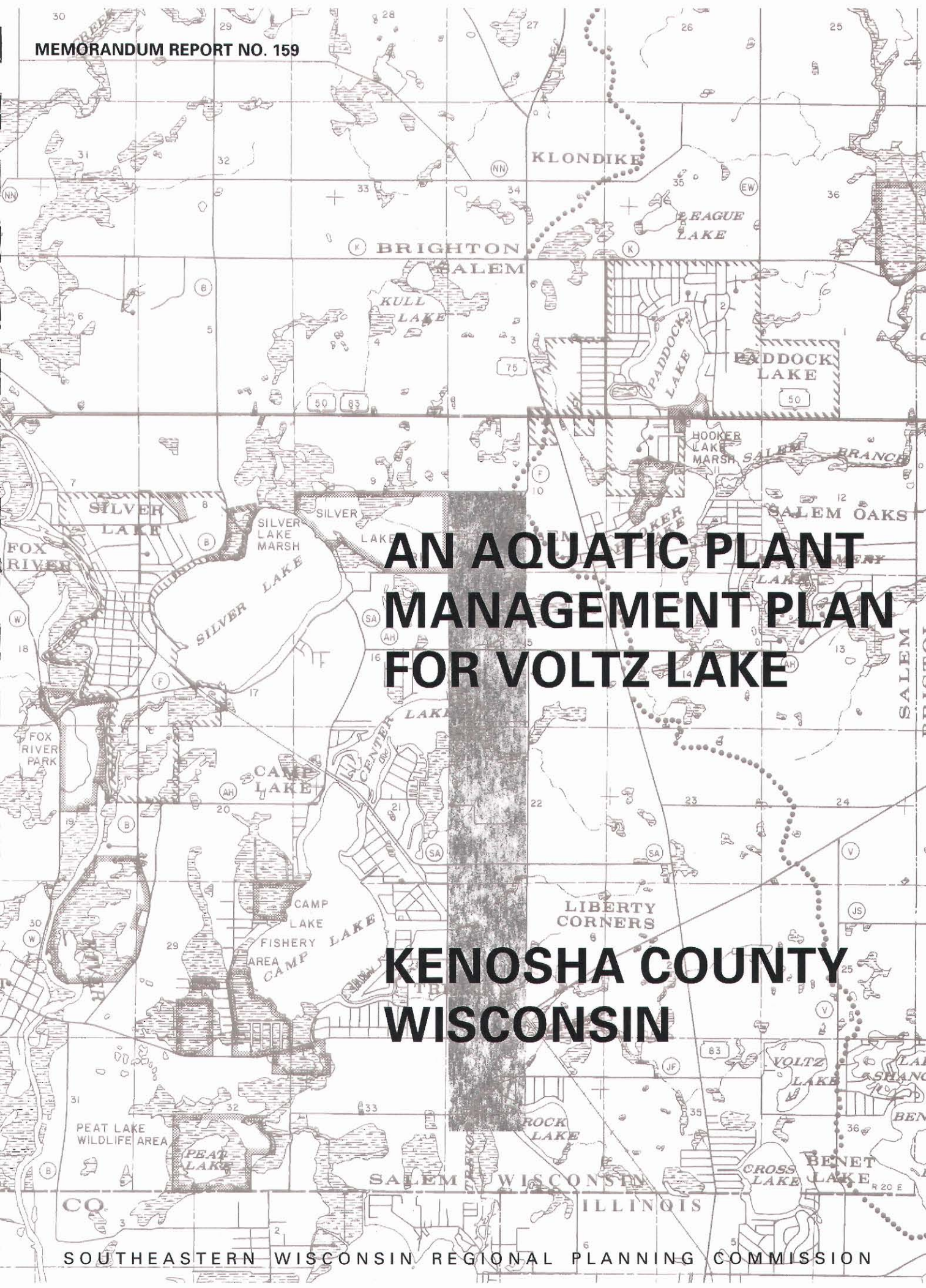
MEMORANDUM REPORT NO. 159



AN AQUATIC PLANT MANAGEMENT PLAN FOR VOLTZ LAKE

KENOSHA COUNTY WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Special acknowledgement is due to Dr. Jeffrey A. Thornton, CLM, PH, and Dr. Thomas M. Slawski, SEWRPC Principal Planners, and Edward J. Schmidt and Michael A. Borst, SEWRPC Research Analysts, for their contributions to the conduct of this study and the preparation of this report.

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AN AQUATIC PLANT MANAGEMENT PLAN FOR VOLTZ LAKE KENOSHA COUNTY, WISCONSIN

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Chapter I

INTRODUCTION

Voltz Lake, located in the Town of Salem, Kenosha County, Wisconsin, is a valuable resource offering a variety of recreational and aesthetic opportunities to the resident community and its visitors. The Lake is an integral part of this lake-oriented community. However, the recreational and visual value of the Lake is perceived to be threatened by changing land use conditions in the drainage area tributary to Voltz Lake.

Seeking to improve the usability and to prevent deterioration of the natural assets and recreational potential of the Voltz Lake, the riparian residents formed a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district. Consequently, the Voltz Lake Management District was duly created to undertake an ongoing program of community involvement, education, and lake management.

This report sets forth an aquatic plant management and lake protection plan for Voltz Lake, which plan is the culmination of much of the effort undertaken by the Voltz Lake Management District since its formation. This plan represents part of the ongoing commitment of the Voltz Lake Management District and the Town of Salem to sound planning with respect to the Lake. The plan was prepared over a three-year period, between 2001 and 2003, by the Southeastern Wisconsin Regional Planning Commission, in cooperation with the Voltz Lake Management District, and includes the results of field surveys conducted by the Commission during the years 2001 and 2002. This planning project was funded, in part, through a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Voltz Lake Management District under Chapter NR 190 of the *Wisconsin Administrative Code*.

This plan is intended to form an integral part of any future comprehensive lake management plan for Voltz Lake. The scope of this report is limited to a consideration of those management measures which can be determined to be effective in the protection of lake water quality and lake use based upon the available data. The preparation of a comprehensive lake management plan for Voltz Lake will require additional water quality and biological data collection and analysis.

The objectives of this aquatic plant management and lake protection plan for the Voltz Lake were developed in consultation with the Voltz Lake Management District, and are as follows:

1. The protection and maintenance of public health, and promotion of public comfort, convenience, necessity, and welfare, through the environmentally sound management of the vegetation, fishery, and wildlife populations in and around Voltz Lake;

2. The provision of a high-quality, water-oriented urban residential setting with recreational and aesthetic opportunities for residents and visitors to the Voltz Lake, and management of the Lake in an environmentally sound manner; and,

3. The maintenance of the water quality of Voltz Lake so as to 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 plan, which conforms to the requirements and standards set forth in the relevant *Wisconsin Administrative Codes*,[1] should serve as an initial guide to achieving these objectives over time.

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

Chapter II

INVENTORY FINDINGS

INTRODUCTION

Voltz Lake is located in northwest one-quarter section of U.S. Public Land Survey Section 36, Town 1 North, Range 20 East, within the south central portion of the Town of Salem, in western Kenosha County, as shown on Map 1. Voltz Lake is primarily a groundwater-fed lake, although the Lake has an intermittent inlet to the south and an outlet to the west. Inflow from the south to Voltz Lake originates in Cross Lake, and drains from that Lake through a short stretch of stream and a culvert under 122nd Street into Voltz Lake. Outflow from Voltz Lake is to Trevor Creek, located to the west of the main lake basin, through a corrugated metal pipe culvert under 231st Court.[1] Inflow also originates from the north, draining to the Lake through an unnamed tributary comprised of a tile drainage system and constructed channel.

The drainage area directly tributary to Voltz Lake is wholly located within the Town of Salem in Kenosha County, and is approximately 310 acres in areal extent. The total drainage area within Wisconsin, inclusive of the tributary drainage area to Cross Lake, is about 500 acres in areal extent. As of 2000, the land uses within this area were primarily rural, with significant areas of open lands including wetlands, woodlands, and agricultural lands. Notwithstanding, some upland areas were undergoing a process of urbanization or were proposed for urbanization, primarily to the south of the Lake, while large tracts of land to the north and east of Voltz Lake, currently in agricultural or open land usage, may be envisioned for urban-density residential development at some future time. Currently, lake-oriented, residential lands are the principal urban land feature within the drainage area tributary to Voltz Lake.

WATERBODY CHARACTERISTICS

Voltz Lake is a 52-acre drained, groundwater-fed lake. Significant surface water sources include contributions of water via a short, constructed stream segment entering the main lake basin from the north, and an intermittent, channelized hydrologic link from Cross Lake in the south, as well as localized surface water runoff. The Lake is linked to Cross Lake by a drainage channel and its associated culvert. A culvert and segment of unnamed stream forms the outflow from Voltz Lake, draining to Trevor Creek, a tributary stream to the Fox River system. Voltz Lake is roughly semi-circular in shape, with the cusps of the semi-circle oriented in a westerly direction. The deepest portions are located in the northern one-third of the Lake, which has a maximum depth of about 24 feet. The mean depth of the Lake is approximately seven feet, and the Lake has a volume of about 364 acre-feet. The hydrographic characteristics and bathymetry of the Lake are shown in Table 1 and on Map 2, respectively.

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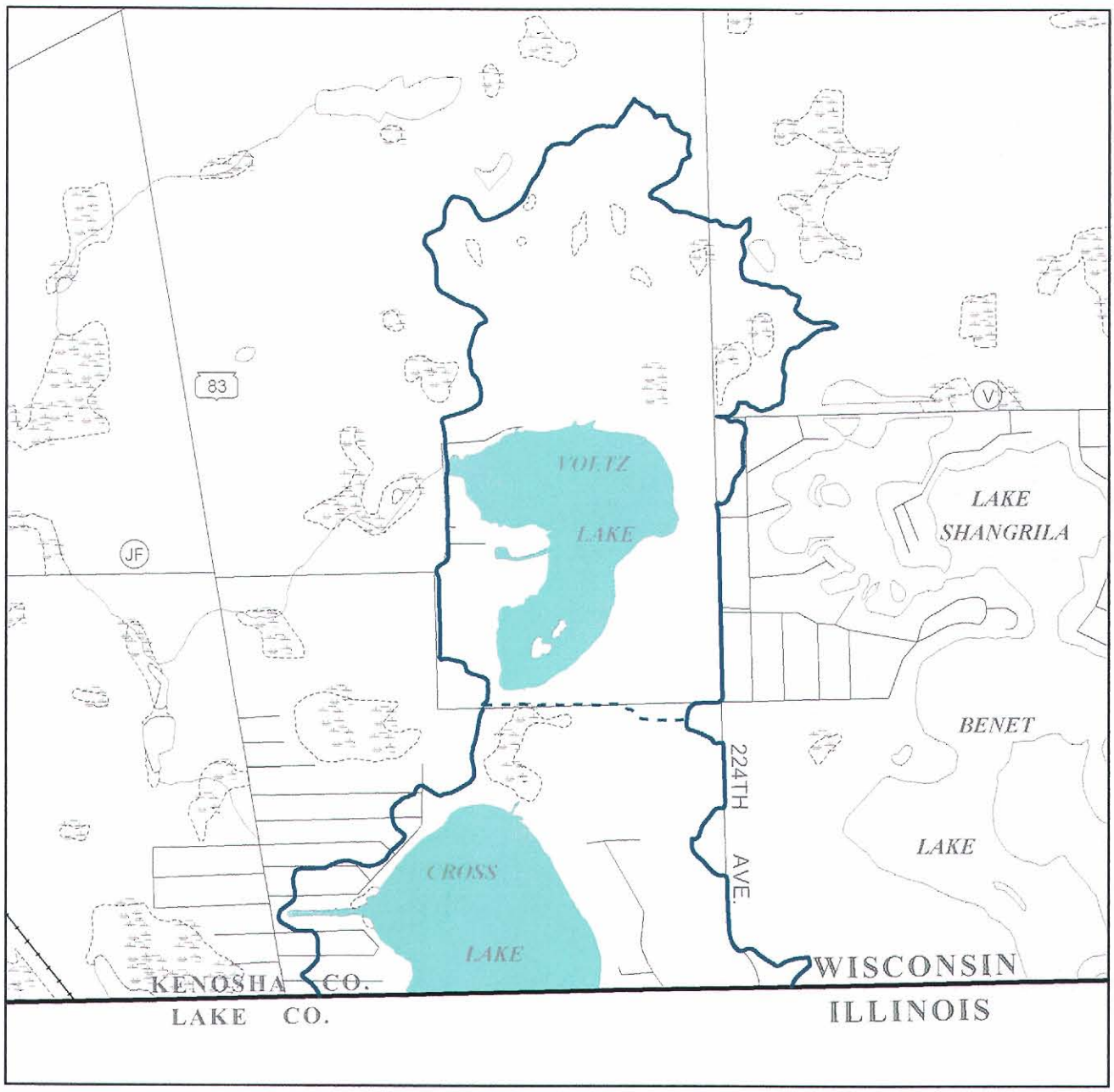
[1] *Cross Lake also discharges independently to the west through a concrete culvert and storm sewer system to Trevor Creek, draining Cross Lake under STH 83. Flow to Voltz Lake appears to be intermittent.*

Map 1

LOCATION OF VOLTZ LAKE, TOWN OF SALEM, KENOSHA COUNTY, WISCONSIN



SURFACE WATER

DRAINAGE AREA DIRECTLY TRIBUTARY TO VOLTZ LAKE

WISCONSIN PORTION OF THE TOTAL DRAINAGE AREA OF VOLTZ LAKE

0 0.1 0.2 0.3 0.4 0.5 MILES

Source: SEWRPC.

Table 1

HYDROGRAPHIC CHARACTERISTICS OF VOLTZ LAKE

Parameter	Measurement
Size	
Surface Area	52 acres
Volume	364 acre-feet
Maximum Depth	24 feet
Mean Depth	7 feet
Direct Drainage Area	309 acres
Total Tributary Drainage Area (Wisconsin portion)	504 acres
Residence Time[a]	2.2 years
Shape	
Maximum Length	0.5 miles
Length of Shoreline	2.3 miles
Maximum Width	0.4 miles
Shoreline Development Factor[b]	2.3
Depth	
Area of Lake Less Than 3 Feet	24.8 percent
Area of Lake 3-20 Feet	69.8 percent
Area of Lake Greater Than 20 Feet	5.4 percent

[a] *Residence Time: Time required for a volume equivalent to the full volume of the lake to enter the lake from the drainage area.*

[b] *Shoreline Development Factor: Ratio of shoreline length to that of a circular lake of the same area.*

Source: SEWRPC.

The lake bottom sediment types of Voltz Lake were surveyed during 2001 by Commission staff. The lakebed of Voltz Lake was comprised primarily of silt with a mud-dominated deep basin in the northern part of the lake, as shown on Map 3.

POPULATION, LAND USE AND SHORELINE DEVELOPMENT

Population

As of 2000, there were approximately 290 persons residing in approximately 90 housing units within the drainage area directly tributary to Voltz Lake. Urban development adjacent to Voltz Lake consisted primarily of residential development that occurred between 1950 and 1963, as shown on Map 4. Within the total drainage area, urban residential development occurred between 1940 and 1970, as shown on the map.

Land Use

As of 1995, almost all of the western and northern shoreland portions of Voltz Lake were occupied by residential land uses. Development in the area of the wetlands located to the south of the Lake containing the intermittent unnamed inflow stream from neighboring Cross Lake and the small inlet along the eastern shoreline, however, was limited, while much of the northern portion of the shoreland was occupied by woodland. Notwithstanding, woodlands, wetlands, and agricultural lands occupied a significant proportion of the lands within the watershed, as shown on Map 5. Public recreational boating access to the Lake was provided by a boat ramp on 231st Court, located at the westernmost extreme of the Lake, adjacent to the outflow. Parking facilities were limited, however, and the Lake was determined not to have adequate public recreational boating access under the standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*.

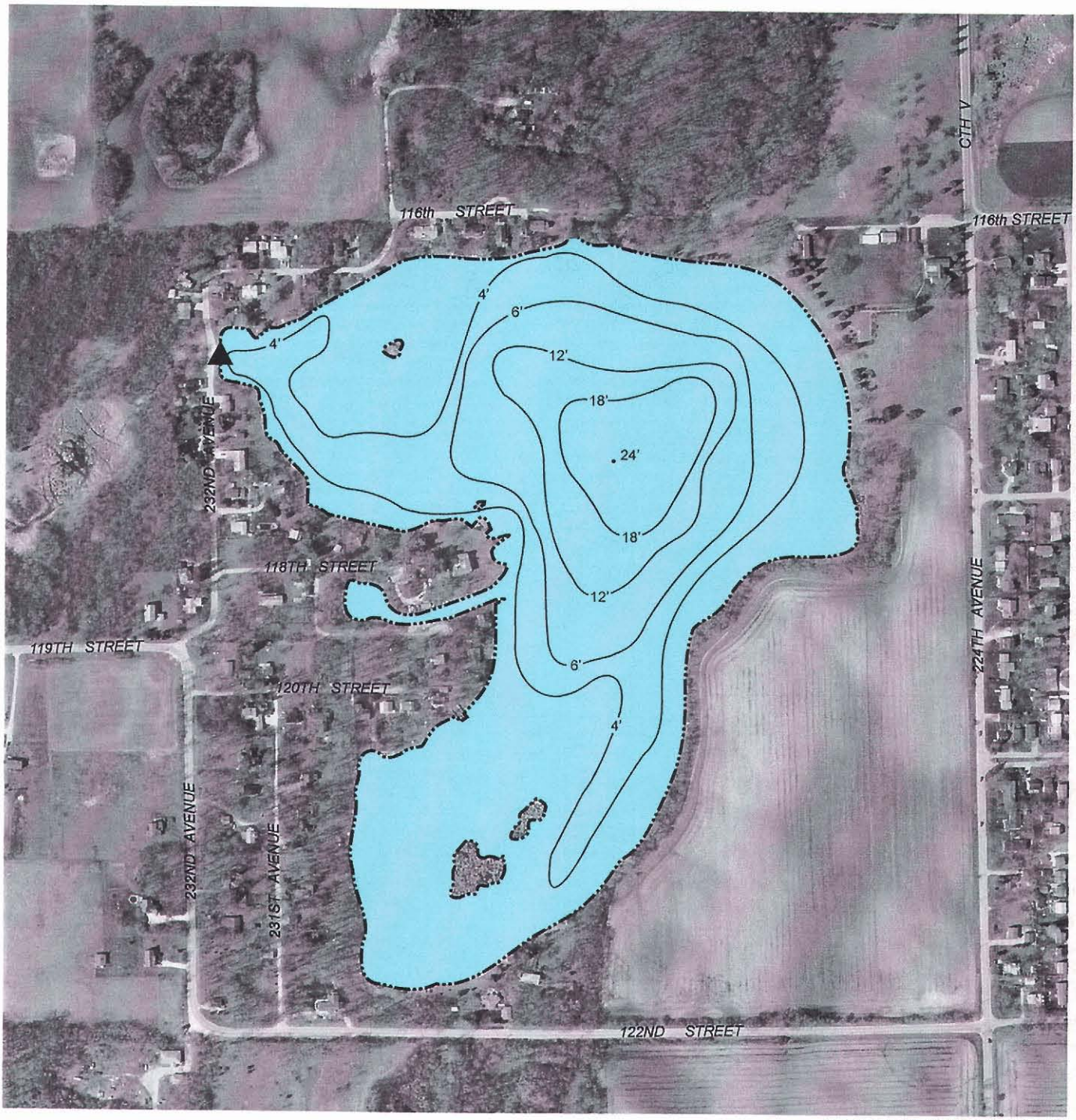
The existing 2000 land use pattern within the drainage area directly tributary to Voltz Lake, shown on Map 5, is quantified in Table 2. About 60 acres, or about 20 percent of the tributary drainage area, were devoted to urban uses. The dominant urban land use, as noted above, was residential, encompassing about 35 acres, or about two-thirds of the area in urban use. About 250 acres, or about 80 percent of the drainage area, were devoted to rural land uses. Approximately 120 acres, or about 40 percent of the rural area, were in agricultural and open land uses. Woodlands, wetlands, and surface waters, including the surface area of Voltz Lake, as shown on Map 6, accounted for approximately 140 acres, or about one-half of the rural land uses.

Under planned 2020 conditions, the conversion of rural lands to urban-density land uses within the drainage area tributary to Voltz Lake is envisioned, as shown on Map 7.[2] A significant amount of the agricultural land to the southeast of Voltz Lake, estimated to be about 40 acres, is expected to be converted to urban residential uses. As shown in Table 2, urban density land uses are expected to increase to about 100 acres, or to about 30 percent of the drainage area directly tributary to Voltz Lake, by the year 2020.

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

Map 2

BATHYMETRIC MAP OF VOLTZ LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

▲ PUBLIC RECREATIONAL ACCESS

Source: SEWRPC.

GRAPHIC SCALE

0 250 500 FEET

Map 3

SEDIMENT SUBSTRATES DISTRIBUTION IN VOLTZ LAKE: 2001

DATE OF PHOTOGRAPHY: MARCH 2000

—12'— WATER DEPTH CONTOUR IN FEET

SILT AND SAND

SILT AND GRAVEL

SILT

MUCK

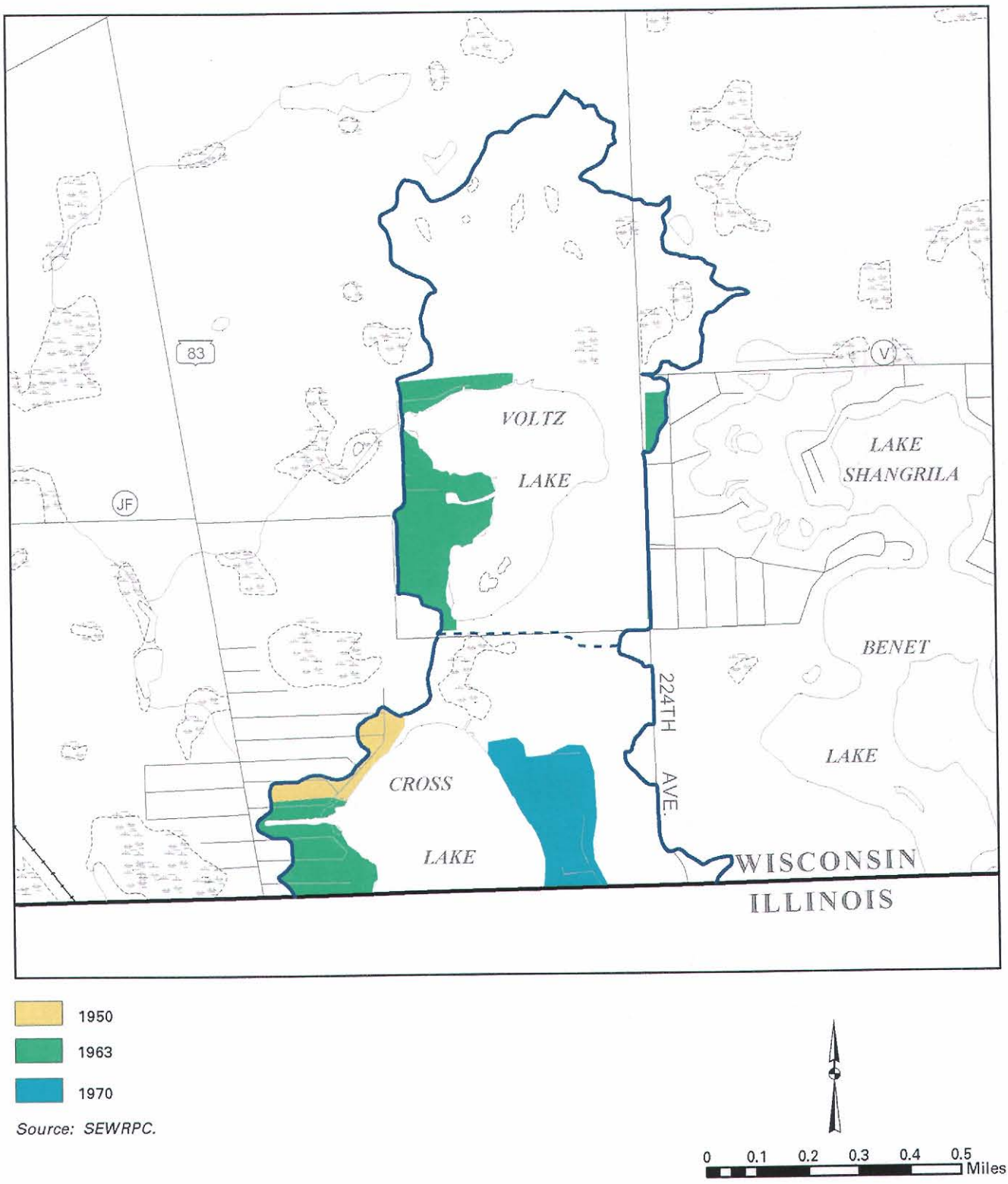
GRAPHIC SCALE

0 250 500 FEET

Source: SEWRPC.

Map 4

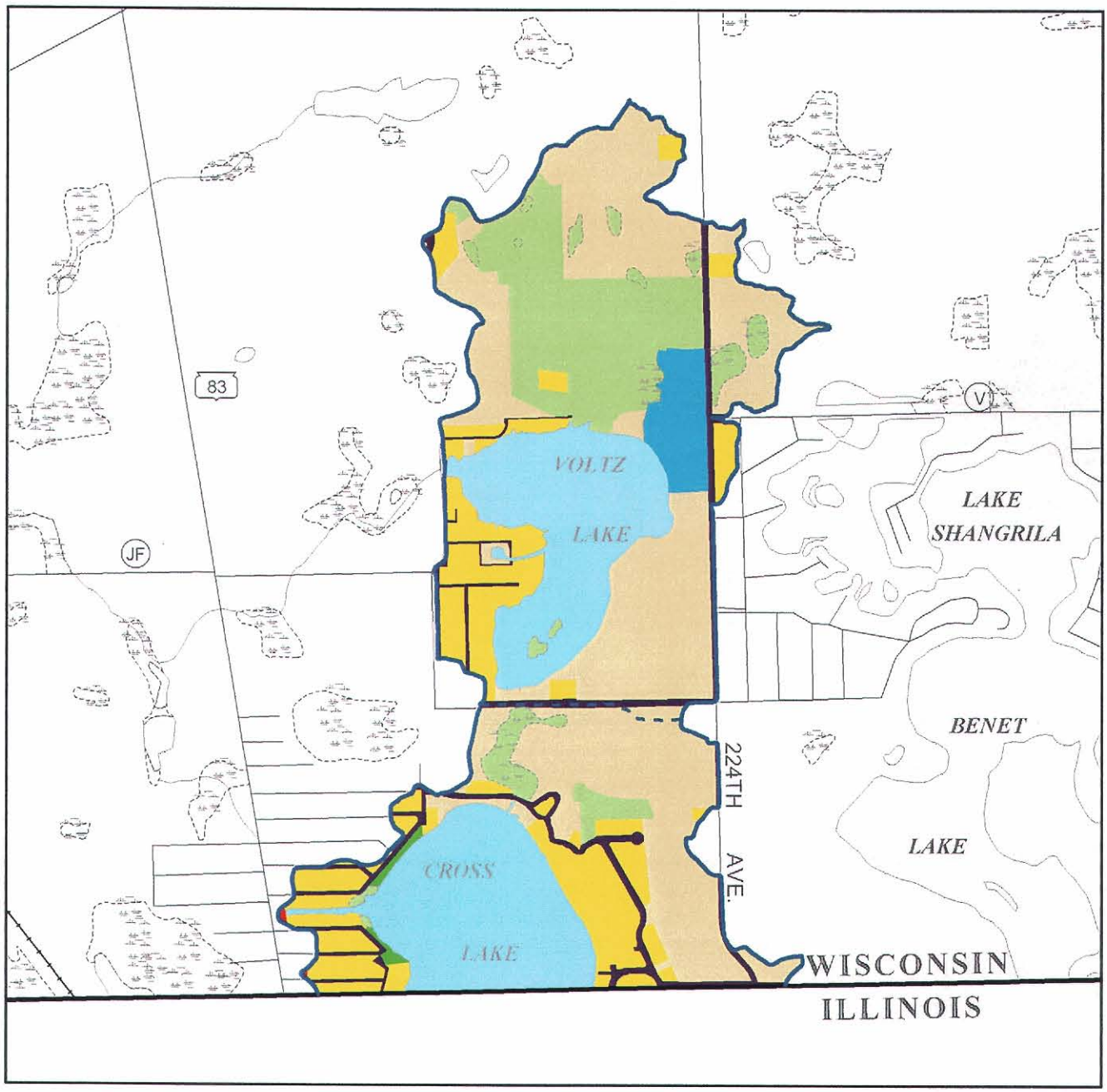
HISTORIC URBAN GROWTH WITHIN THE TRIBUTARY DRAINAGE AREA TO VOLTZ LAKE: 1950-1995



Source: SEWRPC.

Map 5

GENERALIZED LAND USE WITHIN THE TRIBUTARY DRAINAGE AREA TO VOLTZ LAKE: 2000



Single-Family Residential

Commercial

Transportation, Communications, and Utilities

Governmental and Institutional

Recreation

Wetlands and Woodlands

Surface Water

Agricultural, Unused, and Other Open Lands

N

0 0.1 0.2 0.3 0.4 0.5 Miles

Source: SEWRPC.

Table 2

EXISTING AND PLANNED LAND USE WITHIN THE DRAINAGE AREA DIRECTLY TRIBUTARY TO VOLTZ LAKE: 2000 AND 2020

Land Use Categories[a]	2000		2020	
	Acres	Percent of Direct Tributary Drainage Area	Acres	Percent of Direct Tributary Drainage Area
Urban				
Residential	37	11.7	68	21.5
Governmental and Institutional	14	4.4	14	4.4
Transportation, Communication, and Utilities	11	3.5	20	6.4
Subtotal	62	19.6	102	32.3
Rural				
Agricultural and Other Open Lands	117	37.0	77	24.3
Wetlands	10	3.2	10	3.2
Woodlands	64	20.3	64	20.3
Water	63	19.9	63	19.9
Subtotal	254	80.4	214	67.7
Total	316	100.0	316	100.0

[a] *Parking included in associated use.*

Source: SEWRPC.

In addition to the foregoing development, limited infilling of existing platted lots and additional low-density, single-family residential development within the tributary drainage area of the Lake is likely to occur as existing lots are redeveloped over time.

WATER QUALITY

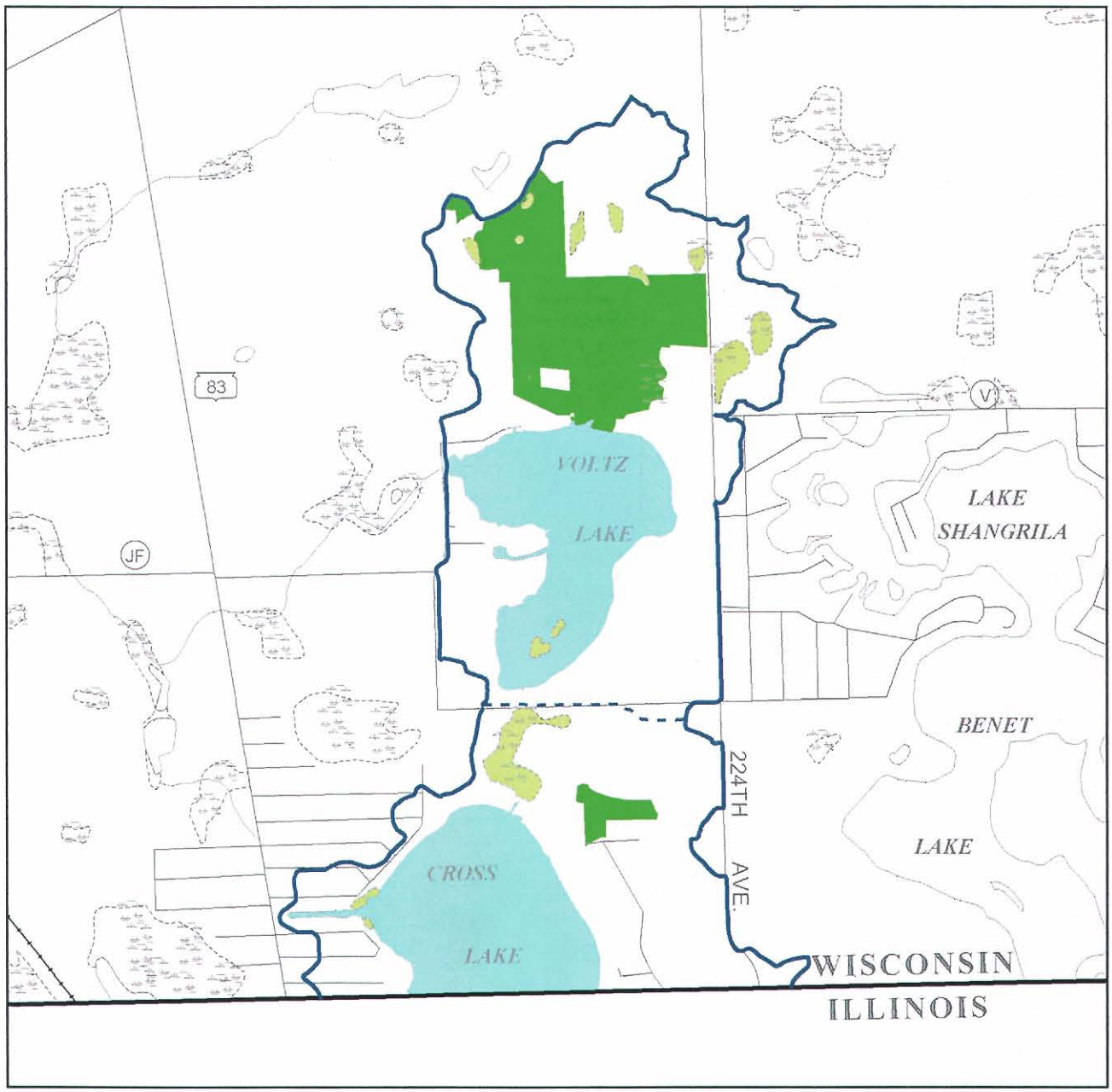
Based on Secchi-disc transparency measurements obtained under the auspices of the Wisconsin Department of Natural Resources Self-Help Monitoring Program between 1989 and 1990, Voltz Lake has poor to fair water quality. Based on the mean Secchi-disc transparency value of about 4.1 feet recorded during this period, Voltz Lake has a Wisconsin Trophic State Index (WTSI) value of about 57 indicating that the lake is a borderline eutrophic waterbody, as shown in Table 3 and Figure 1.[3] Data acquired during the period of preparation of the adopted regional water quality management plan suggest that there has been little change in the condition of Voltz Lake since 1977.[4] Eutrophic lakes are fertile lakes that support abundant aquatic plant growths and productive, if limited, fisheries. As lakes become more enriched, the numbers of individual plants and animals within the lake increase significantly in number but decrease dramatically in type or species. With respect to the fisheries, the more desirable game fish species are generally replaced by the less desirable carp and catfish, with

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

[4] *Secchi-disc transparency values reported during 1997 averaged two feet in depth; SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin–2000, *Volume Two,* Alternative Plans, *February 1979.*

Map 6

WETLANDS AND WOODLANDS WITHIN THE TRIBUTARY DRAINAGE AREA TO VOLTZ LAKE



Wetlands

Woodlands

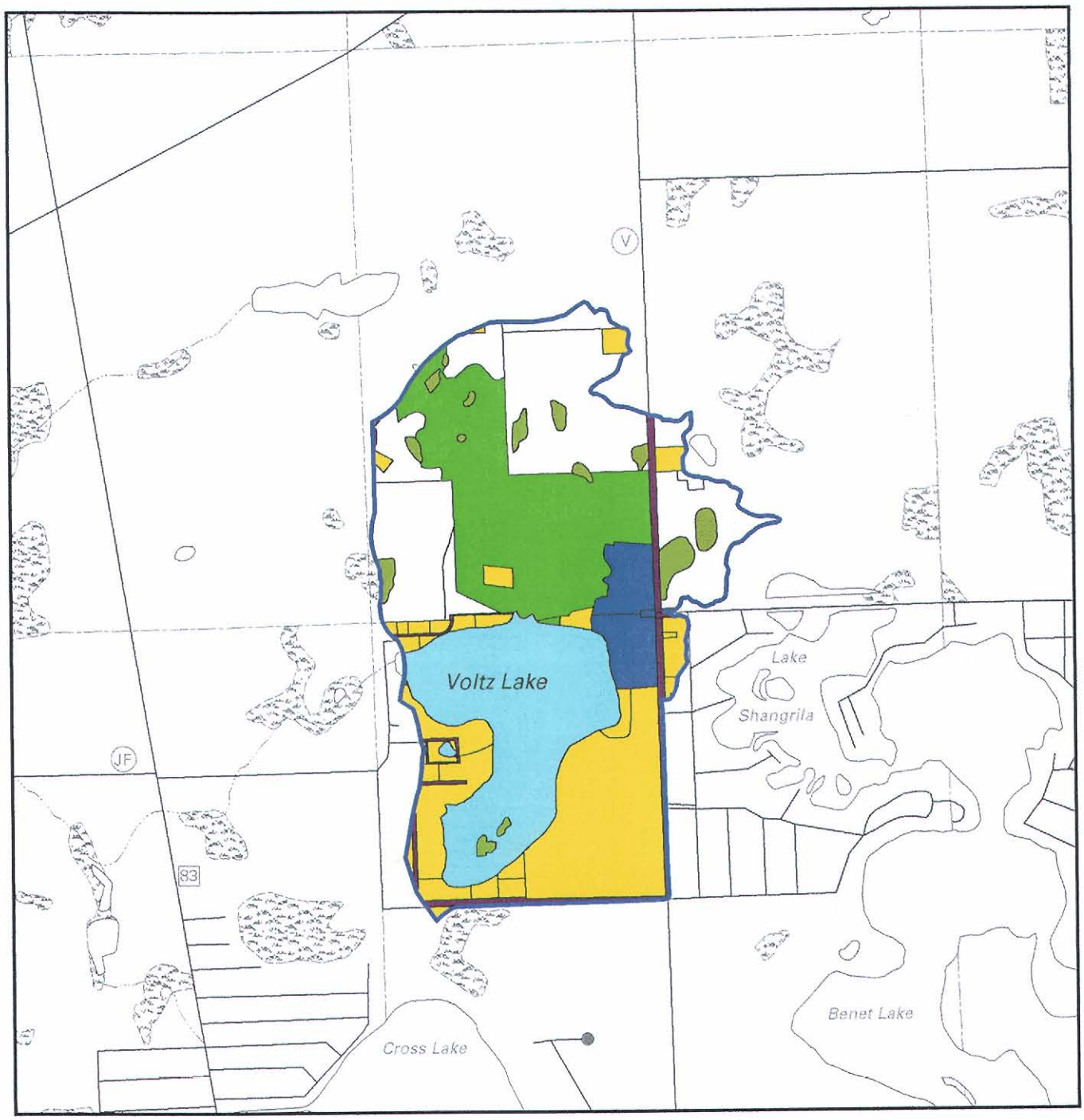
Surface Water

Source: SEWRPC.

0 0.1 0.2 0.3 0.4 0.5 Miles

Map 7

PLANNED LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO VOLTZ LAKE : 2020



SINGLE-FAMILY RESIDENTIAL

TRANSPORTATION, COMMUNICATION, AND UTILITIES

GOVERNMENT AND INSTITUTIONAL

RECREATIONAL

WOODLAND

WETLAND

AGRICULTURE AND OTHER OPEN SPACE

SURFACE WATER

N

GRAPHIC SCALE

0 700 1,400 2,100 Feet

Source: SEWRPC.

Table 3

WATER QUALITY DATA FOR VOLTZ LAKE: 1989

Parameter	Secchi Depth (feet)	WTSI (SD)
Number of Samples.....	4	4
Range.....	2.5-4.0	52-63
Average	4.1	57
Standard Deviation.....	4.2	57

Source: Wisconsin Department of Natural Resources, Self-Help Monitoring Program Annual Reports 1988-1999, *1999.*

these fishes being present in great abundance. Likewise, nuisance growths of algae and plants may be exhibited by eutrophic Lakes. Many of the cleaner Lakes in Southeastern Wisconsin are classified as mesotrophic.[5]

Few water quality data are available on Voltz Lake. The data acquired for the regional water quality management plan form the most complete characterization of the Lake water quality. The reported total phosphorus concentration in Voltz Lake, during 1977, ranged from approximately 0.09 milligrams per liter (mg/l) at the surface to about 0.37 mg/l at the bottom of the Lake. These total phosphorus concentrations exceed the 0.02 mg/l total phosphorus concentration guideline recommended by the Regional Planning Commission as the value above which water quality problems are likely to occur. At the time of this sampling, the Lake was stratified with respect to dissolved oxygen concentrations, leading to the formation of the other chemical gradients, including the aforereferenced gradient in total phosphorus concentration. Total nitrogen concentrations reported during this study ranged from about 3.0 mg/l at the surface to 2.6 mg/l at the bottom. Aquatic plants and algae require such nutrients as phosphorus and nitrogen for growth. In lakes where the supply of one or more of these nutrients is limited, plant growth is limited by the amount of that nutrient available. The ratio of total nitrogen (N) to total phosphorus (P) in lake water indicates which nutrient is the factor most likely limiting aquatic plant growth in a lake. Where the N:P ratio is greater than 14:1, phosphorus is most likely to be the limiting nutrient. If the ratio is less than 10:1, nitrogen is most likely to be the limiting nutrient. The resultant nitrogen-to-phosphorus concentration ratio in Voltz Lake, noted during the 1977 study, was 34:1, suggesting that algal growth in the Lake is limited by phosphorus.

Data obtained during the 1977 survey indicate that Voltz Lake stratifies during the summer months, exhibiting both thermal and dissolved oxygen stratification. These data are typical of lakes in the temperate zone, with the depletion of dissolved oxygen in the hypolimnion or bottom waters of lakes being common in mesotrophic and eutrophic waterbodies.[6]

Associated with these periods of hypolimnetic anoxia is the phenomenon 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 release previously-bound elements back into the water column.[7] 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.

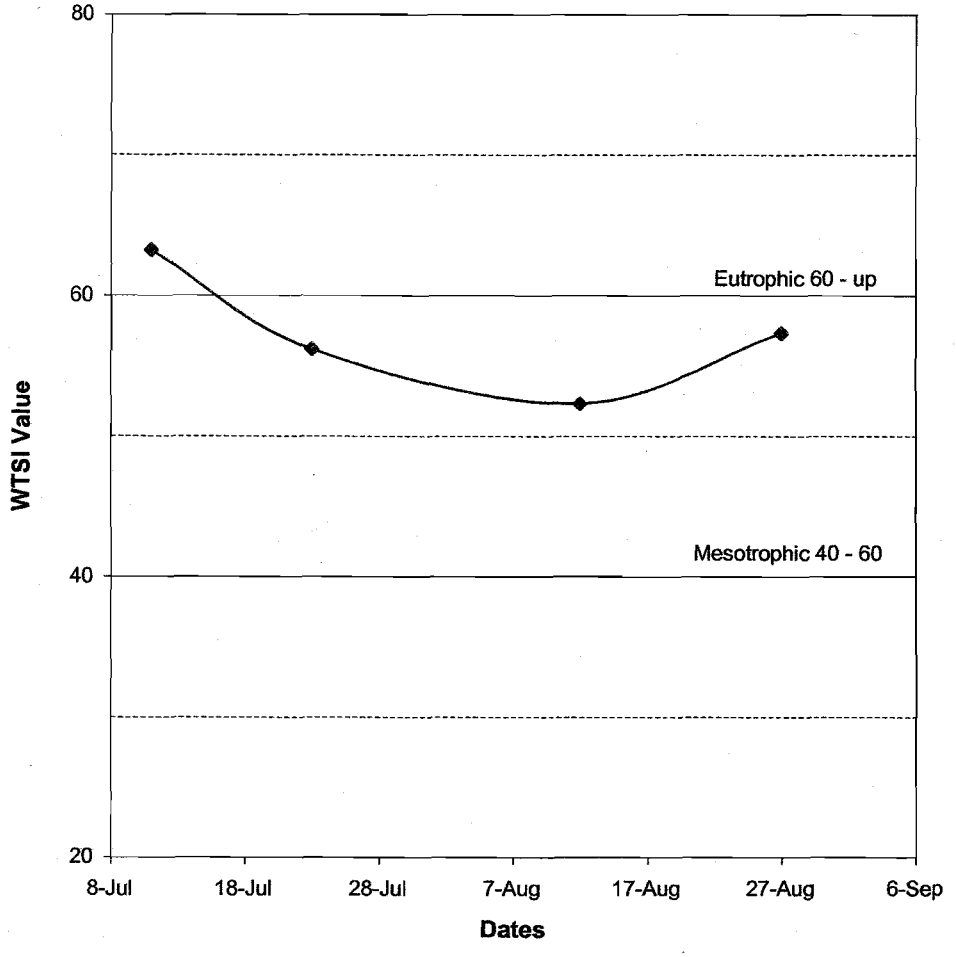
[5]*See R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes, *Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983; also see SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report,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

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

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

Figure 1

TROPHIC STATE INDEX FOR VOLTZ LAKE: 1989



Source: SEWRPC

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 Voltz Lake, the former process seems to be the dominant process. This hypothesis is supported by the fact that the predicted total phosphorus concentrations, discussed below, agreed well with the observed total phosphorus concentrations in the Lake, as would be anticipated if internal loading was minimal.[8]

[8] *Estimates of the long-term annual average total phosphorus concentration in Voltz 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.*

POLLUTANT LOADINGS

Pollutant loads to a lake are generated by various natural processes and human activities that take place within the drainage area tributary to the lake. These contaminant 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 by direct precipitation. Pollutants transported across the land surface enter the lake as direct runoff and, indirectly, as groundwater inflows. In Voltz Lake, pollutants enter the waterbody in runoff from across the land surface directly tributary to the lake, from runoff collected by tributary streams from within the larger tributary watershed, and from the shallow groundwater aquifer. These pollutant sources are generally described as nonpoint-sourced pollution. As of the year 2000, all of the residential lands within the tributary drainage area are served by public sanitary sewerage systems.[9] There were no known direct discharges, or point sources, of water pollutants within the Voltz Lake tributary drainage area. For these reasons, the discussion that follows is based wholly upon the nonpoint source pollutant loadings to Voltz Lake, and upon land usage only within the drainage area directly tributary to Voltz Lake.[10]

The nonpoint source pollutant loads to Voltz Lake were estimated on the basis of 1995 direct drainage area land use inventory data and unit area load coefficients determined for the Southeastern Wisconsin Region.[11] Annual contaminant loads entering Voltz Lake were calculated to be approximately 40 tons of sediment; 150 pounds of phosphorus; and one pound and 12 pounds of copper and zinc, respectively, as shown in Table 4. Copper and zinc were used in this analysis as surrogates for heavy metals and other pollutants contributed primarily from urban sources. Minor changes in land use between 1995 and 2000, approximately 10 acres of agricultural and other open lands were converted to residential land uses during this period, did not significantly change these estimated contaminant loads. However, as urban-density development occurs within the drainage area tributary to Voltz Lake, heavy metal loads to the Lake may be expected to increase, while sediment loads may decrease as conditions stabilize following construction.

Under planned year 2020 conditions within the drainage area directly tributary to the Lake, about 30 tons of sediment; about 110 pounds of phosphorus; and about one pound and 12 pounds of copper and zinc, respectively, are estimated to be contributed to Voltz Lake as urban development continues in the drainage area, assuming no significant urban stormwater management measures in the areas which are developed for urban uses. Recent evidence provided by the U.S. Geological Survey from the Lauderdale Lake in Walworth County, suggest that phosphorus loads from urban lawns receiving fertilization treatments may be up to two times greater than lawns not treated with chemical additives.[12]

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[9]*SEWRPC Memorandum Report No. 93,* op. cit.; *SEWRPC,* Amendment to the Regional Water Quality Management Plan, Town of Salem, *March 2001: the refined Salem sewer service area was initially presented in SEWRPC Community Assistance Planning Report No. 145,* Sanitary Sewer Service Area for the Town of Salem Utility District No. 1, Village of Paddock Lake, and Town of Bristol Utility Districts Nos. 1 and 1B, Kenosha County, Wisconsin, *dated October 1986, and SEWRPC Community Assistance Planning Report No. 143,* Sanitary Sewer Service Area for the Town of Salem Utility District No. 2, Kenosha County, Wisconsin, *dated February 1986, as amended.*

[10]*Because of the intermittent nature of the hydrological connection between Voltz Lake and Cross Lake, the delivery of contaminants to Voltz Lake via this pathway was discounted on an annual average contaminant loading basis.*

[11]*Phosphorus loads were calculated using the Wisconsin Lake Modeling Suite, WILMS version 3.0. Phosphorus loads from the drainage area directly tributary to Voltz Lake under 1995 land use conditions were estimated to range from about 115 pounds per year to 350 pounds per year; under forecast year 2020 land use conditions, phosphorus loads were estimated to range from about 85 pounds per year to 300 pounds per year.*

[12]*U.S. Geological Survey Water-Resources Investigations Report No. 02-4130,* Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lake, Wisconsin, *July 2002.*

Table 4

FORECAST ANNUAL POLLUTANT LOADINGS TO VOLTZ LAKE BY LAND USE CATEGORY: 1995 AND 2020

Land Use	1995				2020			
	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)
Residential	0.24	5.0	--	0.3	0.66	13.6	--	0.7
Communications and Utilities	0.05	1.1	--	--	0.09	2.2	--	--
Governmental	3.57	18.9	0.98	11.2	3.57	18.9	0.98	11.2
Water	5.92	8.2	--	--	5.92	8.2	--	--
Wetlands	0.02	0.4	--	--	0.02	0.4	--	--
Woodlands	0.12	2.6	--	--	0.12	2.6	--	--
Agricultural	29.25	111.8	--	--	17.33	66.2	--	--
Total	38.17	148.0	0.98	11.5	27.71	112.1	0.98	11.9

Source: SEWRPC.

To validate the estimated contaminant loads to Voltz Lake, Commission staff applied the estimated phosphorus load of approximately 150 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 about 0.09 mg/l, which value corresponds to the observed 1977 in-lake phosphorus concentration. This agreement would suggest that the estimated contaminant loads are a reasonable representation of the loads entering Voltz Lake, and that other pollutant sources, including internal loading, to Voltz Lake, are relatively small compared to the loading from external sources.

Table 4 shows the relative potential contributions of the various land uses to the pollutant loads to Voltz Lake. These data indicate that, based on 1995 land use conditions in the drainage area tributary to Voltz Lake, about 75 percent of the phosphorus load to the Lake is contributed from agricultural lands within the tributary drainage area; about 15 percent from urban areas; and, the balance from wetlands, woodlands, and direct deposition onto surface waters. Under planned year 2020 conditions, this contribution is expected to shift somewhat, with about 30 percent of the phosphorus load originating from urban sources. Agricultural contributions of phosphorus are expected to decrease to about 60 percent of the load.

Under 1995 land use condition, about 10 percent of the sediment load to Voltz Lake is estimated to be generated from urban sources; about 75 percent from agricultural lands; and about 15 percent from woodlands, wetlands, and direct deposition onto surface waters, as set forth in Table 4. As in the case of phosphorus, this distribution of source areas is expected to shift somewhat under year 2020 conditions, with about 15 percent of the potential sediment load being contributed from urban sources, and about 60 percent from agricultural sources.

Of the controllable pollutant sources, the most significant sources under existing land use conditions are contaminant loads generated from agricultural and other open lands, which account for the largest percentages of sediment and nutrient loadings to the Lake. Nevertheless, urban land uses in close proximity to the Lake also represent controllable portions of the sediment, nutrient and heavy metals loads. Control of contaminants from both urban and rural sources, therefore, is proposed to be effected through the variety of measures set forth in Chapter IV.

GROUNDWATER RESOURCES

Groundwater resources constitute a valuable element of the natural resource base related to the Voltz Lake. Groundwater in the vicinity of the Lake moves within two distinct systems: a shallow water table system,[13] and a deep sandstone aquifer system.[14] From the land surface downward, the glacial drift aquifer, consisting of water-bearing sand and gravel, extends over 200 feet in thickness in the vicinity of the Voltz Lake, trending to upwards of 250 feet in the northeastern portion of the Lake basin and drainage area. In contrast, the deep sandstone aquifer ranges from 800 to 1,200 feet in thickness.

The surfacial, glacial drift aquifer is the most significant groundwater resource in terms of its relationship to Voltz Lake and its tributary surface waters and adjacent wetlands. The deep sandstone aquifer is virtually isolated from the surfacial aquifer in the vicinity of Voltz Lake, as a consequence of the contrast between the extremely high hydraulic conductivity of the surfacial aquifer and significantly lower hydraulic conductivity of the deeper aquifer. Groundwater flows from northwest to southeast through the Lake within the surfacial aquifer, as shown on Map 8.[15]

Because groundwater in southeastern Wisconsin may contain significant concentrations of dissolved minerals and nitrogen (particularly nitrate), such flows may have consequences for the trophic condition of Voltz Lake. In part, the magnitude of the concentrations of minerals and nutrients transported by the groundwater system is related to the extent and types of land uses within the recharge area or groundwatershed of the Lake. These land uses also affect the rate of recharge to the aquifer, and, hence, the volumes of the dissolved constituents transported by the groundwater inflows. Thus, the protection of groundwater quantity and quality is an issue that should be considered, especially in view of the proposed, continuing urbanization of lands within the Lake's groundwatershed.

SOIL TYPES AND CONDITIONS

In addition to land uses, as described above, soil type, land slope, and land management practices are among the more important factors determining lake and groundwater quality conditions. Soil type, land slope, and vegetative cover are also important factors affecting the rates, amounts, and quality of stormwater runoff and infiltration of precipitation to the groundwater (recharge). The soil texture and soil particle structure influence the permeability, infiltration rate, and erodibility of soils, while land slopes are important determinants of stormwater runoff rates and of susceptibility to erosion.

The U.S. Natural Resources Conservation Service, under contract to the Southeastern Wisconsin Regional Planning Commission, completed a detailed soil survey of the Voltz Lake area in 1966.[16] Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the drainage area tributary to the Voltz Lake. The suitability of the soils for urban residential development was assessed using three common development scenarios. These ratings reflected the requirements of Chapter Comm 83 of the *Wisconsin Administrative Code* governing onsite sewage disposal systems as it existed through the year 2000. 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, significantly altered the existing regulatory

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[13] *The water table is the upper limit of the portion of the ground that is fully saturated with water.*

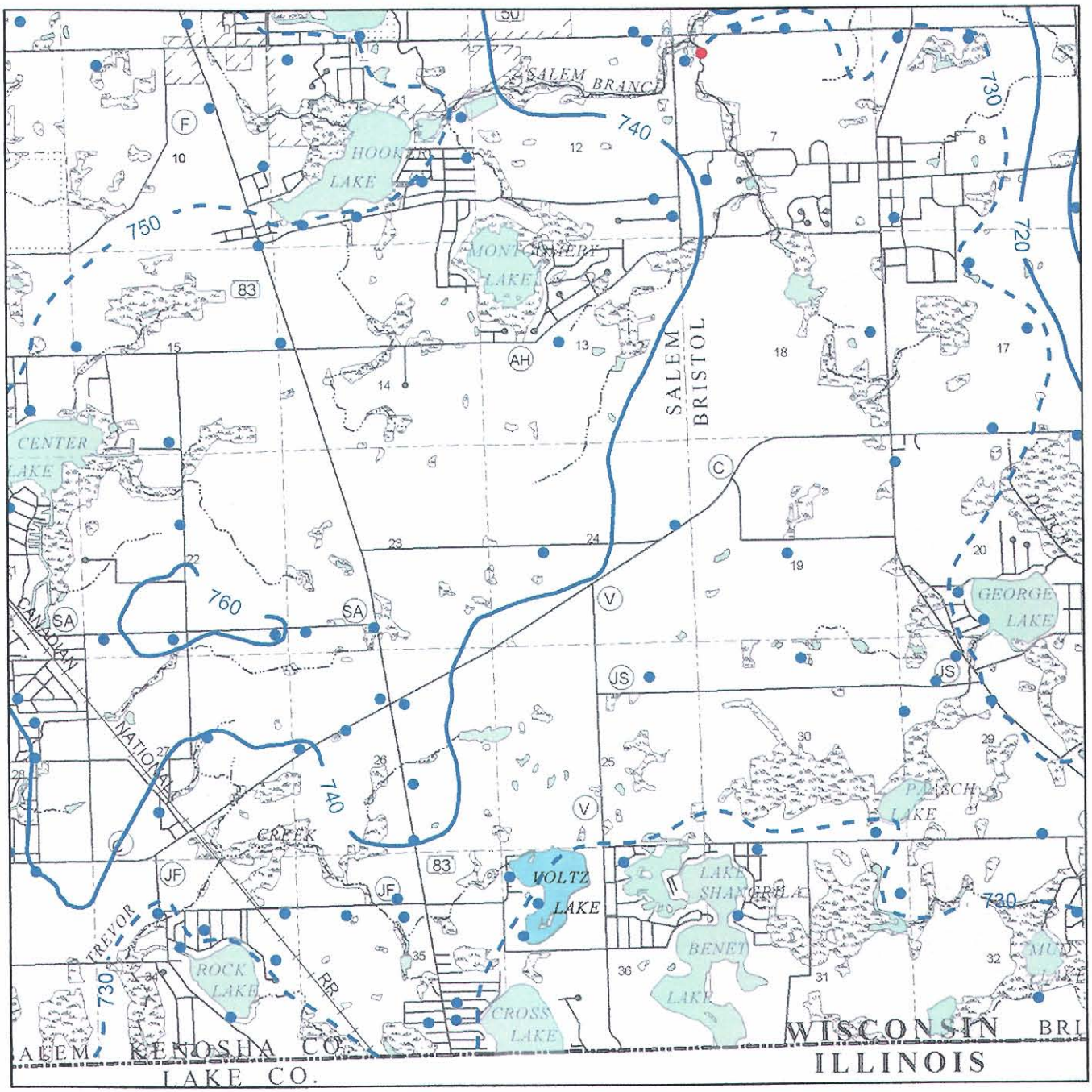
[14] *An aquifer is a water-bearing stratum of rock, sand, or gravel.*

[15] *J.B. Gonthier, U.S. Geological Survey Water-Resources Investigations Open-File Report No. 79-43,* Water-Table Map of Kenosha County, Wisconsin, *May 1979; R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* op. cit.

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

Map 8

WATER TABLE CONTOURS IN THE VICINITY OF VOLTZ LAKE



740 AVERAGE WATER TABLE ELEVATION (FEET ABOVE MEAN SEA LEVEL) CONTOUR INTERVAL 20 FEET

730 SUPPLEMENTAL CONTOUR INTERVAL 10 FEET

WELL DATA POINT

SURFACE WATER POINT

N

GRAPHIC SCALE

0 2,000 4,000 6,000 Feet

Source: SEWRPC.

framework and, effectively, have increased the area in which onsite sewage disposal systems may be utilized. Although the residential lands within the drainage area tributary to Voltz Lake currently are served by public sanitary sewerage, the interpretations associated with the soil survey are such that they continue to provide insights into the potential for land-based sources of pollution to affect the Lake water quality either as a consequence of overland flows during storm events or through groundwater interflows into the Lake. Therefore, Map 9 presents the soil ratings for onsite sewage disposal systems as determined pursuant to the then-existing requirements of Chapter Comm 83 of the *Wisconsin Administrative Code* governing onsite sewage disposal systems as of early 2000. It is useful to note that the vast majority of the lands within the drainage area tributary to Voltz Lake are covered by soils that are categorized as having severe restrictions for onsite sewage disposal systems.

Soils within the drainage area tributary to Voltz Lake were categorized into four main hydrologic soil groups, as well as an "other" category that includes disturbed and filled lands, as shown on Map 10. Approximately 65 percent of the total tributary drainage area was covered with poorly drained soils, with about 15 percent being covered by very poorly drained soils. The remaining areas of the watershed were comprised of surface water, as shown on Map 10.

AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

A survey of aquatic plants within Voltz Lake was conducted by Commission staff during July 2001. The results of this survey are presented in Table 5, and graphically depicted on Map 11. By contrast, a 1967 aquatic plant survey, as shown on Table 6, conducted by the Wisconsin Department of Natural Resources reported that only three species, coontail, curly-leaf pondweed, and elodea, were abundant, with no data on the presence of any other species. This absence of data concerning the presence of other species may be due, in part, to different sampling techniques or the result of a study objective meant to be more species-specific than a general survey of all species present.

Statistical Analysis
Three indices were used to analyze the aquatic plant community species composition:

- The frequency of occurrence is the number of occurrences of a species divided by the number of sampling sites with vegetation, expressed as a percentage. It is the percentage of times a particular species occurred when there was aquatic vegetation present, and is analogous to the Jesson and Lound point system.

- The relative density is the sum of the density ratings for a species divided by the number of sampling points with vegetation. The maximum density possible of 4.0 is assigned to plants that occur at all points sampled at a given depth, the modified Jesson and Lound protocol adopted by the Wisconsin Department of Natural Resources uses four sampling points per depth sampled. The relative density presents an indication of how abundant the growth of a particular plant is throughout the lake. This measure along with the percent occurrence gives a good indication of the distribution of aquatic plant communities in a lake.

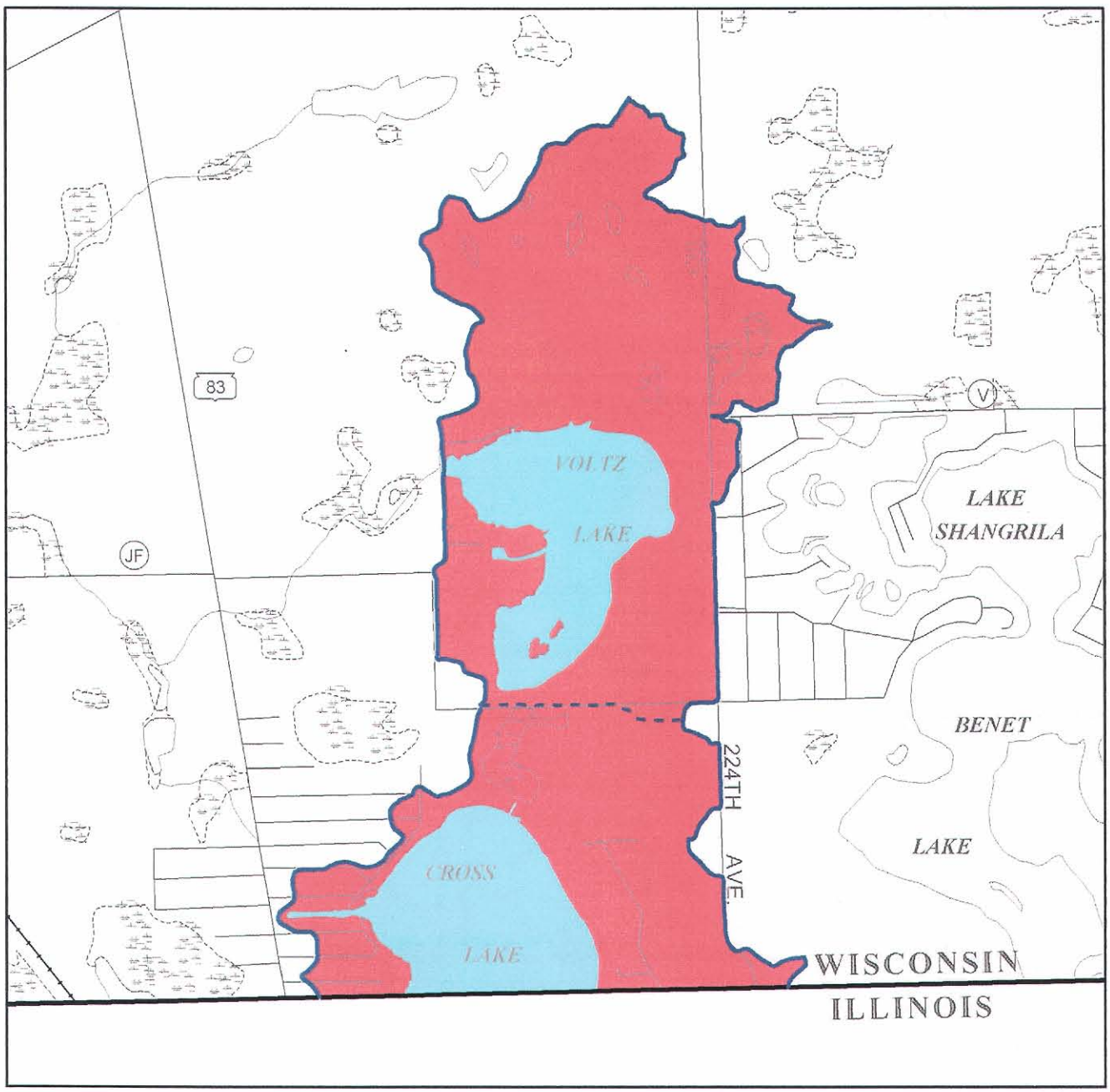
- The importance value is defined as the product of the relative frequency and the average density, expressed as a percentage:

  $$IV = (RFREQ)\ (ADEN)\ (100)$$

  where IV is the importance value, RFREQ is the relative frequency, and ADEN is the average density. This number provides an indication of the dominance of a species within a community based upon both frequency and density. It also somewhat addresses the problem of difference in stature between different plant species.

Map 9

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO VOLTZ 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

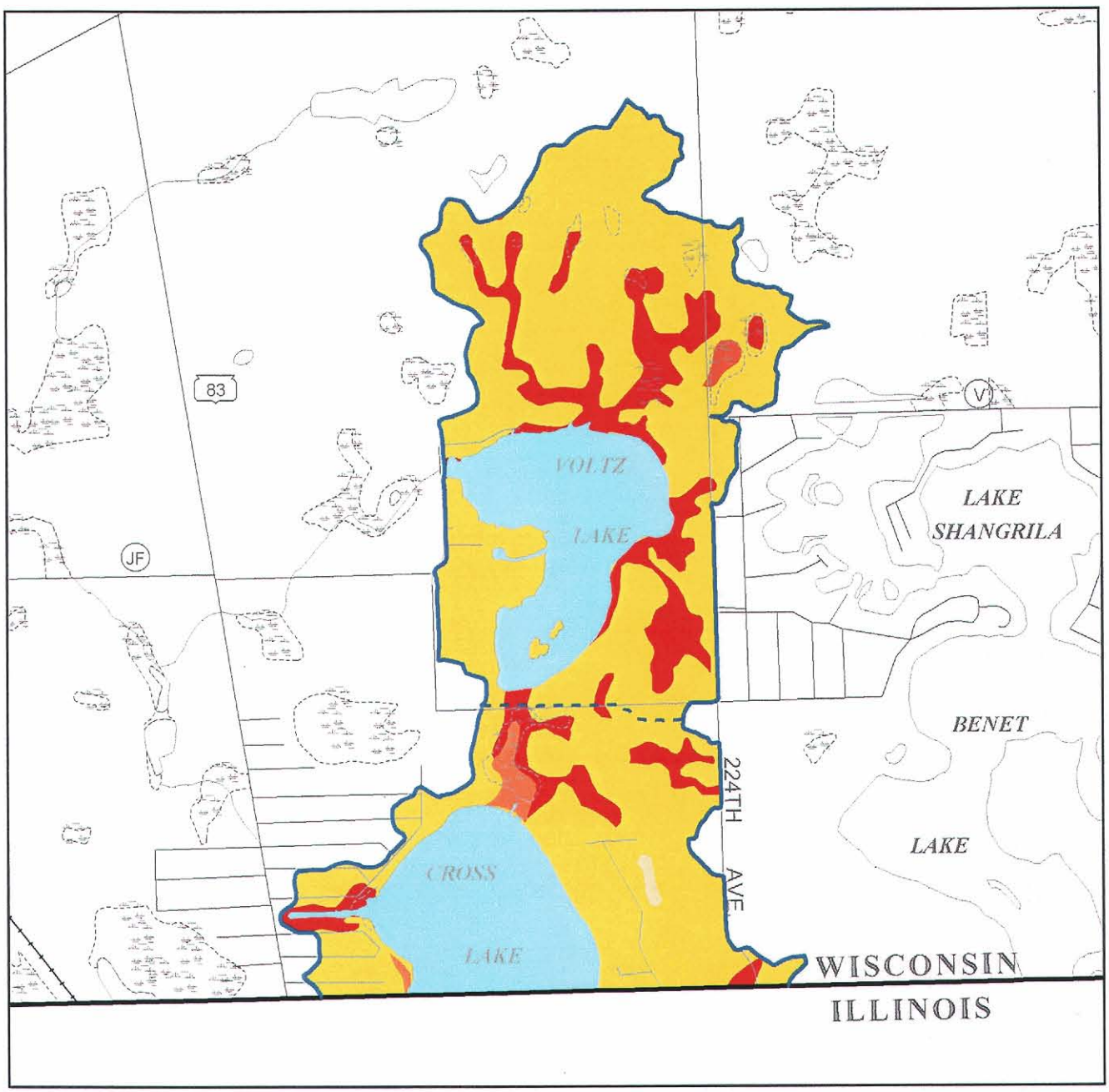
SURFACE WATER

Source: U.S. National Resource Conservation Service and SEWRPC.

0 0.1 0.2 0.3 0.4 0.5 MILES

Map 10

HYDROLOGIC SOIL GROUPS WITHIN THE TRIBUTARY DRAINAGE AREA TO VOLTZ LAKE



GROUP A/D: Well-drained soil/Very poorly drained soil [1]

GROUP B: Moderately drained soil

GROUP B/D: Moderately drained soil/Very poorly drained soil [2]

GROUP C: Poorly drained soil

GROUP D: Very poorly drained soil

Surface Water

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

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

0 0.1 0.2 0.3 0.4 0.5 Miles

Source: U.S. National Resource Conservation Service and SEWRPC.

Table 5

AQUATIC PLANT SPECIES PRESENT IN VOLTZ LAKE AND THEIR ECOLOGICAL SIGNIFICANCE: JULY 2001

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)[a]	Relative Density[b]	Importance Value	Ecological Significance[c]
Ceratophyllum demersum (coontail)	40	100	3.8	3.80	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings
Chara vulgaris (muskgrass)	5	12.2	2.2	0.28	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)	30	75	2.4	1.80	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 trisulca (forked duckweed)	- -d	- -d	- -d	- -d	Good for ducks and geese; provides cover for fish and insects
Myriophyllum spicatum (Eurasian water milfoil)	39	97.5	3.1	2.98	None known
Najas flexilis (bushy pondweed)	14	35	2.4	0.83	Stems, foliage, and seeds important wildfowl food and produces good food 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 crispus (curly-leaf pondweed)	8	20	1.8	0.35	Provides food, shelter and shade for some fish and food for wildfowl
Potamogeton pectinatus (Sago pondweed)	4	10	1.3	0.13	This plant is the most important pondweed for ducks, in addition to providing food and water shelter for young fish
Potamogeton zosteriformis (flat-stemmed pondweed)	4	10	1.8	0.18	Provides some food for ducks
Ranunculus longirostris (stiff water crowfoot)	5	12.5	1.6	0.20	Provides food for trout, upland game birds and waterfowl
Typha latifolia (cattail)	- -d	- -d	- -d	- -d	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
Utricularia sp. (bladderwort)	5	12.5	1.8	0.23	Provides good food and cover for fish
Wolffia Columbiana (watermeal)	- -d	- -d	- -d	- -d	Provides food for waterfowl, muskrat and some fish
Zosterella dubia (water stargrass)	5	12.5	1.2	0.15	Provides food and shelter for fish, locally important food for waterfowl

Table 5 Footnotes

NOTE: There were 40 points sampled during the July 2001 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 Lake Partnership.*

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

Source: SEWRPC.

Aquatic Plant Community Composition

Illustrations of the common aquatic plants found in Voltz Lake are included in Appendix A. While the aquatic plant community of the Lake includes both microscopic, floating or attached plants called algae or phytoplankton, and macroscopic, rooted plants called macrophytes, only the latter were quantified during this study. Rooted submersed and emergent aquatic macrophytes most commonly are associated with recreational use and aesthetic concerns in Wisconsin lakes. In this regard, no significant algal problems have been reported from Voltz Lake.

Of the macroscopic aquatic plants, ten species were observed in Voltz Lake. The Lake had limited floral diversity, with Eurasian water milfoil, *Myriophyllum spicatum*, a nonnative, invasive plant, being abundant and widespread throughout the Lake. Only coontail, *Ceratophyllum demersum*, was more abundant. These two plants, in addition to elodea, *Elodea canadensis*, dominated the aquatic plant flora of the Lake. While other species were present, including a number of pondweed species, these were present in low numbers and would be considered sparse in relation to coontail, Eurasian water milfoil, and elodea.

The occurrence of Eurasian water milfoil in Voltz Lake, as shown in Table 5, is cause for concern. Eurasian water milfoil is an exotic species that is known to exhibit "explosive" growth under suitable conditions, such as in the presence of organic-rich sediments or where the lake bottom has been disturbed. It reproduces by the rooting of plant fragments, and has been known to cause severe recreational use problems in lakes in Southeastern Wisconsin. It often outcompetes the native aquatic vegetation in lakes in Southeastern Wisconsin, and, thereby, reduces biodiversity and degrades the quality of fish and wildlife habitats in the lakes.[17]

Purple loosestrife, *Lythrum salicaria*, another nonnative, nuisance plant, was also observed to be present in the wetlands and in riparian areas surrounding Voltz Lake, especially along the northern and northeastern shorelines. Like Eurasian water milfoil, purple loosestrife is known to spread profusely, outcompeting native plant growth and reducing the quality of fish and wildlife habitat while adding little ecological benefit. Purple loosestrife is a declared weed in the State of Wisconsin and is subject to an ongoing eradication program.

Aquatic Plant Management

Records of aquatic plant management efforts on Wisconsin lakes were not maintained by the WDNR prior to 1950. Thus, while previous interventions were likely, the first recorded efforts to manage the aquatic plants in Voltz Lake have taken place since 1965. Aquatic plant management activities in Voltz Lake can be categorized as chemical macrophyte and algal control, and macrophyte harvesting. Currently, all forms of aquatic plant

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

Map 11

AQUATIC PLANT COMMUNITY DISTRIBUTION IN VOLTZ LAKE: 2001

—20'— WATER DEPTH CONTOUR IN FEET

OPEN WATER

WATER LILIES

CURLY-LEAF PONDWEED

AREA WHERE EURASIAN WATER MILFOIL IS NOT PRESENT IN VOLTZ LAKE

COONTAIL, BLADDERWORT, AND SAGO PONDWEED

COONTAIL, BLADDERWORT, WATERWEED, WATER STAR GRASS, SAGO PONDWEED, AND FLAT-STEM PONDWEED

COONTAIL, BLADDERWORT, WATERWEED, WATER STAR GRASS, WATER CROWFOOT, SAGO PONDWEED, BUSHY PONDWEED, AND FLAT-STEM PONDWEED

COONTAIL, BLADDERWORT, WATERWEED, MUSKGRASS, WATER STAR GRASS, WATER CROWFOOT, SAGO PONDWEED, BUSHY PONDWEED, AND FLAT-STEM PONDWEED

DATE OF PHOTOGRAPHY: MARCH 2000

GRAPHIC SCALE
0 250 500 FEET

Source: SEWRPC.

Table 6

VOLTZ LAKE AQUATIC PLANT SURVEY RESULTS

Aquatic Plant Species Present	1967 WDNR Survey	2001 SEWRPC Survey
Bladderwort (*Utricularia* sp.)	--	Present
Bushy Pondweed (*Najas flexilis*)	--	Common
Coontail (*Ceratophyllum demersum*)	Abundant	Abundant
Curly-Leaf Pondweed (*Potamogeton crispus*)	Abundant	Common
Eurasian Water Milfoil (*Myriophyllum spicatum*)	--	Abundant
Flatstem Pondweed (*Potamogeton zosteriformis*)	--	Present
Muskgrass (*Chara vulgaris*)	--	Present
Sago Pondweed (*Potamogeton pectinatus*)	--	Present
Stiff Water Crowfoot (*Ranunculus longirostris*)	--	Present
Water Stargrass (*Zosterella dubia*)	--	Present
Waterweed (*Elodea canadensis*)	Abundant	Abundant

Source: Wisconsin Department of Natural Resources and SEWRPC.

management are subject to permitting by the WDNR pursuant to authorities granted the Department under Chapters NR 107 and NR 109 of the *Wisconsin Administrative Code.*

Chemical Control Measures

Perceived excessive macrophyte growths on Voltz Lake have historically resulted in the application of a chemical control program. Although the use of chemicals to control aquatic plants has been regulated in Wisconsin since 1941, records of aquatic herbicide applications have only been maintained by the Wisconsin Department of Natural Resources beginning in 1950. Recorded chemical herbicide treatments that have been applied to Voltz Lake from 1965 through 2003 are set forth in Table 7.

In 1926, sodium arsenite, an agricultural herbicide, was first applied to lakes in the Madison area, and, by the 1930s, sodium arsenite was widely used throughout the State for aquatic plant control. No other chemicals were applied in significant amounts to control macrophytes until recent years, when a number of organic chemical herbicides came into general use. The amounts of sodium arsenite applied to Voltz Lake, and years of application during the period 1965 through the present, are listed in Table 7. The total amount of sodium arsenite applied over this period was about 2,320 pounds.

Sodium arsenite was typically sprayed onto the surface of Voltz Lake within an area of up to 200 feet from the shoreline. Treatment typically occurred between mid-June and mid-July. The amount of sodium arsenite used was calculated to result in a concentration of about 10 milligrams per liter (mg/l) sodium arsenite (about five mg/l arsenic) in the treated lake water. The sodium arsenite typically remained in the water column for less than 120 days. Although the arsenic residue was naturally converted from a highly toxic form to a less toxic and less biologically active form, much of the arsenic residue was deposited in the lake sediments. When it became apparent that arsenic was accumulating in the sediments of treated lakes and that the accumulations of arsenic were found to present potential health hazards both to humans and aquatic life, the use of sodium arsenite was discontinued in the State in 1969.

As shown in Table 7, the aquatic herbicides diquat, endothall, and 2,4-D have also been applied to Voltz Lake to control aquatic macrophyte growth. Diquat and endothall (Aquathol) are contact herbicides and kill plant parts exposed to the active ingredient. Diquat use is restricted to the control of duckweed (*Lemna* sp.), milfoil (*Myriophyllum* spp.), and waterweed (*Elodea* sp.). However, this herbicide is nonselective and will kill many other aquatic plants, such as pondweeds (*Potamogeton* spp.), bladderwort (*Utricularia* sp.), and naiads (*Najas*

Table 7

CHEMICAL CONTROL OF AQUATIC PLANTS IN VOLTZ LAKE: 1950-2000

Year	Algal Control		Macrophyte Control							
	Copper Sulfate (pounds)	Cultrine or Cutrine-plus (gallons)	Sodium Arsenite (pounds)	2, 4-D (gallons)	2, 4-D (pounds)	Diquat (gallons)	Endothall (gallons)	Endothall (pounds)	Fluridone (gallons)	Glyphosate (ounces)
1950	--	--	--	--	--	--	--	--	--	--
1951	--	--	--	--	--	--	--	--	--	--
1952	--	--	--	--	--	--	--	--	--	--
1953	--	--	--	--	--	--	--	--	--	--
1954	--	--	--	--	--	--	--	--	--	--
1955	--	--	--	--	--	--	--	--	--	--
1956	--	--	--	--	--	--	--	--	--	--
1957	--	--	--	--	--	--	--	--	--	--
1958	--	--	--	--	--	--	--	--	--	--
1959	--	--	--	--	--	--	--	--	--	--
1960	--	--	--	--	--	--	--	--	--	--
1961	--	--	--	--	--	--	--	--	--	--
1962	--	--	--	--	--	--	--	--	--	--
1963	--	--	--	--	--	--	--	--	--	--
1964	--	--	--	--	--	--	--	--	--	--
1965	--	--	360	--	--	--	--	--	--	--
1966	--	--	720	--	--	--	--	--	--	--
1967	--	--	1,240	76	--	--	--	--	--	--
1968	--	--	--	20	--	--	--	--	--	--
1969	--	--	--	--	--	--	--	--	--	--
1970[a]	--	--	--	--	--	--	10.0	--	--	--
1971	--	--	--	--	--	--	--	--	--	--
1972	--	--	--	--	--	--	--	--	--	--
1973	--	--	--	--	--	20	10.0	--	--	--
1974	--	--	--	--	--	26	--	--	--	--
1975	23	--	--	--	--	25	5.0	--	--	--
1976	--	--	--	--	--	--	--	--	--	--
1977	--	--	--	--	--	--	--	--	--	--
1978	--	--	--	--	--	--	--	--	--	--
1979	--	--	--	--	--	--	--	--	--	--
1980	--	--	--	--	--	--	--	--	--	--
1981	--	--	--	--	--	--	--	--	--	--
1982	--	--	--	--	--	--	--	--	--	--
1983	--	--	--	--	--	--	--	--	--	--
1984	--	--	--	--	--	--	--	--	--	--
1985	--	18.5	--	60	--	--	25.0	--	32	--
1986	--	53.5	--	4	--	13	37.5	--	--	--
1987	--	--	--	--	--	--	--	--	--	--
1988	--	--	--	--	--	--	--	--	--	--
1989	--	--	--	--	--	--	--	--	--	--
1990	--	--	--	--	--	--	--	--	--	--
1991	--	--	--	--	--	--	--	--	--	--
1992	--	--	--	--	--	--	--	--	--	--
1993	--	3.0	--	3	--	3	--	--	--	--
1994	--	--	--	--	--	--	--	--	--	--
1995	--	--	--	--	--	--	--	--	--	--
1996	--	--	--	--	--	--	--	--	--	--
1997	--	--	--	--	--	--	--	--	--	--
1998	--	--	--	--	--	--	--	--	--	--
1999	--	--	--	--	--	--	--	--	--	--
2000	--	--	--	--	1,100	--	--	--	--	--
Total	23	75.0	2,320	163	1,100	87	87.5	--	--	32

[a] *120 pounds of lime were applied in 1970.*

[b] *Private chemical treatments of aquatic plants.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

spp.). Endothall primarily kills pondweeds, but does not control such nuisance species as Eurasian water milfoil (*Myriophyllum spicatum*). The herbicide 2,4-D is a systemic herbicide that is absorbed by the leaves and translocated to other parts of the plant; it is more selective than the other herbicides listed above and is generally used to control Eurasian water milfoil. However, it will also kill species such as water lilies (*Nymphaea* sp. and *Nuphar* sp.).

In addition to the chemical herbicides used to control large aquatic plants, algicides have also been applied to Voltz Lake. As shown in Table 7, copper sulfate (Cutrine Plus) has been applied to Voltz Lake, on occasion. Like arsenic, copper, the active ingredient in many algicides including Cutrine Plus, may accumulate in the bottom sediments. Excessive levels of copper may be toxic to fish and benthic organisms, but, generally, have not been found to be harmful to humans.

Aquatic Plant Harvesting

The aquatic plant harvesting program on Voltz Lake, utilized for several years until 2003, emphasized the selective removal of aquatic plants from those areas of the Lake actively utilized for recreational purposes, only to the extent necessary to facilitate the recreational uses, rather than 100 percent removal of all aquatic plants from the Lake. Under this program, the Voltz Lake Management District contracted with a private contractor for the conduct aquatic plant harvesting services. Typically, this harvesting service was provided twice during any given summer; namely, in early June and again in early July, depending upon the availability of the harvesting contractor at those times. Harvesting was limited to cutting access channels to facilitate navigation from piers and docks, through shared access channels, to the deeper water portions of the Lake. The harvested plant material was removed from the Lake and typically utilized as compost within the Voltz Lake community. In 2003, harvesting was replaced by a targeted chemical treatment, as noted above.

FISHERIES

Voltz Lake is considered by the Wisconsin Department of Natural Resources to be a warmwater sport fishing lake, with a game fishery dominated by northern pike, largemouth bass, and panfish.[18] Panfish were reported to consist of bluegill, black crappie, and brown bullhead, with yellow bullhead, pumpkinseed, and chubsucker also being common. In addition, walleyed pike and channel catfish were reported to be present. Carp were present but are not considered to be a serious problem in the Lake.

WILDLIFE AND WATERFOWL

Given the single-family residential nature of much of the Lake's shoreline, and the area of 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; marsh furbearers, such as muskrat; migratory and resident song birds; marsh birds, such as redwing blackbird and great blue heron; raptors, such as great horned owl and red-tailed hawk; and, waterfowl. White-tailed deer have been reported in the area. 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 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.

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[18] *Wisconsin Department of Natural Resources Lake Use Report No. FX-45,* Voltz Lake, Kenosha County, Wisconsin, *1970; Wisconsin Department of Natural Resources Publication No. PUB-FH-800 2001,* Wisconsin Lakes, *2001.*

Map 12 shows the remaining wildlife habitat areas in the tributary drainage area to Voltz Lake as of 1985. These areas generally occur in association with existing surface water, wetland, and woodland areas located along the northern portion of the lakeshore, and along the northern portion of the lakeshore of Cross Lake, located immediately south of Voltz Lake. These wildlife habitat areas covered about 85 acres, or approximately one-quarter of the drainage area directly tributary to Voltz Lake. About 115 acres of wildlife habitat exist within the total drainage area. Of this total habitat acreage, about six acres, or about 5 percent, were rated as Class I habitat; about 70 acres, or about 60 percent, were rated as Class II habitat; and about 40 acres, or 35 percent, were rated as Class III habitat. The habitat areas shown on Map 12 are largely coincident with Commission-delineated environmental corridors within this watershed, which are shown on Map 13.

ENVIRONMENTAL CORRIDORS

As of 1995, environmental corridors extended over approximately 85 acres, or about 25 percent of the drainage area directly tributary to Voltz Lake. All of these corridor lands were considered to be primary environmental corridor. No secondary environmental corridor lands or isolated natural resource features were delineated in the watershed, as shown on Map 13. These lands are recommended to be considered for preservation as the process of development proceeds within the Region.[19]

RECREATIONAL USES AND FACILITIES

Voltz Lake is a multi-purpose recreational use waterbody serving many forms of recreation, including boating, swimming, and fishing during the summer months, and cross-country skiing, ice fishing, and ice skating during the winter months. The Lake is used year round as a visual amenity; walking and bird-watching being popular passive recreational uses of the waterbody. The Lake is especially valued by its residents for its aesthetic appeal that is enhanced by its natural vistas, perceived good water quality, abundant wildlife, and solitude.

Public recreational boating access to Voltz Lake is provided through one boat launch site on the northwestern shore of the Lake, off of 231st Court, as shown on Map 2. No parking facilities are currently provided. For this reason, Voltz Lake is considered as not having adequate public access in terms of the criteria set forth in Chapter NR 1 of the *Wisconsin Administrative Code*.

A boat survey conducted by Commission staff during July 2001 indicated that 37 boats were either moored in the water or stored on land adjacent to Voltz Lake. The types of boats included: speedboats, fishing boats, paddleboats, rowboats, canoes, sailboats, and personal watercraft (also known as Jetskis®), as shown in Table 8.

In addition, recreational use surveys were conducted by Commission staff on July 7 and 21, 2001. These surveys were designed to quantify typical week day and weekend day usage of the Lake. A variety of watercraft was observed to be in operation on the Lake during these surveys. Water-based recreational activities being engaged in by lake residents and visitors included: fishing, pleasure boating, waterskiing, canoeing, and personal watercraft operation, as set forth in Table 9.

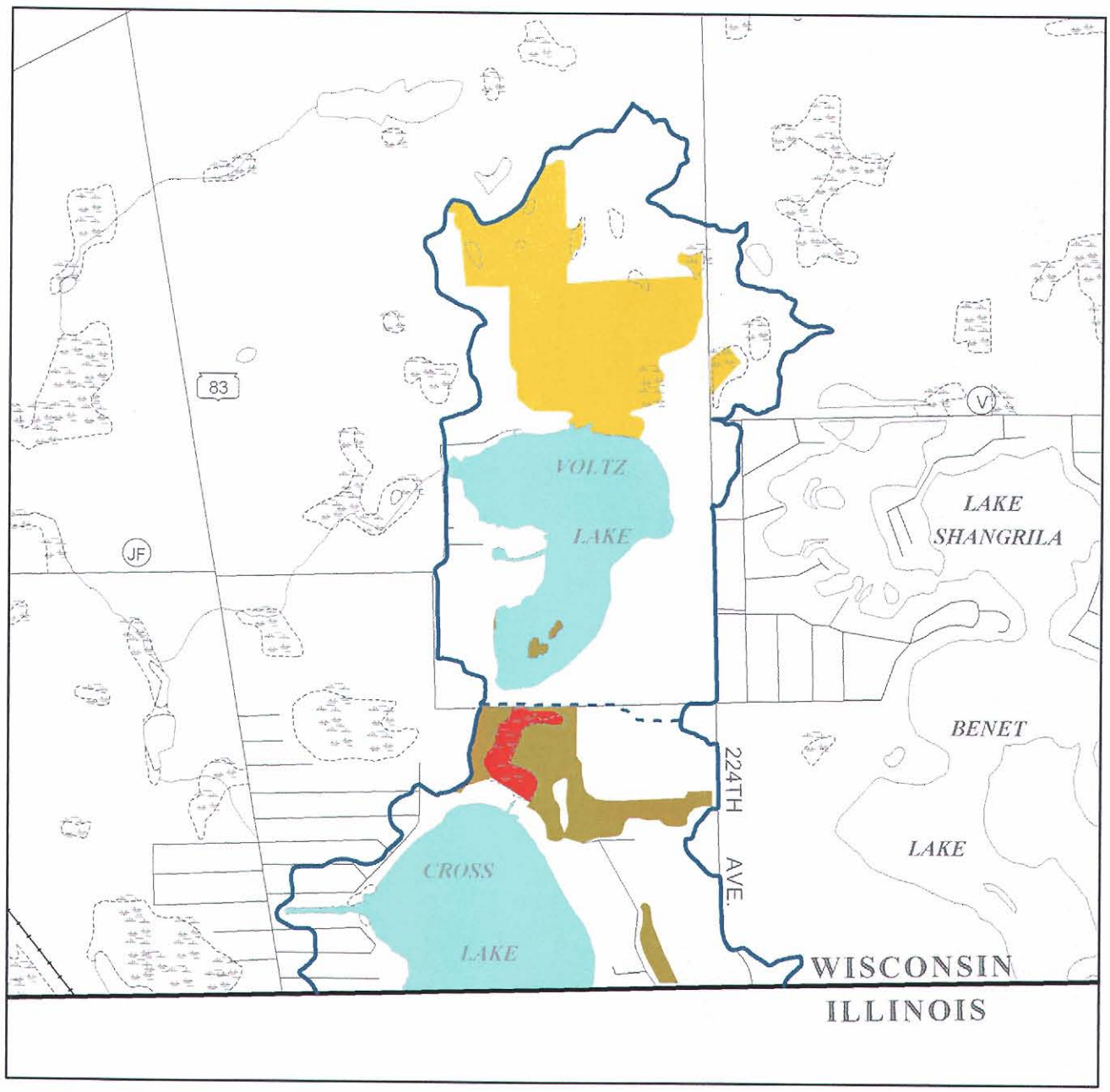
SHORELINE PROTECTION STRUCTURES

As noted above, shoreland erosion was an issue of concern to the survey respondents. Erosion of shorelines results in the loss of land, damage to shoreland infrastructure, interference with lake access and use, and degradation of aquatic habitat. Such erosion is usually caused by wind-wave erosion, ice movement, and/or motorized boat traffic.

[19] *SEWRPC Planning Report No. 40,* op. cit.

Map 12

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



Class I, High-Value Habitat

Class II, Medium-Value Habitat

Class III, Good-Value Habitat

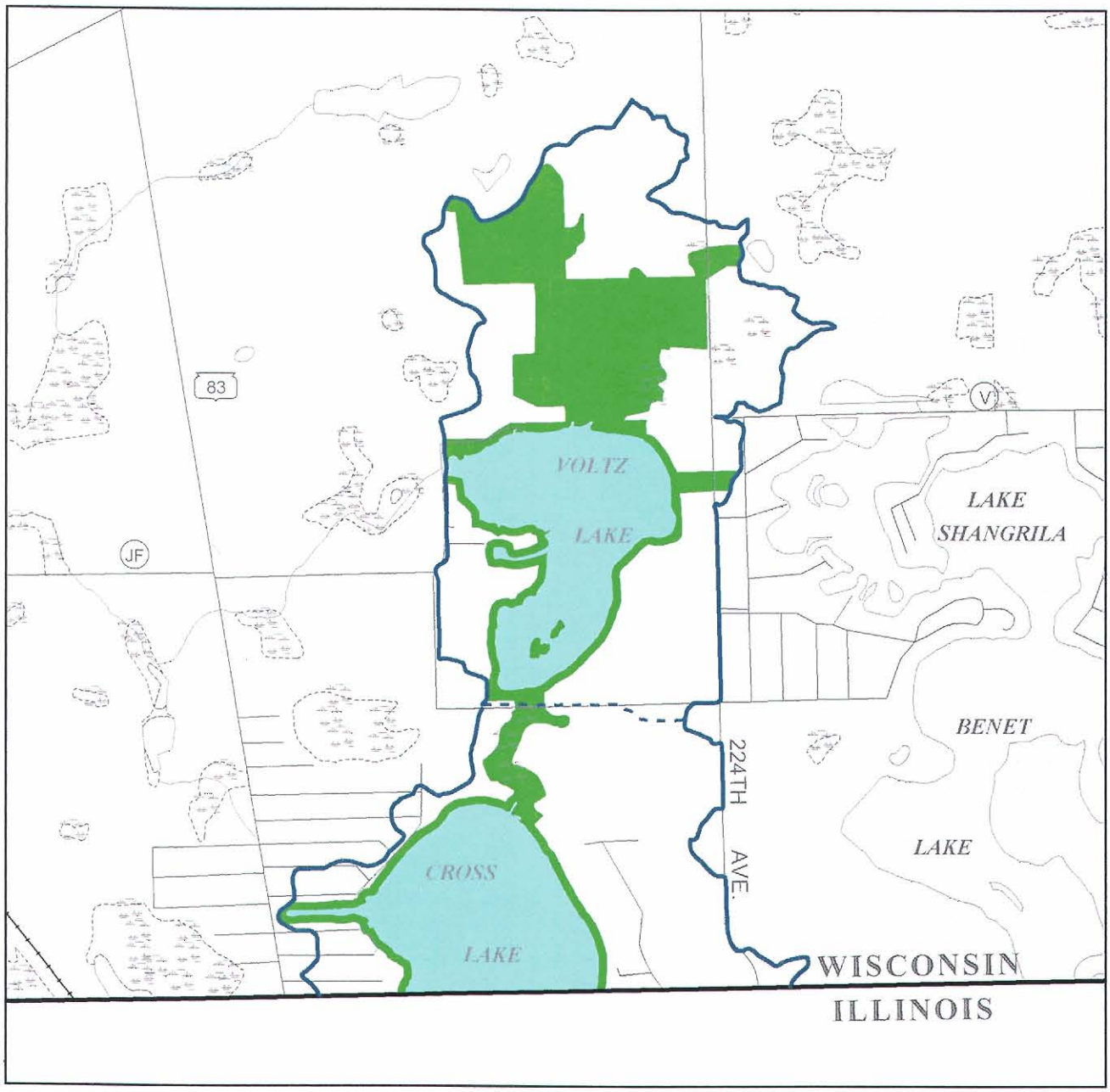
Surface Water

Source: SEWRPC.

0 0.1 0.2 0.3 0.4 0.5 Miles

Map 13

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



Primary Environmental Corridor

Surface Water

Source: SEWRPC.

0 0.1 0.2 0.3 0.4 0.5 Miles

Table 8

WATERCRAFT ON VOLTZ LAKE: 2001

Type of Watercraft									
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddle Boat	Sailboat	Kayak	Personal Watercraft	Other	Total
0	24	4	4	3	0	0	2	0	37

Source: SEWRPC.

Table 9

RECREATIONAL USE SURVEY ON VOLTZ LAKE: 2001

Date and Time	Weekday Participants								
	Fishing Boat	Pleasure Boating	Skiing	Sailing	Personal Watercraft	Swimming	Canoeing	Other	Total
July 11, 2001									
9:30 a.m. to 10:30 a.m.	1	0	0	0	0	0	0	0	1
1:00 p.m. to 2:00 p.m.	0	0	2	0	0	4	0	2	8
Total	1	0	2	0	0	4	0	2	9
Percent	12	0	22	0	0	44	0	22	100

Date and Time	Weekend Participants								
	Fishing Boat	Pleasure Boating	Skiing	Sailing	Personal Watercraft	Swimming	Canoeing	Other	Total
July 14, 2001									
10:00 a.m. to 11:00 a.m.	3	0	0	0	0	3	1	2	9
12:30 p.m. to 1:30 p.m.	1	3	1	0	2	22	0	1	30
Total	4	3	1	0	2	25	1	3	39
Percent	10	8	3	0	5	63	3	8	100

Source: SEWRPC.

A survey of the Voltz Lake shoreline, conducted by Commission staff during July 2001, indicated that the majority of the shoreline remained in a natural condition, without shoreline protection structures. About one-third of the shoreline was protected by riprap and bulkheads, as shown on Map 14.

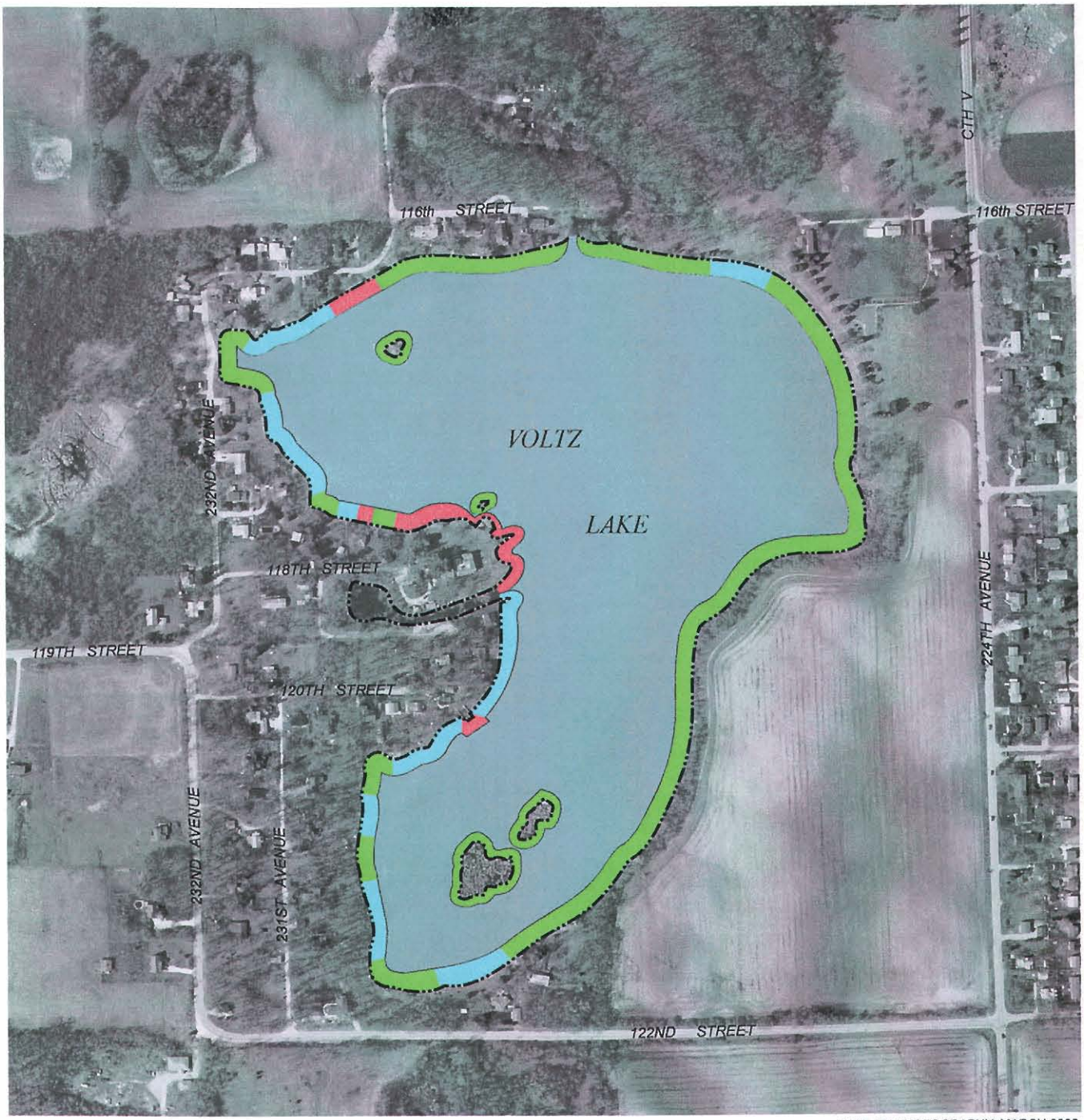
In general, the shoreline protection structures were considered to be in a good state of repair, with few obvious failures noted.

LOCAL ORDINANCES

Voltz Lake is subject to a boating ordinance promulgated by the Town of Salem. This ordinance provides generally applicable rules for Voltz Lake, as set forth in Appendix B. These rules limit the times during which watercraft may be operated on Voltz Lake, and allows for the enactment and enforcement of boating restrictions and limitations. This ordinance conforms to State of Wisconsin boating and water safety laws promulgated pursuant to Chapter 30, *Wisconsin Statutes*.

Map 14

SHORELINE PROTECTION STRUCTURES ON VOLTZ LAKE: 2001



DATE OF PHOTOGRAPHY: MARCH 2000

RIPRAP

NATURAL

BULKHEAD

GRAPHIC SCALE

0 250 500 FEET

Source: SEWRPC.

Chapter III

ISSUES OF CONCERN

INTRODUCTION

Voltz Lake 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 water quality; and, recreational use of the Lake and its environs. Institutional development issues relating to refinement of the boundary of the lake management district also are identified as likely issues of concern to the Voltz Lake community.

AQUATIC PLANT COMMUNITIES AND ECOLOGICALLY VALUABLE AREAS

Concerns Related to Aquatic Plant Communities

Localized recreational use problems have been reported to be experienced in various portions of Voltz Lake. The nature and extent of those problems depend on the specific uses desired of the Lake. However, the abundance of aquatic plants, including Eurasian water milfoil, continues to be perceived as a nuisance by Lake users. These latter plants often grow to the surface of the Lake, limiting certain recreational uses in those areas of the Lake, and impair not only the aesthetic quality of the Lake but also limit habitat for fish and other aquatic life within and adjacent to the Lake, interfering with recreational uses, aesthetic enjoyment, and the ecological health of the waterbody.

Recreational boating activities are impaired by entanglement of propellers and clogging of 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, fishing and swimming activities on the Lake also are adversely affected by aquatic plant growth, especially in those areas of the Lake where Eurasian water milfoil occurs at swimming depths. Fishing is affected by the growths of Eurasian water milfoil entangling lines, and by the poor quality habitat and food stocks provided within the stands of Eurasian water milfoil. 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 5. 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.

Concerns Related to Ecologically Valuable Areas

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

perceived degradation of these resources. Two potential concerns associated with ecologically valuable areas in and near Voltz 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. The currently undeveloped areas, generally lying along the eastern and western shorelines of the northern basin of the Lake, and the northwestern and southern shorelines of the southern Lake basin, contain significant stands of native aquatic and wetland plants and shoreland woodlands that add aesthetic value to the community and provide good quality wildlife habitat. Consequently, management of ecologically valuable areas in and adjacent to the Lake is an important issue to be considered.

Environmentally Sensitive Areas

Within the Lake basin, riparian wetland areas and aquatic macrophyte beds may be included within environmentally 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 areas include prime fish spawning habitat and macrophyte beds containing a diverse native flora within the Lake, as well as shoreline areas supporting this productive aquatic and wetland habitat. To date, the WDNR has not designated sensitive areas within Voltz Lake.

Natural Areas and Environmental Corridors

The ecologically valuable areas within the drainage area tributary to Voltz 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. In addition, 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 13.

Downstream of Voltz Lake, the Trevor Creek Wet Prairie, a 66-acre sedge meadow and shallow marsh complex located along a portion of Trevor Creek, has been designated a critical species habitat site 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. Given this downstream location, this wet prairie can be adversely affected by outflows from Voltz Lake. Such outflows may potentially be impacted by impaired water quality, for example. Thus, the protection of the Trevor Creek drainage system, inclusive of Voltz Lake, from intrusion by incompatible land uses that can degrade and destroy its environmental value, and the preservation of environmental corridors in an essentially open and natural state as an essential element of maintaining the natural resource base of the drainage system, are important issues to be considered.

Shorelands

As mentioned earlier, the majority of the shoreline of Voltz Lake is in a natural state, especially along the eastern shores. As such, these areas are likely to be potentially susceptible to wind, wave, and wake erosion should such vegetative protections be removed or modified. Wherever practical, vegetated buffer strips should be maintained along the lakeshore in order not only to protect these areas from wind and wave erosion, both shoreward and lakeward of the ordinary high-water mark, which mark defines the point at which the Lake and shore meet, but also to maintain habitat value and the natural ambience of the shoreland area. During the study period, the Commission staff examined existing shoreline protection structures and shoreland areas for signs of erosion. These shoreland protection structures, mainly comprised of riprap and bulkheads, were deemed by Commission staff to be in a relatively good state of repair. Nevertheless, because of the extensive amount of natural shoreline on Voltz Lake, shoreland erosion is a potential issue of concern to be considered.

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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.*

LAND USE AND WATER QUALITY

Concerns Related to Nonpoint Source Pollution

Nonpoint source pollutants in the drainage area tributary to Voltz 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 county land and water resource management plan,[3] future development of open lands within the drainage area tributary to Voltz 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 Voltz 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 loadings of heavy metals, sediment, and nutrients may be expected to occur as land uses change, although these loads may decrease or stabilize once more urban land use conditions become established within the drainage area. 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.

The agricultural lands and associated Lake District-funded buffer strip located along the Lake's eastern shoreline, pose a potentially significant challenge to future nonpoint pollution control and water quality in Voltz Lake. Regional trends towards increased urbanization throughout the Southeastern Wisconsin Region are anticipated to create increased pressure for development of these agricultural lands. Currently the lands are in largely single ownership. Therefore, procurement or preservation of these lands by the Voltz Lake Management District through cost-sharing programs under NR 50/51 Stewardship Grant Program or NR 191 Lake Protection Grant Program could be considered.

Utilization of such state grant programs, however, is dependent upon several criteria, one of which is provision of adequate public recreational boating access and associated parking facilities, as specified pursuant to requirements contained in Sections NR 1.91(4) and NR 1.91(5), respectively, of the *Wisconsin Administrative Code*. These provisions, respectively, establish minimum and maximum standards for public recreational boating access development that will qualify waters for resource enhancement services provided by the Wisconsin Department of Natural Resources. For lakes with a boatable surface area similar to that of Voltz Lake, public recreational boating access sites should accommodate five car-top or car-trailer units, plus one handicapped-accessible unit. Where exceptional circumstances exist, Section NR 1.91(6) of the *Wisconsin Administrative Code* provides procedures for determining alternative public access standards which may differ from the minimum and maximum standards set forth in Sections NR 1.91(4) and NR 1.91(5). Such alternative standards are determined on a site-specific basis, in cases where unusual environmental or development factors preclude provision of access within the standards. Given the extensive aquatic plant growth in Voltz Lake, the essentially wetland character of much of the eastern littoral zone of the Lake, and the impact of shallow areas on the boatable area of the Lake, consideration of the development of alternative public recreational boating access standards under the provisions of Section NR 1.91(6) may be warranted. For theses reasons, provision of adequate public recreational boating access and associated parking facilities is an important issue to be considered.

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

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

Concerns Related to Water Quality

As of 2000, as described in Chapter II, Voltz Lake was within the eutrophic range, indicating that water quality problems could be expected in the Lake. Thus, it is not unexpected that citizens within the Voltz Lake community have expressed concerns regarding surface water quality over the longer term, especially if urban density development occurs within the drainage area and groundwatershed tributary to Voltz Lake as is foreseen in the relevant regional and local land use plans. Because domestic water supplies to households within the Voltz Lake community are drawn from the regional groundwater aquifer system, contamination of this aquifer by pollutants leaching into the groundwater from the land surface is an issue of widespread concern within the Voltz Lake community. This concern is shared throughout the Southeastern Wisconsin Region by communities who are dependent upon private wells for their water supply even though they may utilize a public sewage disposal system.[4] Measures taken to minimize water quality degradation in the surface drainage area tributary to Voltz Lake should also serve to protect the groundwater resources of the watershed from contamination. Consequently, water quality is an important issue to be considered.

RECREATIONAL USAGE

Concerns Related to Recreational Boating

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 areas. Given the surface area of Voltz Lake, and the nature of the access site, the potential for the occurrence of problems due to increased or inappropriate boating pressure from outside of the Town of Salem is considered to be slight, although the implications of such problems could potentially be severe should lake uses change or increase beyond those able to be sustained by a relatively small, shallow waterbody. For this reason, the residents of the Voltz Lake community have expressed concerns over the increased power boat and personal watercraft operations occurring on the Lake in recent years, especially with regard to the shoreline damage associated with boat wakes and aesthetic impacts resulting from these activities. Thus, recreational water usage, especially by power boat and personal watercraft operations on the waterbody, is an issue to be considered.

Concerns Related to Recreational Opportunities within the Watershed

In addition to the in-lake recreational opportunities offered by Voltz Lake, the drainage area within which the Lake is situated provides numerous views and aesthetic aspects which are favored by the Voltz Lake community. In large part, these aspects relate to the currently undeveloped status of the eastern shorelands of the Lake. In part, too, these aspects relate to the situation of the Lake community in a relatively isolated portion of the Town of Salem, leading to the sense of community expressed by the electors and property owners of the Voltz Lake Management District and its immediate environs. Given the single-family residential nature of this lake-oriented community, concern has been expressed with regard to public safety in respect of waterfowl hunting on the Lake. In addition, citizens attending the 2003 annual meeting of the Voltz Lake Management District expressed concern regarding the forecast development of the lands forming the eastern shorelands of the Lake, and proposed that the District investigate the feasibility of a walking/hiking trail that would form a route around the Lake, possibly utilizing existing roadways to the extent practicable. Consequently, off-lake recreational opportunities, including the proposed trail system, as well as lake-oriented recreational opportunities, including waterfowl hunting on the Lake, are additional recreational issues to be considered.

ANCILLARY ISSUES OF CONCERN

Concerns Related to Institutional Development

As the Voltz Lake community seeks a more active role in the management of the Voltz Lake, it is essential that an adequate institutional base to support such activities be developed. Currently, the community-based lake management activities are being carried out by the Voltz Lake Management District, a Chapter 33, *Wisconsin*

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

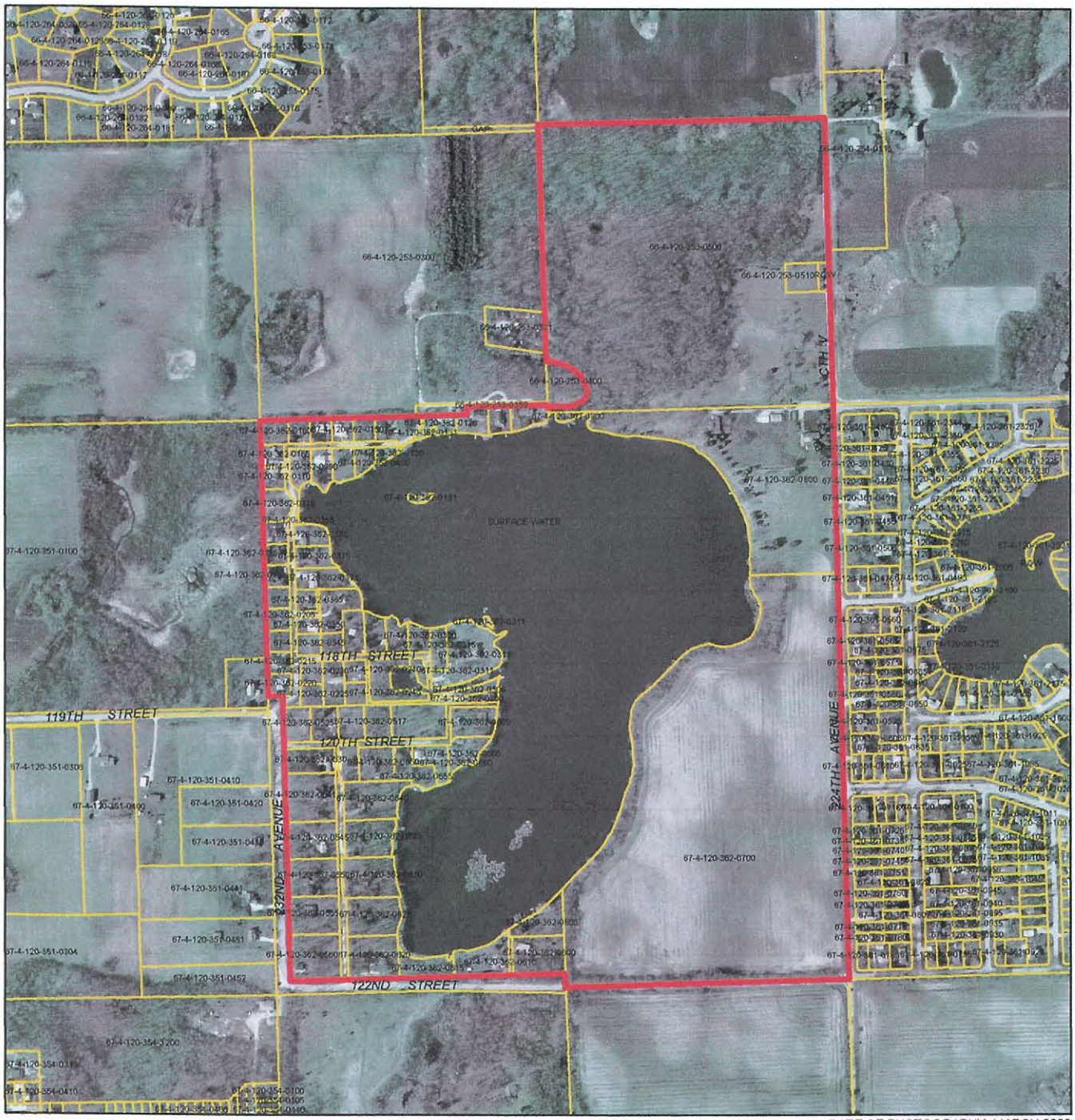
Statutes, public inland lake protection and rehabilitation district. The District was created by the Town of Salem to encompass those lands riparian to the Lake bounded by 116th Street in the north, 224th Avenue in the east, 122nd Street in the south, and 232nd Avenue in the west. The southeastern one-quarter of the southwestern one-quarter of U.S. Public Land Survey Section 25, Town 1 North, Range 20 East, and the southeastern one-quarter of the southwestern one-quarter of U.S. Public Land Survey Section 25, Town 1 North, Range 20 East were also included within the District, as shown on Map 15. This District maintains an active aquatic plant management program as previously noted. Nevertheless, concerns have been expressed regarding the long-term impacts of the agricultural operations proposed for the lands located in southwestern one-quarter of the southwestern one-quarter of U.S. Public Land Survey Section 25, Town 1 North, Range 20 East, which operations can potentially influence water quality within Voltz Lake as these lands are directly connected to the Lake via the constructed channel entering the Lake as an inflow from the north of the main lake basin. As a result, the refinement of the institutional structure for lake management is an issue to be considered. Consequently, the Voltz Lake Management District Board of Commissioners have requested the Southeastern Wisconsin Regional Planning Commission to assist them in a review of the current boundaries.

Concerns Related to Informational and Educational Programming

It is the policy of the Voltz Lake Management District and Town of Salem to maintain an active dialogue with the community. This is done through the medium of the public press and through various town committees, public meetings and other scheduled hearings. In addition, the Voltz Lake Management District holds regular public meetings. The education and information program should discourage human disturbances in ecologically valuable areas, except as may be necessary to provide riparian residents with a reasonable level of access to the main body of the Lake. Lake residents and visitors should be made aware of the invasive nature of species, such as purple loosestrife and Eurasian water milfoil, and be encouraged to participate in citizen-based control programs coordinated by the Wisconsin Department of Natural Resources and University of Wisconsin-Extension. Where necessary, personal contacts with homeowners should be made, most likely through the Voltz Lake Management District. Developing such a program of informational and educational programming, therefore, is an issue to be considered.

Map 15

EXISTING BOUNDARY OF THE VOLTZ LAKE MANAGEMENT DISTRICT: 2001



DATE OF PHOTOGRAPHY: MARCH 2000

DISTRICT BOUNDARY

67-4-120-362-0700 PARCEL BOUNDARY AND NUMBER

N

GRAPHIC SCALE

0 350 700 1,050 Feet

Source: SEWRPC.

Chapter IV

ALTERNATIVE AND RECOMMENDED LAKE PROTECTION MEASURES

INTRODUCTION

There are a number of issues of concern affecting the recreational use and protection of Voltz Lake ecosystem. These issues were identified in Chapter III and include: aquatic plant management and protection of ecologically valuable areas; control of nonpoint source pollution and protection of water quality; and, provision of public recreational use opportunities, as well as ancillary concerns relating to the conduct of community-based informational and educational programming, and the system of lake governance. In some ways, these issues of concern are interrelated. For example, in those areas of the Lake where Eurasian water milfoil is abundant, certain recreational uses are limited, the aesthetic quality of the Lake is impaired, and in-lake habitat degraded. From a boating standpoint, the plant primarily interferes with recreational use by restricting propeller movement and clogging cooling-water intakes, snagging paddles, and slowing sailboats by wrapping around keels and control surfaces. The plant also causes concern amongst swimmers who can become entangled within the plant stalks. Thus, without control measures, areas of abundant growths of Eurasian water milfoil can become problematic with respect to such recreational uses as boating, fishing, and swimming. In this regard, it should be noted that native aquatic plants, generally found at slightly deeper depths, pose fewer potential problems for navigation, swimming, and fishing, especially as the majority of these plants are low-growing and occur at lower densities than the invasive Eurasian water milfoil. In addition, many species of fish have come to be dependent on native aquatic plants for habitat, food resources, and shelter, especially for juvenile and young-of-the-year fishes. Consequently, when native plant species are crowded out and replaced by invasive species like Eurasian water milfoil, negative impacts are experienced throughout the lake ecosystem at all levels, and control measures, such as those discussed in this Chapter, are warranted.

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

- Land use management measures designed to limit the inputs of contaminants, and protect ecologically valuable areas and associated biota;
- Aquatic and shoreland plant management measures designed to encourage native plant communities and limit the spread of nonnative, invasive species;
- Shoreland protection measures designed to reduce erosion-related problems and encourage the establishment of natural, native shoreline vegetation where appropriate;

- Fisheries management measures designed to mitigate the habitat-related impacts of a changing aquatic flora and maintain an ecologically viable system; and

- Recreational use management measures designed to promote safe boating, curtail the spread of invasive species of aquatic flora and fauna, and provide the potential for the community to gain access to outside funding sources and lake enhancement services.

Alternative and recommended management measures are described below. The alternatives and recommendations set forth herein focus on those measures which are applicable to the Voltz Lake Management District, but include recommendations applicable to other governmental units having responsibility for land and water resource management in the drainage area tributary to Voltz Lake.

Past and Present Lake Management Actions
The residents of Voltz Lake, in conjunction with the Town of Salem, have long recognized the importance of informed and timely action in the management of the Voltz Lake. Consequently, the residents of the community around the Voltz Lake created the Voltz Lake Management District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district to address shared concerns with respect to the Lake, its water quality, and environment. The District maintains an effective working relationship with the Town of Salem, and with Kenosha County and Wisconsin Department of Natural Resources.

The Voltz Lake Management District conducts an active, ongoing public information program. Informational programming is an integral part of the District's annual meeting, which is open to all of the residents of the Voltz Lake community and other interested parties. The District uses this opportunity, as well as periodic mailings, to distribute informational materials to District residents. These mailings and programs have addressed issues such as aquatic plant management, shoreland management and urban housekeeping, and lake ecology. A volunteer monitor drawn from the community participates in the Wisconsin Department of Natural Resources Self-Help Monitoring Program, which facilitates the collection of water clarity data from the State's lakes.

AQUATIC PLANT MANAGEMENT AND PROTECTION OF ECOLOGICALLY VALUABLE AREAS

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

As noted in Chapter III, the presence of Eurasian water milfoil in the Voltz Lake basin, and the presence of purple loosestrife in wetlands and shorelands adjoining the Lake, represents an issue of concern particularly in regards to the problems these two invasive species represent to native flora and, consequently, to the entire natural ecosystem. These invasive species also pose direct nuisance threats to humans through their deleterious effects on recreational activities and aesthetic qualities of the lake. Degradation of wetland areas as a result of purple loosestrife infestation can have serious negative consequences on the ability of these areas to perform their natural functions vital to the health of the Voltz Lake ecosystem including containment of floodwaters, retention of sediments, and filtering of nonpoint pollutants. The reduction of native in-lake plants as a result of Eurasian water milfoil colonization seriously reduces the biodiversity not only of the Lake's plant population but also of the animal populations that are dependent upon them.

Array of Protection Measures
The presence of nonnative and nuisance aquatic plant species within the Lake basin and along the shorelines is indicative of a further loss of ecosystem integrity and function, affecting submergent and emergent lacustrine vegetation. Various in-lake management actions may be considered to mitigate and manage the consequences of

aquatic habitat degradation in Voltz Lake. Generally, aquatic plant management measures, designed to minimize the environmental and recreational impacts of degraded habitat, are classed into five groups: **physical measures** which include lake bottom coverings and water level management; **mechanical measures** which include harvesting; **manual removal**; **chemical measures** which include the use of aquatic herbicides; and **biological control measures** which include the use of various organisms, including insects. All 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 $50,000 for the purchase of a mechanical plant harvester, for which the operational costs can approach $2,500 to $15,000 per year depending on staffing and operating policies. Harvesting is probably the measure best suited to large areas of open water, while chemical controls may be best suited for use in confined areas and for the initial control of invasive plants. Controlling Eurasian water milfoil by planting native plant species or by introducing the milfoil weevil, *Eurhychiopsis lecontei*, is largely experimental and currently subject to State permitting, while the use of other biological controls, such as grass carp, is prohibited in Wisconsin.

Physical Measures

Lake bottom covers and screens provide limited control of rooted plants by creating a physical barrier which reduces or eliminates the amount of sunlight available to the plants. Placement of bottom covers on the beds of inland Lake is subject to State permitting requirements. Barriers must be placed and removed annually, and can be subject to disturbance as a consequence of, among others, recreational boating activities. Lake bottom coverings are not considered a viable plant management option for Voltz Lake.

Mechanical Measures

Aquatic macrophytes may be 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. Mechanical harvesting can be a practical and efficient means of controlling plant growth as it removes the plant biomass and nutrients from a lake. Mechanical harvesting is particularly effective as a measure to control large-scale growths of aquatic plants.

The advantages of aquatic plant harvesting are that the harvester typically leaves enough plant material in the lake to provide shelter for fish and other aquatic organisms, and to stabilize the lake bottom sediments. The disadvantages of mechanical harvesting are that the harvesting operation may cause fragmentation and facilitate the spread of some plants, including Eurasian water milfoil, and may disturb loosely consolidated bottom sediments increasing turbidity and smothering fish breeding habitat and nesting sites. Disrupting the bottom sediments by plant removal also could increase the risk that an exotic species, such as Eurasian water milfoil, may colonize the disturbed area. Nevertheless, if done correctly and carefully, harvesting has been shown to be of benefit in ultimately reducing the regrowth of nuisance plants. Aquatic plant harvesting operations are subject to State permitting requirements.

Given the extent of shallow water areas needing aquatic plant management, the loosely consolidated nature of the bottom sediments in these shallow areas, and the species composition with correspondingly dense amounts of Eurasian water milfoil in these same areas, mechanical harvesting is not considered a viable management option as a control of aquatic plants in much of Voltz Lake.

Manual Measures

When the water depth is inadequate to operate mechanical harvesting equipment, as in shoreline areas, manual harvesting provides a reasonable alternative technique. Manual aquatic plant harvesting also is subject to State permitting requirements, with the exception that manual harvesting of plants along a 30-feet width of shoreline within which a pier, if any, is situated, can be undertaken without a permit, pursuant to the requirements of Chapter NR 109 of the *Wisconsin Administrative Code*. Manual harvesting involves the use of specially designed rakes to remove aquatic plants. The advantage of the rakes is that they are relatively inexpensive, easy and quick to use, and immediately remove the plant material from the lake, without a waiting period. Removal of the plants from the lake avoids the accumulation of organic matter on the lake bottom, which adds to the nutrient pool that

favors further plant growth. State permitting requirements for manual aquatic plant harvesting mandate that the harvested material be removed from the lake.

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

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

Manual harvesting is recommended for use in Voltz Lake when nearshore aquatic plant growths around piers are perceived to interfere with recreational boating and other active recreational activities. Hand pulling of stems, where they occur in isolated stands, also provides a viable alternative means of controlling plants, such as Eurasian water milfoil in the Lake and purple loosestrife on or near the lakeshore.

Chemical Measures

Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. Chemicals are applied to the growing plants in either liquid or granular form. The advantages of using chemical herbicides to control aquatic macrophyte growth are the relatively low cost and the ease, speed, and convenience of application. The disadvantages associated with chemical control include unknown long-term effects on fish, fish food sources, and humans; a risk of increased algal blooms due to the eradication of macrophyte competitors; an increase in organic matter in the sediments, possibly leading to increased plant growth, as well as anoxic conditions which can cause fish kills; adverse effects on desirable aquatic organisms; loss of desirable fish habitat and food sources; and, finally, a need to repeat the treatment the following summer due to existing seed banks and/or plant fragments.

To minimize the collateral impacts of deoxygenation, loss of desirable plant species, and contribution of organic matter to the sediments, early spring or late fall applications should be considered. Such applications also minimize the concentration and amount of chemicals used due to the colder water temperatures that enhance the herbicidal effects. Use of chemical herbicides in aquatic environments is subject to State permitting requirements. Widespread chemical treatment is not recommended as a means of controlling aquatic plant growth. Consideration should be given, however, to the limited use of early spring chemical controls especially in those shoreline areas of shallow water where mechanical harvesting would not be deemed viable and targeting growths of Eurasian water milfoil would be possible. Targeted herbicide applications, specifically aimed at controlling Eurasian water milfoil and purple loosestrife in and around the Lake, form a viable option for the Voltz Lake community.

Biological Measures

Biological controls provide an alternative approach to controlling nuisance plants, particularly Eurasian water milfoil. Classical biological control techniques have been successfully used to control both nuisance plants and

herbivorous insects.[1] Recent studies have shown that *Eurhychiopsis lecontei*, an aquatic weevil, has potential as a biological control agent for Eurasian water milfoil.[2] However, as very few studies have been completed using *Eurhychiopsis lecontei* as a means of aquatic plant management control, it is not recommended that it be undertaken on Voltz Lake at this time. Biological control of aquatic plant communities is subject to State permitting requirements pursuant to Chapter NR 109 of the *Wisconsin Administrative Code*.

Grass carp, *Ctenopharyngodon idella*, another potential biological control, are not permitted for use in Wisconsin.

Recommended Management Measures

The following measures are recommended for implementation in order to provide for aquatic and shoreline plant community protection and management:

- The Voltz Lake Management District should monitor the Lake and surrounding wetlands on a three- to five-yearly basis 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.

- Should the growth of Eurasian water milfoil or purple loosestrife be determined to reach nuisance proportions, the use of chemical herbicides could be considered. 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.

- Recreational boating activity is recommended to be limited in areas where Eurasian water milfoil populations are abundant and fragmentation of the plants from propellers could lead to the spread of this nuisance species. Plant fragments resulting from either manual harvesting or boating activities should be collected and removed from the water.

- It is recommended that the success of the current aquatic plant management program be evaluated every three to five years in order to track the effects of changes in the tributary drainage area that may affect Voltz Lake and its aquatic plant community.

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

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[1] *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; and C.B. Huffacker and R.L. Rabb, editors,* Ecological Entomology, *John Wiley, New York, New York, USA.*

[2] *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.*

- The Voltz Lake Management District should monitor the lake in order to provide an early warning of undesirable changes in lake water quality and aquatic species composition. Information can be acquired through participation in programs such as the Wisconsin Department of Natural Resources Self-Help Monitoring. A report on the year's lake monitoring should be featured at the annual meeting of the District.

Protection of Ecologically Valuable Areas

Voltz Lake and its tributary drainage area contain a variety of ecologically valuable areas, including diverse aquatic and wetland vegetation, wildlife habitats, and substrates suitable for fish spawning, located within and immediately adjacent to the Lake, as noted in Chapter II. As described in Chapter III, the potential problems associated with ecologically valuable areas in and near Voltz Lake include the potential loss of wetlands and other important ecologically valuable areas due to new development, urbanization, and other encroachments; and the degradation of wetlands and aquatic habitat due to nonpoint source pollution, and the presence of invasive species, including Eurasian water milfoil and purple loosestrife.

Array of Protection Measures

Land Use Management

The recommended future land use condition of the drainage area tributary to Voltz Lake is set forth in the adopted local and regional land use plans.[3] Those plans, and the county land and water resource management plan,[4] recommend the preservation of the designated environmental corridor lands within the drainage area tributary to Voltz Lake in essentially natural, open space uses. Most of the wetlands and other ecological valuable lands adjacent to Voltz Lake and within the drainage area tributary to Voltz Lake are included within these designated environmental corridors. Hence, the protection and preservation of the environmental corridor lands is to be recommended.

In addition, all lakes, rivers, streams, wetlands, and associated undeveloped floodlands and shorelands are recommended to be placed in lowland conservancy or floodplain protection zoning districts. The existing Town of Salem zoning for the lands in the vicinity of Voltz Lake and in the drainage area directly tributary to Voltz Lake is generally consistent with the recommended future land use pattern set forth in the local and regional land use plans. The Town zoning for the drainage area directly tributary to Voltz Lake generally provides for conservancy zoning of the wetland portions of the primary environmental corridor.

With respect to the future land use pattern within the drainage area tributary to Voltz Lake, the adopted County and Town land use plans indicate future new development, much of this development being comprised of urban residential lands planned to occur on lands currently in agricultural usage situated to the east of the Lake. In the event of such new development occurring, conservation development practices, that maintain open space areas within the developments in the tributary drainage area to the Lake and that cluster the development beyond the shorelands of the Lake, should be encouraged. In addition, any new development within the drainage area tributary to Voltz Lake should be closely scrutinized with respect to potential deleterious effects on the Lake, and appropriate and effective stormwater management and construction site erosion control practices implemented.

Some limited infilling of existing, platted lots also would be expected to occur, and the redevelopment and reconstruction of some existing single-family homes on lakefront properties may be anticipated. Such redevelopment also would suggest an increase in urban-density land uses within the drainage area tributary to Voltz Lake. Such development will contribute to the subsequent increase in the pollutant loadings to the Lake associated with urbanization, and could potentially increase the pressure for recreational use of the Lake. These

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

[4]*SEWRPC Community Assistance Planning Report No. 255,* A Land and Water Resource Management Plan for Kenosha County: 2000-2004, *September 2000.*

land use changes also have the potential to impact the quantity and quality of groundwater inflows to the Lake. To the extent that the urbanization of the drainage area contributes to the generation of urban-sourced nonpoint source pollution, implementation of effective and appropriate management measures is recommended. Recommended nonpoint source pollution control measures are set forth in the section on Protection of Water Quality, below.

Shoreland Protection Measures
A significant portion of the Voltz Lake shoreline remains in a natural state, and, as such, is unprotected from erosion. Among the problems associated with the erosion of shorelands are: loss of land, damage to shoreline infrastructure, interference with lake access and use, and susceptibility to the influx of nonpoint source pollutants. Wind-wave erosion, ice movement, and motorized boat traffic usually cause such erosion. In addition, the absence of native shoreline vegetation adversely affects the aesthetic quality of the Lake and negatively impacts other native biota, as well as contributing to shoreland erosion. Maintenance of the shorelines to limit shoreland erosion is important in order to protect the structure and functioning of the aquatic ecosystem in the Lake, and, especially, to preserve the wetland and nearshore aquatic vegetation in and around the Lake that provided habitat, shelter, and foodstocks for a variety of wild and aquatic life. Such protections also contribute to preserving and enhancing water quality and the essential structure and functioning of the waterbody and adjacent areas.

Protection of shorelands can be accomplished using both physical and biological measures. Physical measures involve placing protective barriers along the water line to provide protection to the land immediately behind it. Rock revetments and various types of wooden materials are common methods that have been used historically by lakefront property owners across the State. Continued maintenance of existing revetments and other protection structures is of value. Biological methods primarily involve the planting of natural vegetation. In many areas of southeastern Wisconsin, lakefront property owners are encouraged to use vegetative buffer strips where feasible. Typically, such a method involves planting a three- to five-foot-wide strip of indigenous vegetation along the shore above the water line with an adjoining two- to six-foot-wide strip of native emergent vegetation in the water. There are variations of this basic plan. Such a method serves to act not only as a means of erosion control, but has the added advantages of restoring native flora and thus maintaining habitat value, creating a natural ambiance of the lakeshore, and providing a natural filtering and trapping device for possible pollutant runoff.

Two alternative shoreline erosion control techniques are considered potentially viable: vegetated buffer strips and rock revetments or riprap. These alternatives, as shown in Figure 2, 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 Management Measures
In order to provide for shoreline erosion protection, encourage natural habitat and enhance the aesthetic qualities of Voltz Lake, the following recommendations are made:

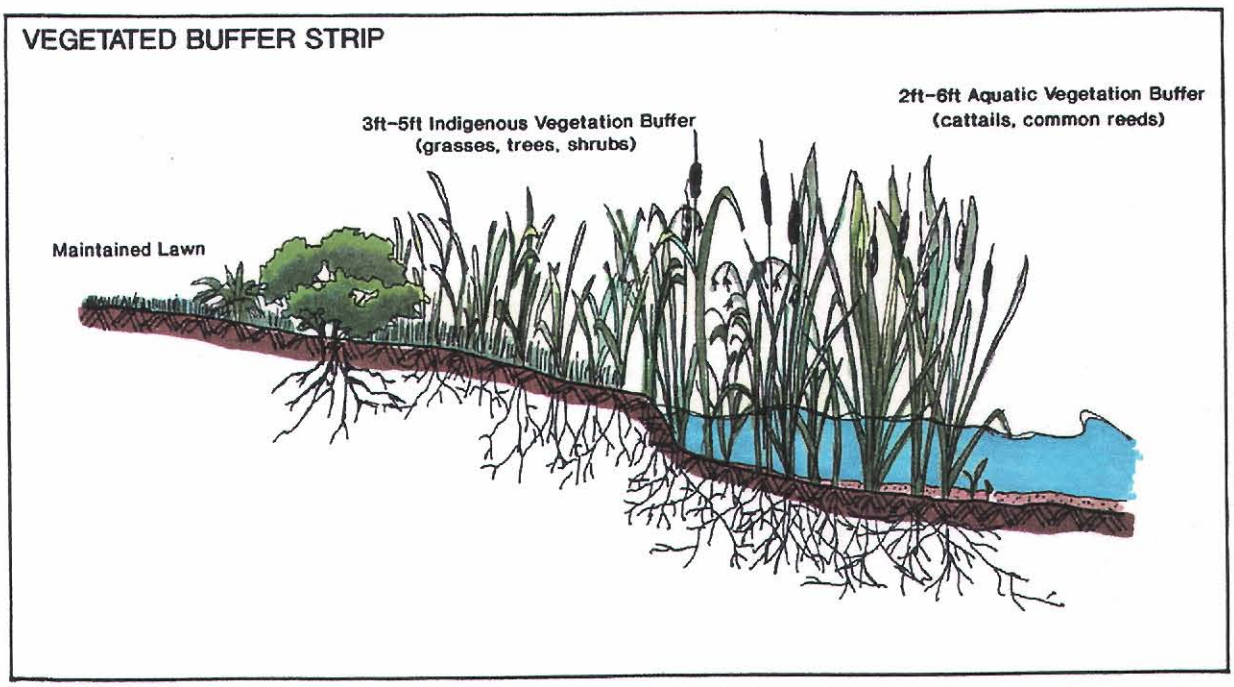
- Repair and maintain shoreline protection structures already in existence.

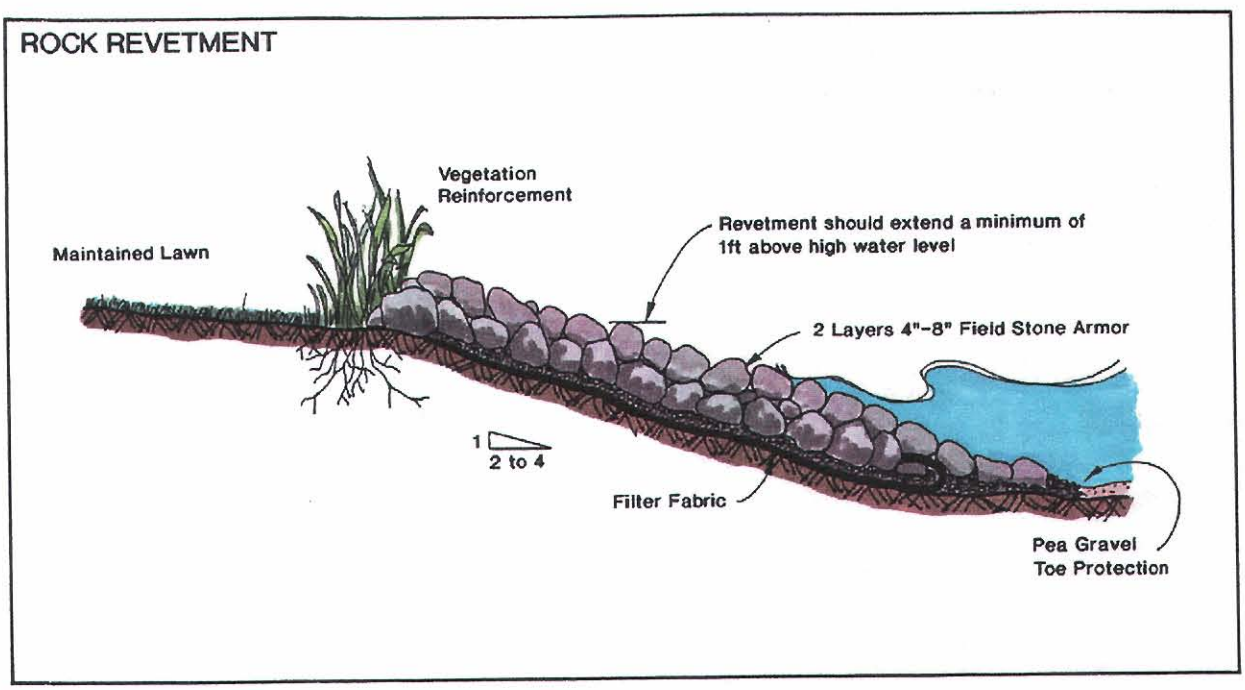
- Where new shoreline protection measures are needed or where it is desirable to replace existing structures, where feasible, plant vegetative buffer strips along shoreline areas using native species.

- It is recommended that the Voltz Lake Management District provide the Lakeshore residents with information on the methods of proper construction and maintenance or 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. Conduct of shoreland vegetative buffer development workshops for riparian homeowners and householders is recommended.

Figure 2

PLAN ALTERNATIVES FOR SHORELINE EROSION CONTROL





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

Source: SEWRPC.

CONTROL OF NONPOINT SOURCE POLLUTION AND PROTECTION OF WATER QUALITY

Voltz Lake is a eutrophic 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. The anticipated urbanization of the watershed under buildout conditions, as set forth in the aforereferenced local and regional land use plans, when viewed in light of the recent U.S. Geological Survey findings regarding the potential impacts of suburban lawn care practices on stormwater runoff in urbanized watersheds in Wisconsin,[5] has heightened concern among Lakeshore residents that the water quality of the Lake could deteriorate. As described in Chapter II, the primary sources of pollutant loadings to Voltz Lake are nonpoint sourced, generated from within the drainage area tributary to the Lake. 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 pollution control measures considered in this report are based upon the recommendations set forth in the regional water quality management plan,[6] the Kenosha County land and water resource management plan,[7] and information presented by the U.S. Environmental Protection Agency.[8]

Array of Protection Measures

To control nonpoint source pollution to Voltz Lake and its tributary drainage area, application of both urban and rural nonpoint source controls is recommended. In addition, measures to control nonpoint source pollution loading during land development activities also are recommended.

Urban Nonpoint Source Controls

Nonpoint Source Pollution Control in Developed Urban Areas

Potentially applicable urban nonpoint source control measures include wet detention basins, stormwater infiltration basins, grassed swales, and good urban housekeeping practices. 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

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[5]*U.S. Geological Survey Water-Resources Investigations Report No. 02-4130,* Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lake, Wisconsin, *July 2002.*

[6]*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, Volume Three,* Recommended Plan, *June 1979; and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report, *March 1995.*

[7]*SEWRPC Community Assistance Planning Report No. 255,* op. cit.; *see also recommendations set forth in SEWRPC Community Assistance Planning Report No. 164,* Kenosha County Agricultural Soil Erosion Control Plan, *April 1989.*

[8]*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 Lake and Reservoirs: Technical Supplement to the Lake and Reservoirs Restoration Guidance Manual, *May 1993; and R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* Simulation of the Shallow Hydrologic System in the Vicinity of Voltz Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000.*

reduced use of street deicing salt. Generally, the application of low-cost urban housekeeping practices may be expected to reduce nonpoint source loadings from urban lands by about 25 percent.

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 Voltz Lake. Management measures that can be applied within the Town of Salem in the immediate vicinity of Voltz Lake are limited largely to good urban housekeeping practices and grassed swales.

Nonpoint Source Pollution Control in Developing Urban Areas
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, additional urban development is presently occurring and/or planned within the drainage area tributary to Voltz Lake. 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.

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 Voltz Lake. Estimated phosphorus and sediment loadings from croplands, woodlots, pastures, and grasslands in the drainage area tributary to Voltz Lake were presented in Chapter II. As set forth, much of the remaining agricultural lands within the drainage area tributary to Voltz Lake will be replaced, over time, with urban density residential, commercial, and industrial development. While such development could potentially reduce the agro-chemical loadings to Voltz Lake, this benefit maybe offset by the fact that urban lands contribute a wider range of contaminants to surface waters and generally increased rates of surface runoff.

Protection of Environmentally Sensitive Shoreland Areas
The natural shorelands of Voltz Lake, particularly along the eastern and the northern shorelines of the Lake, offer scenic vistas, valuable wildlife habitat, and important contributions to the natural functioning of the Lake ecosystem and its watershed. Protection of these ecologically sensitive and currently undeveloped shorelands needs to be an important part of any lake protection plan. Appropriate shoreland management practices, including acquisition of conservation easements or acquisitions of properties themselves, to help control sources of nonpoint pollution and to maintain the natural functioning and integrity of the Voltz Lake aquatic and land systems, represent an important consideration. The purchase of specific critical properties or the acquisition of conservation easements, as a means of protecting them from encroachment or further degradation, or as a means of facilitating their rehabilitation and restoration, is possible through the Chapter NR 50/51 Stewardship Grant and Chapter NR 191 Lake Protection Grant 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. Cost-sharing and other state funding assistance programs through the Wisconsin Department

of Natural Resources would be contingent, in part, upon the existence of adequate parking facilities to meet the Chapter NR 1 public recreational boating access standards.

With the implementation of public sanitary sewerage services within the drainage area tributary to Voltz Lake, the level of point source pollution, previously generated from onsite sewage disposal systems, can be assumed to have diminished. However, trophic state data and on-site observations of abundant growths of in-lake macrophytes would suggest that the waters of Voltz Lake continue to experience the effects of elevated concentrations of nutrients. Consequently, periodic review of public sanitary sewerage service area and facility plans is recommended.

Public Informational Programming

Additional actions can be undertaken to minimize nutrient and pollutant loadings from source areas within the drainage area tributary to Voltz 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 Lake. 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 for water quality purposes.[9]

Programming should also be developed to keep the householders in Voltz 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 Voltz 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 Lake Management District Board of Commissioners can permit the District, and the Town, to initiate appropriate responses in a timely manner.

Recommended Management Measures

Insofar as future land usage reflects these latter recommendations, it is recommended that development proceed so as not to impair the water quality or ecologically valuable areas in and near Voltz Lake. To wit, it is recommended that:

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

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

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[9] *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.*

- Residential developments be placed in conservation development, preserving portions of the open space on each property or group of properties considered for development and preserving the natural and cultural resources to the extent practicable;[10]

- Undeveloped areas of shoreland be considered for acquisition of conservation easements or purchase in order to protect the viewshed and provide habitat and nonpoint source pollution control;

- Existing public sanitary sewerage plans providing public sanitary sewer services to urban areas of the drainage area tributary to Voltz Lake continue to be monitored and reviewed periodically;

- Construction site erosion control, stormwater management, and development control ordinances pertinent to the drainage area tributary to Voltz Lake continue to be enforced;

- Informational programming be developed and delivered to encourage good urban housekeeping practices by landowners within the drainage area tributary to Voltz Lake.

In addition, where new development or redevelopment is proposed within the shoreland area, it is recommended that the provisions of the relevant Kenosha County land division and construction site erosion control ordinances be strictly enforced. In this regard, with respect to conservation developments, it is recommended that such development principles be applied especially on the lands to the north, south and southeast of Voltz Lake which are within the drainage area tributary to the Lake at such time as these lands are considered for urban residential development. In these areas, it would be desirable to maintain open space areas within the Lake drainage area and cluster the development beyond the drainage area tributary to the Lake. It is also recommended that the relevant performance standards set forth in the adopted County land and water resource management plan be enforced as necessary. These practices would be intended to minimize the impact of development on the surface and ground water flows to Voltz Lake.

PROVISION OF PUBLIC RECREATIONAL USE OPPORTUNITIES

In addition to the structural shoreline protection measures set forth above, consideration could be given to adoption of a refined recreational boating ordinance. The proposals (buoyage or WDNR Slow-No-Wake law) concerning the establishment of slow-no-wake zones within the shallow areas of the Lake, those areas with a water depth of less than five feet, should be considered to protect sensitive shorelines from erosion and human disturbances and contribute to the quality recreational experiences afforded by the waterbody. In addition, provision of additional recreational opportunities within the lake-oriented community should be considered, as discussed below.

Array of Protection Measures

Public Recreational Boating Access and Management

Public Recreational Boating Access

Chapter NR 1 of the *Wisconsin Administrative Code* establishes recreational boating access standards for Wisconsin lakes. These standards define adequate access in terms of maximum and minimum numbers of parking facilities to be provided for public recreational boating access, and are determined based upon the *boatable* surface acreage of a waterbody. For lakes of less than 50 acres, these standards are the same: five car-top parking spaces and one handicapped accessible parking space must be provided, within a predetermined distance of the boat access point, in order to meet the standards and qualify for funding assistance through various state programs. Similarly, for lakes between 50 and 99 acres, the maximum and minimum public recreational boating standards require a total of five car-top and car-trailer parking spaces plus one handicapped accessible parking space to meet the public recreational boating access standards. Because a significant portion of Voltz Lake is too shallow for boating use, the number of boatable acres is less than the 52 acres of Lake surface. Consequently, for

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

purposes of satisfying the requirements of Chapter NR 1, it is recommended that Voltz Lake be subject to the less than 50 acre standard, and that parking facilities be provided for a total of five cars plus one handicapped accessible parking space.

Boating Ordinances and Signage

The promulgation of more stringent controls on the use of powered watercraft within Voltz 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 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.[11]

2. Designation of a navigational watercraft access route to open water from the public boat launch, approximately 50 feet in width, 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 portion 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, such a zone within Voltz Lake could extend up to a distance of approximately 400 feet from the shoreline, and would be designed to avoid damage to aquatic vegetation from motorboat propeller-induced sheer.

4. Consider applying the Wisconsin Department of Natural Resources *Slow-No-Wake* law to Voltz Lake. This law prohibits the operation of any motorboat at speeds above that which is as slow as possible to be able to maintain steerage control on lakes with public access that are 50 acres in size or less. Although Voltz Lake is designated by the WDNR to have a surface area of 52 acres, the intent of the law is in regards to lakes with a *boatable* surface area of 50 acres or less. The slow speed prohibits water skiing and personal watercraft use. One of the stated goals of this law is to prevent erosion damage to shorelines caused by extensive wave action. This could be a significant factor considering the large amount of unprotected shoreline at Voltz Lake. Another goal of this law is to maintain aesthetics provided by wildlife and the serenity and relative quiet that smaller lakes offer. Many homeowners purchase property on small lakes to enjoy the tranquil lakefront.

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. 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*. Where necessary, such ordinances should be supported by appropriate regulatory marker buoys.

Placement of regulatory markers must conform to Section NR 5.09 of the *Wisconsin Administrative Code*, and buoys placed within waters of the State of Wisconsin are subject to the requirements set forth in Chapter 30,

[11] *Wisconsin Department of Natural Resources,* Guidelines: Ordinance Writing and Buoy Placement for Wisconsin Waters, *s.d.*

Wisconsin Statutes. Such buoys are white in color, cylindrical in shape, seven or more inches in diameter, and extend 36 or more inches above the water line. Two general types of buoyage exist: *regulatory buoys*, such as those used to demarcate slow-no-wake or exclusionary areas; and *informational buoys*, such as those used to enhance public awareness. Regulatory buoys include buoys used to demarcate restricted areas, prohibit boating or types of boating activity in specific areas, and control the movement of watercraft. Whereas regulatory buoys are enforceable, informational buoys are not. Local authorities have jurisdiction over the waters involved. Although buoyage has the advantages of being visible to recreational boaters and clearly demarcating the affected areas, it can be expensive to obtain, install, and maintain. Establishment of slow-no-wake areas within Voltz Lake will require amendment of the Town of Salem boating ordinance, and a Wisconsin Department of Natural Resources permit for placement of the buoys.

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 Section NR 7.087 of the *Wisconsin Administrative Code.*

Fisheries Management Measures

Few data on the fisheries of Voltz Lake are available. Notwithstanding, as is noted in Chapter III, fishing is a popular pastime on Voltz Lake. Voltz Lake appears to be able to provide a suitable habitat for a warmwater fishery with adequate water quality and dissolved oxygen levels that can contribute to the maintenance of a fish population that is dominated by desirable sport fish. To this end, a more rigorous fisheries survey should be considered in order to better identify fish population composition, length-weight distributions, community age structure, and related life history information, such as proportion of available spawning habitat, spawning success, and juvenile recruitment, that will be important for making stocking-related decisions. While assistance in stocking programs and fisheries management is potentially available through the Wisconsin Department of Natural Resources, the ability of Voltz Lake to utilize such assistance is limited by the lack of adequate public recreational boating access, pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*; however, assistance may be privately available from local commercial hatcheries. Fish stocking may require a Wisconsin Department of Natural Resources permit.

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

Species composition management refers to a group of conservation and restoration measures that include the stocking of desirable species designed to enhance the angling resource value of a lake. The mixture of species is determined by the stocking objectives. These are usually to: supplement an existing population, maintain a population that cannot reproduce itself, add a new species to a vacant niche in the food web, replace species lost to a natural or man-made disaster, or establish a fish population in a depopulated lake. Enforcement of state fishing regulations is important to the success of any sound fish management program. Such requirements provide an opportunity for both game and forage fish population to reach a sustainable level.

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

Land-Based Recreational Opportunities

The request made was at the 2003 annual meeting of the District for consideration into providing a means for residents to be able to complete a circuitous walking trail around Voltz Lake. Existing paved roadways provide suitable walking surface at the present time for a looped, noncircuitous route. Interest was expressed for

connecting the "end" of the present route from its northern limit at 116th Street to 122nd Street at the south end of the Lake, thereby completing a circuitous pathway around the eastern side of the Lake, either by means of some connecting pathway to Nelson Road/CTH V or by connecting directly to 122nd Street. Such a pathway would necessitate the crossing of some private land and possibly utilizing the present buffer strip along the eastern shorelands of the Lake.

Recommended Management Measures

- Periodic monitoring of fish populations is recommended to be conducted to determine when adequate food stock populations for predatory fishes have been established and are stable. Utilize fishing regulations to improve the opportunity for predatory fish populations to become self-sustaining, it is recommended that residents participate in volunteer creel surveys so that an ongoing monitoring of the fish population in Voltz Lake can be carried out.

- Continue to enforce fishing regulations of the Wisconsin Department of Natural Resources.

Fish surveys and other fisheries services offered by the Wisconsin Department of Natural Resources would be contingent, in part, upon the existence of adequate parking facilities to meet Chapter NR 1 public recreational boating access standards.

INSTITUTIONAL DEVELOPMENT AND PUBLIC INFORMATIONAL PROGRAMMING

Institutional Development

As the Voltz Lake community seeks a more active role in the management of the Voltz Lake, it is essential that an adequate institutional base to support such activities be developed. Currently, the community-based lake management activities are being carried out by the Voltz Lake Management District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district. The District was created by the Town of Salem to encompass those lands riparian to the main basin of Voltz Lake. Lands connected to the main basin of the Lake by tributary streams or channels were excluded from the District at the time of its creation. Notwithstanding, recent experience has demonstrated a close connection between the lands located on the constructed channel immediately to the north of the main Lake basin and the Lake proper. Consequently, in order to better manage the Lake, the Voltz Lake Management District requested that Commission staff consider the attachment of lands located to the north of Voltz Lake, within the drainage area tributary to Voltz Lake, and directly connected to the Lake via a navigable channel. Since the majority of nonpoint source pollution to Voltz Lake is the result of land use in the drainage area tributary to Voltz Lake, inclusion of such lands, to the extent possible, would provide the District with the ability to better protect and/or rehabilitate the water quality condition of the Lake.

Array of Institutional Measures

Two alternatives were identified; namely, 1) maintaining the *status quo* and 2) attaching specific lands within the drainage area directly tributary to the Lake to the District. Defining the boundary based upon a delineated sanitary sewer service area was not considered as the entire area currently within the District is served by sanitary sewerage services provided by the Town of Salem. The Town of Salem sanitary sewer service area is extensive and includes portions of drainage areas tributary to other Lakes.

The boundary review was predicated upon consideration of the following criteria:

1. Consistency with Chapter 33, *Wisconsin Statutes*, requirements that properties included within a public inland lake protection and rehabilitation district be benefited by inclusion in the district;

2. Consistency with University of Wisconsin-Extension guidance set forth in *A Guide to Wisconsin's Lake Management Law*, Tenth Edition, that recommends that the district, at a minimum, include the entire lakeshore, all riparian property, areas directly affecting the lake and/or which are included in planned service areas, and entire parcels; and

3. Consistency with applicable regional and local plans including the aforereferenced lake management plan, county development plan, and other applicable plans.

The first alternative would be to attach the properties located within the southwest one-quarter of the southwest one-quarter of U.S. Public Land Survey Section 25, Township 1 North, Range 20 East, which are outside of the current boundaries of the drainage area directly tributary to Voltz Lake. This alternative includes approximately three properties that, while within the area draining to Voltz Lake, were not initially perceived of as being "lake" properties. This is the largest boundary to be considered. Under this alternative, as shown on Map 16, the boundaries of the Voltz Lake Management District would encompass all of those lands within the Town of Salem that are riparian to Voltz Lake or that drain to Voltz Lake through a direct tributary stream connection. This alternative also would provide a more substantial operating base for the District and continue to be consistent with applicable guidance and *Statutes*.

Lands may be attached to an existing lake management district pursuant to requirements set forth in Section 33.33(2), *Wisconsin Statutes*. Attachment may be initiated either by petition of the affected landowners within the district, or by motion of the district commissioners to detach lands from the district. In both cases, the district commissioners must make a finding that the lands to be attached are benefited by inclusion within the district. This finding can be appealed to the circuit court for judicial review. While bound by the specific process and requirements of Section 33.33(2) the district commissioners have full discretion regarding the granting of a petition for attachment. If attaching lands to a District by motion of the board of commissioners, the governmental unit initially creating the district must hold a hearing on the attachment pursuant to Section 33.26 insofar as it may be applicable. In this latter case, the Town of Salem would have to consider the request for attachment of the designated lands to the Voltz Lake Management District. In any event, attachment of lands to a district should not create a hole within the district.

The second alternative would leave the boundaries of the Voltz Lake Management District unchanged, the boundaries would remain those described at the time the District was created, as shown on Map 15.

Recommended Institutional Development Measures

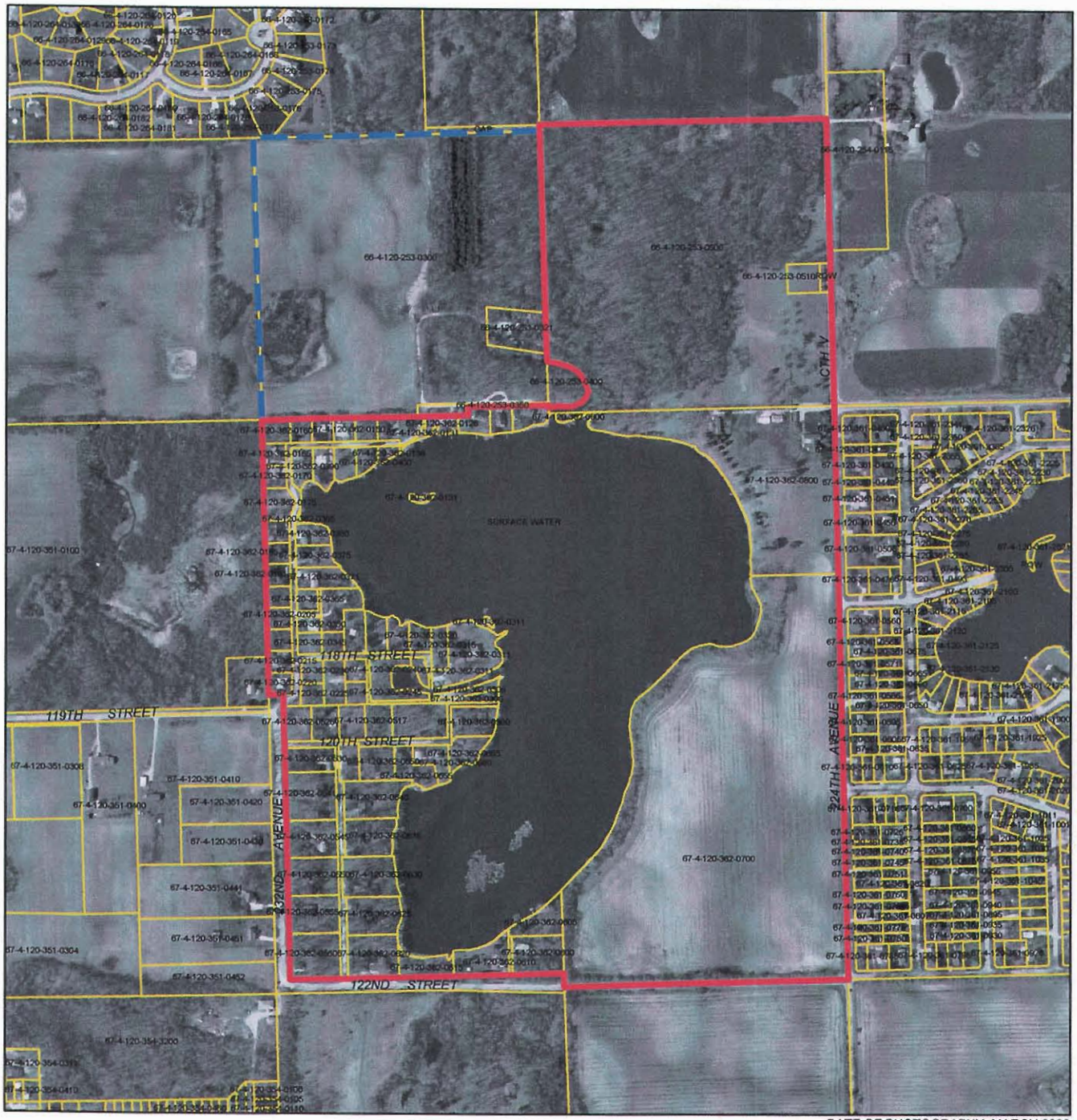
It is recommended that the Voltz Lake Management District consider increasing the existing boundaries to encompass those lands within the drainage area tributary to Voltz Lake, including those lands ultimately connected to the Lake by way of the channel entering the Lake from the north. The refined boundary, summarized graphically on Map 16, would continue to allow the Voltz Lake community to manage Voltz Lake on a sustainable basis and provide for a sound fiscal base from which to conduct lake management activities.

Public Informational and Educational Programming

In addition to the lake management measures specifically identified and set forth above, an ongoing campaign of community information will support the lake management program by encouraging the use of shoreland buffer strips, the responsible use of household and garden chemicals, and the adoption of environmentally friendly household and garden practices to minimize the input of nutrients from these riparian areas is recommended. Lake 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 the environmental impacts. Removal of aquatic vegetation can reduce or eliminate fish and wildlife habitat to the detriment of both active and passive recreational uses of the lake. Thus, public information is an important component of a lake management program. Posters and pamphlets are available from the University of Wisconsin-Extension and Wisconsin Department of Natural Resources that provide information about and illustrations of aquatic plants, detailing their importance in providing habitat and food resources aquatic environments, and explaining the need to control the spread of undesirable and nuisance plant species. Similar information is available to support good urban yard care practices which directly affect the generation and transport of nutrients and other contaminants from riparian lands to a lake. The actions recommended to be supported by a public informational campaign can be undertaken by individual householders and landowners within the drainage area tributary to Voltz Lake, and will directly contribute to the lake protection program being implemented by the Voltz Lake Management District.

Map 16

RECOMMENDED BOUNDARY OF THE VOLTZ LAKE MANAGEMENT DISTRICT



DATE OF PHOTOGRAPHY: MARCH 2000

DISTRICT BOUNDARY

PROPOSED ADDITIONAL DISTRICT BOUNDARY

67-4-120-362-0700 PARCEL BOUNDARY AND NUMBER

Source: SEWRPC.

N

GRAPHIC SCALE

0 350 700 1,050 Feet

SUMMARY

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

Voltz Lake was found to be a eutrophic, moderately deep water lake of average water quality located in close proximity to the Milwaukee metropolitan area and adjacent to a progressively urbanizing part of Kenosha County in which its tributary drainage area is 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 Voltz Lake protection plan, summarized in Table 10 and depicted graphically on Map 17, 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.

The recommended plan includes continuation of an ongoing program of public information and education providing 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 Lake should be made available to riparian householders, thereby providing riparian residents with alternatives to traditional alternatives and activities. Periodic, ongoing monitoring of lake water quality are recommended as part of this program.

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

Table 10

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN ELEMENTS FOR VOLTZ LAKE

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Aquatic and Shoreland Plant Management	Manual harvesting[b]	Areas of nuisance growth around piers, docks, and beaches; and wetlands	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers, and in shoreland areas, especially during summer and fall; collect plant fragments arising from boating and harvesting activities	Voltz Lake Management District, private lakeshore homeowners
	Chemical control	Areas of nuisance growth around piers, docks, and beaches; and wetlands	Consider limited use of herbicides to control nuisance and nonnative vegetation in and around the developed portions of the Lake; consider an early spring treatment to control Eurasian water milfoil growth, subject to WDNR permits.	Voltz Lake Management District, WDNR
	Nonnative aquatic plant management program	Eurasian water milfoil control zone and areas containing purple loosestrife	Limit recreational boating through Eurasian water milfoil areas to minimize the spread of the plant throughout the Lake; limited use of herbicides in spring, and manual removal during summer and fall recommended	Voltz Lake Management District
Land Use Management[a]	Land use zoning	Entire watershed	Observe guidelines set forth in the regional and local land use plans, and Kenosha County land and water resource management plan; protect environmentally sensitive lands as recommended in the regional natural areas and critical species habitat protection and management plan; encourage conservation development practices providing for the clustering of any new development within the lake drainage area to minimize nonpoint pollution impacts on, and potential losses of, groundwater recharge	Kenosha County, Town of Salem
	Protection of environmentally sensitive shorelands	Shoreland areas	Apply appropriate shoreland management practices; consider acquisition of conservation easement(s) to protect the viewshed and provide continued nonpoint source pollution control benefit in currently undeveloped areas of shoreland.	Kenosha County, Town of Salem, Voltz Lake Management District
	Public sanitary sewage system management	Entire watershed	Periodically review current public sanitary sewerage service area plan to continue to provide water-borne sewerage services to urban areas of the watershed.	Kenosha County, Town of Salem, Town of Salem Utility District No. 2
	Ordinance enforcement	Entire watershed	Enforce construction site erosion control, stormwater management, and development control ordinances and programs as necessary	Kenosha County, Town of Salem
Nonpoint Source Pollution Control	Urban nonpoint source controls	Entire watershed	Promote sound urban housekeeping and yard care practices through informational programming	Kenosha County, Town of Salem, Voltz Lake Management District
	Construction site erosion control and stormwater management ordinances	New clustered developments in conservation subdivisions	Develop and enforce construction site erosion control and stormwater management ordinances; review ordinances for concurrency with proposed NR 152	Kenosha County, Town of Salem
	Rural nonpoint source controls	Entire watershed	Promote sound rural land management practices to reduce soil loss and contaminant loadings through preparation of farm conservation plans in accordance with the county land and water resource management plan	USDA, WDATCP, Kenosha County
Shoreland Protection	Shoreland erosion	Shoreland areas	Construct, maintain and repair structures where needed.	Voltz Lake Management District and private lakeshore homeowners

Table 10 (continued)

Plan Element	Subelement	Location	Management Measures	Management Responsibility
Shoreland Protection (continued)	Native aquatic plant community establishment	Shoreland areas	Encourage shoreland management practices that maintain or reestablish native shoreline vegetation in and adjacent to the Lake	Voltz Lake Management District and private lakeshore homeowners
Recreational Use Management	Public Recreational Boating Access	Voltz Lake	Provide adequate parking facilities to meet Chapter NR 1 public recreational boating access standards	Wisconsin Department of Natural Resources, Voltz Lake Management District
	Recreational use zoning	Voltz Lake	Enforce slow-no-wake ordinance within 100 feet of shoreline; 200 feet for personal water craft; develop and refine ordinances as appropriate	Wisconsin Department of Natural Resources, Town of Salem, Voltz Lake Management District
	Hiking trail	Voltz Lake	Explore possibility of completing hiking trail around lake utilizing mainly existing paved roadways and rights-of-way	Voltz Lake Management District; Town of Salem, riparian property owners
Fisheries Management	Fisheries survey	Voltz Lake	Conduct fisheries survey to determine the status of the fishery; monitor carp populations through fish surveys; consider developing a Lake resident volunteer creel census program	Wisconsin Department of Natural Resources, Voltz Lake Management District
	Develop a fishery enhancement program based upon survey	Voltz Lake	Review survey data and habitat protection measures for improved fisheries as needed; continue to enforce fishing regulations and review as necessary	Wisconsin Department of Natural Resources, Voltz Lake Management District
Organizational Development and Ancillary Management Measures	Voltz Lake Management District	Voltz Lake Management District	Consider attachment of lands located to the north of the current boundary of the Voltz Lake Management District	Voltz Lake Management District; Town of Salem
	Monitoring programs[c,d]	Voltz Lake	Continue to participate in the WDNR Self-Help monitoring program; conduct an aquatic plant survey every 3 to 5 years	Wisconsin Department of Natural Resources, Voltz Lake Management District
	Public informational programming	Direct drainage area tributary to Voltz Lake	Continue public awareness and informational programming	Voltz Lake Management District, University of Wisconsin-Extension

[a]*Land use recommendations are those set forth in the regional land use, water quality management, and natural areas and critical species habitat protection and management plans. No specific costs allocated to the Voltz Lake Management District.*

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

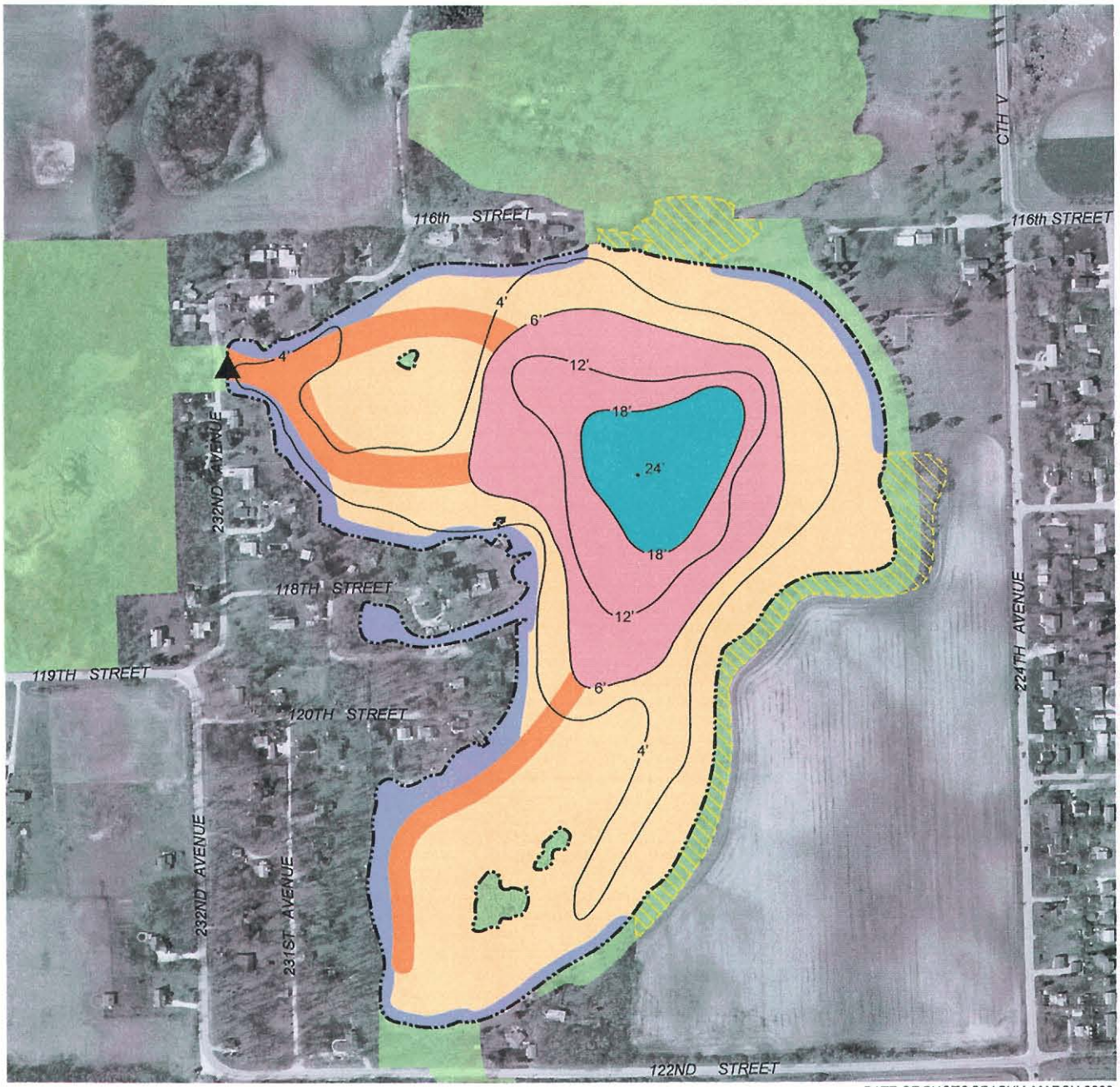
[c]*Partial funding available through the Wisconsin Department of Natural Resources grant programs.*

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

Source: SEWRPC.

Map 17

RECOMMENDED LAKE MANAGEMENT PLAN ELEMENTS FOR VOLTZ LAKE



—20'— WATER DEPTH CONTOUR IN FEET

DATE OF PHOTOGRAPHY: MARCH 2000

LAND USE MANAGEMENT

- PROTECT ENVIRONMENTAL CORRIDOR LANDS
- PROTECT RIPARIAN WOODLANDS
- OBSERVE GUIDE LINES IN REGIONAL AND LOCAL LAND USE PLANS
- PERIODICALLY REVIEW SANITARY SEWER AREA
- ENFORCE LOCAL ORDINANCES

AQUATIC PLANT MANAGEMENT

- MAINTAIN RECREATIONAL BOATING ACCESS LANES
- MANUALLY HARVEST AROUND PIERS AND DOCKS; MAINTAIN NATIVE AQUATIC AND SHORELAND PLANT GROWTH FOR HABITAT PROTECTION

WATER QUALITY MANAGEMENT

- PARTICIPATE IN WISCONSIN DEPARTMENT OF NATURAL RESOURCES SELF-HELP MONITORING PROGRAM
- PROMOTE GOOD URBAN HOUSE KEEPING PRACTICES

RECREATIONAL USE MANAGEMENT

- PROVIDE PARKING FACILITIES; MAINTAIN PUBLIC RECREATIONAL ACCESS
- HABITAT: NO AQUATIC PLANT MANAGEMENT (EXCEPT CONTROL OF NONNATIVE SPECIES)
- BOATING: MANAGE AQUATIC PLANTS AS NECESSARY TO PROMOTE NAVIGATION
- OPEN WATER GREATER THAN 18 FEET

GRAPHIC SCALE
0 250 500 FEET

Source: SEWRPC.

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APPENDICES

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Appendix A

REPRESENTATIVE ILLUSTRATIONS OF AQUATIC PLANTS FOUND IN VOLTZ LAKE

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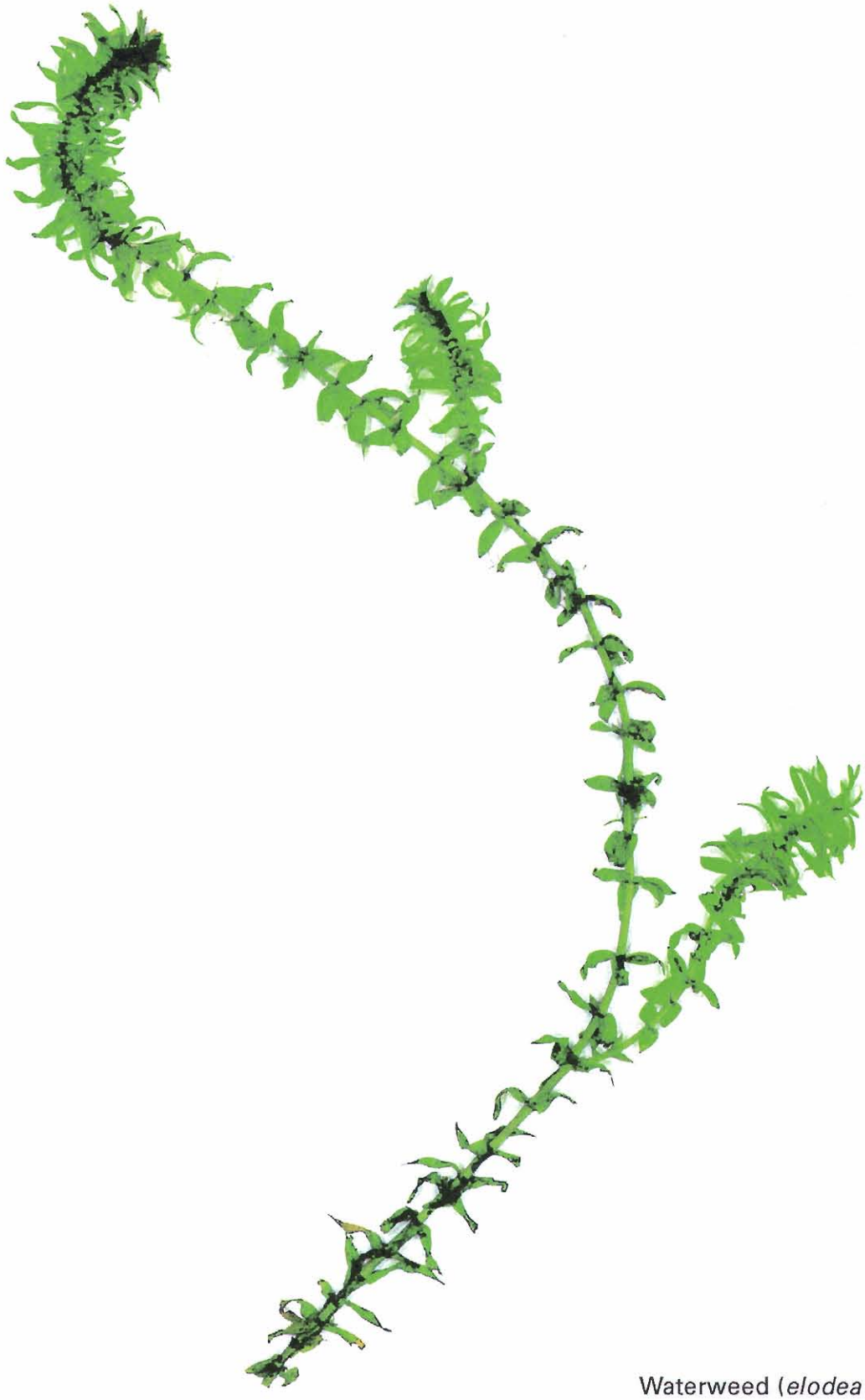
Coontail (*ceratophyllum demersum*)



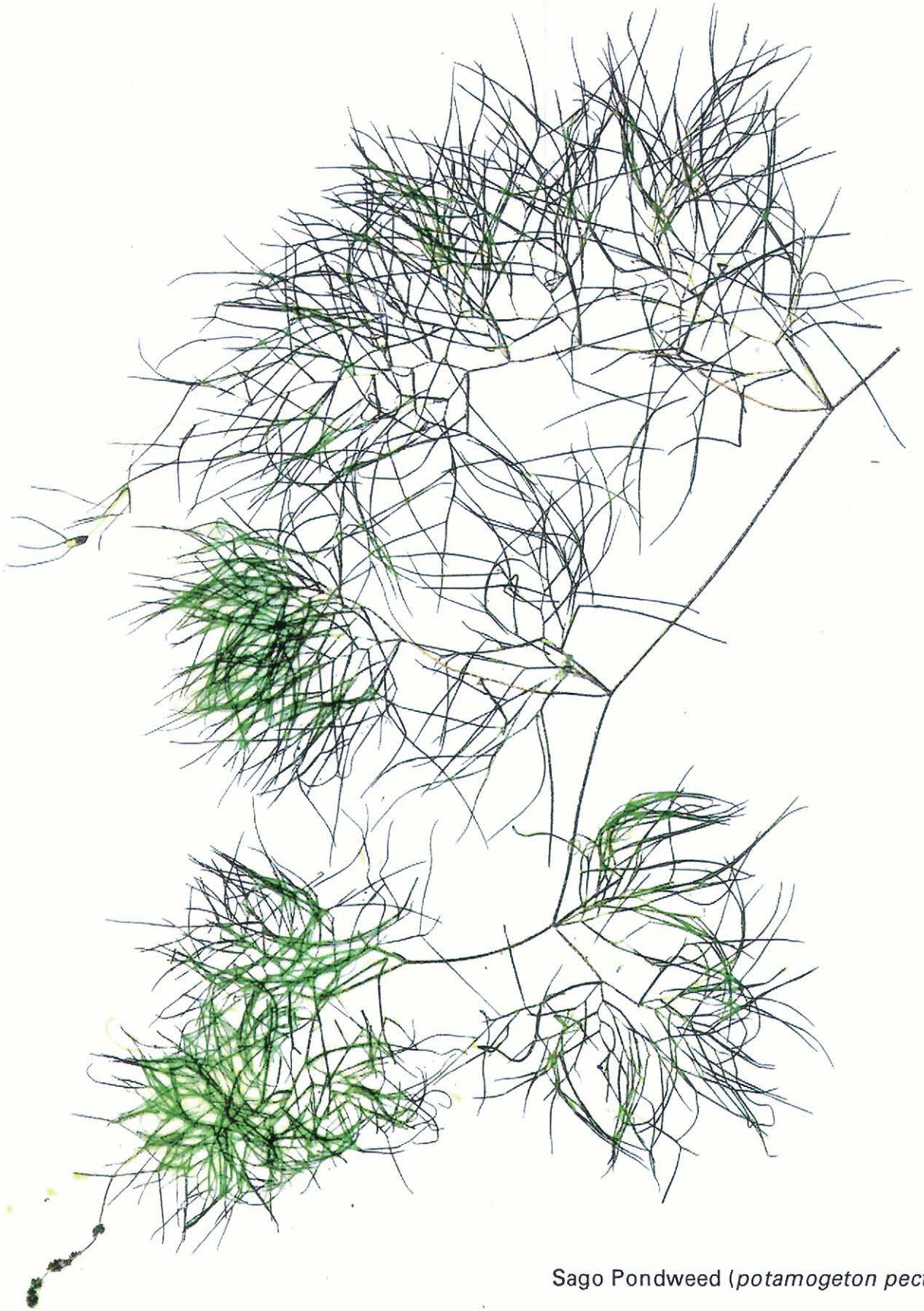
Waterweed (*elodea canadensis*)

Eurasian Water Milfoil (*myriophyllum spicatum*)

Bushy Pondweed (*najas flexilis*)

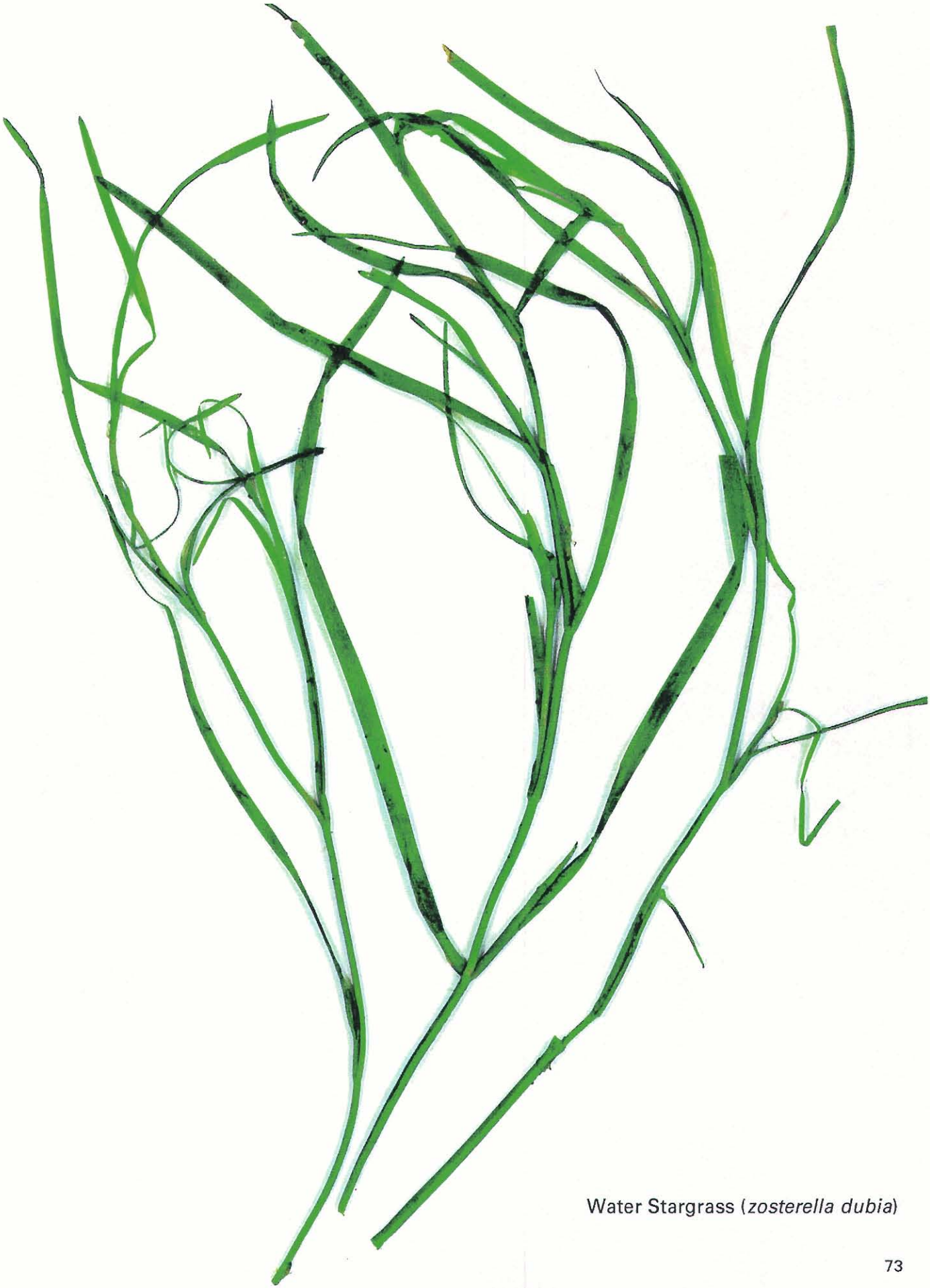
Curly-Leaf Pondweed (*potamogeton crispus*)

White Water Lily (*nymphaea odorata*)



Sago Pondweed (*potamogeton pectinatus*)

Flat-Stem Pondweed (*potamogeton zosteriformis*)

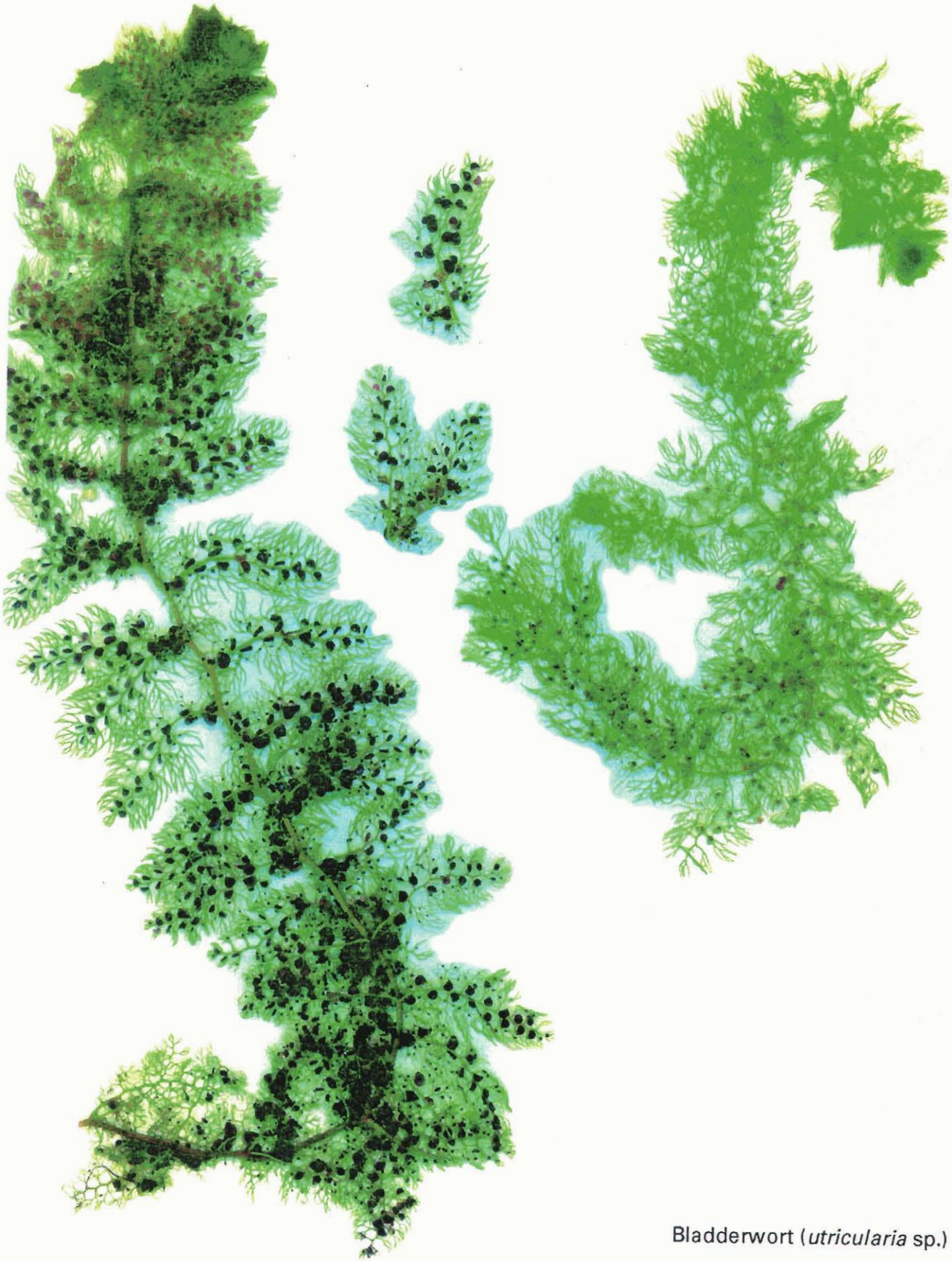


Water Stargrass (*zosterella dubia*)

Yellow Water Crowfoot (*ranunculus flabellaris*)

NOTE: Plant species in photograph are not to scale.

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



Bladderwort (*utricularia* sp.)

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Appendix B

TOWN OF SALEM RECREATIONAL BOATING ORDINANCES APPLICABLE TO VOLTZ LAKE

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CHAPTER 20

LAKES AND BEACHES

20.01 INTENT. The intent of this chapter is to provide safe and healthful conditions for the enjoyment of aquatic recreation consistent with public needs and the capacity of the water resource.

20.02 APPLICABILITY AND ENFORCEMENT. The provisions of this chapter shall apply to the lakes within the jurisdiction of the Town and to the rivers within the Town wherever the provisions of this chapter would be applicable to river traffic, except to the waters of Silver Lake, which shall be enforced exclusively by the Village of Silver Lake. (Adopted April 10, 2000; Ordinance No. 00-04-10).

20.03 STATE STATUTES INCORPORATED.

(1) The following sections of the Wis. Stats., 1987, 1988 and any subsequent amendments thereto are hereby adopted and by reference, made a part of this section as though fully set forth herein.

30.05	Definitions
30.51	Operation of Un-numbered Boats Prohibited
30.52	Certificate of Number
30.53	Identification Number to be Displayed on Boat; Certificate to be Carried
30.531	Certificate of Title; Requirements; Exemptions
30.54(2)	Transfer of Ownership of Numbered Boat
30.55	Notice of Abandonment or Destruction of Boat or change of address
30.60	Classification of Motorboats
30.61	Lighting Equipment
30.62	Other Equipment
30.635	Motorboat Prohibition
30.64	Patrol Boats exempt from Certain Traffic Regulations
30.65	Traffic Rules
30.66	Speed Restrictions
30.67	Accidents and Accident Reports
30.675	Distress Signal Flag
30.68	Prohibited Operation
30.681	Intoxicated Boating

30.682	Preliminary Breath Screening Test
30.683	Implied Consent
30.684	Chemical Tests
30.686	Report Arrest to Department
30.687	Officers Action After Arrest
30.69	Water Skiing
30.70	Skin Diving
30.71	Boats Equipped with Toilets

(2) Any act required to be performed or prohibited by the provisions of any of the above-referenced statutory sections incorporated herein, is required or prohibited by this section.

20.04 DEFINITIONS.

(1) "SHORE ZONE" shall mean the water area within two hundred (200) feet of any lakeshore within the Town of Salem except as to Silver Lake, where the shore zone shall mean the water area from the shore to the five (5) foot depth as shown on the hydrographic map bearing legend DNR 1968.

(2) "SWIMMING ZONE" shall mean an authorized area marked by official buoys to designate a swimming area.

(3) "MOORAGE" shall mean an area where continuous mooring of boats for more than 24 hours is permitted.

(4) "PUBLIC ACCESS" shall mean a marina or landing facility and the adjoining public shoreline under the ownership of the state, county or other municipality.

(5) "SLOW NO-WAKE SPEED" shall mean that speed at which a boat moves as slowly as possible while still maintaining steerage control.

20.05 SPEED RESTRICTIONS.

(1) In addition to the speed restrictions set forth in Sec. 20.03 of this Code adopting Sec. 30.66 Wis. Stats., no person shall operate a boat in excess of the slow no-wake speed:

a. On any lake within a defined shoreline zone;

b. On any lake between the hours of 7 p.m. and 10 a.m. on either the shore zone or the traffic lane;

c. On that part of the Fox River bounded on the north by the Highway C bridge and on the south by the Wisconsin-Illinois border. (Adopted March 9, 1998; Ordinance No. 98-3-9B).

d. On Lake Shangri-La in the area of the lake known as "the narrows". Slow no-wake buoys shall be placed to implement the speed restrictions as follows:

1 buoy 140 feet from the shore of the property identified as 12026 214th Avenue.

1 buoy 140 feet from the shore of the property identified as 21401 121st Street.

(2) Pursuant to Sec. 30.635, Wis. Stats., no person shall operate a motorboat on Rock Lake in excess of the slow no-wake speed.

20.06 CAPACITY RESTRICTIONS. No person shall operate or loan, rent or permit a boat to leave the place where it is customarily kept for operation on the waters covered by this chapter with more passengers or cargo than shall be stated on the capacity information plate as required by Sec. 30.501, Wis. Stats.

20.07 BUOYS, PIERS AND RAFTS.

(1) REMOVAL. The Town may remove or cause to be removed all buoys, markers, piers and their supports, privately owned or placed, which are not removed by December 1 of each year, and charge the cost and expense of such removal to the riparian owner. If such charge is not paid within thirty (30) days after request therefor, a penalty of ten (10%) percent shall be added to such charge and the same shall constitute a lien on the property of the riparian owner and be inserted on the Town tax roll by the Town Clerk upon order of the Town Board and after notice to riparian owner. (Adopted April 10, 2000; Ordinance No. 00-04-10)

(2) COMPLIANCE. All buoys and aids to navigation must comply with Sec. 30.74(2), Wis. Stats., and administrative regulations and

shall have affixed thereto such numbers as assigned to them by the permit. Such numbers shall be located at least twelve (12) inches above the waterline and shall be not less than three (3) inches in height.

(3) WHARVES AND PIERS. No person shall erect or maintain any wharf or pier contrary to the statutes and regulations of the state or extending more than one hundred (100) feet from the shore unless prior written approval is obtained from the Town on all lakes and waters within the Town's jurisdiction. (Adopted April 10, 2000; Ordinance No. 00-04-10).

(4) PIER OR MOORING BUOY. No pier or mooring buoy shall be placed in the waters located within the boundary of a designated fire lane (extended into the water) unless so authorized in writing by the Town Board as to all waters under the jurisdiction of the Town Board, including those waters of Silver Lake into which designated Town fire lanes are extended. (Adopted April 10, 2000; Ordinance No. 00-04-10).

(5) RAFTS AND PLATFORMS.

a. No person shall place or maintain any raft or platform more than 100 feet from shore.

b. Each raft or platform must:

1. Be firmly anchored with at least eighteen (18) inches of freeboard above the waterline;

2. Be painted white; and

3. Have attached thereto not more than twelve (12) inches from each corner or projection, a red reflector of not less than three (3) inches in diameter.

(6) BUOY PERMITS.

a. No bathing beachmarker, speed zone marker, information marker, mooring buoy, fishing buoy or other marker shall be anchored or placed on any of the waters

under the jurisdiction of the Town unless a written application therefor is made to and approved by the Town Board. The Town shall issue numbers for buoys as required in paragraph (2) above. (Adopted April 10, 2000; Ordinance No. 00-04-10).

b. PERMIT FEE ESTABLISHED. Any person making application for the placement of a mooring buoy or other approved marker in the waters of any lake within the Town of Salem in accordance with the above section shall pay to the Clerk a permit fee of $10. Such permit shall remain in effect so long as the applicant owns or rents the property for which such permit is granted. The permits granted hereunder shall automatically expire when an applicant sells or no longer occupies the premises for which the permit has been granted.

(7) PLACEMENT OF AUTHORIZED MARKERS. The chief of the Water Safety Patrol is authorized and directed to place authorized markers, navigation aids and signs in such water areas as shall be appropriate to advise the public of the provisions of this chapter and to post and maintain a copy of this chapter at all public access points within the jurisdiction of the Town.

20.08 SWIMMING REGULATIONS.

(1) SWIMMING FROM BOATS PROHIBITED. No person shall swim from any unmanned boat unless such boat is anchored.

(2) DISTANCE FROM SHORE OR BOATS. No person shall swim beyond the shore zone or more than fifty (50) feet from any pier unless within marked or authorized areas, or more than twenty-five (25) feet from anchored rafts or boats unless accompanied by a boat manned by a competent person and having readily available a ring buoy. Such boat shall stay reasonably close to and guard such swimmer, not less than one boat for each two (2) swimmers.

(3) HOURS LIMITED. No person shall swim more than two-hundred (200) feet from the shoreline between the hours of 7 p.m. and 10 a.m.

20.09 WATERSKIING.

(1) HOURS. No person shall operate a boat for the purpose of towing a water-skier, aquaplane or similar device or engage in waterskiing between the hours of 7 p.m. and 10 a.m.

(2) TRAFFIC LANE. Any boat engaged in towing a person on water skis, aquaplane or similar device must conform to all sections of this chapter and, in addition, must operate in a counterclockwise pattern on the lake in the traffic lane. There shall be no waterskiing, aquaplaning or similar activity within the shore zone.

(3) TOWING. There shall be not more than two (2) persons being towed by one (1) boat and each shall have an individual towline. Persons being towed must wear personal flotation devices as defined in Sec. 30.62(3), Wis. Stats.

(4) EXCEPTIONS. The limitations of this section shall not apply to participants in ski meets or exhibitions authorized and conducted as provided in Sec. 20.11 of this chapter.

20.10 LITTERING WATERS PROHIBITED.

(1) Any boat or craft which is designed for persons to use as living, sleeping or camping activities, commonly referred to as a "houseboat", shall be equipped with suitable sanitation facilities and comply with Sec. 20.03 of this chapter, adopting Sec. 30.71, Wis. Stats.

(2) No person shall leave, deposit, place or throw on the waterways, ice, shores of waterways or upon any other public or private property adjacent to waterways any cans, bottles, debris, refuse or other solid waste material of any kind.

20.11 RACES, REGATTAS, SPORTING EVENTS AND EXHIBITIONS.

(1) PERMIT REQUIRED. No person shall direct or participate in any boat race, regatta, waterski meet or other water sporting event or exhibition on Silver Lake, unless such event has been authorized jointly by the Village Board of Silver Lake and the Town Board. On all other waters under the jurisdiction of the Town, such permit shall be authorized by the Town Board.

(2) PERMIT. A permit issued under this section shall specify the course or area of water to be used by participants in such event and the permittee shall be required to place markers, flags or buoys approved by the chief of the Water Safety Patrol designating the specified area. Permits shall be issued only when the proposed use of the water can be carried out safely and without danger to or substantial obstruction of other watercraft or persons using the lake.

(3) RIGHT-OF-WAY OF PARTICIPANTS. Boats and participants in any such permitted event shall have the right-of-way on the marked area and no other persons shall obstruct such area during the race or event or interfere therewith.

(4) PERMIT FEE REQUIRED. Upon making application for a special event permit, the applicant shall pay a $10 permit fee to the Town Clerk.

20.12 DRIVING AUTOMOBILES OR OTHER MOTOR DRIVEN VEHICLES ON THE ICE.

(1) SPEED. No person shall use or operate any automobile at a speed in excess of 10 mph on the ice of any lake or waterway within the Town of Salem.

(2) HOURS. No person shall use or operate any automobile on the ice of any lake or other waterway within the Town of Salem after 9 p.m.

(3) DEFINITION. The word "automobile" as used in this chapter shall be construed to mean all motor vehicles of the type and kind permitted to be operated on the highways in the State.

(4) RISK AND LIABILITY. All traffic on the ice-bound waters within the Town of Salem shall be at the risk of the traveler as set forth in Sec. 30.81(3), Wis. Stats. Nothing in this chapter shall be construed as rendering the Town liable for any accident to those engage in permitted traffic while this chapter is in effect.

20.13 JURISDICTION. Recognizing the joint jurisdiction of the Village of Silver Lake and the Town over the waters of Silver Lake, it is the intent of this chapter that the Village of Silver Lake and the Town shall cooperate and coordinate ordinances, rules and regulations and shall have joint jurisdiction for enforcement purposes, except that violations occurring in the Town shall be brought before the Municipal Court of the Town and those violations under

the jurisdiction of the Village of Silver Lake shall be brought before the Municipal Court of the Village of Silver Lake.

20.14 DUTIES AND QUALIFICATIONS OF WATER PATROL OFFICER.

(1) QUALIFICATIONS. The Town Board of the Town of Salem may appoint one (1) or more water patrol officers who shall be adults of good moral character with no prior criminal record. The water patrol officer shall be a certified law enforcement officer.

(2) AUTHORITY. The Water Patrol Officer of the Town of Salem shall have the authority to make arrests in the course of duty enforcing the provisions of this chapter, including those provisions of the Wisconsin Statutes incorporated be reference. The Water Patrol Officer shall have the authority to carry firearms in the course of duty, subject to the restrictions and policies established by the Town Board from time to time. (Adopted February 13, 1995; Ordinance 95-2-13B).

(3) ORDINANCE ENFORCEMENT OFFICER. The Town of Salem Ordinance Enforcement Officer may perform the additional duties of water patrol officer and shall have the power of arrest and may issue citations for violations of this chapter, but shall not carry a firearm. (Adopted April 12, 1993; Ordinance 93-4-12).

20.15 PENALTIES.

(1) Unless otherwise provided herein, any person violating any provisions of this chapter, shall, upon conviction, be subject to the penalty provided in Sec. 25.04(1)a. of this Code for the first offense and shall be subject to the penalty provided in Sec. 25.04(1)b. of this Code upon conviction for the same offense a second or subsequent time within one year.

(2) Any person violating the provisions of Sec. 20.03 of this chapter incorporating Sec. 30.681 or Sec. 30.684 Wis. Stats., shall, upon conviction, be subject to a forfeiture of not less than $150 nor more than $300.

(3) Any person violating any provision of the Wis. Stats. incorporated herein, which violation is punishable by the

imposition of a fine or imprisonment or both shall be referred to state authorities for prosecution.

(4) Citations for violations of this chapter shall be issued on forms prepared by the Department of Natural Resources and the Uniform Wisconsin Schedule adopted pursuant to Sec. 23.66, Wis. Stats., shall be effective for the posting of bonds for violations under this chapter.

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Appendix C

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

INTRODUCTION

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

DATA ACQUISITION AND REPORTING

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

The body of the form, shown in Figure C-1, provides space for recording data on individual fishes caught during the angling experience. The major fish species present in Voltz Lake are listed in the right hand column, together with a numeric code that represents that fish species. Not all fish species reported from the Lake are listed,

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

Figure C-1

CREEL SURVEY FORM

Lake Name: VOLTZ LAKE

Interviewer/person submitting report: _____

Date: _____
(Month/Day/Year)

Type of Fishing: (1) Boat fishing (2) Shore fishing
(2) Open-ice fishing (4) Ice shanty fishing
(5) Wading

Weather: _____

Number in Fishing Party: _____

Air Temperature (°F): _____

Start Fishing Time: ____:____am/pm

Water Temperature (°F): _____

End Fishing Time: ____:____am/pm

Secchi Depth (ft): _____

Total Fish Time (hour): _____hrs. _____min.

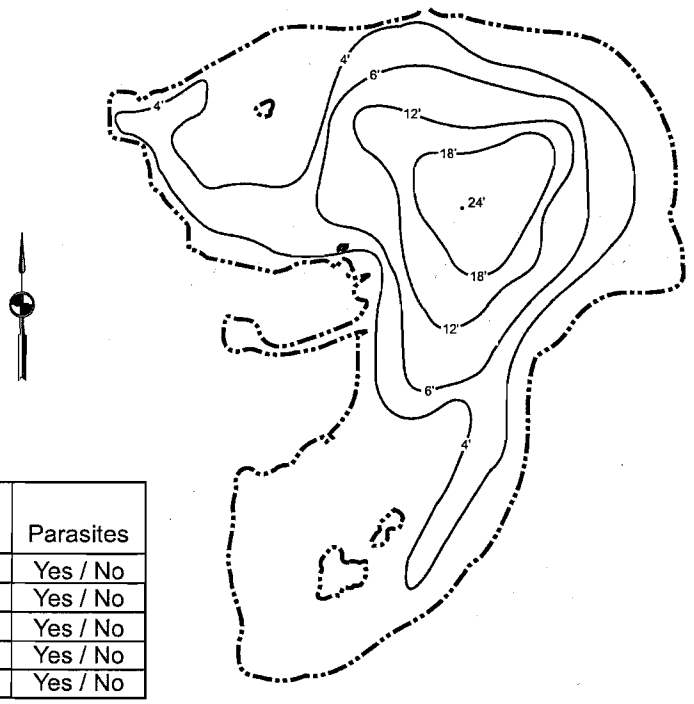
Measurements for all Fish Caught

Species Code	Total Length (in)	Weight (lbs)

Species List

Species	Code	% of Time Fished For	# Caught	# Kept
Bluegill	1			
Yellow Perch	2			
Green Sunfish	3			
Pumpkinseed	4			
Rock Bass	5			
Largemouth Bass	6			
Smallmouth Bass	7			
Musky	8			
Northern Pike	9			
Walleye	10			
Warmouth	11			
White Sucker	12			
Bullhead	13			
Carp	14			
	15			
	16			
	17			
	18			

Show Location of Area Fished on Map below:



Fish Condition Observations

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

however. Fishes not listed can be added in the blank spaces provided. Some species, such as the bullheads, have a number of variants, e.g., yellow bullheads, brown bullheads, and black bullheads, that have been reported in the Lake as documented in Chapter II. There are specific taxonomic difficulties in distinguishing these varietals, and, from a fisheries management point of view, little difference between their habitat, feeding, and reproductory requirements. However, should the census taker have access to an appropriate taxonomic key and be able to determine these varietals, each could be listed in the spaces provided. Aides to taxonomic identification of fishes are available either on-line or in book form;[2] an example of a taxonomic key to distinguish green sunfish from bluegill, pumpkinseed, orange spotted sunfish, longear sunfish, and warmouth is shown as Figure C-2.

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

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

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

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

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

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

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

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

Figure C-2

PICTORIAL IDENTIFICATION FOR SUNFISHES

Green Sunfish

Adult

Mouth reaches to or beyond the middle of the eye

2 dorsal fins that appear as one

Light blue to whitish streaks emanating from the head

No tooth patch on the tongue

Relatively elongated gill rakers

Adult

Breeding male

Similar Species

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

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

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

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

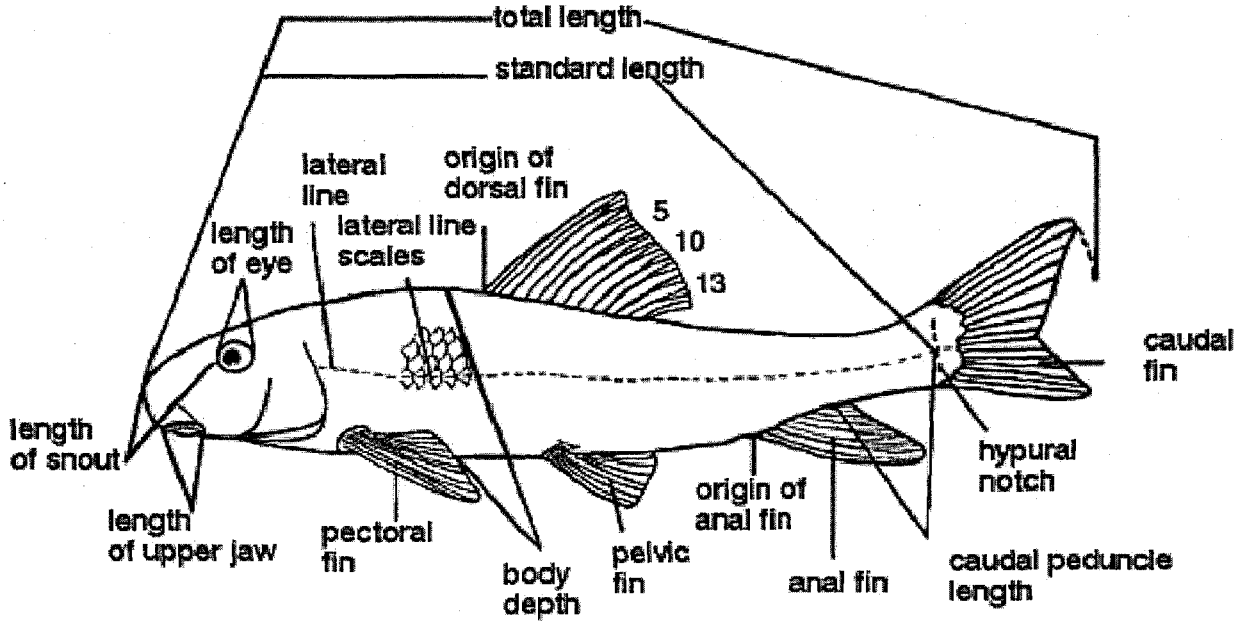
Longear sunfish
The longear sunfish is somewhat similar to the green sunfish. The longear sunfish has a reddish margin around its opercular tab (which is elongated in large specimens but not in small ones) and 34-38 lateral line scales. The green sunfish has a white to yellow margin around its opercular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

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

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

Figure C-3

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



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

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

DATA ANALYSIS AND INTERPRETATION

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

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

Species Caught

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

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

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

Catch per Unit Effort

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

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

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

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

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

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

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

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

Average Total Length and Average Weight

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

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

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

In a lake where conditions are not changing dramatically, these average total length and average weight values would be likely to remain somewhat similar over time. This similarity is due to the fact that anglers are as likely to catch young fishes as well as older fishes in a random manner. Provided all of these data are recorded, the numbers of younger and older fish would tend to remain somewhat constant over time. Dramatic changes in these numbers would suggest that a summer kill or winter kill may have occurred, or that a particular species of fish had had a poor breeding season where few young survived. Dramatic changes could also indicate a change in angling pressure, such as would be expected in the case where anglers capture larger (or smaller) numbers of fishes in a given year, altering the make up of the fish community. These latter changes can be evaluated using total length and weight data "classes," since the length and weight of fishes is proportionate to their age. By plotting the data in the form of bar graphs or histograms, missing or abnormal age classes (see below) can be identified. Such instances should be reported to the Wisconsin Department of Natural Resources fisheries managers or other trained individuals for further investigation.

Age Classes

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

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

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

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

Condition Factor

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

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

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

Miscellaneous Information

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

PUBLIC INFORMATIONAL PROGRAMMING

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