minimize nutrient and pollutant loadings from source areas within the drainage area tributary to Little Cedar Lake. Based upon the aforereferenced findings of the U.S. Geological Survey, residential lawns can form a major source of phosphorus to watercourses in urban areas. In some cases, this phosphorus source is enhanced as a consequence of the lawn care practices employed by householders within the drainage area. For this reason, informational programming directed at alternative and appropriate lawn care practices should be provided within this rapidly urbanizing drainage area. Such programming should be predicated upon a knowledge of the soil chemistry and soil nutrient requirements for urban residential lawns and gardens. These nutrient requirements can be determined through a relatively simple soil testing procedure conducted by the University of Wisconsin-Extension. Soil test results allow householders to apply appropriate levels of fertilization to their gardens, generally saving the householder some level of expense and effort, while providing additional protections to the Lakes. In addition, distribution of lawn care pamphlets within the drainage area, providing information on composting, yard care, and maintenance of the grassed swale stormwater system, would apprise householders of alternative means of maintaining their properties.[18]

Programming should also be developed to keep the householders in Little Cedar Lake community informed of the current state of their Lake's water quality. To this end, continued participation in the Wisconsin Department of Natural Resources Self-Help Program is recommended as a means of assessing the health of Little Cedar Lake on a regular basis. Such programs not only supplement the more detailed analysis provided by the U.S. Geological Survey TSI water quality monitoring program, but also can provide an early warning of undesirable changes in lake water quality. Additional data compiled from regular, three- to five-yearly interval surveys of the aquatic species composition form an important complementary assessment tool. Review of these data annually by the Little Cedar Lake Protection and Rehabilitation District Board of Commissioners can permit the District, and the Towns, to initiate appropriate responses in a timely manner. Regular reports on the results of these studies have been featured at the annual meetings of the Little Cedar Lake Protection and Rehabilitation District and should be continued as one means of informing residents of the current state of the Lake.

Recommended Control Measures

The following management actions are recommended for the management of nonpoint source pollution sources and surface water quality:

1. The Little Cedar Lake Protection and Rehabilitation District, in conjunction with the Towns of Polk and West Bend, should assume the lead in the development of a public educational and informational program for the residents around Little Cedar Lake and within the drainage area tributary to Lake, which encourages the institution of good urban housekeeping practices including, pesticide and fertilizer use management, improved pet waste and litter control, and yard waste management, as well as other lake management-related topics. The Little Cedar Lake Protection and Rehabilitation District, in cooperation with service clubs and other nongovernmental organizations within the drainage area tributary to Little Cedar Lake, should acquire and distribute relevant publications in the University of Wisconsin-Extension "Yard Care and the Environment" series to encourage sound yard care practices within the watershed, and encourage their memberships to participate in the soil testing program offered by the University of Wisconsin-Extension. It is recommended that informational programming related to nonpoint source pollution abatement and other lake management topics be included at the annual meetings of the Little Cedar Lake Protection and Rehabilitation District.

2. The stormwater and construction site erosion control ordinances adopted by Washington County, and the Towns of Polk and West Bend, should be strictly enforced to reduce sediment and contaminant loadings from the urbanizing areas in the tributary drainage area to Little Cedar Lake. Furthermore, urban stormwater pollutants such as salts and metals can infiltrate into the shallow groundwater

[18]*University of Wisconsin-Extension Publication No. GWQ007,* Practical Tips for Home and Yard, *1993, and related publications in the "Yard Care and the Environment" series.*

aquifer affecting groundwater quality in the Little Cedar Lake area, and should be monitored to minimize the risk to the Lake associated with these contaminants.

3. Periodic continuation of the U.S. Geological Survey TSI monitoring program, including periodic sampling of groundwater quality, is recommended so as to identify potential in-lake water quality problems that might arise due to nutrient and other inputs from private on-site sewage disposal systems, and possible wetland impacts, especially during high water level periods. Conduct of this monitoring is recommended to be carried out at intervals of approximately three to five years.

4. The Little Cedar Lake Protection and Rehabilitation District also should participate in the Wisconsin Department of Natural Resources Self-Help Monitoring Program as a means of regularly assessing the health of the Lake and in order to provide an early warning of undesirable changes in lake water quality and aquatic species composition during the intervals between the conduct of TSI monitoring by the U.S. Geological Survey. Such monitoring would allow the District, in cooperation with relevant governmental agencies, to initiate appropriate responses in a timely manner. The report of the citizen monitor should be featured at the annual meeting of the District in like manner as the reports of the U.S. Geological Survey.

RECREATIONAL USE MANAGEMENT

Prior to the establishment of the Ackerman's Grove County Park, recreational boating access to Little Cedar Lake was provided by a private provider through the former Ackerman's Resort located on the southeastern shoreline of the Lake. This Resort was subsequently purchased by Washington County and converted to parkland use. This park provides public recreational boating access to the Lake, and, as noted in Chapter II, provides adequate public recreational boating access as defined by the public recreational boating access standards promulgated in Chapter NR 1 of the *Wisconsin Administrative Code*. Consequently, recreational use management concerns currently center on issues of enforcement of boating ordinances, and protection of the Lake and its environs from disturbances related to recreational boating, angling, and similar activities.

Alternative Protection Measures

Recreational Boating

The promulgation of more stringent controls on the use of powered watercraft within Little Cedar Lake is one means of regulating the effects of boating activity that could be harmful to ecologically valuable areas of the Lake. Control of boating traffic in the southern portion of the Lake would have the advantage of better regulating the movements of boat traffic in this area. Such regulation would potentially limit the spread of Eurasian water milfoil by minimizing the potential for boat propellers fragmenting the plant and distributing the fragments to new locations in the Lake basin. Controls on boat traffic could be put in place using the following three options:

1. Enforcement of slow-no-wake operation of motorized boats within a specific distance of the shoreline, such as within the "shore zone," which is defined as within 100 feet of pierheads or 200 feet of the shoreline, in the case of personal watercraft, as defined in the Wisconsin Department of Natural Resources boating ordinance guidelines.

2. Designation of a navigational watercraft access route to open water from the public boat launch, approximately 50 feet in width and five feet in depth, to limit boating impacts on the Lake substrate and aquatic vegetation in the shallow southern portion of the Lake.

3. Limitation of the speed at which boat traffic travels in the shallow portions of the Lake, by designation of a "slow-no-wake" area or application of some other form of "speed restriction" in water depths of less than five feet, that would be designed to avoid damage to aquatic vegetation from motorboat propeller-induced sheer.

Boat exclusion areas, slow-no-wake zones, and boating access channels must be designated by approved regulatory markers. Boat exclusion areas are generally preferable to motorboat prohibition areas as the latter can lead to legal challenges based on the right of free use of navigable water. Similarly, slow-no-wake restrictions are preferable to speed limits designated in miles per hour terms owing to implementation and enforcement considerations. Placement of regulatory markers must conform to Section NR 5.09 of the Wisconsin Administrative Code, and all restrictions placed on the use of the waters of the State must be predicated upon the protection of public health, safety, or welfare. Boating ordinances, enacted in conformity with State law, must be clearly posted at public landings in accordance with the requirements of Section 30.77(4) of the *Wisconsin Statutes*.

Buoyage has the advantage of being visible to recreational boaters, and affected areas can be clearly demarcated. However, buoys can be expensive to obtain, install, and maintain. 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. 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. 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. Regulatory buoys used to demarcate regulated areas display their instructions in black lettering. Some types of regulatory buoys display an orange diamond with an orange cross inside; others display an orange circle. Informational buoys are similar in construction to the regulatory buoys, but contain an orange square on the white background. Whereas regulatory markers are enforceable, informational buoys are not.

Funding for aids to navigation and regulatory markers is available to governmental units and qualified lake associations through the Wisconsin Department of Natural Resources in accordance with NR 7.087 of the Wisconsin Administrative Code.

Angling

As noted in Chapter II, Little Cedar Lake has a productive fishery, with good diversity. While the Wisconsin Department of Natural Resources noted the small size of panfish in the Lake during their 1999 fisheries survey of the Lake, the Department suggested that the fishery could be considered healthy and in balance. Notwithstanding, the presence of carp in the Lake was a cause for concern, and ongoing, periodic monitoring of fish populations was recommended.

Shoreline Protection

A significant portion of the Little Cedar Lake shoreline still remains in a natural state. As described in Chapter III, limited portions of this shoreline are subject to erosion and undercutting banks due to high water levels and wave action. However, the shorelines most at risk seem to be where native shoreline vegetation has been mowed or removed, or where the lakeshore is associated with steep slopes or wetlands.

The need for maintenance of the shorelines in order to avoid erosion is important in order to protect the structure and functioning of the aquatic ecosystem of the Lake, and, especially, to preserve the wetland and nearshore aquatic vegetation in and around the Lake. Such protections also contribute to preserving and enhancing water quality and the essential structure and functioning of the waterbody and adjacent areas, and provide habitat for fishes and other aquatic life.

Two alternative shoreline erosion control techniques are considered potentially viable: vegetated buffer strips and rock revetments or riprap. These alternatives, as shown in Figure 5, were considered because they can be constructed, at least partially, by local residents; because most of the construction materials involved are readily available; because the techniques would, in many 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. These measures may be combined with selected regrading of the eroded banks and

accumulated soils, designed to facilitate navigation and recreational boating access, on a site-by-site basis. These management measures require permits from the WDNR pursuant to Chapter 30 of the *Wisconsin Statutes*.

Recommended Protection Measures
It is recommended that the Little Cedar Lake Protection and Rehabilitation District provide the lakeshore residents with information on the methods of proper construction and maintenance of shoreline protection structures. Adoption of the vegetated buffer strip and riprap or rock revetment methods of shoreline protection is recommended as appropriate to the specific locations on the Lake.

The proposed extension of the slow-no-wake zone within shallow areas, those areas with a water depth of less than 5 feet, especially on the southern side of the Lake, regardless of the distance offshore or pier heads should be considered to further protect these sensitive shorelines from erosion and human disturbances.

In addition, the conduct of periodic fisheries surveys by the Wisconsin Department of Natural Resources is recommended.

ANCILLARY PLAN RECOMMENDATIONS

The conduct of public informational programming by the Little Cedar Lake Protection and Rehabilitation District has been a recurring theme throughout this recommended plan. As such, informational and educational programming is identified as a specific action recommended to be undertaken by the District. Educational programming is focused primarily on classroom-based teaching opportunities, such as those provided through the Adopt-A-Lake and Project WET programs that the Little Cedar Lake Protection and Rehabilitation District may wish to support through the West Bend School District. Informational programming, in contrast, is focused on a more general program of information dissemination targeting the community. Actions that can be undertaken in terms of informational programming include programming directed at alternative and appropriate lawn care practices within this rapidly urbanizing drainage area, promotion of soil testing in cooperation with the University of Wisconsin-Extension, continued participation in the Wisconsin Department of Natural Resources Self-Help Program, and conduct of an annual review of these data by the Lake Management District Board of Commissioners, including regular reports on the results of these studies at the annual meeting of the Lake Management District. In this way, the Little Cedar Lake Protection and Rehabilitation District will continue to have an active role within the Little Cedar Lake community, and fulfill its mandate to protect and rehabilitate Little Cedar Lake.

SUMMARY

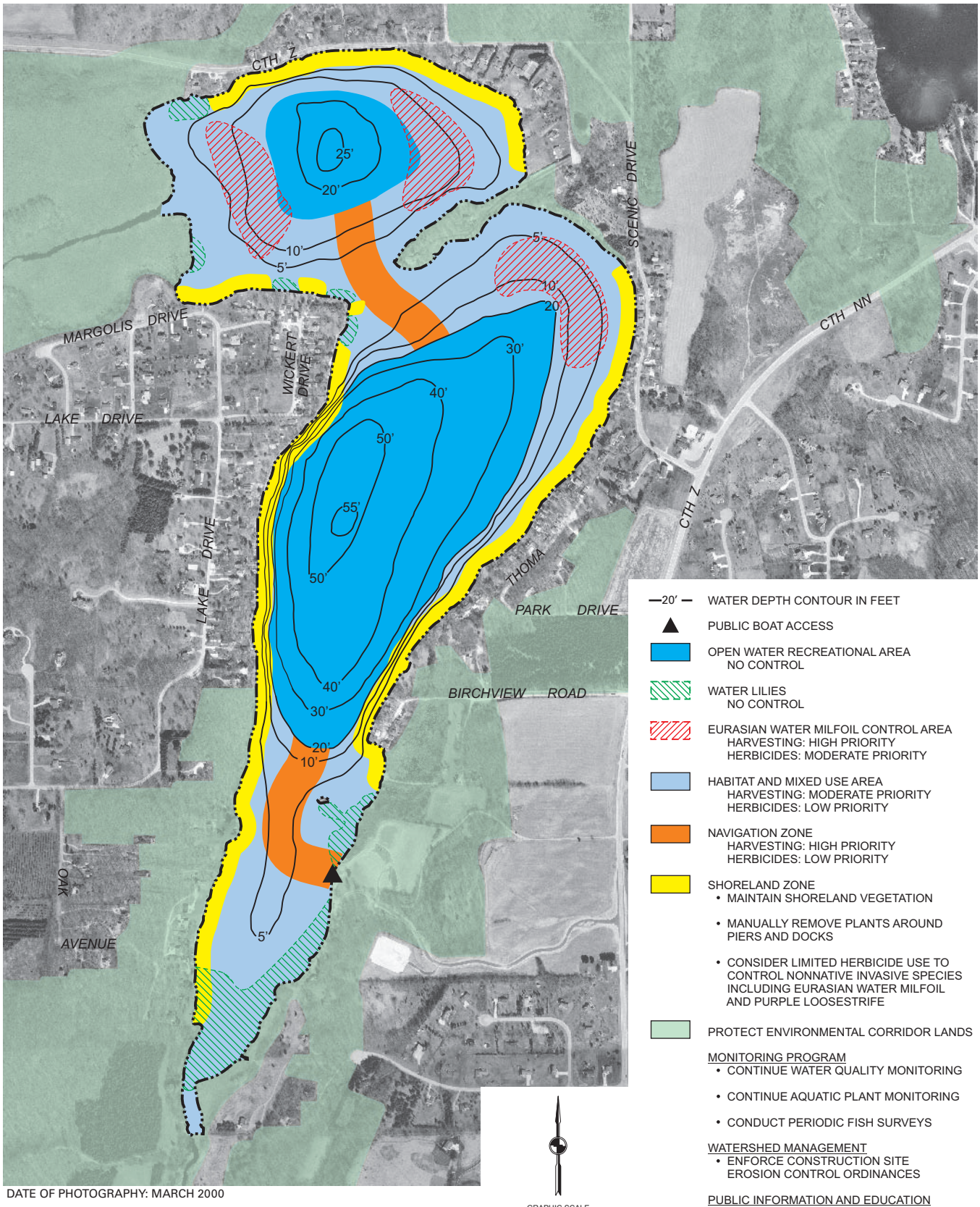
This plan, which documents the findings and recommendations of a lake management planning study requested by the Little Cedar Lake Protection and Rehabilitation District, examines existing and anticipated conditions and potential management problems of Little Cedar Lake and presents a recommended plan for the resolution of these problems.

Little Cedar Lake was found to be a mesotrophic, moderately deep water lake of good quality located in close proximity to the Milwaukee metropolitan area and adjacent to a progressively urbanizing part of Washington County in which its tributary drainage area is almost entirely located. Surveys indicated that the Lake and the tributary drainage area contain significant areas of ecological value, including numerous wetlands and high-quality wildlife habitat.

The Little Cedar Lake protection and recreational use plan, summarized on Map 16 and in Table 12, recommends actions be taken to limit further human impacts on the in-lake macrophyte beds and reduce human impacts on the ecologically valuable areas adjacent to the Lake and in its watershed. The plan recommends only limited aquatic plant management action, including selected manual removal and surveillance activities at this time, mainly in the cases where purple loosestrife and Eurasian water milfoil are present, with the limited use of chemical treatment only to treat such species, if needed. Additional and periodic future fishery surveys are also recommended.

Map 16

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN FOR LITTLE CEDAR LAKE



Source: SEWRPC.

Table 12

RECOMMENDED PROTECTION PLAN ELEMENTS FOR LITTLE CEDAR LAKE

Issue	Plan Element	Subelement	Location	Management Measures[a]	Management Responsibility
Ecologically Valuable Areas and Aquatic Plants	Land use management	Land use plan implementation	Entire watershed	Support implementation of the regional land use plan	Towns of Polk and West Bend, and Washington County
		Environmentally sensitive lands protection	Entire watershed	Support preservation of primary environmental corridor lands and critical species habitat	Little Cedar Lake Protection and Rehabilitation District, and Towns of Polk and West Bend
	Shoreland and Nearshore management	Nuisance species monitoring program	Entire watershed	Monitor lakes and surrounding wetlands for the presence or spread of nuisance species, including Eurasian water milfoil, purple loosestrife, and zebra mussel Monitor lakes for the presence or spread of the aquatic weevil (*Eurhychiopsis lecontei*)	Little Cedar Lake Protection and Rehabilitation District
	Aquatic plant management	Mechanical harvesting	Areas of nuisance growth	Harvest nuisance aquatic plants, especially to provide public recreational boating navigational access to deeper water portions of the Lake	Little Cedar Lake Protection and Rehabilitation District
		Manual harvesting	Areas of nuisance growth	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers	Little Cedar Lake Protection and Rehabilitation District
		Recreational use zoning	Entire Lake	Enforce slow-no-wake ordinance within 100 feet of shoreline or 200 feet for personal water craft; refine ordinance as appropriate	Towns of Polk and West Bend, and Little Cedar Lake Protection and Rehabilitation District
		Nuisance species management	Entire watershed	Monitor lakes and surrounding wetlands for the presence or spread of nuisance species, including Eurasian water milfoil, purple loosestrife, and zebra mussel Monitor lakes for the presence or spread of the aquatic weevil (*Eurhychiopsis lecontei*)	Little Cedar Lake Protection and Rehabilitation District, and Wisconsin Department of Natural Resources
		Chemical control of nonnative plants	Eurasian water milfoil control zone and areas containing purple loosestrife	Consider limited use of herbicides in spring; obtain appropriate permits from WDNR; conduct management programs as appropriate	Little Cedar Lake Protection and Rehabilitation District, and Wisconsin Department of Natural Resources
Nonpoint Source Pollution and Water Quality	Watershed land management	Urban nonpoint source controls	Entire watershed	Implement and maintain recommended good urban housekeeping practices, and maintenance of grassed swales	Little Cedar Lake Protection and Rehabilitation District, and Towns of Polk and West Bend
		Construction site erosion control	Entire watershed	Continue to enforce existing erosion control and water quality protection ordinances; refine ordinances where necessary	Towns of Polk and West Bend, and Washington County

Table 12 (continued)

Issue	Plan Element	Subelement	Location	Management Measures	Management Responsibility
Nonpoint Source Pollution and Water Quality (continued)	Watershed land management (continued)	Rural nonpoint source controls	Entire watershed	Implement and maintain rural land best management practices, and integrated nutrient and pest management practices	Towns of Polk and West Bend
	Water quality management	Water quality control	Entire lake	Incorporate specific actions within the stormwater management plan for the protection of the surface water quality of Little Cedar Lake	Towns of Polk and West Bend
		Water quality monitoring	Entire lake	Continue to participate in the DNR Self-Help Monitoring Program	Little Cedar Lake Protection and Rehabilitation District
		Water quality protection	Entire watershed	Implement and maintain recommended good urban housekeeping practices Encourage proper on-site sanitary sewer maintenance	Little Cedar Lake Protection and Rehabilitation District, Towns of Polk and West Bend, and Washington County
Recreational Use	Recreational boating management	Navigational access provision	Entire Lake	Maintain public recreational boating navigational access to deep water areas of the Lake Promote slow-no-wake speeds in shallow areas of less than five feet of water depth within the Lake	Little Cedar Lake Protection and Rehabilitation District Little Cedar Lake Protection and Rehabilitation District and Towns of Polk and West Bend
	Angling	Fisheries management	Entire lake	Conduct fisheries survey to determine the current status of the fishery; review survey data and develop fishing regulations and habitat protection measures for improved fisheries as needed; and implement recommendations as necessary	Wisconsin Department of Natural Resources, and Little Cedar Lake Protection and Rehabilitation District
	Shoreland protection	Shoreline erosion	Entire Lake	Construct, maintain and repair structures where needed; encourage maintaining or reestablishing native shoreline vegetation	Little Cedar Lake Protection and Rehabilitation District
Informational and Educational Programming	Public informational programming	- -	Entire watershed	Continue public awareness and information programming Encourage householders to adopt environmentally sustainable land management practices Participate in soil testing program offered by UW-Extension	Little Cedar Lake Protection and Rehabilitation District, Towns of Polk and West Bend, Wisconsin Department of Natural Resources; Washington County, and University of Wisconsin-Extension

[a]*Costs to be determined.*

Source: SEWRPC.

The recommended plan includes continuation of an ongoing program of public information and education provided to riparian residents and lake users. For example, additional options regarding household chemical usage, lawn and garden care, shoreland protection and maintenance, and recreational usage of the Lakes should be made available to riparian householders, thereby providing riparian residents with alternatives to traditional alternatives and activities.

This recommended plan seeks to balance the demand for high-quality residential and recreational opportunities at Little Cedar Lake with the requirements for environmental protection of the Lake.

APPENDICES

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Appendix A

ILLUSTRATIONS OF COMMON AQUATIC PLANTS FOUND IN LITTLE CEDAR LAKE

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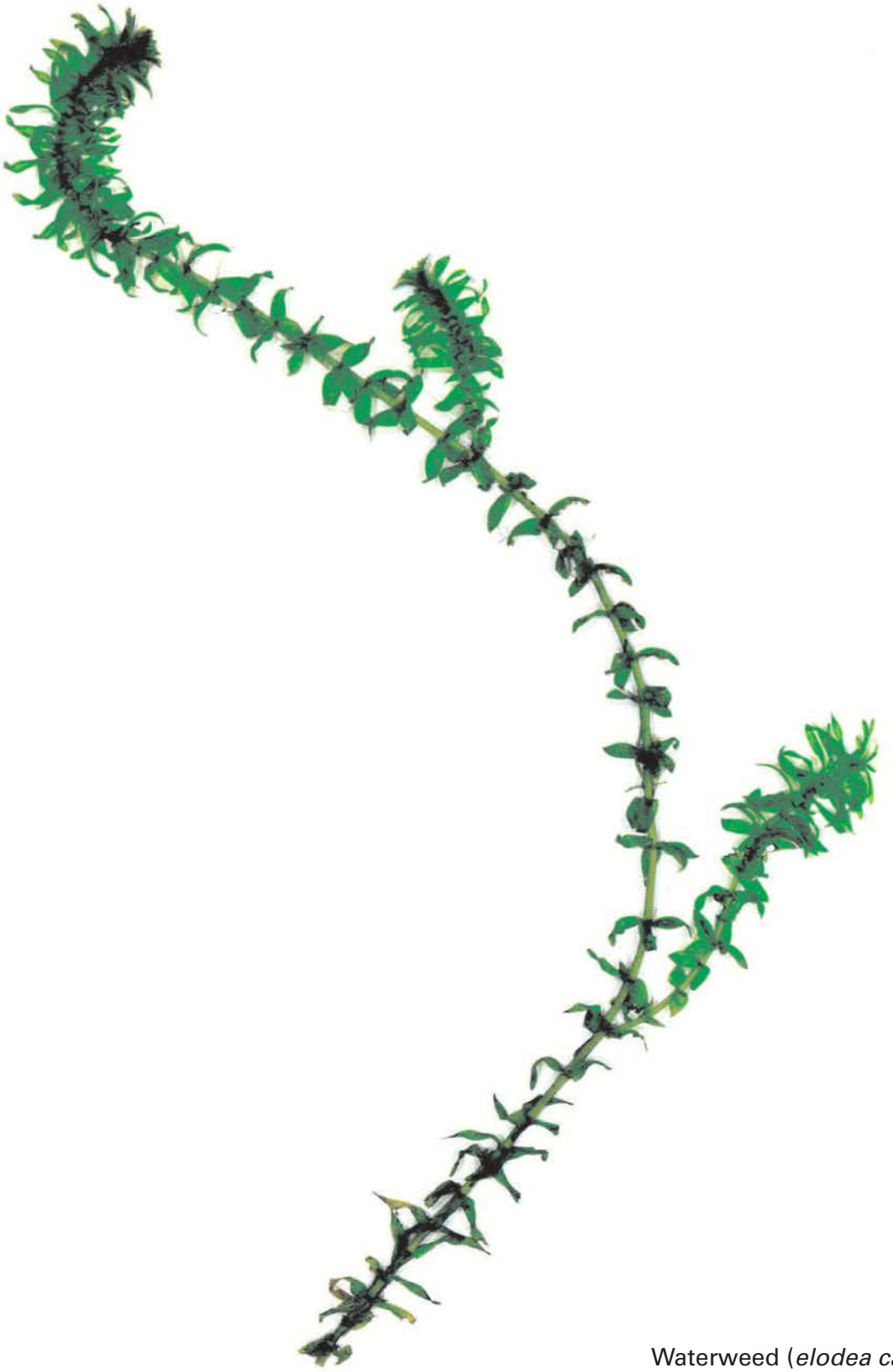
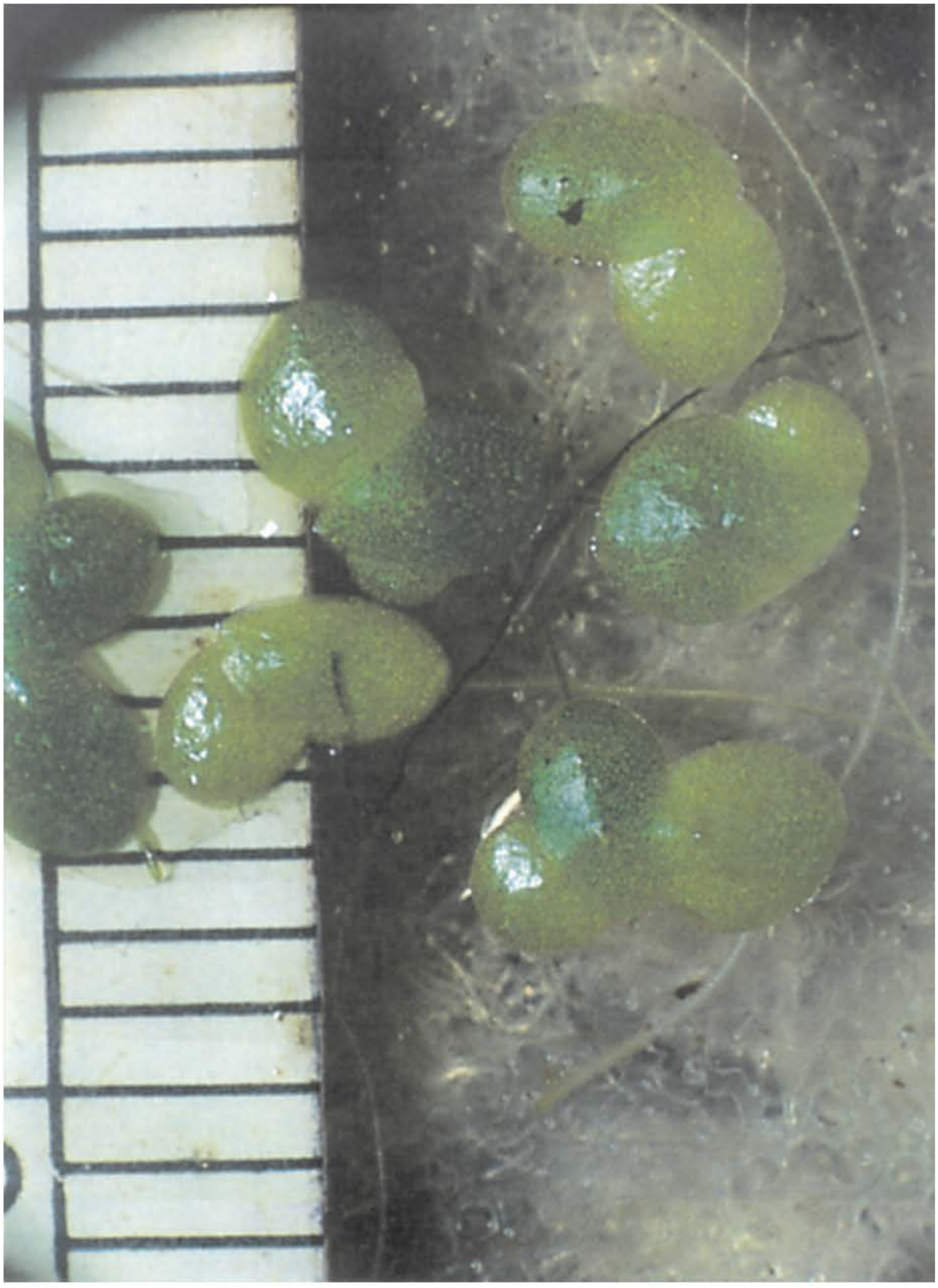
Coontail (*ceratophyllum demersum*)

Muskgrass (*chara vulgaris*)



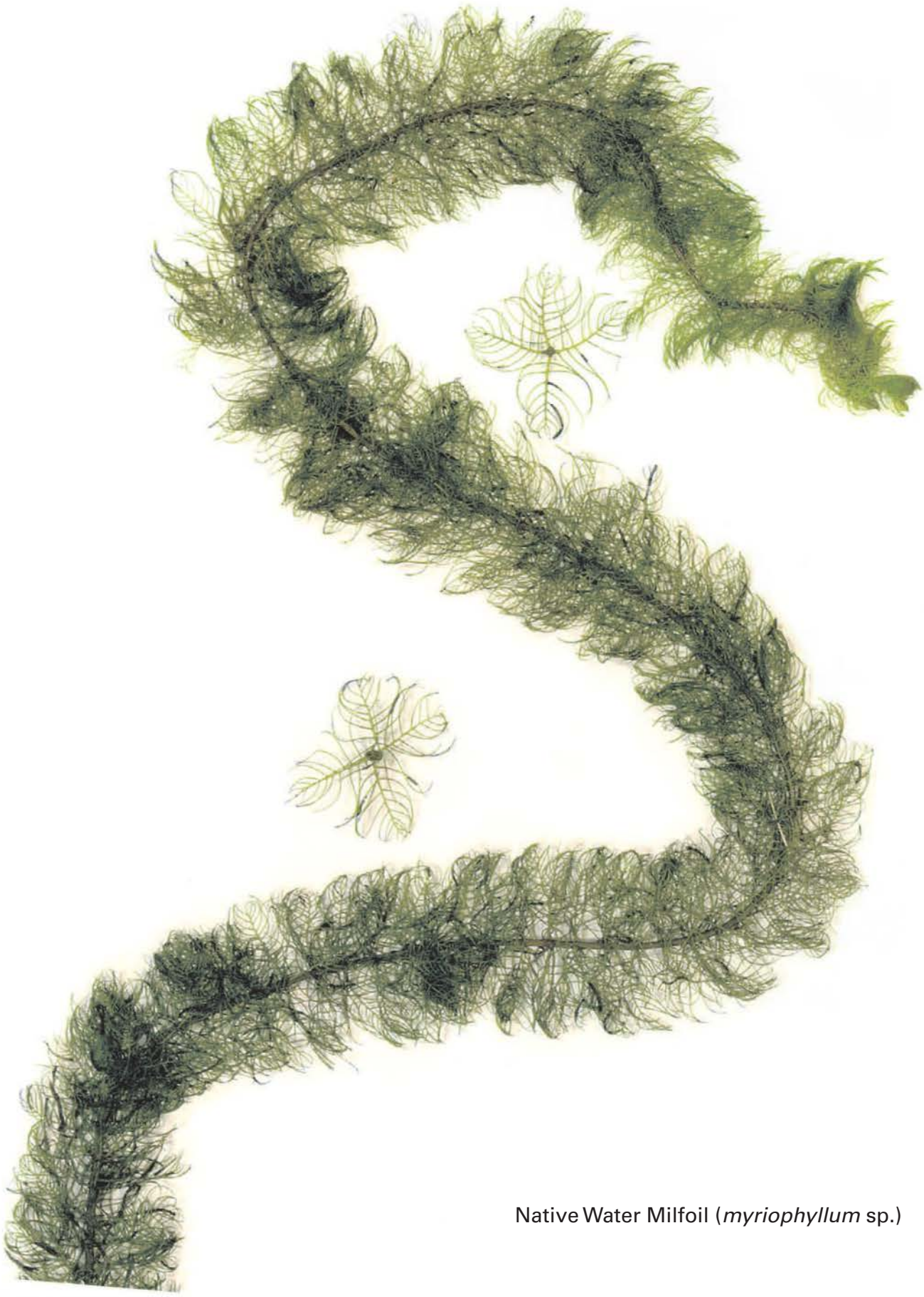
Waterweed (*elodea canadensis*)



Lesser Duckweed (*lemna minor*)

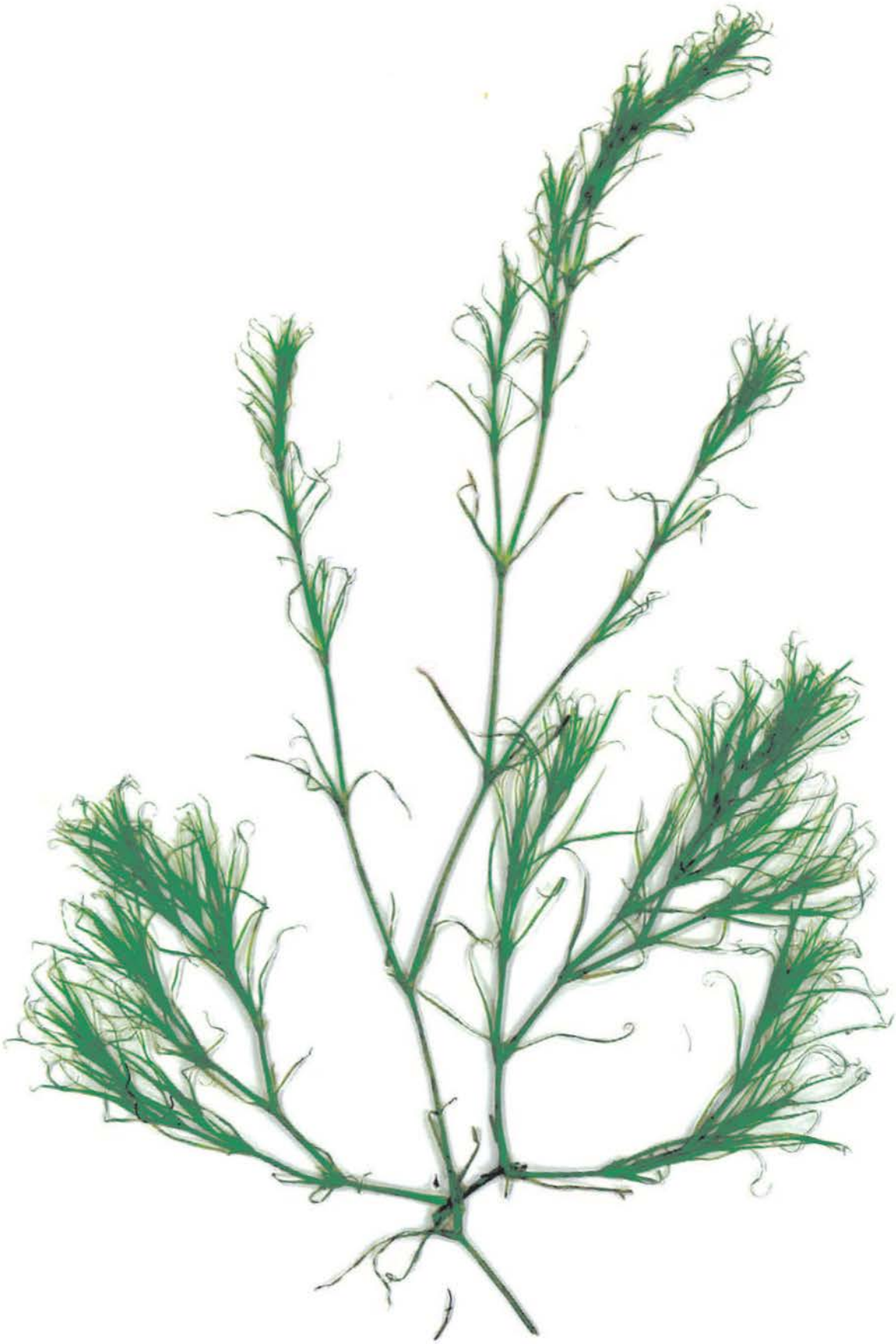
NOTE: Plant species in photograph are not shown proportionate to actual size

Source: Steve D. Eggers and Donald M. Reed, Wetland Plants and Plant Communities of Minnesota & Wisconsin*, 2nd Edition, 1997*



Native Water Milfoil (*myriophyllum* sp.)

Eurasian Water Milfoil (*myriophyllum spicatum*)



Bushy Pondweed (*najas flexilis*)

Spiny Naiad (*najas marina*)

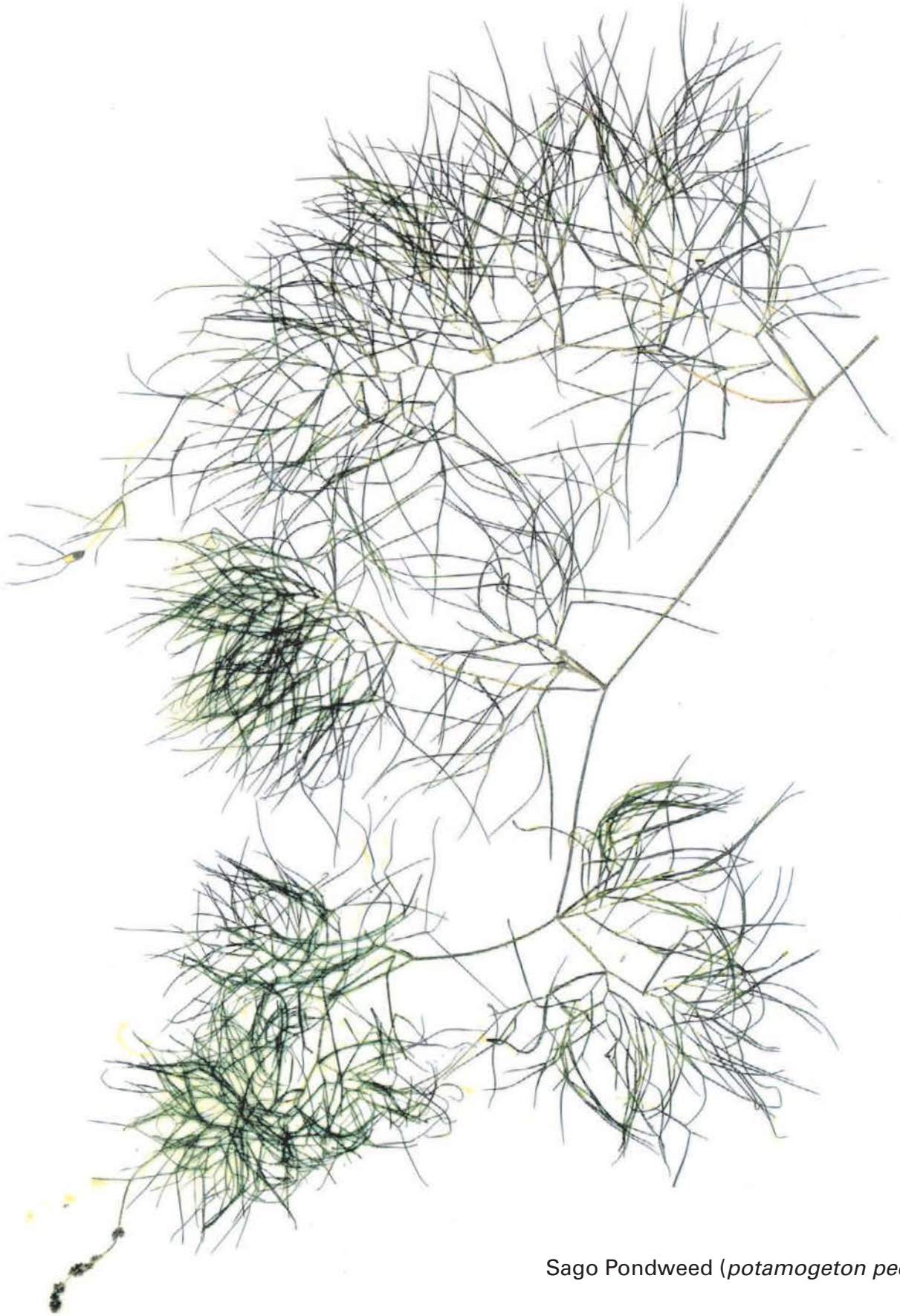
Yellow Water Lily (*nuphar variegatum*)

White Water Lily (*nymphaea odorata*)

Large-Leaf Pondweed (*potamogeton amplifolius*)

Curly-Leaf Pondweed (*potamogeton crispus*)

Variable Pondweed (*potamogeton gramineus*)



Sago Pondweed (*potamogeton pectinatus*)

Clasping-Leaf Pondweed
(*potamogeton richardsonii*)

Robbins Pondweed (*potamogeton robbinsii*)

Flat-Stem Pondweed (*potamogeton zosteriformis*)

Eel Grass / Wild Celery (*valisneria americana*)

Water Stargrass (*zosterella dubia*)

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Appendix B

PRELIMINARY VEGETATION SURVEYS OF WETLANDS ADJACENT TO LITTLE CEDAR LAKE

Appendix B-1

PRELIMINARY VEGETATION SURVEY
THE CEDAR CREEK WETLANDS AT THE LITTLE CEDAR LAKE INLET

Date: June 27, 2000

Observer: Rachel E. Lang, Senior Specialist-Biologist
Southeastern Wisconsin Regional Planning Commission

Location: Town of West Bend in parts of U.S. Public Land Survey Section 33,
Township 11 North, Range 19 East, Washington County, Wisconsin.

Species List:

POLYPODIACEAE
Thelypteris palustris–Marsh fern

TYPHACEAE
Typha latifolia[1]–Broad-leaf cat-tail

CYPERACEAE
Eleocharis sp.–Spike-rush
Carex stricta–Tussock sedge
Carex spp.–Sedges

LEMNACEAE
Spirodela polyrhiza–Duckweed

BETULACEAE
Betula glandulifera–Bog birch

POLYGONACEAE
Rumex orbiculatus–Great water dock
Polygonum amphibium–Water smartweed

NYMPHAEACEAE
Nuphar advena–Yellow water lily

ROSACEAE
Potentilla palustris–Bog cinquefoil

BALSAMINACEAE
Impatiens capensis–Jewelweed

LYTHRACEAE
Lythrum salicaria[2]–Purple loosestrife

UMBELLIFERAE
Cicuta bulbifera–Water-hemlock

CORNACEAE
Cornus amomum–Silky dogwood

ASCLEPIADACEAE
Asclepias incarnata–Marsh milkweed

LABIATAE
Lycopus uniflorus–Northern bugleweed

Total number of plant species: 17+
Number of nonnative plant species: 1 (6 percent)

This plant community area is part of the Cedar Creek and Little Cedar Lake wetland complex and consists of shallow marsh. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

———

[1]Dominant plant species.

[2]Nonnative plant species.

Appendix B-2

PRELIMINARY VEGETATION SURVEY
LITTLE CEDAR LAKE SHORELINE WETLANDS

Dates: June 13, 15, 22, and 27; July 15, 2000

Observer: Rachel E. Lang, Senior Specialist-Biologist
Southeastern Wisconsin Regional Planning Commission

Location: Town of Polk in parts of U.S. Public Land Survey Section 3, Township 10 North, Range 19 East, and the Town of West Bend in parts of U.S. Public Land Survey Section 33, Township 11 North, Range 19 East, Washington County, Wisconsin.

Species List:

TYPHACEAE
- *Typha latifolia*–Broad-leaf cat-tail
- *Typha angustifolia*–Narrow-leaf cat-tail

SPARGANIACEAE
- *Sparganium eurycarpum*–Common bur-reed

ALISMATACEAE
- *Sagittaria latifolia*–Common arrowhead

GRAMINEAE
- *Phalaris arundinacea*[1]–Reed canary grass

CYPERACEAE
- *Scirpus validus*–Soft-stemmed bulrush
- *Carex stricta*–Tussock sedge
- *Carex comosa*–Bristly sedge
- *Carex* spp.–Sedges

IRIDACEAE
- *Iris versicolor*–Blue flag iris
- *Iris pseudacorus*[1]–Yellow iris

SALICACEAE
- *Salix nigra*–Black willow
- *Salix exigua*–Sand-bar willow
- *Salix* sp.–Willow

POLYGONACEAE
- *Rumex orbiculatus*–Great water dock
- *Polygonum amphibium*–Water smartweed

NYMPHAEACEAE
Nuphar advena–Yellow water lily
Nymphaea odorata–White water lily

LYTHRACEAE
Lythrum salicaria[1]–Purple loosestrife

ASCLEPIADACEAE
Asclepias incarnata–Marsh milkweed

Total number of plant species: 20+
Number of nonnative plant species: 3 (15 percent)

The Little Cedar Lake shoreline plant community area consists of shallow marsh, fresh (wet) meadow, and scattered second growth, Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include past filling; placement of shoreline protection structures; mowing and selective cutting of trees. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

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[1]Nonnative plant species.

Appendix B-3

PRELIMINARY VEGETATION SURVEY
THE CEDAR CREEK WETLANDS AT THE LITTLE CEDAR LAKE OUTLET

Date: July 15, 2000

Observer: Rachel E. Lang, Senior Specialist-Biologist
Southeastern Wisconsin Regional Planning Commission

Location: Town of Polk in the Northeast one-quarter of U.S. Public Land Survey Section 3, Township 10 North, Range 19 East, Washington County, Wisconsin.

Species List:

EQUISETACEAE
Equisetum sp.–Horsetail

TYPHACEAE
Typha latifolia–Broad-leaf cat-tail

GRAMINEAE
Agrostis gigantea[1]–Redtop grass

CYPERACEAE
Eleocharis acicularis–Needle spike-rush
Scirpus validus–Soft-stemmed bulrush
Scirpus atrovirens–Green bulrush
Carex stricta–Tussock sedge
Carex lacustris–Lake sedge

IRIDACEAE
Iris versicolor–Blue flag iris

SALICACEAE
Populus tremuloides–Quaking aspen
Salix nigra–Black willow
Salix bebbiana–Beaked willow
Salix discolor–Pussy willow

LYTHRACEAE
Lythrum salicaria[1]–Purple loosestrife

CORNACEAE
Cornus stolonifera–Red-osier dogwood

CONVOLVULACEAE
Convolvulus sepium–Hedge bindweed

LABIATAE
Lycopus americanus–Cutleaf bugleweed

CAMPANULACEAE
Campanula aparinoides–Marsh bellflower

COMPOSITAE
Aster simplex–Marsh aster
Eupatorium maculatum–Joe-pye weed

Total number of plant species: 20
Number of nonnative plant species: 2 (10 percent)

This plant community area is part of the Little Cedar Lake and Cedar Creek wetland complex and consists of shallow marsh, Southern sedge meadow, fresh (wet) meadow, shrub-carr and second growth, scattered Southern wet to wet-mesic lowland hardwoods. Disturbances to the plant community area include establishment of footpaths. No Federal- or State-designated Special Concern, Threatened, or Endangered species were observed during the field inspection.

_____

[1]Nonnative plant species.

Appendix C

TOWN OF WEST BEND RECREATIONAL BOATING ORDINANCES APPLICABLE TO LITTLE CEDAR LAKE

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Town of West Bend

Little Cedar Lake Boating Regulations

Speed Limits in Traffic Lanes	No person shall operate a boat or aquaplane faster than prescribed speed limits between the following hours
Monday through Friday	10:00 a.m. to 7:00 p.m. – 35 mph Maximum
	7:00 p.m. to 10:00 a.m. – Slow No Wake
Saturday, Sunday and Holidays	10:00 a.m. to 6:00 p.m. – 35 mph Maximum
	6:00 p.m. to 10:00 a.m. – Slow No Wake
Water Skiing Regulations	No person shall operate a boat for the purpose of towing a water skier, aquaplane or similar device, or engage in water skiing or aquaplane between the following hours
Monday through Friday	7:00 p.m. to 10:00 a.m.
Saturday, Sunday and Holidays	6:00 p.m. to 10:00 a.m.
Number of Towed Skiers	
Monday through Friday	No motorboat operator shall tow more than TWO water skiers nor shall any water skier allow himself/herself to be towed by any motorboat already towing TWO water skiers. No person shall water ski in any marked fish spawning area
Saturday, Sunday and Holidays	No motorboat operator shall tow more than ONE water skier nor shall any water skier allow himself/herself to be towed by any motorboat already towing ONE water skier. No person shall water ski in any marked fish spawning area
Swimming Regulations	No person shall swim in the water traffic lane unless he is accompanied by and within fifty (50) feet of a manned boat. No person shall swim in the water traffic lane from sunset to sunrise unless the accompanying boat is properly lighted and no person shall skin dive in any marked fish spawning area

Source: Town of West Bend.