MEMORANDUM REPORT NO. 148

A LAKE PROTECTION PLAN FOR MIDDLE GENESEE LAKE

WAUKESHA COUNTY WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

MEMORANDUM REPORT
NUMBER 148

A LAKE PROTECTION PLAN FOR MIDDLE GENESEE LAKE WAUKESHA COUNTY, WISCONSIN

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Chapter I

INTRODUCTION

Middle Genesee Lake, located in the Town of Summit, Waukesha County, Wisconsin, is a valuable resource offering a variety of recreational and aesthetic opportunities to the resident community and its visitors. The Lake, which is the central waterbody in a chain of three seepage lakes, is an integral part of this lake-oriented community. However, the recreational and visual value of the Lakes is perceived to be threatened by changing land use conditions in the drainage area tributary to Middle Genesee Lake. Seeking to improve the usability and to prevent deterioration of the natural assets and recreational potential of the Middle and Lower Genesee Lakes, the riparian residents formed the Genesee Lakes Association. This voluntary body has undertaken a number of lake-oriented projects over the years since its formation. Nevertheless, the voluntary nature of the Association was determined not to provide the level of constant investment in the Lakes as was considered necessary by the residents of the middle lake. Thus, during 1993, the citizens within the Middle Genesee Lake community petitioned for the creation of a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district. Subsequently, the Middle Genesee Lake Management District was duly created to undertake an ongoing program of community involvement, education, and management.[1]

This report sets forth a lake protection plan for Middle Genesee Lake, which plan is the culmination of much of the effort undertaken by the Middle Genesee Lake Management District since its formation. This plan represents part of the ongoing commitment of the Middle Genesee Lake Management District, the Genesee Lakes Association, and the Town of Summit to sound planning with respect to the Lakes. The plan was prepared over a two-year period between 2001 and 2002 by the Southeastern Wisconsin Regional Planning Commission, in cooperation with the Middle Genesee Lake Management District. The plan includes the results of field surveys conducted by the Commission during the year 2001, and incorporates water quality monitoring data collected by the U.S. Geological Survey from 1996 through 2001. This planning project was funded, in part, through a Wisconsin Department of Natural Resources Lake Management Planning Grant awarded to the Middle Genesee Lake Management District under the Chapter NR 190 Lake Management Planning Grant program.

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[1] *While the initial conceptualization of the boundary of the public inland lake protection and rehabilitation district included lands riparian to all three lakes in the Genesee Lakes chain, property owners of Upper Genesee Lake and Lower Genesee Lake areas decided not to participate in the process of forming a Chapter 33,* Wisconsin Statutes, *public inland lake protection and rehabilitation district. Hence, the Middle Genesee Lake Management District, as currently created, serves only lands riparian to the central of the three waterbodies in the Genesee Lakes chain. Notwithstanding, the opportunity exists for the Upper and Lower Genesee Lakes communities to join with the Middle Genesee Lake community within an expanded public inland lake protection and rehabilitation district at a future date should the landowners decide to do so.*

This plan is intended to form an integral part of any future comprehensive lake management plan for Middle Genesee 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 Middle Genesee Lake will require additional water quality and biological data collection and analysis.

The objectives of this lake protection and recreational use plan for the Middle Genesee Lake were developed in consultation with the Middle Genesee Lake Management District, and the Genesee Lakes Association. These objectives are:

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

2. To provide a high-quality, water-oriented urban residential setting with recreational and aesthetic opportunities for residents and visitors to the Middle Genesee Lake, and to manage the Lake in an environmentally sound manner; and,

3. To effectively maintain the water quality of Middle Genesee 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*,[2] should serve as an initial guide to achieving these objectives over time.

[2]*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

Middle Genesee Lake is located in the south central portion of the Town of Summit, in western Waukesha County, as shown on Map 1. Middle Genesee Lake is a groundwater-fed lake having an inlet to the northeast and an outlet to the south. Inflow to Middle Genesee Lake originates in Upper Genesee Lake and drains from that Lake through a short stretch of stream and a culvert under STH 67 into Middle Genesee Lake. Outflow from Middle Genesee Lake is to Lower Genesee Lake to the south through a box culvert under Genesee Lake Road. This latter culvert also provides a surface-water connection between Middle and Lower Genesee Lakes. All three lakes form a hydrologic unit, with no surface water connection to other surface water resources.[1] This hydrologic link between the three Lakes is shown clearly on the 1873 plat map, reproduced herein as Map 2.

The drainage area tributary to Middle Genesee Lake is wholly located within the Town of Summit in Waukesha County, and is approximately 1,800 acres in areal extent. As of 1995, the land uses within this area were primarily rural, with significant areas of open lands including wetlands, woodlands, and agricultural lands, although upland areas were undergoing a process of urbanization or were proposed for urbanization. Lake-oriented urban lands were the principal urban land feature within the drainage area tributary to Middle Genesee Lake. Urban land uses were expected to increase significantly as development of the former agricultural lands located to the north of Middle Genesee Lake, largely within the former Pabst Farms, Inc., property, are developed for urban residential and commercial purposes.

WATERBODY CHARACTERISTICS

Middle Genesee Lake is a 109-acre groundwater-fed lake. Significant surface water sources include contributions of water via a short stream segment from Upper Genesee Lake and localized surface water runoff. The Lake is separated from, and linked to, Lower Genesee Lake by a causeway and its associated culvert, which forms the outflow from Middle Genesee Lake. Middle Genesee Lake is roughly circular to oval in shape. The deepest portions are located in the northern one-third of the Lake, which has a maximum depth of about 40 feet. The mean

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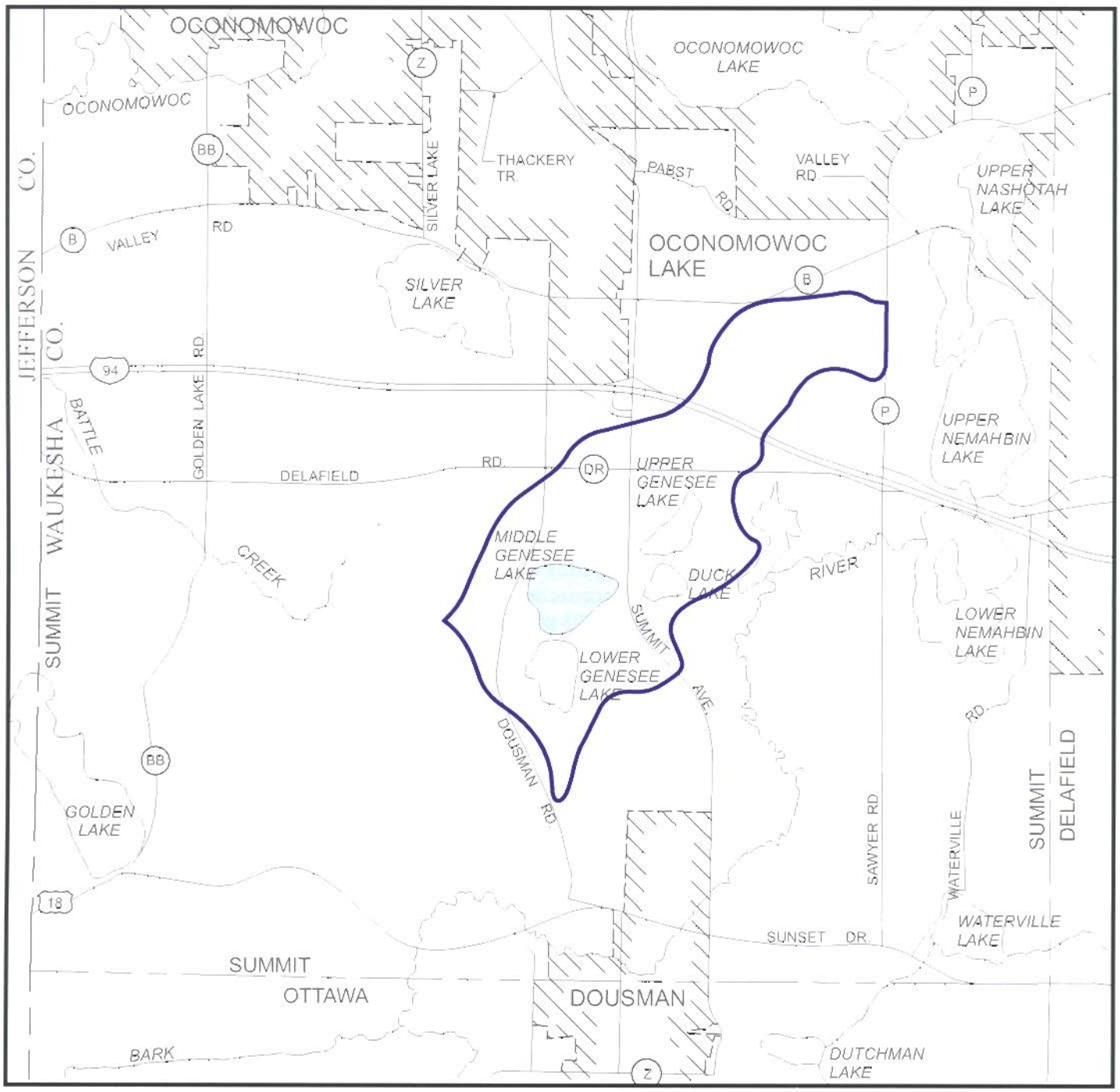
[1] *The three Genesee Lakes form part of a larger Bark River-related groundwater drainage system as noted by R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem in U.S. Geological Survey Water-Resources Investigations Report 00-4136,* Simulation of the Shallow Hydrologic System in the Vicinity of Middle Genesee Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000. Groundwater inflow to the Lakes originates along the Bark River to the northeast of the Genesee Lakes and discharges from the Genesee Lakes to the Bark River in a generally southwesterly direction.*

Map 1

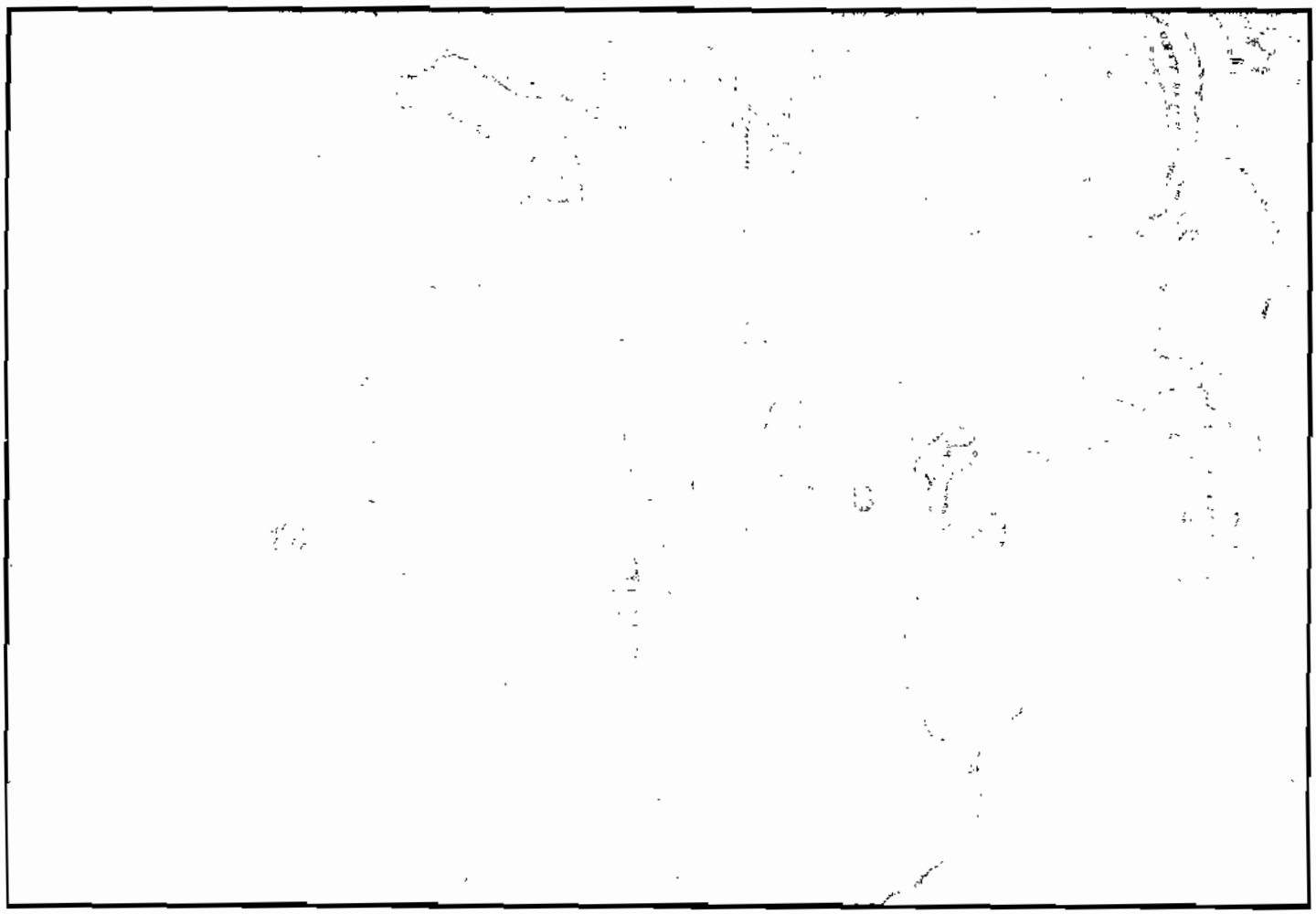
LOCATION OF MIDDLE GENESEE LAKE



Source: SEWRPC.

Map 2

HISTORIC PLAT MAP FOR THE MIDDLE GENESEE LAKE AREA: 1873



Source: Harrison and Warner, Combination Atlas Map of Waukesha County, Wisconsin, *1873.*

depth of the Lake is approximately eight feet, and the Lake has a volume of about 872 acre-feet. The hydrographic characteristics and bathymetry of the Lake are shown in Table 1 and on Map 3, respectively.

POPULATION, LAND USE AND SHORELINE DEVELOPMENT

Population

As of 2000, there were approximately 420 persons residing in approximately 155 housing units within the drainage area tributary to Middle Genesee Lake. Urban development in the drainage area consisted primarily of residential development that has occurred largely between 1940 and 1963, as shown on Map 4.

Land Use

As of 1995, residential land uses occupied almost all of the upland portions of the shorelands of Middle Genesee Lake. Development in the area of the wetlands located on the northeastern shore of the Lake, however, was limited. Notwithstanding, woodlands, wetlands, and agricultural lands occupied the majority of lands within the watershed, as shown on Map 5. Public recreational boating access to the Lake was provided by a boat ramp on Genesee Lake Road, located at the southern end of the Lake, with shared parking facilities—with Lower Genesee Lake—being provided just west of the boat ramp. Middle Genesee Lake was determined by the Wisconsin Department of Natural Resources to have adequate public recreational boating access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*.

The existing 1995 land use pattern within the drainage area tributary to Middle Genesee Lake, shown on Map 5, is quantified in Table 2. About 270 acres, or about 16 percent of the tributary drainage area, were devoted to urban uses. The dominant urban land use, as noted above, was residential, encompassing about 170 acres, or about 60 percent of the area in urban use. About 1,370 acres, or about 84 percent of the drainage area, were devoted to rural land uses. Approximately 970 acres, or about 70 percent of the rural area, were in agricultural and open land uses. Woodlands, wetlands, and surface waters, including the surface area of Middle Genesee Lake, as shown on Map 6, accounted for approximately 400 acres, or about 30 percent of the rural land uses.

Under planned 2020 conditions, the conversion of rural land to rural-density urban land uses within the drainage area tributary to Middle Genesee Lake is envisioned both in the adopted regional land use plan and Waukesha County development plan, as shown on Map 7.[2] A significant amount of the agricultural land in the northern half of the drainage area directly tributary to Middle Genesee Lake, estimated to be about 750 acres, is expected to be converted to urban land uses as part of the proposed Pabst Farms, Inc., development, currently planned. These lands are anticipated to be converted to mixed office/commercial land uses adjacent to IH 94, and to medium-density urban residential uses under the long-term buildout projections. As shown in Table 2, urban density land uses are expected to increase to about 1,020 acres, or about 60 percent of the drainage area tributary to Middle Genesee Lake, by the year 2020. The Pabst Farms, Inc., development is subject to stormwater management measures set forth in a site-specific stormwater management plan prepared pursuant to the County ordinance requirements. As of late-2002, work on the Pabst Farms, Inc., development was underway, with the initial phase being located along the corridor adjacent to the northernmost right-of-way of IH 94.

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

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[2]*SEWRPC Planning Report No. 40,* A Regional Land Use Plan for Southeastern Wisconsin: 2010, *January 1992; SEWRPC Community Assistance Planning Report No. 209,* A Development Plan for Waukesha County, Wisconsin, *August 1996.*

Table 1

HYDROGRAPHIC CHARACTERISTICS OF MIDDLE GENESEE LAKE

Parameter	Measurement
Surface Area	109 acres
Volume	872 acre-feet
Maximum Depth	40 feet
Mean Depth	8 feet
Tributary Drainage Area	1,637 acres

Source: SEWRPC.

WATER QUALITY

Based on Secchi-disc transparency measurements obtained by the U.S. Geological Survey between 1996 and 2001, Middle Genesee Lake has good to excellent water quality. Based on total phosphorus data, Middle Genesee Lake has a Wisconsin Trophic State Index (WTSI) value of about 42 indicating that the lake is a mesotrophic waterbody, as shown in Figure 1.[3] Mesotrophic lakes are moderately fertile lakes that support abundant aquatic plant growths and may support productive fisheries. Nuisance growths of algae and plants are usually not exhibited by mesotrophic lakes. Many of the cleaner lakes in Southeastern Wisconsin are classified as mesotrophic.[4] The sampling location used U.S. Geological Survey is shown on Map 3.

The annual average surface water total phosphorus concentration of Middle Genesee Lake, reported by the U.S. Geological Survey for the period from 1996 to 2001, was approximately 0.01 milligrams per liter (mg/l). The annual average chlorophyll-*a* concentration was reported by the U.S. Geological Survey to be about 2.0 micrograms per liter (µg/l), as shown in Table 3. The observed chlorophyll-*a* and total phosphorus concentrations are indicative of very good water quality. The spring surface water total phosphorus concentrations in the Lake, reported by the U.S. Geological Survey, were below 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.

Data obtained by the U.S. Geological Survey, between 1996 and 2001, indicated that Middle Genesee Lake stratifies during the summer months, as shown in Figure 2, exhibiting both thermal and dissolved oxygen stratification with depth during the months of June through September. Winter stratification also was suggested by the data reported by the U.S. Geological Survey for the month of February during the period between 1996 and 2001. These data are typical of dimictic lakes in the temperate zone. The depletion of dissolved oxygen in the hypolimnion or bottom waters of a lake is common in mesotrophic and eutrophic waterbodies.[5]

Associated with these periods of hypolimnetic anoxia is increased conductivity levels in the hypolimnion of Middle Genesee Lake, as shown in Figure 3. This phenomenon is indicative of internal loading occurring within the Lake. Internal loading is the result of the release of phosphorus and other elements from the lake sediments as a result of changes in oxidation state of the multivalent cations such as iron, calcium, and aluminum which releases previously-bound elements back into the water column.[6] The impact of this internal loading on lake

[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 Lakes,"* Research and Management Findings, *May 1993.*

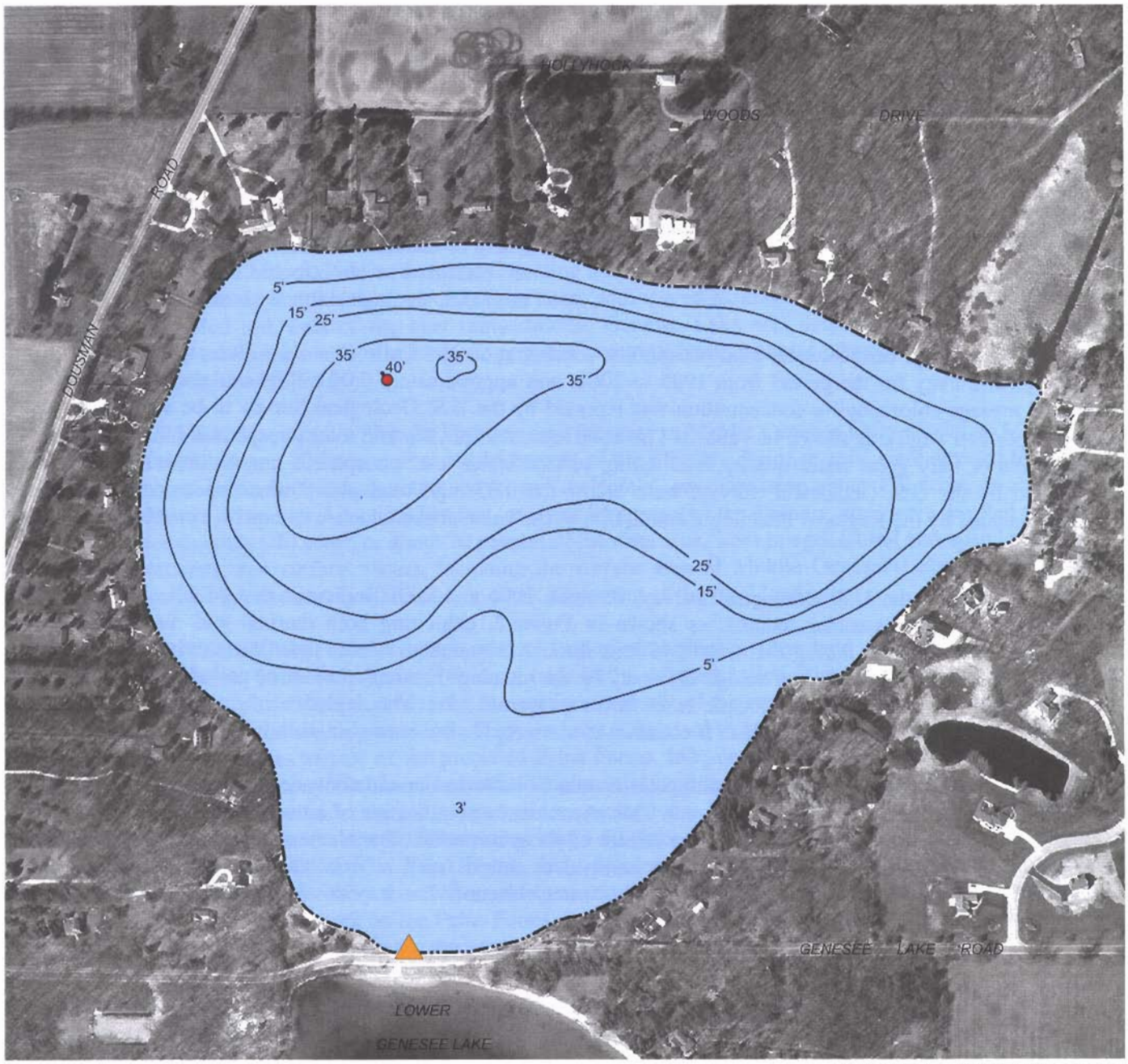
[4]*See R.A. Lillie, and J.W. Mason,* Limnological Characteristics of Wisconsin Lakes, *Wisconsin Department of Natural Resources Technical Bulletin No. 138, 1983; also see SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report,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

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

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

Map 3

BATHYMETRIC MAP OF MIDDLE GENESEE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20'— WATER DEPTH CONTOUR IN FEET

MONITORING SITE

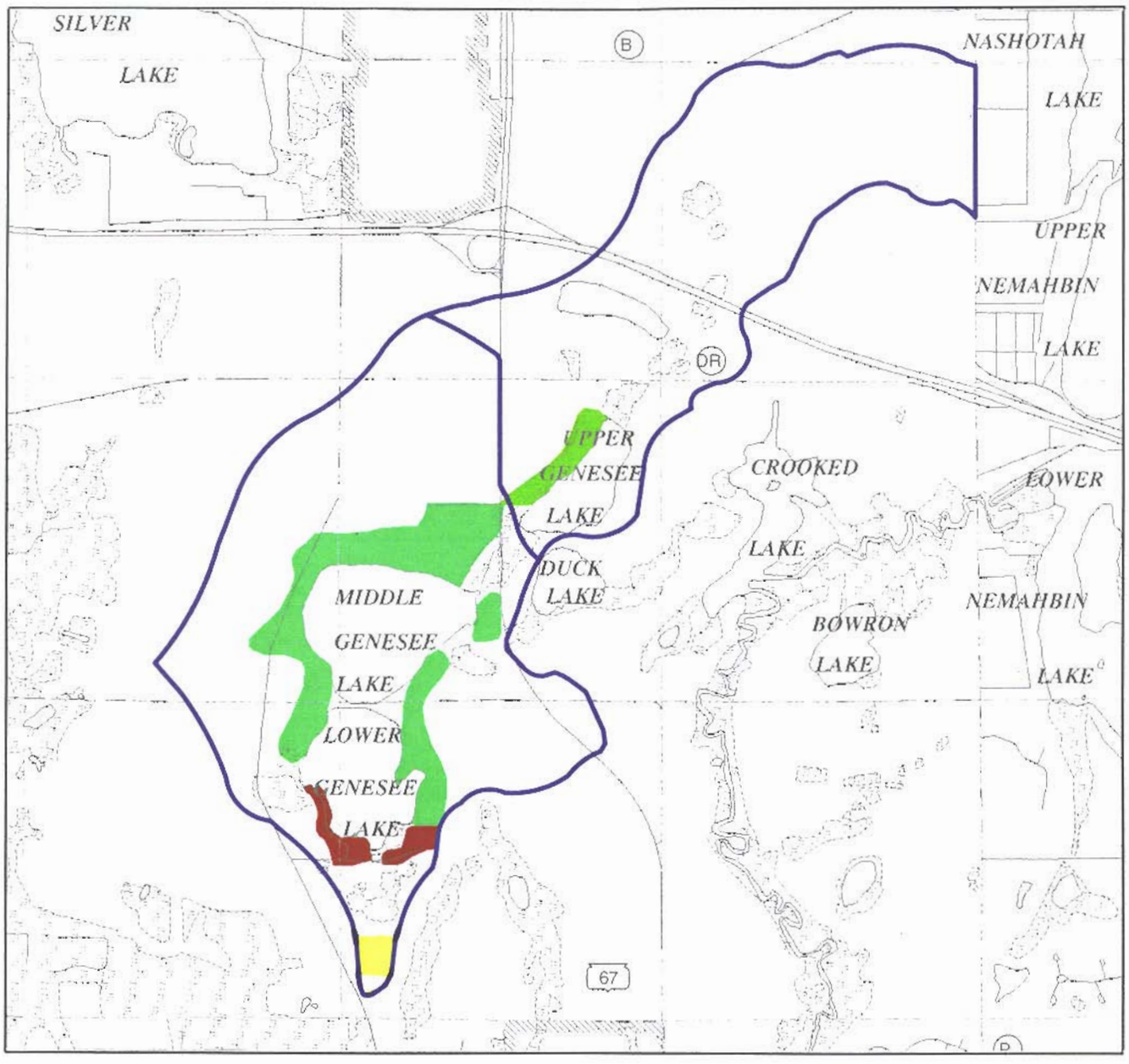
PUBLIC BOAT ACCESS

GRAPHIC SCALE
0 250 500 FEET

Source: U.S. Geological Survey and SEWRPC.

Map 4

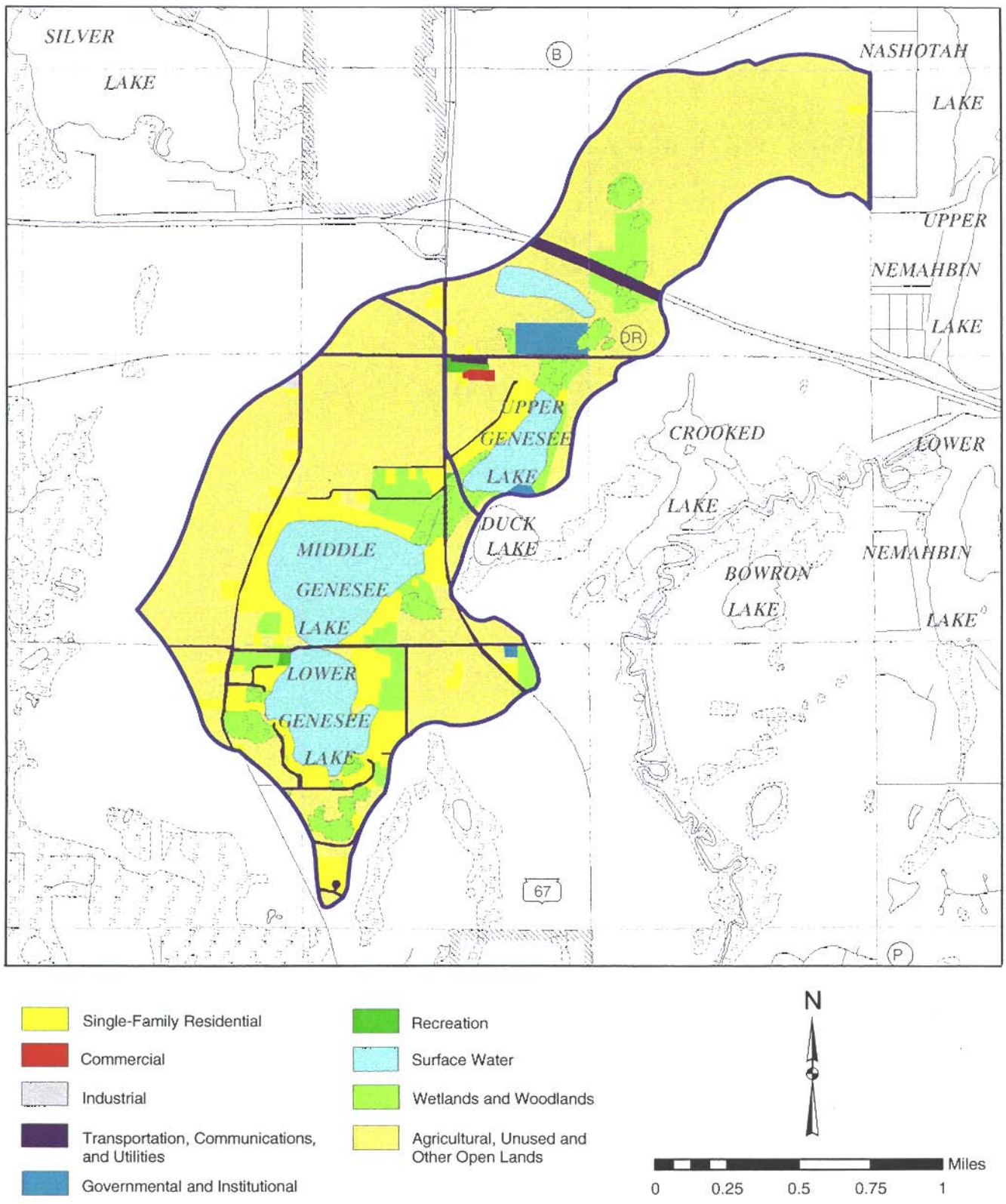
HISTORIC URBAN GROWTH WITHIN THE TRIBUTARY DRAINAGE AREA TO MIDDLE GENESEE LAKE: 1940-1995



Source: SEWRPC.

Map 5

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



Source: SEWRPC.

Table 2

EXISTING AND PLANNED LAND USE WITHIN THE DRAINAGE AREA TRIBUTARY TO MIDDLE GENESEE LAKE: 1995 AND 2020

Land Use Categories[a]	1995		2020	
	Acres	Percent of Total Tributary Drainage Area	Acres	Percent of Total Tributary Drainage Area
Urban				
Residential	168	10.3	357	21 8
Commercial	3	0.2	19	1.2
Industrial	1	0.1	220	13.4
Governmental and Institutional	20	1.2	47	2 9
Transportation, Communication, and Utilities	73	4.4	145	8.9
Recreational	4	0.2	233	14.2
Subtotal	269	16.4	1,021	62.4
Rural				
Agricultural and Other Open Lands	970	59.3	218	13.3
Wetlands	76	4.7	76	4.7
Woodlands	94	5.7	94	5.7
Water	228	13.9	228	13.9
Extractive	- -	- -	- -	- -
Subtotal	1,368	83.6	616	37.6
Total	1,637	100.0	1,637	100.0

[a]*Parking included in associated use.*

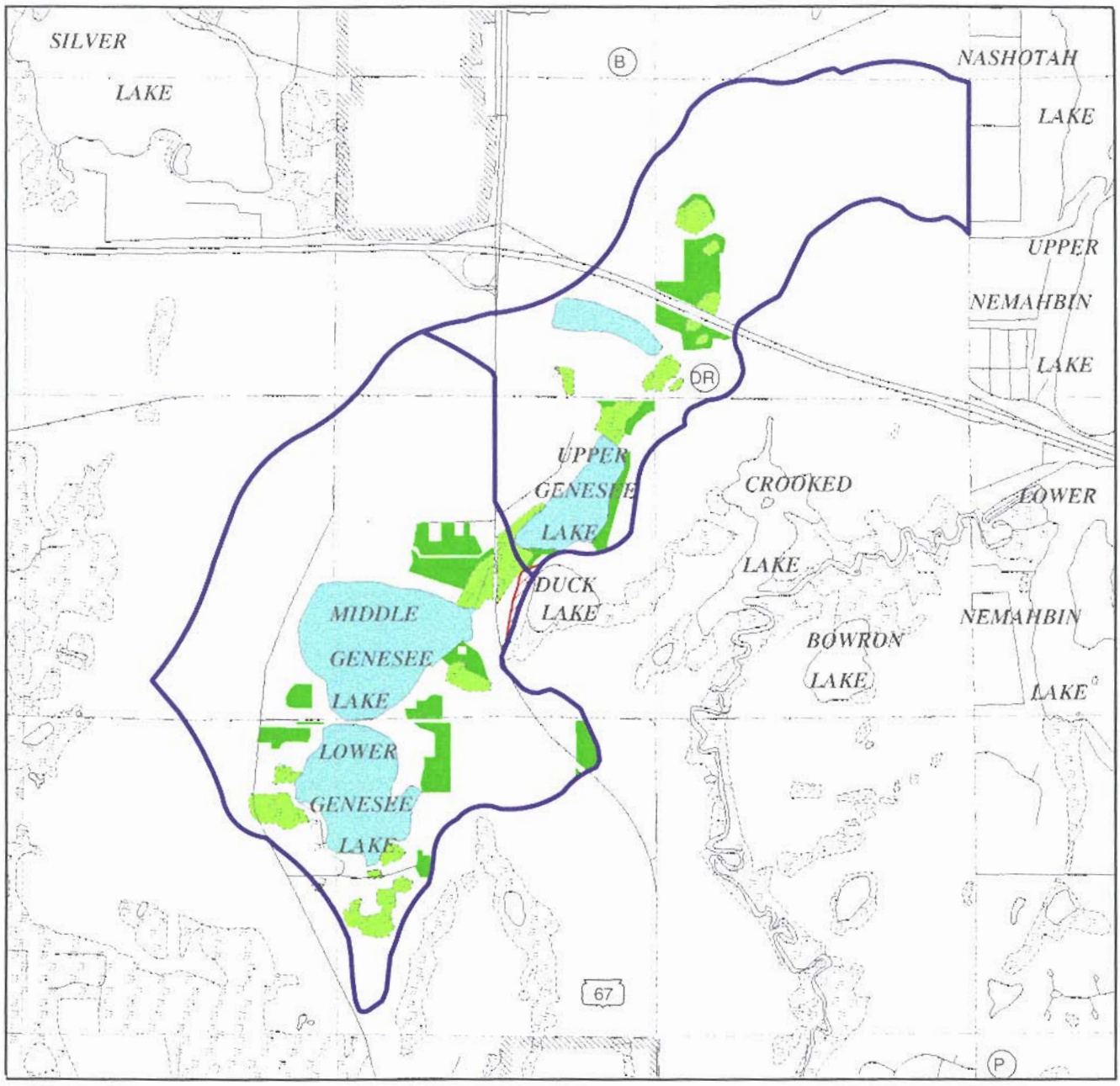
Source: SEWRPC.

trophic state is related to the rate at which the Lake mixes from top to bottom during the spring and fall overturn events. In spring and fall, differential warming and cooling of the lake surface waters, respectively, alters the density of the lake waters in such a manner as to promote the mixing of lake water. When the mixing process is relatively slow, on the order of days to weeks, minerals and nutrients released from the lake sediments into the hypolimnion of the lake tend to recombine with the multivalent cations in the lake sediments and precipitate out of the water column. Conversely, if the mixing process is relatively rapid, on the order of hours or days, as may occur due to the passage of an intense storm, the minerals and nutrients may be mixed upward into the epilimnion or surface waters where they are available for plant growth. In Middle Genesee Lake, the former process seems to be the dominant process. This hypothesis is supported by the fact that the predicted total phosphorus concentrations exceeded the observed total phosphorus concentrations in the Lake, as would be anticipated in a groundwater-fed Lake where phosphorus loads are attenuated by retention of phosphorus within the soil profile prior to discharge of the groundwater into the Lake.[7]

[7]*Estimates of the long-term annual average total phosphorus concentration in Middle Genesee Lake were derived from the WILMS model, described in Wisconsin Department of Natural Resources Publication No. PUBL-WR-363-96 REV.* Wisconsin Lake Model Spreadsheet, Version 2.00, User's Manual, *June 1994; observed in-lake total phosphorus concentrations in Middle Genesee Lake for the period February 1996 through August 2001 are reported in the annual U.S. Geological Survey Open-File Reports,* Water-Quality and Lake-Stage Data for Wisconsin Lakes, *for each water year, the current report being: U.S. Geological Survey Open-File Report No. 02-135,* Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 2001, *2002.*

Map 6

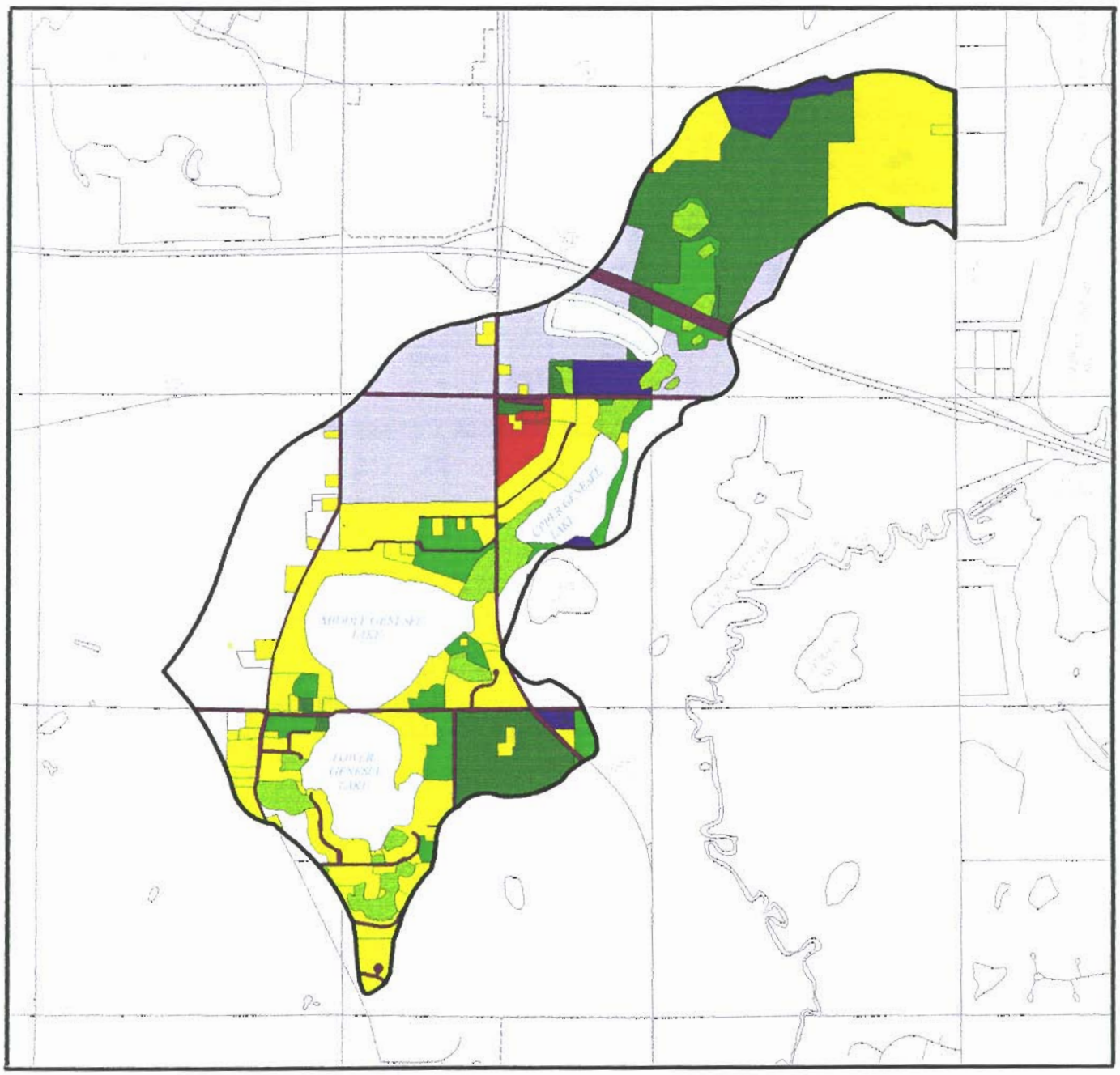
WOODLANDS AND WETLANDS WITHIN THE DRAINAGE AREA TRIBUTARY TO MIDDLE GENESEE LAKE: 1995



Source: SEWRPC.

Map 7

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



SINGLE-FAMILY RESIDENTIAL
COMMERCIAL
MANUFACTURING, WHOLESALE, AND STORAGE
TRANSPORTATION, COMMUNICATION, AND UTILITIES
GOVERNMENTAL AND INSTITUTIONAL
RECREATIONAL
WOODLAND
WETLAND
AGRICULTURE AND OTHER OPEN SPACE
SURFACE WATER

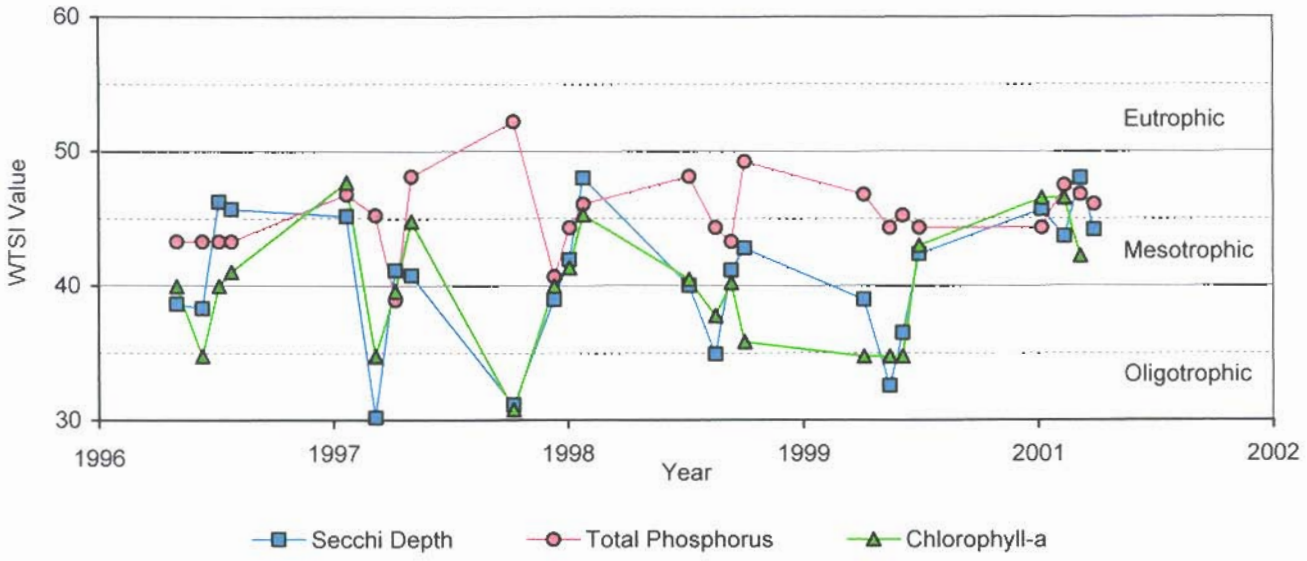
N

GRAPHIC SCALE
800 0 800 1600 2400 Feet

Source: SEWRPC.

Figure 1

TROPHIC STATE INDICES FOR MIDDLE GENESEE LAKE: 1996-2001



Source: U.S. Geological Survey.

Notwithstanding, the Commission staff observed what appeared to be calcium carbonate, or marl, deposition on aquatic plants in Middle Genesee Lake during July 2001. Such deposition is consistent with significant groundwater inflows into the Lake. Marl deposition occurs as a result of pH changes between the ground and lake waters which result in the precipitation of dissolved calcium carbonate carried into the Lake by the groundwater inflows.[8] Groundwater inflows to the Lake constitute a major portion of the Lake's water budget.[9]

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 a 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 groundwater-fed lakes, like Middle Genesee 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. Further, there are no known point sources of water pollutants within the Middle Genesee Lake tributary drainage area. As of the year 2000, all of the residential lands within the tributary drainage area are served by onsite sewage disposal

[8] *Werner Stumm and James J. Morgan,* op. cit.

[9] *R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* op. cit.

Table 3

WATER QUALITY DATA FOR MIDDLE GENESEE LAKE: 1996-2001

Water Quality Parameter	February 8,1996		April 11, 1996		June 5, 1996		July 11, 1996		August 6, 1996		February 12, 1997		April 9, 1997		June 9, 1997	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	3.0	38	1.5	39	1 5	38	1 5	40	1.5	43	1 5	40	1.5	36	1.5	36
Specific Conductance (µS/cm)	422	509	420	421	425	430	438	454	417	476	437	477	413	410	523	434
pH	8.4	7 5	8.3	8 3	8.3	8.0	8.4	7 9	8.3	7 6	8.6	7.6	8.4	8.4	8.2	7.7
Water Temperature (°F)	39 2	41.0	44.6	42.8	64.4	51.8	75.2	54 5	77.9	55.4	35.6	41.0	46.4	43.7	68.0	55.4
Color (platinum-cobalt scale)	--	--	10.0	20.0	--	--	--	--	--	--	--	--	10.0	10.0	--	--
Turbidity (Nephelometric turbidity units)	--	--	0.6	1.4	--	--	--	--	--	--	--	--	1.1	1.5	--	--
Secchi Disc (feet)	--	--	14.4	--	14 8	--	8 5	--	8.9	--	--	--	9.2	--	25.9	--
Dissolved Oxygen	12.9	0.3	12.6	12.4	9.6	7.0	7.8	3.3	8.5	0	12.5	0.1	11.7	10.8	9.5	1.2
Hardness, as $CaCO_3$	--	--	210	210	--	--	--	--	--	--	--	--	200	200	--	--
Calcium	--	--	33	33	--	--	--	--	--	--	--	--	31	31	--	--
Magnesium	--	--	30	30	--	--	--	--	--	--	--	--	29	29	--	--
Sodium	--	--	10	10	--	--	--	--	--	--	--	--	10	10	--	--
Potassium	--	--	2.0	2 0	--	--	--	--	--	--	--	--	2 0	2.0	--	--
Alkalinity, as $CaCO_3$	--	--	180	180	--	--	--	--	--	--	--	--	170	170	--	--
Chloride	--		23	23	--	--	--	--	--	--	--	--	23	23	--	--
Fluoride	--	--	<0.1	<0.1	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	18	18	--	--	--	--	--	--	--	--	19	18	--	--
Silica	--	--	1.9	1.9	--	--	--	--	--	--	--	--	1.0	1.1	--	--
Dissolved Solids	--	--	252	250	--	--	--	--	--	--	--	--	238	240	--	--
Nitrate/Nitrite Nitrogen	--	--	0.02	0.06	--	--	--	--	--	--		--	0.08	0.08	--	--
Ammonia Nitrogen	--	--	0.21	0.23	--	--	--	--	--	--	--	--	0 15	0.016	--	--
Kdeldahl Nitrogen	--	--	0.59	0.57	--	--	--	--	--	-	--	--	0.8	0.8	--	--
Total Phosphorus	--	--	0.007	0.011	0.007	0.007	<0.007	0.012	<0.007	0.022	<0 007	0.029	0.011	0.014	0.009	0.024
Orthophosphorus	--		0.002	<0 002	--	--	--	--	--	--	--	--	<0.002	<0.002	--	--
Iron (µg/l)	--	--	<10	<10	--	--	--	--	--	--	--	--	<10	<10	--	--
Manganese (µg/l)	--	--	<0 4	<0.4	--	--	--	--	--	--		--	<0.4	<0.4	--	--
Chlorophyll-a (µg/l)	--	--	2 0	--	1.0	--	2.0	--	2.3	--	--	--	5.6	--	1.0	--

Table 3 (continued)

Water Quality Parameter	July 22, 1997		August 25, 1997		February 17, 1998		March 30, 1998		June 25, 1998		July 27, 1998		August 25, 1998		February 10, 1999	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	40	1.5	40	1 5	40	1.5	35	1.5	40	1.5	38	1.5	38	1 5	36
Specific Conductance (µS/cm)	405	454	405	508	399	510	389	393	413	430	405	447	390	487	357	450
pH	8.2	7.5	8.2	7.3	8.6	7.4	8.3	8.5	8.2	7.6	8.3	7.6	8.5	7.4	7.7	7.8
Water Temperature (°F)	76.1	59.9	70.7	59.9	38.1	41.0	51.1	46.4	79.3	56.3	77.7	57.6	79.5	57.2	40.1	39.4
Color (platinum-cobalt scale)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Turbidity (Nephelometric turbidity units)	--	--	--	--	--	--	1 4	1.2	--	-	--	--	--	--	--	--
Secchi Disc (feet)	12.1	--	12.5	--	--	--	24 3	--	14.1	-	11.5	--	7.5	--	--	--
Dissolved Oxygen	8.1	0.2	9.1	0	14.2	0.2	11 4	11.7	8.1	0 5	8.7	0.1	8.9	0.3	13.8	8.1
Hardness, as $CaCO_3$	--	--	--	--	--	--	188	185	--	--	--	--	--	--	--	--
Calcium	--	--	--	--	--	--	29	28	--	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	28	28	--	--	--	--	--	--	--	--
Sodium	--	--	--	--		--	11	11	--	--	--	--	--	-	-	--
Potassium	--	--	--	--	--	--	1.7	1.4	--	-	--	--	--	-	--	--
Alkalinity, as $CaCO_3$	--	--	--	--	--	--	166	166	--	-	--	--	--	--	--	--
Chloride	--	--	--	--	--	--	24	28	--	--	--	--	--	--	--	--
Fluoride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	--	--	--	--	16	5.0	-	--	--	--	--	--	--	--
Silica	--	--	--	--	--	--	0.5	0.6	-	--	--	--	--	--	--	--
Dissolved Solids	--	--	--	--	--	--	224	228	--	--	-	--	--	--	--	--
Nitrate/Nitrite Nitrogen	--	--	--	--	--	--	0.062	0.057	--	--	--	--	--	--	--	--
Ammonia Nitrogen	--	--	--	--	--	--	0.142	0.14	--	-	--	--	--	--	--	--
Kdeldahl Nitrogen	--	--	--	--	--	--	0.65	0.58	--	--	--	--	--	--	--	--
Total Phosphorus	0.004	0.014	0 013	0.069	0 008	0.131	0.022	0 033	<0.005	0.024	0 008	<0.005	0.01	0.038	<0.005	0.01
Orthophosphorus	--	--	--	--	--	--	<0.002	<0.002	--	--	--	--	--	--	--	--
Iron (µg/l)	--	--	--	--	--	--	<10	<10	--	--	--	--	--	--	--	--
Manganese (µg/l)	--	--	--	--	--	--	<0.4	<0.4	--	--	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	1.9	--	3.8	--	--	--	0 59	--	0.02	--	2.4	--	4 05	--	--	--

Table 3 (continued)

Water Quality Parameter	April 7, 1999		June 2, 1999		July 6, 1999		August 3, 1999		February 15, 2000		April 13, 2000		June 7, 2000	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	38	1.5	38	1.5	38	1.5	36	1.5	36	1.5	40	1.5	38
Specific Conductance (µS/cm)	416	415	408	432	415	463	399	461	421	453	407	409	413	450
pH	8.2	8.3	8.1	7.7	8.2	7.7	8.3	7.5	8.4	7.4	8.2	8.2	8.1	7.6
Water Temperature (°F)	48.6	47.3	68.4	52.3	80.1	54.9	81.9	55.6	36.5	41.2	45.3	45.1	66.7	51.1
Color (platinum-cobalt scale)	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Turbidity (Nephelometric turbidity units)	0.6	--	--	--	--	--	--	--	--	--	1.0	--	--	--
Secchi Disc (feet)	13.1	--	18.7	--	12.1	--	10.8	--	--	--	14.1	--	22.0	--
Dissolved Oxygen	11.7	10.9	9.0	0.5	8.0	0.4	8.5	0	14.5	1.0	11.8	11.4	9.0	2.9
Hardness, as $CaCO_3$	180	--	--	--	--	--	--	--	--	--	190	--	--	--
Calcium	29	--	--	--	--	--	--	--	--	--	31	--	--	--
Magnesium	26	--	--	--	--	--	--	--	--	--	27	--	--	--
Sodium	10	--	--	--	--	--	--	--	--	--	11	--	--	--
Potassium	1.7	--	--	--	--	--	--	--	--	--	1.6	--	--	--
Alkalinity, as $CaCO_3$	164	--	--	--	--	--	--	--	--	--	162	--	--	--
Chloride	25	--	--	--	--	--	--	--	--	--	27	--	--	--
Fluoride	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	17	--	--	--	--	--	--	--	--	--	15.9	--	--	--
Silica	1.6	--	--	--	--	--	--	--	--	--	0.5	--	--	--
Dissolved Solids	228	--	--	--	--	--	--	--	--	--	242	--	--	--
Nitrate/Nitrite Nitrogen	0.023	--	--	--	--	--	--	--	--	--	0.049	--	--	--
Ammonia Nitrogen	0.141	--	--	--	--	--	--	--	--	--	0.159	--	--	--
Kjeldahl Nitrogen	0.84	--	--	--	--	--	--	--	--	--	0.77	--	--	--
Total Phosphorus	0.013	0.016	0.008	0.011	0.007	0.023	0.015	0.041	0.01	0.033	0.011	0.012	0.008	0.013
Orthophosphorus	0.002	--	--	--	--	--	--	--	--	--	<0.002	--	--	--
Iron (µg/l)	<10	--	--	--	--	--	--	--	--	--	<10	--	--	--
Manganese (µg/l)	1.0	--	--	--	--	--	--	--	--	--	<0.4	--	--	--
Chlorophyll-*a* (µg/l)	2.14	--	1.49	--	2.07	--	1.15	--	--	--	<1.00	--	<1.00	--

Table 3 (continued)

Water Quality Parameter	July 5, 2000		August 9, 2000		February 12, 2001		April 26, 2001		June 13, 2001		July 17, 2001		August 15, 2001	
	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep	Shallow	Deep
Depth of Sample (feet)	1.5	36	1.5	40	1.5	40	1.5	40	1.5	40	1.5	38	1.5	40
Specific Conductance (µS/cm)	411	447	410	483	405	506	410	412	409	442	415	480	404	532
pH	8.0	7.7	8.2	7.4	8.1	7.3	11.2	9.4	9.7	0.3	8.1	7.3	8.2	7.1
Water Temperature (°F)	77.0	53.6	78.1	54.9	37.2	41.5	55.2	50.5	71.8	53.0	80.4	53.6	78.6	54.0
Color (platinum-cobalt scale)	--	--	--	--	--	--	10	-	--	--	--	--	--	--
Turbidity (Nephelometric turbidity units)	--	--	--	--	--	-	1.9	--	--	--	--	--	--	--
Secchi Disc (feet)	16.7	--	11.2	--	--	--	8.9	--	10.2	--	7.6	--	9.9	--
Dissolved Oxygen	8.6	1.1	9.5	0	12.9	0.5	11.2	9.4	9.7	0.3	8.9	0.2	9.0	02.
Hardness, as $CaCO_3$	--	--	--	--	--	--	187	--	--	--	--	--	--	--
Calcium	--	--	--	--	--	--	32	--	--	--	--	--	--	--
Magnesium	--	--	--	--	--	--	26	--	--	--	--	--	--	--
Sodium	--	--	--	--	--	--	11	--	--	-	--	--	-	--
Potassium	--	--	--	--	--	--	1.2	--	--	--	--	--	--	--
Alkalinity, as $CaCO_3$	--	--	--	--	--	--	160	--	--	--	--	--	--	--
Chloride	--	--	--	--	--	--	26	--	--	-	--	--	--	--
Fluoride	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	--	--	--	--	14.1	--	--	--	--	--	--	--
Silica	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--
Dissolved Solids	--	--	--	--	--	--	244	--	--	--	--	--	--	--
Nitrate/Nitrite Nitrogen	--	--	--	--	--	--	0.114	--	--	--	--	--	--	--
Ammonia Nitrogen	--	--	--	--	--	--	0.12	--	--	--	--	--	--	--
Kdeldahl Nitrogen	--	--	--	--	--	--	1.02	--	--	-	--	--	--	--
Total Phosphorus	0.009	0.018	0.008	0.033	0.008	0.024	0.008	0.009	0.012	0.031	0.011	0.050	0.010	0.068
Orthophosphorus	--	--	--	--	--	--	<0.002	--	--	--	--	--	--	--
Iron (µg/l)	--	--	--	--	--	--	<10	--	--	--	--	--	--	--
Manganese (µg/l)	--	--	--	--	--	--	<0.4	--	--	--	--	--	--	--
Chlorophyll-*a* (µg/l)	<1.00	-	3.00	--	--	--	4.8	--	4.8	--	2.7	--	--	--

NOTE: Where no units are given, units are in milligrams per liter (mg/l).

Source: U.S. Geological Survey and SEWRPC.

Figure 2

DISSOLVED OXYGEN AND TEMPERATURE PROFILES FOR MIDDLE GENESEE LAKE: 1996-2001

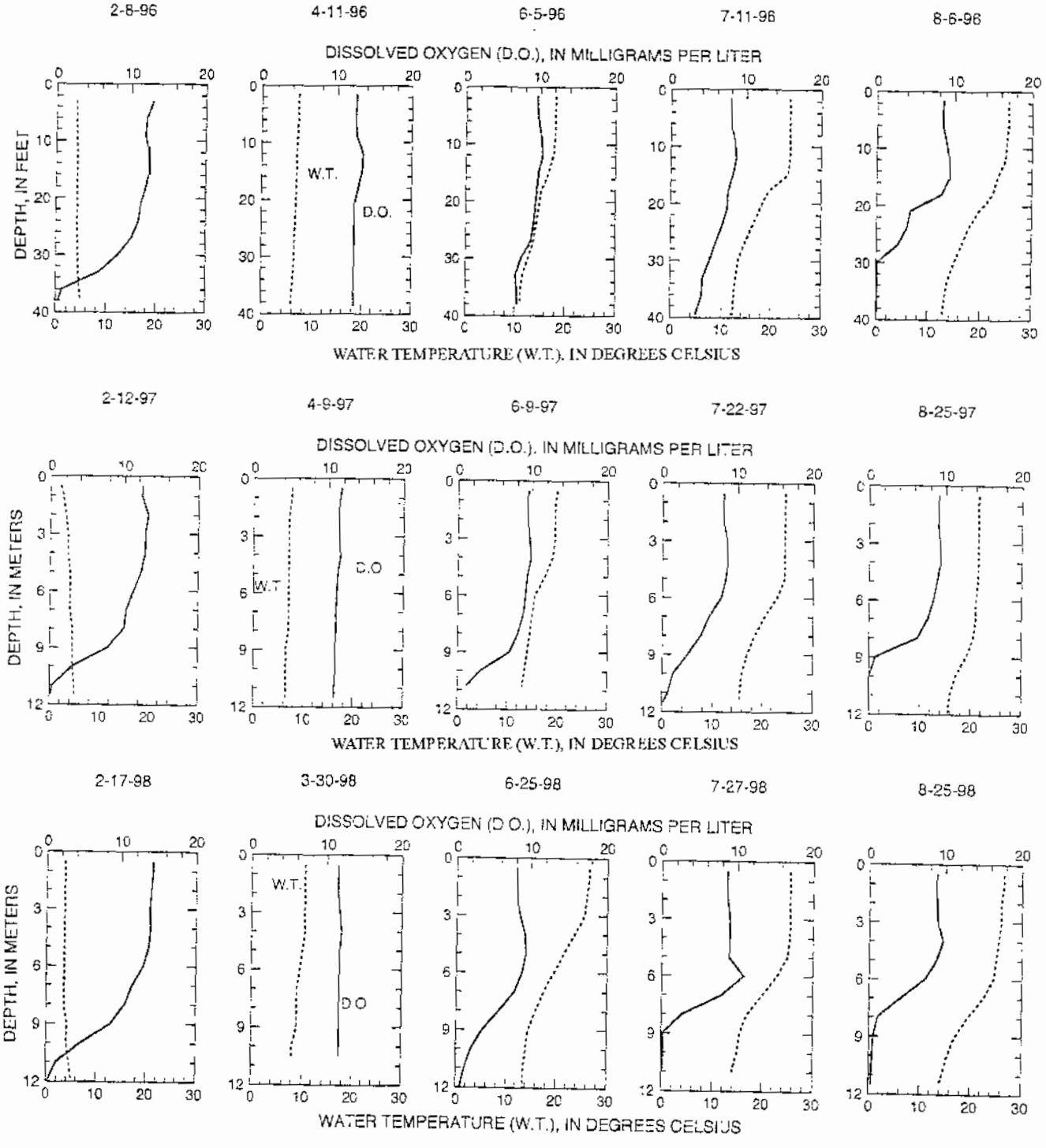
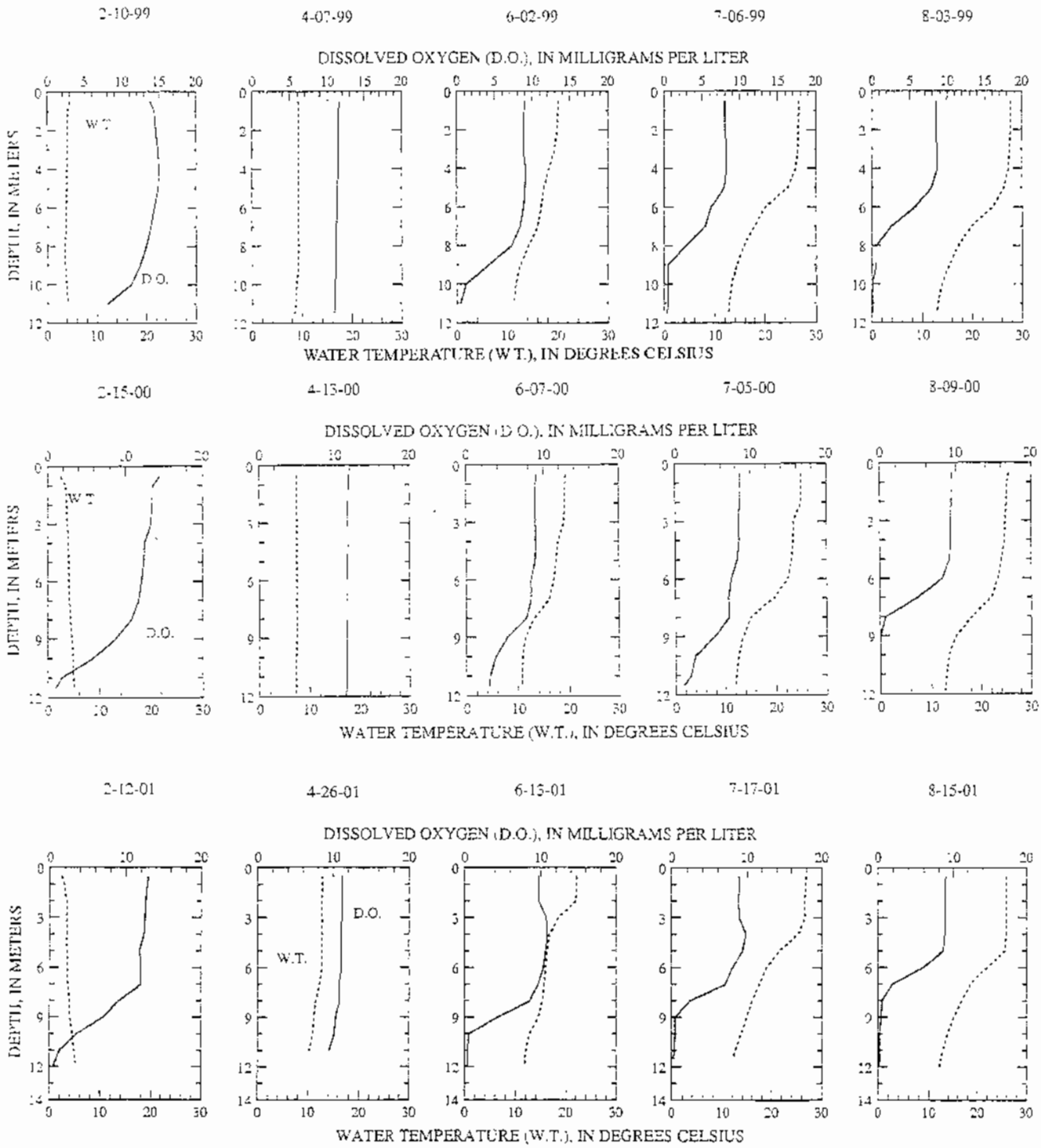


Figure 2 (continued)



Source: U S. Geological Survey.

Figure 3

SPECIFIC CONDUCTANCE AND pH PROFILES FOR MIDDLE GENESEE LAKE: 1996-2001

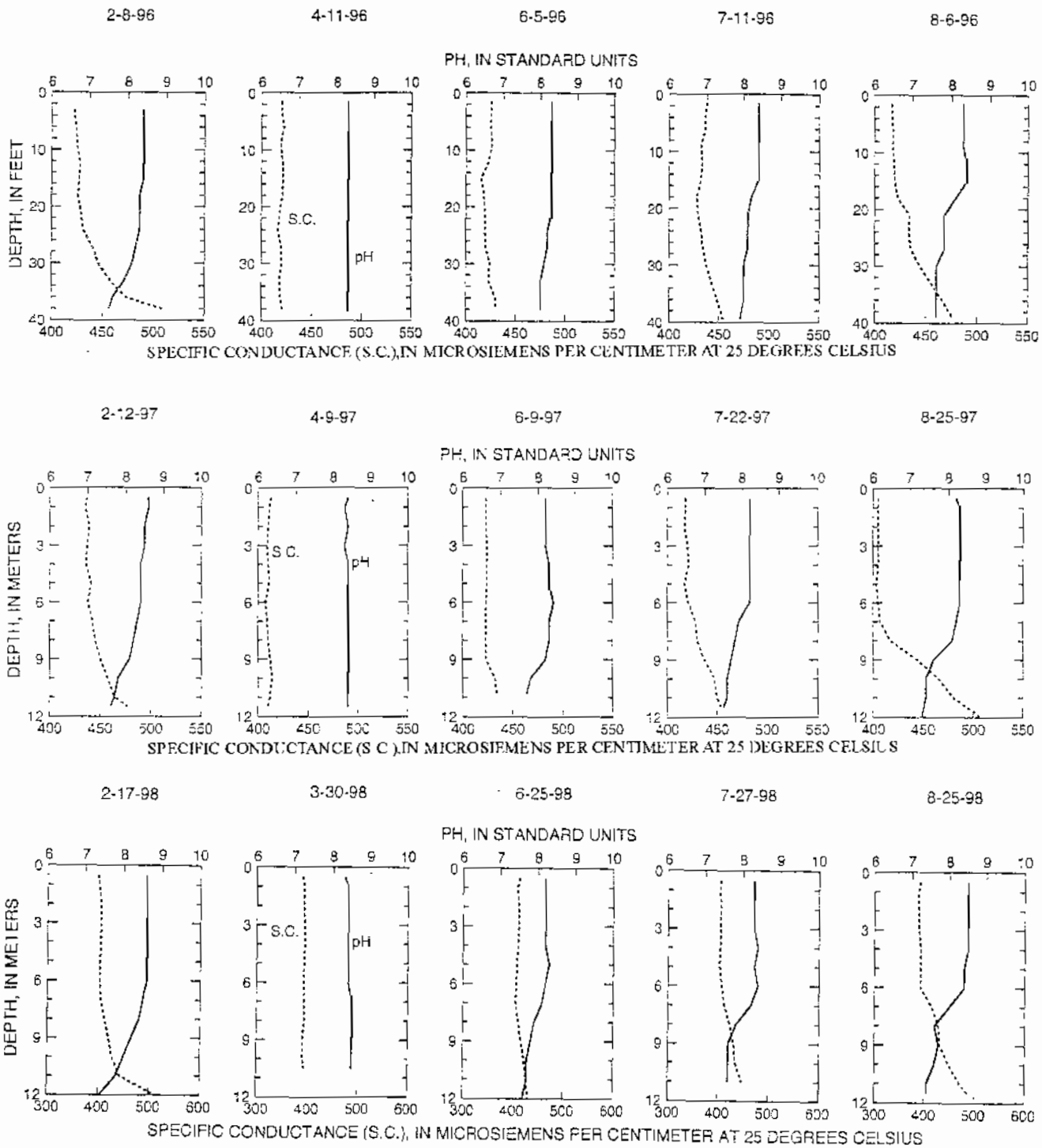
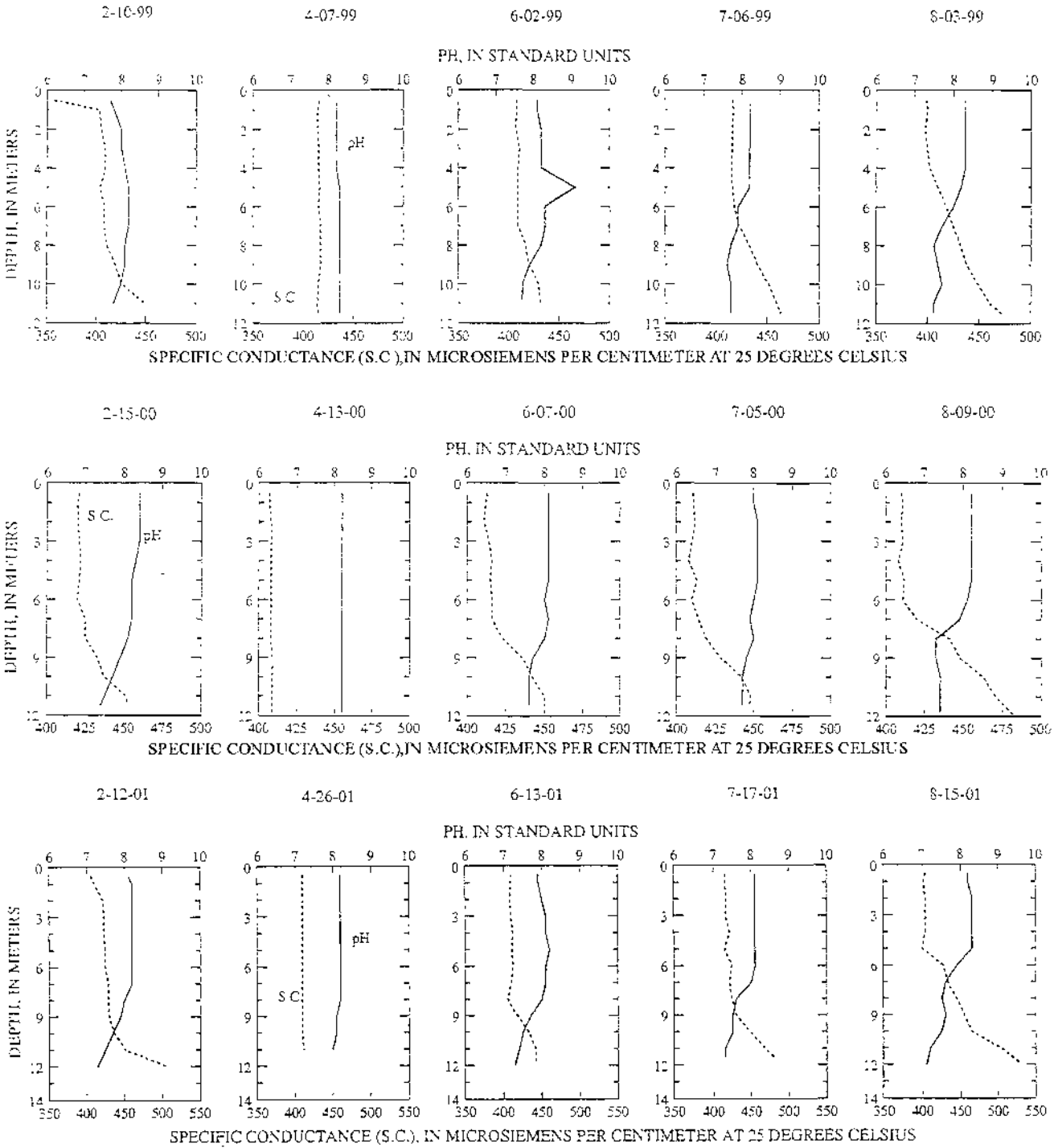


Figure 3 (continued)



Source: U.S. Geological Survey

systems.[10] For these reasons, the discussion that follows is based wholly upon the nonpoint source pollutant loadings to Middle Genesee Lake.

The nonpoint source pollutant loads to Middle Genesee Lake were estimated on the basis of 1995 land use inventory data and unit area load coefficients determined for the Southeastern Wisconsin Region.[11] Annual contaminant loads entering Middle Genesee Lake were calculated to be approximately 250 tons of sediment; 945 pounds of phosphorus; and two pounds and 24 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. As urban-density development occurs within the drainage area tributary to Middle Genesee 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, about 180 tons of sediment, and about 56 pounds and 400 pounds of copper and zinc, respectively, are estimated to be contributed to Middle Genesee 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. However, given that the new development is proposed to include stormwater management measures, the future loadings are expected to be lower than the "potential loadings." Phosphorus loads are forecast to decrease to about 720 pounds annually, although this loading will depend upon the lawn care practices and stormwater management practices adopted within the urban portions of the watershed, and on the extent of the stormwater management measures installed with new urban development. Recent evidence provided by the U.S. Geological Survey from the Lauderdale Lakes 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]

To validate the estimated contaminant loads to Middle Genesee Lake, Commission staff applied the estimated phosphorus load of approximately 945 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 0.010 mg/l, which value corresponds reasonably well to the observed in-lake phosphorus concentration of about 0.013 mg/l. This agreement would suggest that the estimated contaminant loads are a reasonable representation of the loads entering Middle Genesee Lake, and that other pollutant sources, including internal loading, to Middle Genesee 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 Middle Genesee Lake. These data indicate that, based on 1995 land use conditions in the drainage area tributary to Middle Genesee Lake, almost 90 percent of the phosphorus load to the Lake is contributed from agricultural lands within the tributary drainage area; about 5 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 to an urban dominated condition, with about 70 percent of the phosphorus load originating from urban sources. Agricultural contributions of phosphorus are expected to decrease to about 25 percent of the load. The planned condition pollutant loadings represent "potential loadings" which would be expected in the absence of significant stormwater management controls for new development. In fact, the pollutant loadings under future conditions

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

[11] *Phosphorus loads were calculated using the Wisconsin Lake Modeling Suite, WILMS version 3.0. Phosphorus loads under 1995 land use conditions were estimated to range from about 345 pounds per year to 1,260 pounds per year; under forecast year 2020 land use conditions, phosphorus loads were estimated to range from about 425 pounds per year to 1,210 pounds per year. The most likely phosphorus load estimated using WILMS is expected to increase by about 5 percent.*

[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 Lakes, Wisconsin, *July 2002.*

Table 4

ESTIMATED ANNUAL POLLUTANT LOADINGS TO MIDDLE GENESEE LAKE BY LAND USE CATEGORY: 1995 AND 2020

Land Use	1995						2020[a]					
	Area (acres)	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)	Cadmium (pounds)	Area (acres)	Sediment (tons)	Phosphorus (pounds)	Copper (pounds)	Zinc (pounds)	Cadmium (pounds)
Residential[b]	168	1.5	34	-	1.7	- -	357	3.5	71	- -	4	- -
Commercial	3	1.2	4	0.7	4.5	<0.1	19	7.4	23	4	28	0.2
Industrial	1	0.4	1	0.2	1.5	<0.1	220	82.7	257	49	328	2.2
Communications and Utilities	73	0.3	8	- -	- -	- -	220	0.7	16	- -	-	- -
Governmental	20	5.1	27	1.4	16.0	- -	47	12.0	63	3	38	- -
Recreational	4	<0.1	1	-	- -	- -	233	2.8	63	- -	-	- -
Water	228	21.4	30	- -	- -	-	228	21.4	30	- -	- -	- -
Wetlands	76	0.1	3		- -	- -	76	0.1	3	- -	-	- -
Woodlands	94	0.2	4	- -	- -	-	94	0.2	4	-	- -	- -
Agricultural	970	218.2	834	- -	- -	- -	218	49.0	188		- -	- -
Total	1,637	248.6	946	2.3	23.7	0.1	1,637	179.8	718	56	398	2.4

[a]*The planned land use loadings are "potential" loadings, assuming no significant stormwater management facilities are in place. The actual planned land use loadings are expected to be lower because stormwater management facilities designed to reduce the urban nonpoint source pollutant loadings are planned for the new development in the tributary drainage area.*

[b]*Includes the contribution from onsite sewage disposal systems. The contribution from onsite sewage disposal systems, based upon the per capita phosphorus contribution contained within wastewater estimated within the WILMS model and 1995 land use, could range from approximately one pound per year to as much as about 30 pounds per year, depending upon soil type, system condition, and system location. For purposes of this analysis, about 10 pounds per year were used as the value that provided the loading that was best correlated with measured in-lake phosphorus concentrations. This mass of phosphorus could potentially increase by more than two-fold based upon projected 2020 land use conditions.*

Source: SEWRPC

may be less than indicated, since stormwater management facilities designed to reduce nonpoint source pollutant loadings are proposed. Thus, the actual future loadings will be lower than the "potential loadings."

Under 1995 land use condition, about 5 percent of the sediment load to Middle Genesee Lake is estimated to be generated from urban sources; about 85 percent from agricultural lands; and about 10 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 under year 2020 conditions, with about 60 percent of the potential sediment load being contributed from urban sources, and about 25 percent from agricultural sources.

Of the controllable pollutant sources, the most significant sources under existing land use conditions are contaminant loads generated from agricultural lands, which account for the largest percentages of sediment and nutrient loadings to the Lake. However, as land uses are currently changing from a largely agricultural condition within the drainage area tributary to Middle Genesee Lake, it is anticipated that controllable sediment, nutrient and heavy metals loads will shift toward urban source areas. Control of contaminants from urban sources, therefore, is proposed to be effected through the variety of measures set forth in Chapter IV.

GROUNDWATER RESOURCES

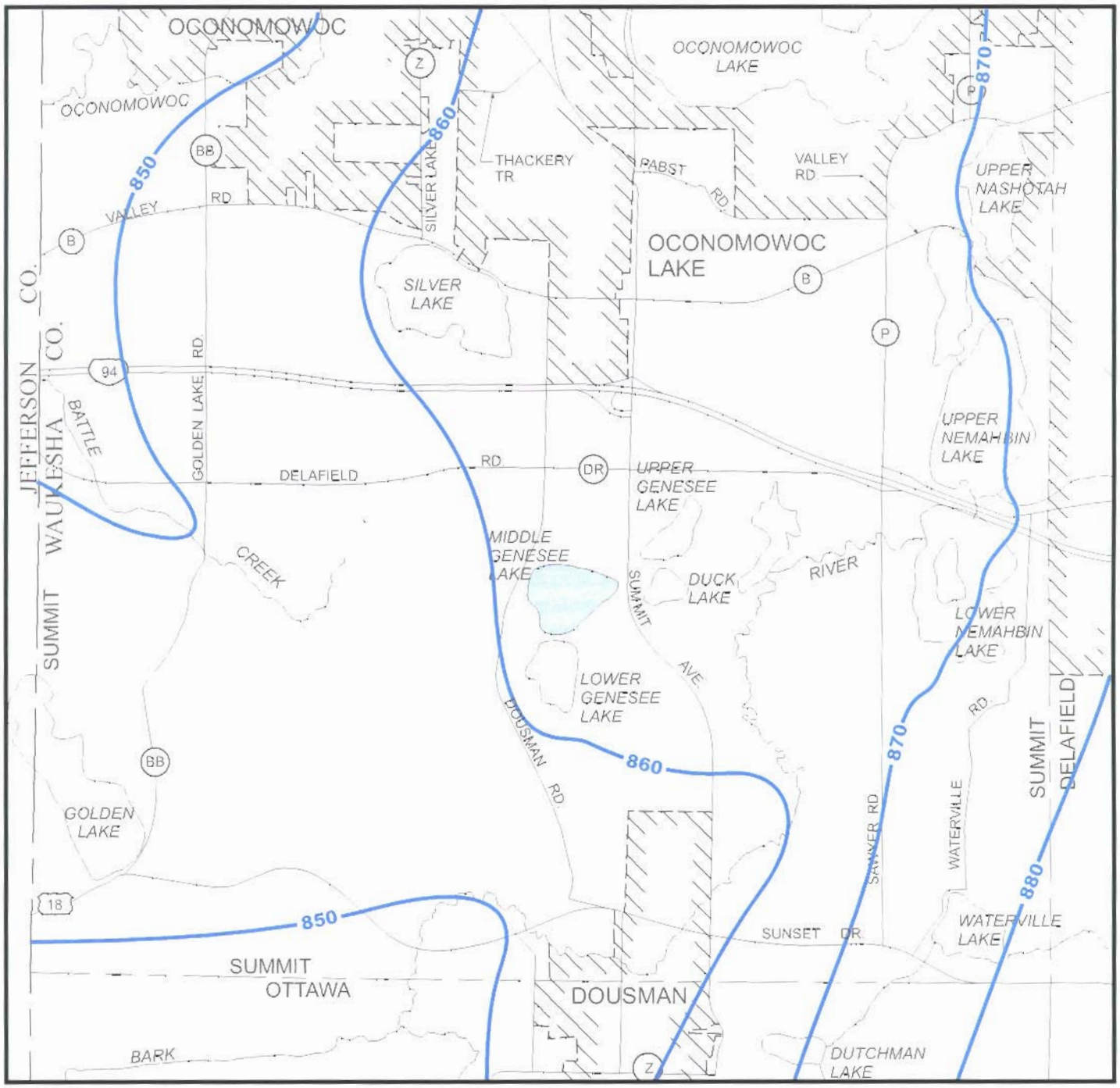
Groundwater resources constitute an extremely valuable element of the natural resource base related to the Middle Genesee Lake, both as a source of water, and as a component of the surface water system. Groundwater in the vicinity of the Middle Genesee Lake moves within two distinct systems: a shallow water table system,[13] and a deep sandstone system. The shallow water table system consists of glacial deposits and a deep sandstone aquifer with no confining layer of shale or dolomite, as shown on Map 8 and Figure 4.[14] From the land surface

[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.*

Map 8

WATER TABLE CONTOURS IN THE VICINITY OF MIDDLE GENESEE LAKE



WATER TABLE CONTOUR

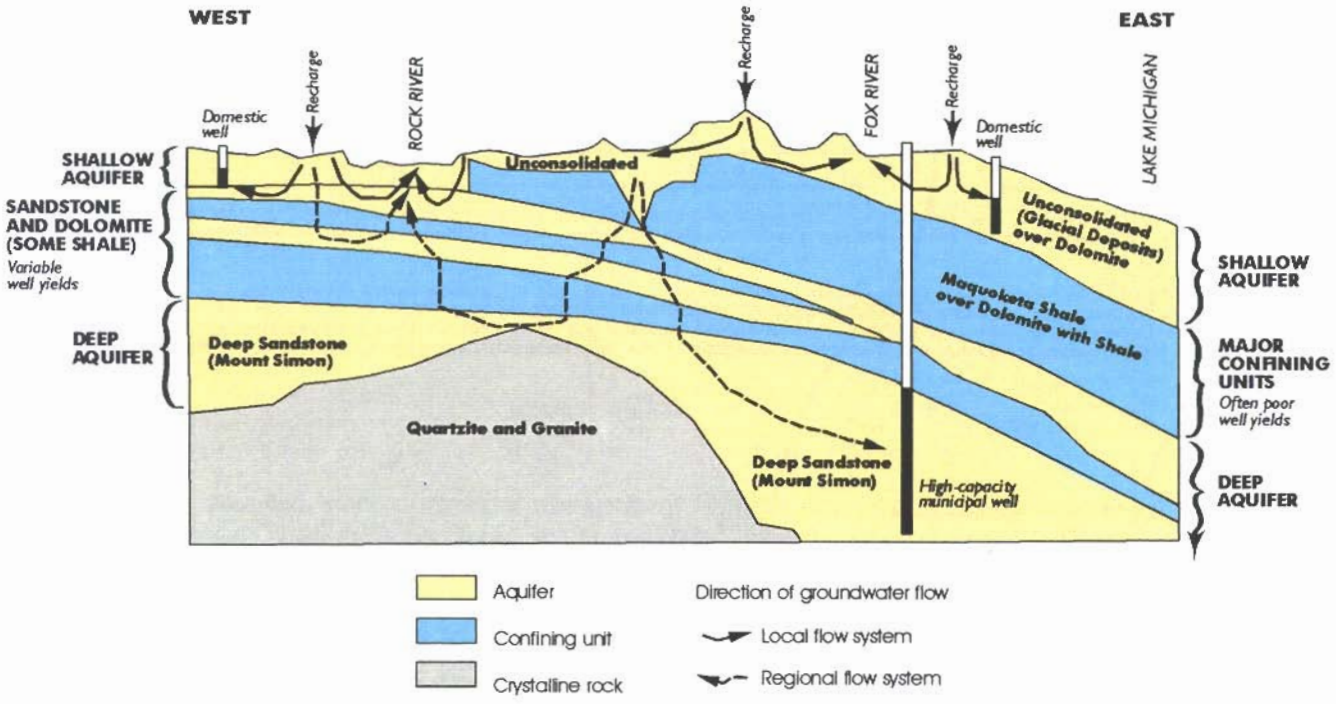
860 WATER TABLE ELEVATION

GRAPHIC SCALE
0 2500 5000 FEET

Source: U.S. Geological Survey and SEWRPC.

Figure 4

CONCEPTUAL GROUNDWATER-FLOW SYSTEM AFFECTING THE SOUTHEASTERN WISCONSIN REGION



Source: U.S. Geological Survey, UW-Extension, and SEWRPC.

downward, the glacial drift aquifer, consisting of water-bearing sand and gravel, is relatively thin, extending over less than 200 feet in thickness in the vicinity of the Middle Genesee Lake. 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 Middle Genesee Lake and its tributary surface waters and adjacent wetlands. The deep sandstone aquifer is virtually isolated from the surfacial aquifer in the vicinity of Middle Genesee 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. The hydraulic conductivity of the sand and gravel aquifer is amongst the highest reported in the State.[15] These rates are similar to those reported from observations made in the vicinity of Pretty Lake in the Town of Ottawa, immediately south of the Town of Summit within Waukesha County.[16]

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[15]*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 Memorandum Report No. 122,* A Lake Protection Plan for Pretty Lake, Waukesha County, Wisconsin, *April 1998.*

The U.S. Geological Survey used the GFLOW and UCODE groundwater flow models to simulate the surficial groundwater contributions and movements into and out of Middle Genesee Lake.[17] These model results indicate that groundwater flows are approximately 112 feet per day (ft/d), and result in a recharge rate of 6.7 inches per year (in/yr). Based upon these values, estimates of the hydrologic budget for Middle Genesee Lake show that the rates of groundwater inflow, estimated to be 25.2 in/yr, and outflow, estimated to be 27.2 in/yr, are approximately equivalent to the rates of precipitation and evaporation reported for this portion of the Region, which are approximately 32 in/yr and 30 in/yr, respectively.

This groundwater flows from northeast to southwest through the Lake within the surficial aquifer, as shown on Map 9.[18] These flows have a direct affect on water quality and lake water levels in Middle Genesee Lake, making the surficial groundwater system the principal hydrologic pathway by which water enters and leaves the Genesee Lakes.[19] 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 Middle Genesee 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 seepage lakes. 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 important 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 Middle Genesee Lake area in 1966.[20] Using the regional soil survey, an assessment was made of the hydrologic characteristics of the soils in the drainage area tributary to the Middle Genesee Lake. Soils within the drainage area tributary to Middle Genesee 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 80 percent of the total tributary drainage area was covered with moderately drained soils, with less than 1 percent of the tributary drainage area being covered by poorly drained soils and about 5 percent by very poorly drained soils. The remaining areas of the watershed were comprised of surface water, as shown on Map 10.

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[17] *R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* op. cit.

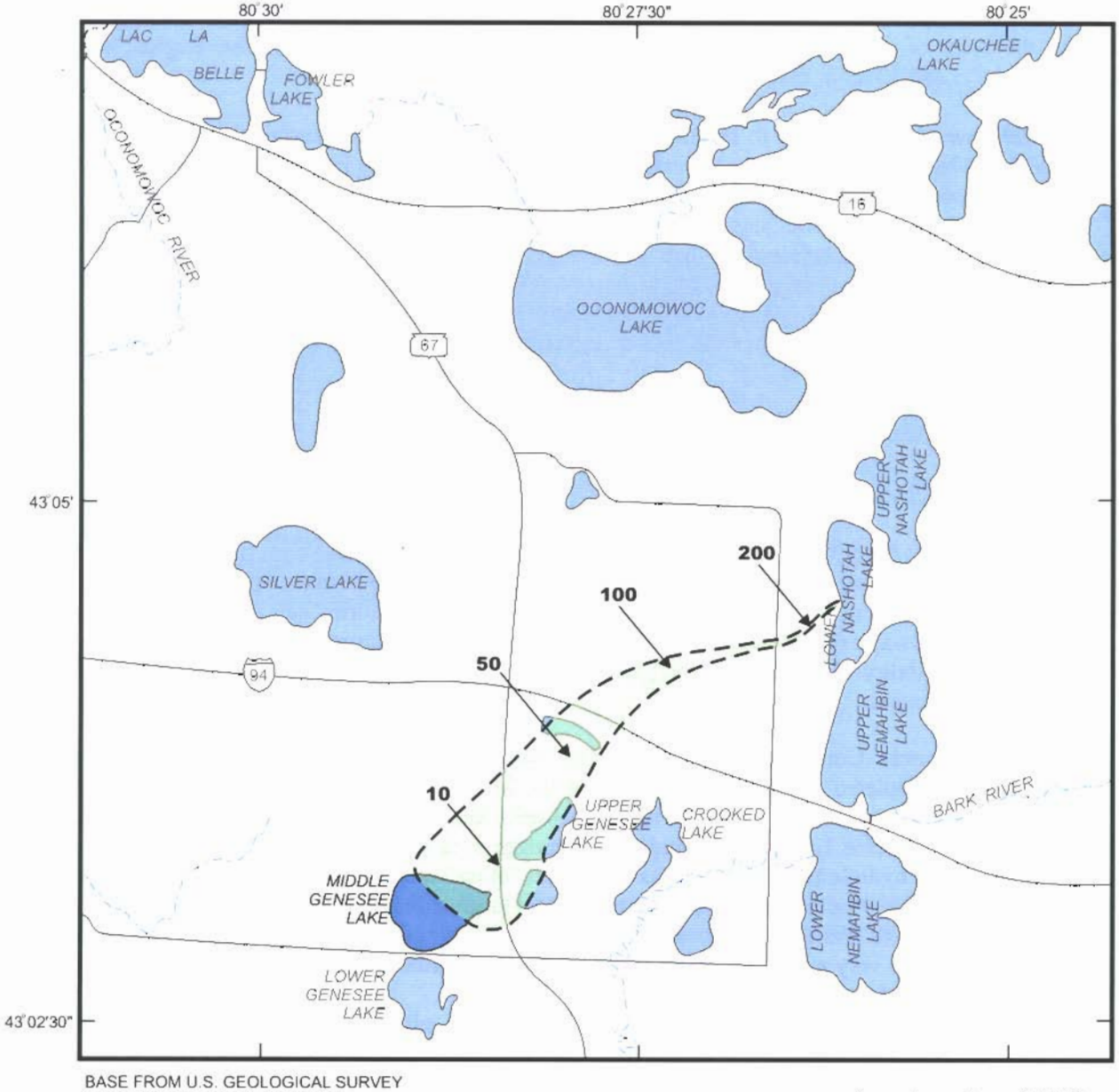
[18] *J.B. Gonthier, U.S. Geological Survey Water-Resources Investigations Open-File Report No. 79-43,* Water-Table Map of Waukesha County, Wisconsin, *May 1979; R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* op. cit.

[19] *R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem, U.S. Geological Survey Water-Resources Investigations Report 00-4136,* op. cit.

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

Map 9

GROUNDWATER CAPTURE ZONE OF MIDDLE GENESEE LAKE



BASE FROM U.S. GEOLOGICAL SURVEY
1:100,000 OCONOMOWOC WEST

0 1 2 3 MILES
0 1 2 3 KILOMETERS

UNDEVELOPED CAPTURE ZONE

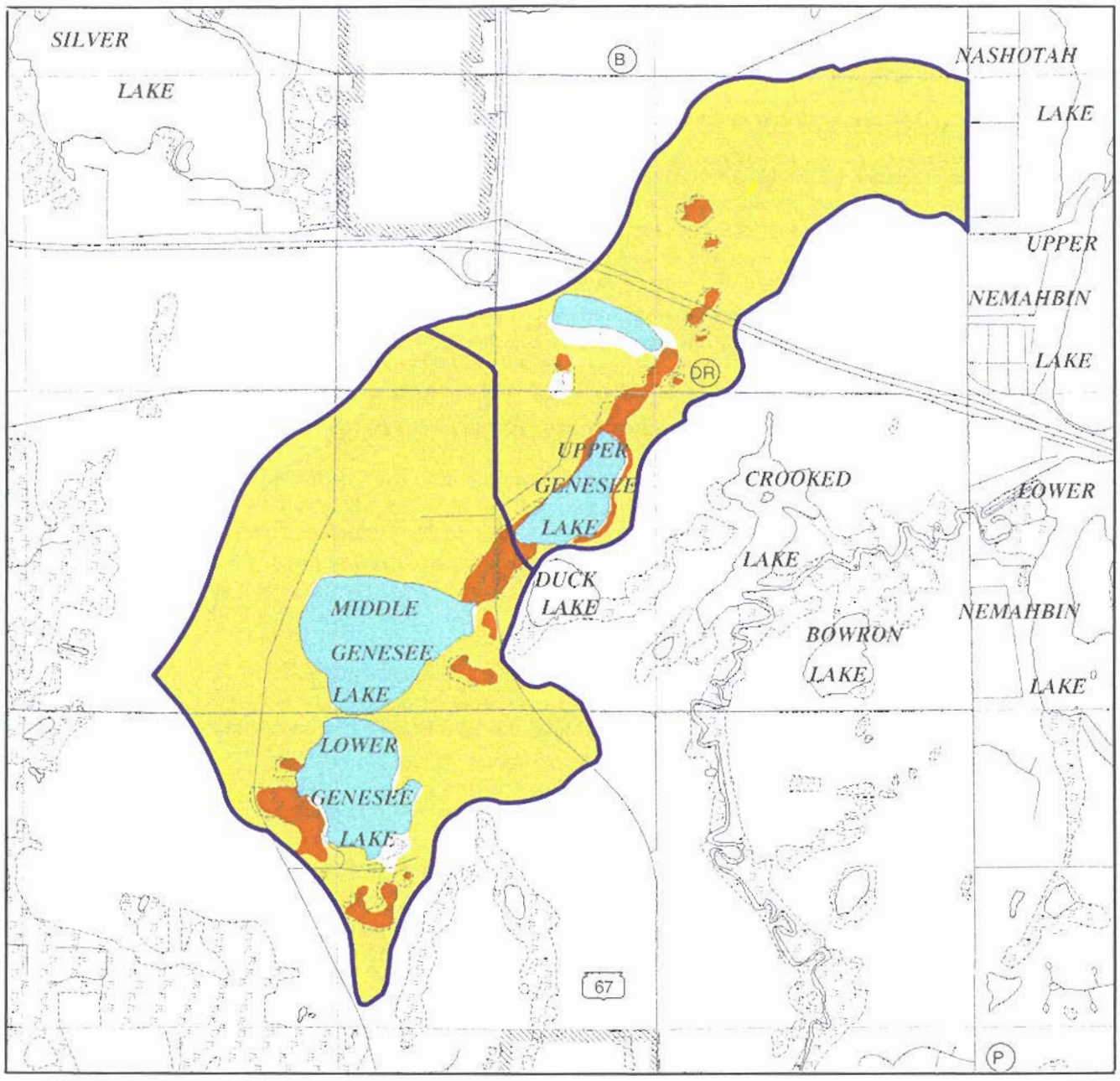
50 TRAVEL TIME IN YEARS

MIDDLE GENESEE LAKE LEVEL	
Average measured lake level:	863.00 feet above sea level
Simulated level:	862.62 feet above sea level

Source: U.S. Geological Survey.

Map 10

HYDROLOGIC SOIL GROUPS WITHIN THE TRIBUTARY DRAINAGE AREA TO MIDDLE GENESEE LAKE



GROUP A: Well-drained

GROUP B: Moderately drained soil

GROUP C: Poorly drained soil

GROUP D: Very poorly drained soil

Hydrologic Soil Group Not Determined

Surface Water

Source: SEWRPC.

N

0 0.25 0.5 0.75 1 Miles

This regional soil survey also contained interpretations of the suitability of soils for urban development with conventional onsite disposal systems and with alternative onsite sewage disposal systems, based upon the then current soils requirements for the use of such onsite sewage disposal systems, as shown on Maps 11 and 12.[21] At present, all riparian residential lands and adjacent lands in the tributary drainage area are served by such private onsite sewage disposal systems. However, based upon the data presented on Maps 11 and 12, there appears to be little likelihood of significant contamination to the Lake from these sources if such private onsite sewage disposal systems are regularly and properly managed and maintained.

AQUATIC PLANTS, DISTRIBUTION, AND MANAGEMENT AREAS

A survey of aquatic plants within Middle Genesee Lake was conducted by Commission staff during July 2001. The results of this survey are presented in Table 5, and graphically depicted on Map 13. Illustrations of the common aquatic plants found in Middle Genesee Lake are included in Appendix A. In addition, a shoreline vegetation survey was conducted by the Commission staff during July 2001. The results of this survey are included herein as Appendix B. While the aquatic plant community of lakes 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 Middle Genesee Lake. This is consistent with the observed chlorophyll-*a* concentrations reported by the U.S. Geological Survey that typically average less than 5.0 µg/l.

Of the macroscopic aquatic plants, fourteen species were observed in Middle Genesee Lake. Thus, while the Lake had good floral diversity, the density of aquatic plants throughout the Lake was generally sparse. Only muskgrass, *Chara vulgaris*, and bushy pondweed, *Najas flexilis*, appeared to be present in significant density. Notwithstanding, Eurasian water milfoil, *Myriophyllum spicatum*, a nonnative, invasive plant, was observed in the Lake. However, the plant was present in relatively low abundance in the Lake, except in one small bay where it was abundant and the dominant species.

The occurrence of Eurasian water milfoil in Middle Genesee 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 of lakes in Southeastern Wisconsin, and, thereby, reduces biodiversity and degrades the quality of fish and wildlife habitats in the lakes.[22]

Purple loosestrife, *Lythrum salicaria*, another nonnative, nuisance plant, was also observed to be present in the wetlands and in riparian areas surrounding Middle Genesee Lake. 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.

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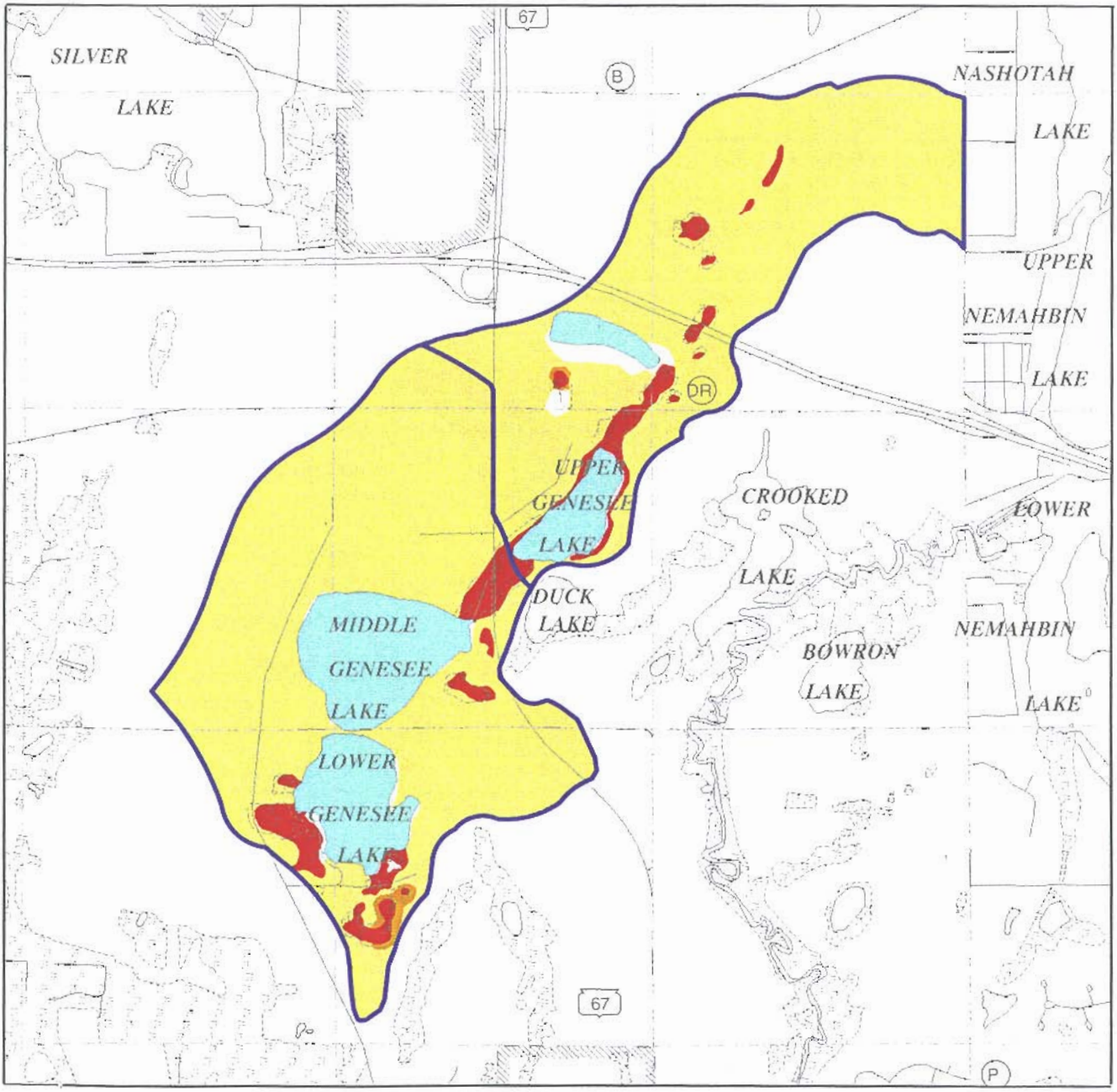
[21]*The soil ratings for onsite sewage disposal systems presented on Map 11 reflect the requirements of Chapter Comm 83 of the* Wisconsin Administrative Code *governing onsite sewage disposal systems as it existed early in the year 2000. During 2000, the Wisconsin Legislature amended Chapter Comm 83 and adopted new rules governing onsite sewage disposal systems. These rules, which had an effective date of July 1, 2000, increased the number of types of onsite sewage disposal systems that legally could be used from four to nine. The Wisconsin Department of Commerce envisions that other systems also will be approved in the future. These new rules significantly alter the existing regulatory framework, and will increase the area in which onsite sewage disposal systems may be utilized.*

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

Map 11

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



UNSUITABLE: Areas covered by soils which have a high probability of not meeting the June 2000 criteria of Chapter Comm 83 of the *Wisconsin Administrative Code* governing conventional onsite sewage disposal systems

UNDETERMINED: Areas covered by soils having a range of characteristics and/or slopes which span the June 2000 criteria of Chapter Comm 83 of the *Wisconsin Administrative Code* governing conventional onsite sewage disposal systems so that no classification can be assigned

SUITABLE: Areas covered by soils having a high probability of meeting the June 2000 criteria of Chapter Comm 83 of the *Wisconsin Administrative Code* governing conventional onsite sewage disposal systems

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

SURFACE WATER

N

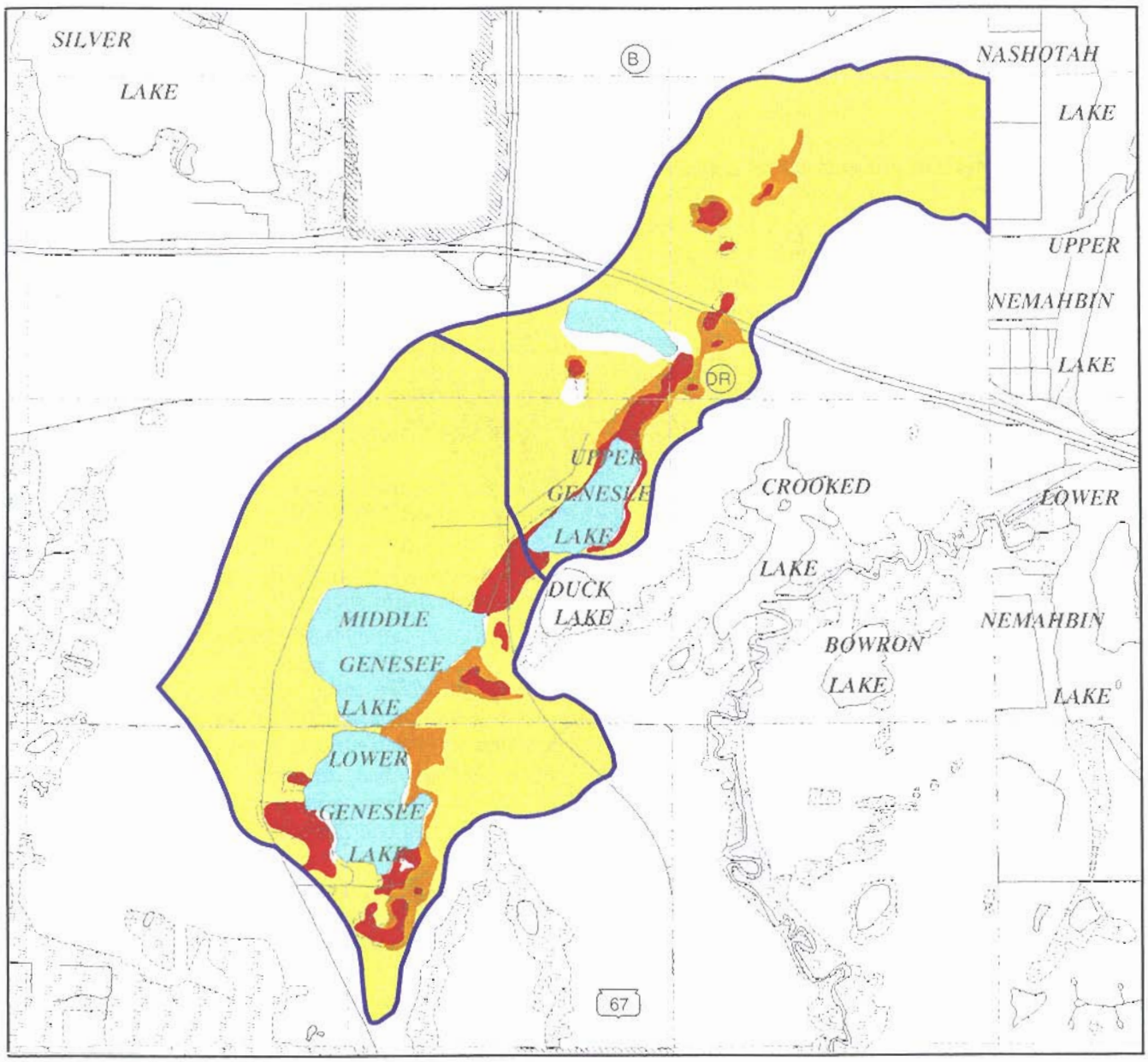
Miles

0 0.25 0.5 0.75 1

Source: SEWRPC.

Map 12

SUITABILITY OF SOILS WITHIN THE DRAINAGE AREA TRIBUTARY TO MIDDLE GENESEE LAKE FOR ALTERNATIVE 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 mound sewage disposal systems

UNDETERMINED: Areas covered by soils having a range of characteristics and/or slopes which span the June 2000 criteria of Chapter Comm 83 of the *Wisconsin Administrative Code* governing conventional mound sewage disposal systems so that no classification can be assigned

SUITABLE: Areas covered by soils having a high probability of meeting the June 2000 criteria of Chapter Comm 83 of the *Wisconsin Administrative Code* governing conventional mound sewage disposal systems

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

SURFACE WATER

N

0 0.25 0.5 0.75 1 Miles

Source: SEWRPC.

Table 5

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

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)[a]	Density at Sites Found[b]	Density in Whole Lake[b]	Ecological Significance[c]
Ceratophyllum demersum (coontail)	1	1.72	3.00	0.05	Provides good shelter for young fish and supports insects valuable as food for fish and ducklings
Chara vulgaris (muskgrass)	45	77.58	2.98	2.31	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
Myriophyllum spicatum (Eurasian water milfoil)	4	6.89	1.25	0.09	None known
Najas flexilis (bushy pondweed)	37	63.79	2.72	1.74	Stems, foliage, and seeds important wildfowl food and produces good food and shelter for fish
Najas marina (spiny naiad)	3	5.17	1.33	0.67	Provides good food and shelter for fish and food for ducks
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
Polygonum amphibium (water smartweed)	--[d]	--[d]	--[d]	--[d]	Provides seeds for waterfowl, upland game birds, deer and muskrats; offers shade and shelter for fish and habitat for invertebrates
Potamogeton crispus (curly-leaf pondweed)	1	1.72	1.00	0.02	Provides food, shelter and shade for some fish and food for wildfowl
Potamogeton (foliosus?) (leafy pondweed)	--[e]	--[e]	--[e]	--[e]	Provides cover for juvenile fish, locally important food for waterfowl
Potamogeton gramineus (variable pondweed)	26	44.82	1.77	0.79	Provides habitat for fish and food for waterfowl, in addition to muskrat, beaver, deer, and moose
Potamogeton natans (floating-leaf pondweed)	1	1.72	3.00	0.05	Provides food and shelter for fish and food for wildfowl
Potamogeton pectinatus (Sago pondweed)[f]	12	20.68	1.67	0.34	This plant is the most important pondweed for ducks, in addition to providing food and shelter for young fish
Potamogeton zosteriformis (flat-stemmed pondweed)	1	1.72	3.00	0.05	Provides some food for ducks
Sagittaria latifolia (arrowhead)	--[d]	--[d]	--[d]	--[d]	Provides food for ducks, muskrats, porcupines, beavers and fish, and provides shelter for young fish
Scirpus acutus (hard-stem bulrush)[f]	--[d]	--[d]	--[d]	--[d]	Provides shelter for young fish, seeds provide food for wildfowl, stems and rhizomes provide food for geese and muskrats, in addition the plant material provides nesting material and cover for wildfowl and muskrats

Table 5 (continued)

Aquatic Plant Species Present	Sites Found	Frequency of Occurrence (percent)[a]	Density at Sites Found[b]	Density in Whole Lake[b]	Ecological Significance[c]
Scirpus americanus (chairmakers rush)[f]	--[d]	--[d]	--[d]	--[d]	Supports insects; provides food for a variety of ducks and muskrats and provides cover for wildfowl
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
Vallisneria americana (water celery)[f]	6	10.34	1.83	0.18	Provides good shade and shelter, supports insects, and is valuable fish food
Zosterella dubia (water stargrass)	3	5.17	2.33	0.12	Provides food and shelter for fish, locally important food for waterfowl

NOTE: There were 58 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 Lakes Partnership.*

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

[e]*Aquatic macrophytes sampled using nonstatistical methods not to be included in the analysis of density and frequency of occurrence.*

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

Source: SEWRPC.

The distributions of both of these plants should be monitored as part of a proposed aquatic plant monitoring program being developed within the Wisconsin Department of Natural Resources Self-Help Monitoring Program.

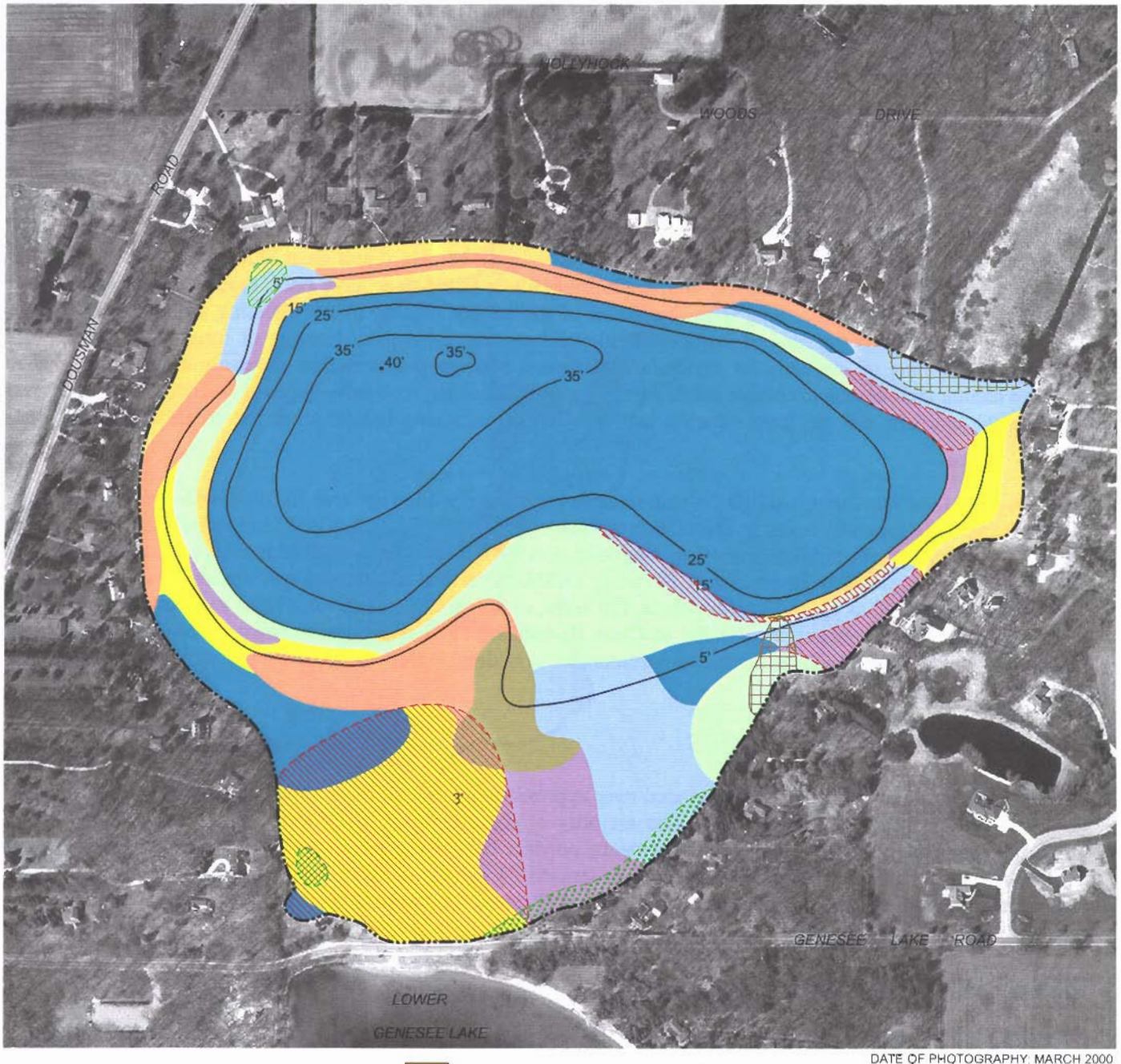
FISHERIES

An electrofishing survey was conducted on Middle Genesee Lake by Wisconsin Department of Natural Resources staff during 1998 and is included herein as Appendix C. This survey indicated a predominantly largemouth bass and bluegill fish community.[23] The survey results indicated that largemouth bass was the dominant species. However, the survey results also suggested that the density and growth rates of both bluegills and largemouth bass were below the target range. Other species present in order of dominance included: yellow perch, yellow bullhead, and walleyed pike.

[23]*S. Beyler and S. Gospodarek, WDNR Memorandum, File No. 3600,* Middle Genesee Lake Electrofishing Survey, *May 1998.*

Map 13

AQUATIC PLANT COMMUNITY DISTRIBUTION IN MIDDLE GENESEE LAKE: 2001



DATE OF PHOTOGRAPHY: MARCH 2000

—25' — WATER DEPTH CONTOUR IN FEET

OPEN WATER

WATER LILIES

CATTAILS

HARD-STEM BULRUSH

EURASIAN WATER MILFOIL

COONTAIL

MUSKGRASS

MUSKGRASS AND BUSHY PONDWEED

MUSKGRASS, BUSHY, AND VARIABLE PONDWEEDS

MUSKGRASS, WILD CELERY, SPINY NAIAD, WATER STAR GRASS, AND BUSHY, SAGO, AND FLAT-STEM PONDWEEDS

MUSKGRASS, WILD CELERY, SPINY NAIAD, WATER STAR GRASS, AND BUSHY, SAGO, VARIABLE, AND CURLY LEAF PONDWEEDS

MUSKGRASS, WILD CELERY, SPINY NAIAD, WATER STAR GRASS, AND BUSHY, SAGO, VARIABLE, AND FLAT-STEM PONDWEEDS

GRAPHIC SCALE

0 250 500 FEET

Source: SEWRPC.

These results were contrasted with those obtained during a 1964 Wisconsin Conservation Department fyke-net survey which indicated that bluegill were the dominant species.[24] The bluegill population was noted as relatively slow growing, although largemouth bass reproduction and growth rates were considered to be good, at the time of that survey. Bullhead, pumpkinseed, rock bass, and green sunfish also were reported to be present.

Though carp were not reported during the 1964 survey, they were observed during the 1998 survey. The individuals captured in the survey were considered to be large, but the carp population did not appear to be over-abundant, indicating that the fishery appeared to be relatively well-balanced.

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.

Map 14 shows the remaining wildlife habitat areas in the tributary drainage area to Middle Genesee Lake as of 1985. These areas generally occur in association with existing surface water, wetland, and woodland areas located along the Genesee chain of lakes and other, neighboring waterbodies. These wildlife habitat areas covered about 310 acres, or approximately 20 percent of the study area. Of this total habitat acreage, about 130 acres, or about 40 percent, were rated as Class I habitat; about 120 acres, or about 40 percent, were rated as Class II habitat; and about 60 acres, or 20 percent, were rated as Class III habitat. The habitat areas shown on Map 14 are largely coincident with Commission-delineated environmental corridors within this watershed, which are shown on Map 15.

ENVIRONMENTAL CORRIDORS

As of 1995, environmental corridors extended over approximately 300 acres or about 15 percent of the tributary drainage area to Middle Genesee Lake. The majority of these corridor lands were considered to be primary environmental corridor. No secondary environmental corridor lands were delineated in the watershed, and isolated natural resource features covered about 6 acres, or less than 1 percent of the tributary drainage area. These lands are shown on Map 15, and are recommended to be considered for preservation as the process of development proceeds within the Region.[25]

RECREATIONAL USES AND FACILITIES

Middle Genesee 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, ice skating, and, occasionally, "polar bear" swimming during the winter months. The Lake is used year round as a visual amenity; walking, bird-watching, and picnicking being popular passive recreational uses of the waterbody.

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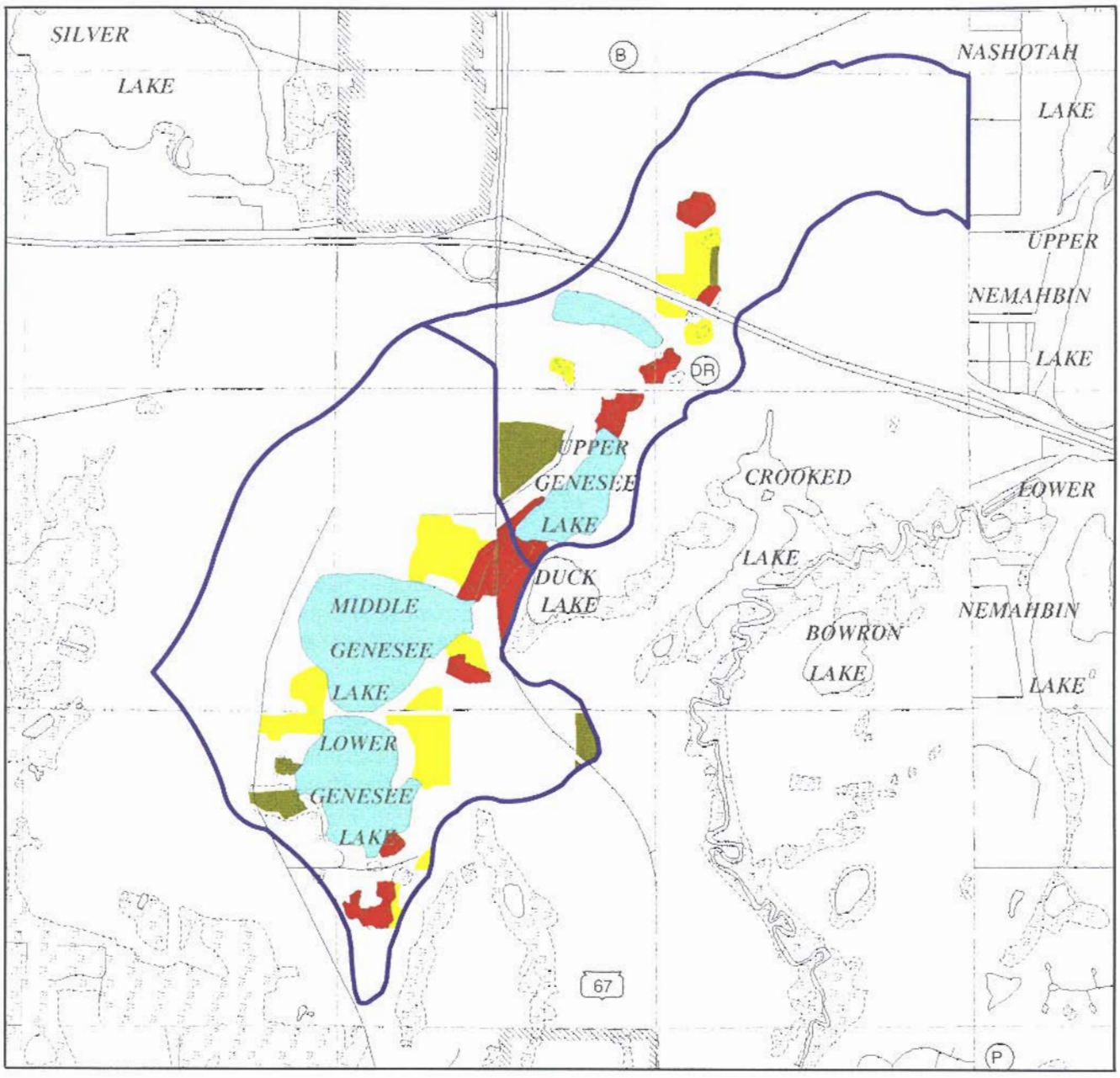
[24]*The Wisconsin Conservation Department is now the Wisconsin Department of Natural Resources.*

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

Map 14

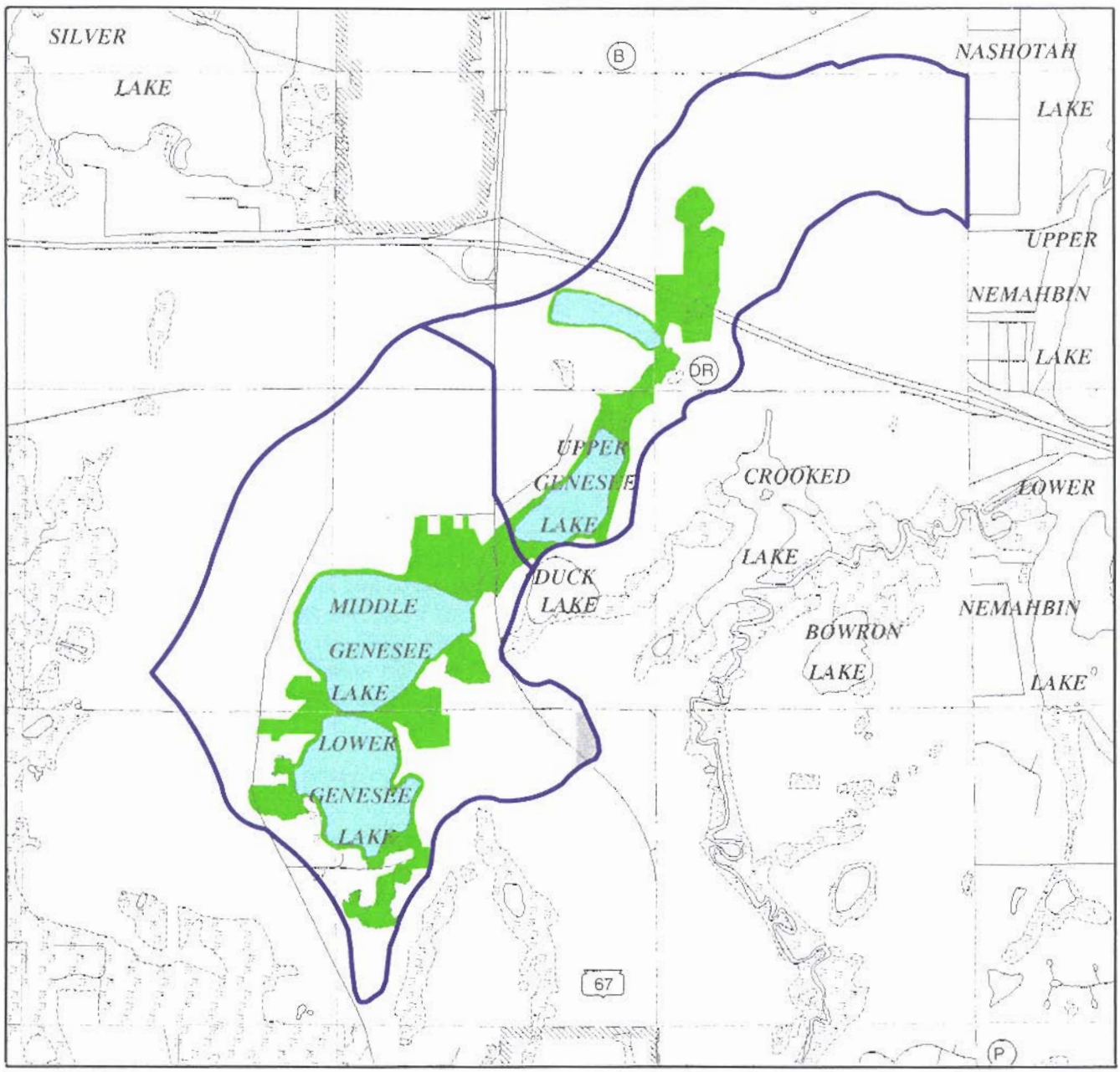
WILDLIFE HABITAT AREAS WITHIN THE TRIBUTARY DRAINAGE AREA TO MIDDLE GENESEE LAKE: 1985



Source: SEWRPC.

Map 15

ENVIRONMENTAL CORRIDORS AND ISOLATED NATURAL RESOURCE AREAS WITHIN THE TRIBUTARY DRAINAGE AREA TO MIDDLE GENESEE LAKE: 1995



Primary Environmental Corridor

Isolated Natural Resource Area

Surface Water

N

0 0.25 0.5 0.75 1 Miles

Source: SEWRPC.

Public recreational boating access to Middle Genesee Lake is provided through one boat launch site on the south shore of the Lake, off of Genesee Lake Road, as shown on Map 3. Parking is currently provided just west of the launch site in a lot shared with Lower Genesee Lake. Middle Genesee Lake is considered as 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 94 boats were either moored in the water or stored on land adjacent to Middle Genesee Lake. The types of boats included: speedboats, fishing boats, paddleboats, rowboats, canoes, sailboats, and personal watercraft (also known as Jetskis®), as shown in Table 6.

In addition, recreational use surveys were conducted by Commission staff on July 11 and 14, 2001. These surveys were designed to quantify typical week day and weekend day usage of the Lake. A variety of watercraft were 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 7.

A questionnaire-based resident survey, conducted by the Middle Genesee Lake Management District during 1997, indicated a high degree of satisfaction among lakeshore residents and property owners regarding their ability to utilize this resource for both active and passive recreational purposes. Respondents did indicate concerns about water quality, numbers of personal watercraft, the abundance of algal and aquatic plant growths, shoreline erosion, boating traffic, and water level fluctuations. This was consistent with the approximately equal split between respondents who felt that the Lake had deteriorated over time and those who felt that the Lake had remained the same over time. The complete survey results are reproduced in Appendix D.

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.

A survey of the Middle Genesee Lake shoreline, conducted by Commission staff during July 2001, indicated that about 50 percent of the shoreline remained in a natural condition, without shoreline protection structures. About 35 percent of the shoreline was protected by riprap, with the balance either being protected by bulkheads or consisting of sand beach, as shown on Map 16, in approximately equal proportions.

In general, the shoreline protection structures were considered to be in a good state of repair, with few obvious failures noted. One small area of shoreland erosion was observed along the northeastern shoreline of the Lake, where the shore was being undercut by wave action.

LOCAL ORDINANCES

Middle Genesee Lake is subject to a boating ordinance promulgated by the Town of Summit. This ordinance provides generally applicable rules for Middle and Lower Genesee Lakes, as set forth in Appendix E. These rules limit the times during which watercraft may be operated on Middle and Lower Genesee Lakes, 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*.

Table 6

WATERCRAFT ON MIDDLE GENESEE LAKE: 2001

Type of Watercraft									
Power Boat	Fishing Boat	Pontoon Boat	Canoe	Paddle Boat	Sailboat	Kayak	Personal Watercraft	Other	Total
10	18	19	11	16	8	0	11	1	94

Source: SEWRPC.

Table 7

RECREATIONAL USE SURVEY ON MIDDLE GENESEE 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.

Map 16

SHORELINE PROTECTION STRUCTURES ON MIDDLE GENESEE LAKE: 2001

DATE OF PHOTOGRAPHY: MARCH 2000

RIPRAP

BEACH

NATURAL

BULKHEAD

Source: SEWRPC.

GRAPHIC SCALE

0 250 500 FEET

Chapter III

LAKE USE PROBLEMS AND ISSUES

INTRODUCTION

Middle Genesee Lake is a high-quality waterbody that is capable of supporting a variety of recreational water uses. Notwithstanding, there are a number of existing and potential future problems and issues of concern that should be addressed in this lake protection plan. These concerns include potential changes in ecologically valuable areas, aquatic plant communities, and fisheries; construction site erosion, nonpoint source pollution, and lake water quality; lake water levels, shoreland protection; and groundwater quality and quantity.

ECOLOGICALLY VALUABLE AREAS, AQUATIC PLANTS, AND FISHERIES

Ecologically Valuable Areas

The ecologically valuable areas within the tributary drainage area of Middle Genesee Lake, as documented in Chapter II, include wetlands, woodlands, and wildlife habitat areas. Most of these areas are included in the lands designated as primary environmental corridors. Critical sites within the Lake include: fish spawning habitat, and macrophyte beds, especially those containing a diverse flora and those in the littoral zone along shoreline areas supporting productive aquatic habitat, primarily along the northeastern shoreline. Protection of these areas is an important issue that should be considered.

Aquatic Plants

The presence of Eurasian water milfoil in limited areas of the Middle Genesee Lake basin, and the presence of purple loosestrife in wetlands and shorelands adjoining the Lake, represents another important issue to be considered. Eurasian water milfoil often outcompetes native aquatic plants and dominates the plant communities in the lakes of Southeastern Wisconsin, to the detriment of fish and wildlife populations, and native plant species. The dominance of Eurasian water milfoil in aquatic ecosystems in Southeastern Wisconsin degrades the natural resource base and commonly interferes with human recreational and aesthetic use of the natural resources. As discussed in Chapter II, this aquatic plant is found in limited areas in Middle Genesee Lake, and, therefore, its monitoring and management is an issue that should be considered.

As discussed in Chapter II, wetland areas adjacent to Middle Genesee Lake provide important habitat for wildlife. The wetland areas physically connected to the Lake provide valuable fish spawning habitat, especially during the early spring. In addition to providing habitat, these areas also contribute to the scenic vistas that characterize the Middle Genesee Lake watershed. Shoreland wetlands help to absorb floodwaters, and, by retaining sediments and nonpoint source pollutants, can help to protect the Lake from degradation. Wetlands provide a nutrient filter and a

buffer that protects the Lake from urban runoff; provide wildlife habitat; and contribute to the ecological structure and function of aquatic ecosystems which provide a broad range of benefits for the natural resources base and ambience of Southeastern Wisconsin.[1] The presence of purple loosestrife within these wetlands can degrade these benefits, limit habitat, and alter the wetland plant community structure. Consequently, the management and control of purple loosestrife infestations is an important element of wetland and shoreland management to be considered.

The environmental corridors in the drainage area tributary to Middle Genesee Lake, together with the isolated natural resource features, contain almost all of the best remaining woodlands, wetlands, and wildlife habitat in the area. The protection of these resources from additional intrusion by incompatible land uses that degrade and destroy the environmental values of these sites, and the preservation of the corridors, is an important issue that should be considered.

Fisheries

Based upon the fisheries surveys conducted by the Wisconsin Department of Natural Resources and set forth in summary form in Chapter II, it would appear that the fishery of Middle Genesee Lake, while relatively well-balanced, may be developing signs of over-harvesting. The aquatic plant survey conducted by the Commission staff during 2001 indicated a relatively sparse aquatic flora. This may limit the availability of cover and habitat structure for fishes. Further, the 1998 fish survey noted the presence of carp in Middle Genesee Lake. While this population appears to be within acceptable bounds,[2] ongoing monitoring of the fishery is an important issue that should be considered, especially given that angling is a popular recreational activity on the Lake.

CONSTRUCTION SITE EROSION, NONPOINT SOURCE POLLUTION, AND WATER QUALITY

Construction Site Erosion and Nonpoint Source Pollution

Erosion during construction, and nonpoint source pollutants associated with new urban development, in the drainage area tributary to Middle Genesee Lake represents a potentially significant threat to the Lake's water quality. Based upon recommendations set forth in the aforereferenced regional land use and Waukesha County development plans, and the county land and water resource management plan,[3] future development of open lands within the drainage area tributary to Middle Genesee Lake is expected to occur as part of the Pabst Farms, Inc. Additionally, unplanned development and development of existing platted lots and redevelopment of current sites, could potentially occur within the drainage area with 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 Middle Genesee 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 and practices 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 some pollutants associated with urban development, such as heavy metals, may be expected to occur as land uses change. As indicated in Chapter II, however, sediment and phosphorus loads may decrease once more urban land use conditions stabilize within the

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[1]*The range of benefits to be derived from a sound natural resources base within Southeastern Wisconsin is summarized in SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997.*

[2]*S. Beyler and S. Gospodarek, WDNR Memorandum, File No. 3600,* Middle Genesee Lake Electrofishing Survey, *May 1998.*

[3]*Waukesha County,* Land and Water Resource Management Plan: 1999-2002, *January 1999.*

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.

Hence, the control of construction site erosion and of stormwater-borne, nonpoint-sourced pollutants remains an important issue to be considered.

Surface Water Quality

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

LAKE WATER LEVELS, SHORELAND PROTECTION, AND GROUNDWATER

Lake Water Levels

Riparian residents have reported significant seasonal changes in the water levels of Middle Genesee Lake. While water level management in a lake is a common technique for managing fish and aquatic macrophytes, the consequences of fluctuating lake water levels can be both beneficial and deleterious. The major impacts, from the riparian owner standpoint, is that the fluctuating water levels modify the rates of shoreline erosion, interfere with the placement and height of piers, limit recreational boating opportunities, and affect the correct placement of shoreline protection structures.

Periodic changes in precipitation and weather patterns between years often result in fluctuations in the water loads to lakes. In seepage lakes, where water levels are directly affected by amounts of precipitation and are largely independent of external inflows, such seasonality can result in significant changes in lake level throughout a year and across a period of years. Notwithstanding, water level fluctuations in seepage lakes often are subject to a lag time or delay imposed by the rate at which groundwaters are recharged that can result in periods of lower precipitation being manifested in diminished lake levels during subsequent years.

While many plant and animal species can cope with such water surface fluctuations without experiencing either positive or negative consequences, some species are extremely susceptible to such fluctuations. Less mobile species, such as shellfish and molluscs, often fare poorly under conditions of extreme lake level fluctuation. Plants such as the cattail often take advantage of lower water levels to expand their range lakeward. Thus, generally, it is desirable from the point of view of aquatic habitat that water levels be maintained so as to avoid major shifts.

Historically, both Middle Genesee and Lower Genesee Lakes have had substantial variations in water level. In some years, problems have been experienced due to low water levels—which are most severe in the Middle Lake where large areas of shoreland may be exposed, and, in other years, due to high water levels, which are most pronounced in the Lower Lake—where shorelands and onsite sewage treatment systems have been flooded. Therefore, control of the lake level at Middle Genesee Lake is, then, an important issue to be considered.

Shoreline Protection

The 2001 survey of the Middle Genesee Lake shoreline identified many regions of natural shorelines some of which appear subject to erosion and undercutting banks. Shoreline erosion could be expected to increase if lake usage increases. With high water levels, erosion-related problems could worsen. Hence, shoreline protection is an issue to be considered.

Groundwater Quality and Quantity

As note above, Middle Genesee Lake is subject to changes in lake levels as a consequence of inter-annual variations in rainfall and changing rates of infiltration. Being a groundwater-fed, flow-through lake, these fluctuations reflect changes in the volume of groundwater recharge due largely to natural climatic variations. However, changes in land use such that increased areas of impervious surface limit aquifer recharge also have the

potential to affect the volume of groundwater entering the Lake, which, in turn, affects the levels and quality of the Middle and Lower Genesee Lakes. Thus, groundwater inflows are an issue to be considered.

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

Since groundwater is the primary source of supply for Middle Genesee Lake, it is also important to maintain the quality and quantity of groundwater. Urban development can cause a reduction in groundwater recharge. This minimizing the loss of groundwater recharge is an important issue of concern.

Chapter IV

ALTERNATIVE AND RECOMMENDED LAKE PROTECTION MEASURES

INTRODUCTION

Chapter III described four issues of concern to be considered as part of this lake protection plan. These issues are related to: 1) ecologically valuable areas, aquatic plants, and fisheries; 2) construction site erosion, nonpoint source pollution, and surface water quality; 3) shoreland protection; and 4) lake levels and groundwater quality and quantity. Following a brief summary of the ongoing lake management program activities, alternatives and recommended measures to address each of these issues and concerns are described in this chapter.

PAST AND PRESENT LAKE MANAGEMENT ACTIONS

The residents of Middle Genesee Lake, in conjunction with the Town of Summit, have long recognized the importance of informed and timely action in the management of the Middle Genesee Lake. The initial action in this regard resulted in the formation of the Genesee Lakes Association, which provided the forum for many of the lake management activities undertaken by the residents of Lower and Middle Genesee Lakes. Subsequently, the residents around the Middle Genesee Lake created the Middle Genesee Lake Management District, a Chapter 33, *Wisconsin Statutes*, public inland lake protection and rehabilitation district. The District is currently enrolled in the Trophic State Index (TSI) water quality monitoring program conducted under the auspices of the U.S. Geological Survey, and maintains an active program of public information and involvement in lake management actions. The District maintains an effective working relationship with the Genesee Lakes Association and Town of Summit.

The current planning project program derives from a Phase I Planning Grant Program study, conducted by Welch, Hanson & Associates for the Genesee Lakes Association, which identified issues to be addressed by the Middle and Lower Genesee Lakes community. These issues included flooding issues and high water overflow outlet options, stormwater discharge issues, and groundwater issues. With respect to lake water levels, an earlier study, conducted by the Regional Planning Commission and Ruekert & Mielke, Inc., at the request of the Town of Summit and appended hereto as Appendix F, evaluated three alternatives actions addressing the flooding problems on Lower and Middle Genesee Lakes. The recommended control alternative proposed a system for the passive management of high water levels in the Lakes, an alternative that was confirmed by the Phase I planning study noted above. While this recommendation is yet to be implemented, the importance of groundwater flows in maintaining water levels within the Lakes led to the development and conduct of a Phase II, Chapter NR 190 Lake Management Planning Grant Program project, involving a more detailed investigation of hydrologic budget

and groundwater issues.[1] The current initiative is being undertaken as a Phase III lake management planning program by the Middle Genesee Lake Management District, and is designed to identify both the issues of concern relating to Middle Genesee Lake and the measures necessary to mitigate their negative impacts of the lake environment and use.

Presently, the Middle Genesee Lake Management District is actively pursuing public participation opportunities relating to land use and stormwater management in the vicinity of Middle Genesee Lake, and conducting an ongoing program of lake water quality monitoring. The Middle Genesee Lake Management District Commissioners regularly attend Town of Summit Plan Commission meetings regarding the development of the plans and lands within the drainage area tributary to the Lake, and have provided reports and other documentation to this body and other agencies and organizations dealing with community development decisions. In this regard, the District is an active participant in the planning process with respect to the development of the Pabst Farms, Inc., property, a portion of which is within the drainage area tributary to the Genesee Lakes. The District also is an active participant in the public process relating to the preparation of a stormwater management plan for this development.

The Middle Genesee Lake Management District maintains an active 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 Genesee Lakes community and other interested parties. The District uses this opportunity, as well as periodic mailings, to distribute informational materials to District residents. Included in this informational programming are regular reports of lake water quality, based upon data gathered for the District by the U.S. Geological Survey through their TSI monitoring lake water quality program.

ECOLOGICALLY VALUABLE AREAS, AQUATIC PLANTS, AND FISHERIES

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

Array of Protection Measures

Three measures to protect and maintain the biodiversity of Middle Genesee Lake and the tributary drainage area have been identified as potentially viable: 1) land management measures, 2) in-lake management measures, and 3) citizen informational and educational measures.

Land Management Measures

The recommended future land use plan for the drainage area tributary to Middle Genesee Lake is set forth in the adopted regional land use plan and in the Waukesha County development plan.[2] Those plans recommend the preservation of environmental corridor lands in essentially natural, open uses. Most of the wetlands and other ecological valuable lands adjacent to Middle Genesee Lake and within the drainage area tributary to Middle Genesee Lake are included within these primary environmental corridors.

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[1] *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 Middle Genesee Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000.*

[2] *SEWRPC Planning Report No. 40,* A Regional Land Use Plan for Southeastern Wisconsin: 2010, *January 1992; and SEWRPC Community Assistance Planning Report No. 209,* A Development Plan for Waukesha County, Wisconsin, *August 1996.*

All lakes, rivers, streams, wetlands, and associated undeveloped floodlands and shorelands are recommended to be placed in lowland conservancy or floodplain protection districts. The existing Town of Summit zoning for the lands in the vicinity of Middle Genesee Lake and in the drainage area directly tributary to Middle Genesee Lake is generally consistent with the recommended future land use pattern set forth in the regional land use plan and Waukesha County development plan. The Town zoning for the drainage area directly tributary to Middle Genesee Lake generally provides for conservancy zoning of wetland portions of the primary environmental corridor. The upland portions of the drainage area are included in A-3, and R-4 and R-5 zoning districts, which provide for agriculture, and low-density, single family residential development, respectively.[3]

In-Lake Management 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 Middle Genesee Lake. Generally, aquatic plant management measures, designed to minimize the environmental and recreational impacts of degraded habitat, are classed into four groups: physical measures which include lake bottom coverings and water level management; mechanical measures which include harvesting and manual removal; chemical measures which include the use of aquatic herbicides; and biological control measures which include the use of various organisms, including insects. All 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.

Aquatic Herbicides

Chemical treatment with aquatic herbicides is a short-term method of controlling heavy growths of aquatic macrophytes and algae. Chemicals are applied to the growing plants 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. However, 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. Because Middle Genesee Lake does not have significant growths of nuisance plant species, widespread chemical treatment is not recommended as a means of controlling aquatic plant growth. Consideration may be given, however, to the limited use of early

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[3]*These zoning categories contain the following provisions: A-3, agricultural, zoning provides for lot sizes of at least two acres but not more than five acres in areal extent, with dwelling units being situated on lots of at least three acres in areal extent; R-4, suburban residential, zoning provides for lot sizes of at least 1.5 acres, but not more than five acres in areal extent, and includes both country home and rural estate land uses with dwelling units being situated on lots of at least two acres and three acres, respectively; and, R-5, rural estate residential, zoning provides for lots of at least five acres in areal extent with dwelling units being situated on lots of at least five acres in areal extent.*

spring chemical controls targeting Eurasian water milfoil growths, particularly in isolated embayments of the Lake.

Aquatic Plant Harvesting
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 limited extent of the aquatic plant communities within Middle Genesee Lake, mechanical harvesting is not considered a viable management option as a control of aquatic plants.

Manual Harvesting
Mechanical harvesting requires a minimum depth of water in which to operate the harvesting equipment. When the water depth is inadequate depth, 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.

Manual harvesting is recommended for use in Middle Genesee Lake when nearshore aquatic plant growths around piers are perceived to interfere with recreational boating and other active recreational activities.

Biological Controls
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.[4] Recent studies have shown that *Eurhychiopsis lecontei*, an aquatic weevil, has potential as a biological control agent for Eurasian water milfoil.[5] 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

[4]*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.*

[5]*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.*

undertaken on Middle Genesee 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.

Lake Bottom Covering

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 lakes 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.

Boating Ordinances

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

1. Enforcement of slow-no-wake operation of motorized boats within a specific distance of the shoreline, such as within the "shore zone," which is defined as within 100 feet of pierheads or 200 feet of the shoreline—in the case of personal watercraft, as defined in the Wisconsin Department of Natural Resources boating ordinance guidelines.[6]

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

3. Limitation of the speed at which boat traffic travels in the shallow 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 Middle Genesee 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.

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

Although buoyage has the advantage of being visible to recreational boaters, it can be expensive to obtain, install, and maintain. However, it clearly demarcates the affected areas. Two general options exist regarding the use of buoyage: the establishment of public awareness using informational buoys. Establishment of slow-no-wake areas

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

within Middle Genesee Lake will require amendment of the Town of Summit boating ordinance, Ordinance 191, and a Wisconsin Department of Natural Resources permit. Only regulatory markers are enforceable.

Buoys placed within waters of the State of Wisconsin are subject to the requirements set forth in Chapter 30, *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. 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. Buoys used to demarcate regulated areas display their instructions in black lettering. Prohibition buoys display an orange diamond with an orange cross inside. Control buoys display an orange circle. Local authorities having jurisdiction over the waters involved may place danger buoys or informational buoys without an ordinance, although a Wisconsin Department of Natural Resources permit is still required. Informational buoys are similar in construction to the regulatory buoys, but contain an orange square on the white background. Informational buoys are not enforceable.

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

Citizen Information and Education
In addition to these in-lake management measures, an ongoing campaign of community information will support the aquatic plant management program by encouraging the use of shoreland buffer strips, responsible use of household and garden chemicals, and adoption of environmentally friendly household and garden practices to minimize the input of nutrients from these riparian areas. Aquatic plant management usually centers on the eradication of nuisance aquatic plants for the improvement of recreational lake use. The majority of the public views all aquatic plants as "weeds" and residents often spend considerable time and money removing desirable plant species from a lake without considering 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 an aquatic plant management program. Posters and pamphlets are available from the University of Wisconsin-Extension and Wisconsin Department of Natural Resources that provide information 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.

Fisheries Management Measures
Few data on the fisheries of Middle Genesee Lake are available. Notwithstanding, as is noted in Chapter III, fishing is a popular pastime on Middle Genesee Lake. Reconnaissance fisheries surveys conducted by the Wisconsin Department of Natural Resources during 1998 indicated that the fishery in the Lake may be unbalanced. Additional fisheries inventory data may be needed to supplement these reconnaissance data, which can be used as a basis for evaluating future management actions.

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

1. The Middle Genesee Lake Management District should support the preservation of the primary environmental corridor lands and isolated natural resource features in the Middle Genesee Lake tributary drainage area. These lands, and especially their associated wetland areas, are recommended to be protected and preserved to the extent practicable through their incorporation into the stormwater management system and related drainageways; their inclusion within site plans as local parks, recreational trails, or open spaces; and the restoration of their natural structure and functions within

the landscape.[7] Such preservation should be promoted through the existing regulations and programs intended to protect such natural resources.

2. The Middle Genesee Lake Management District should monitor the Lake and surrounding wetlands for the presence or spread of nuisance plant species such as Eurasian water milfoil and purple loosestrife. Manual harvesting of plants around piers and docks is the recommended means of controlling milfoil and other nuisance species of plants in those areas given the small size of the Lake. In this regard, the District could consider purchasing several specialty rakes designed for the removal of vegetation from shoreline property and make these available to riparian owners. This would allow the riparian owners to use the rakes on a trial basis before purchasing their own. The rakes cost approximately $90 each, and do not require a permit for use. Should the growth of Eurasian water milfoil be determined to reach nuisance proportions, the use of chemical herbicides could be considered, but should be limited to small areas. 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. It is recommended that an aquatic plant survey be conducted every three to five years in order to track the success of the current aquatic plant management program, as well as any other changes in the tributary drainage area that may affect Middle Genesee Lake.

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

4. The Wisconsin Department of Natural Resources recommended the conduct of a follow-up fisheries survey to determine if additional regulatory measures may be required. Implementation of regulatory or remedial measures, such as modified size limits for catches and stocking, in Middle Genesee Lake should be based upon the findings set forth in this recommended survey.

CONSTRUCTION SITE EROSION, NONPOINT SOURCE POLLUTION, AND SURFACE WATER QUALITY

Middle Genesee Lake is a mesotrophic waterbody. As such, it may be considered, by definition, to be in need of protection to maintain and enhance its current aesthetic and recreational uses. The anticipated urbanization of the watershed under buildout conditions, as set forth in the aforereferenced regional land use and County development 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,[8] has heightened concern among lakeshore residents that the water quality of the Lakes may deteriorate. Thus, consideration is given in this section to those actions that will protect lake water quality and potentially reduce contaminant loads to the Lake.

As described in Chapter II, the primary sources of pollutant loadings to Middle Genesee Lake are nonpoint sources generated within the drainage area tributary to the Lake. The Waukesha County development plan envisions an increase in commercial, industrial, and urban residential lands in the drainage area tributary to

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[7] *SEWRPC Community Assistance Planning Report No. 209,* op. cit.

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

Middle Genesee Lake, particularly on the property currently owned by the Pabst Farms, Inc. Such development has the potential to result in increased loadings of some pollutants associated with urban development and construction sites. Consequently, the adopted regional water quality management plan nonpoint source pollution abatement plan element for the Bark River watershed generally recommends the implementation of both urban and rural nonpoint source pollution control practices designed to reduce the pollutant loadings from nonpoint sources by about 25 percent.[9] The regional plan also recommended that local agencies charged with responsibility for nonpoint source pollution control prepare refined and detailed local-level nonpoint source pollution control plans.

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,[10] the Waukesha County land and water resource management plan,[11] the Wisconsin Department of Natural Resources Lower Rock River Basin Water Quality Management Plan,[12] and information presented by the U.S. Environmental Protection Agency.[13]

Array of Control Measures

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

Urban Nonpoint Source Controls

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

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

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

[11]*Waukesha County,* Waukesha County Land and Water Resource Management Plan: 1999-2002, *January 1999; see also recommendations set forth in SEWRPC Community Assistance Planning Report No. 159,* Waukesha County Agricultural Soil Erosion Control Plan, *June 1988, and SEWRPC Community Assistance Planning Report No. 209,* op. cit.

[12]*Wisconsin Department of Natural Resources PUBL-WT-280-98-REV,* Lower Rock River Basin Water Quality Management Plan, *October 1998.*

[13]*U.S. Environmental Protection Agency, Report No. EPA-440/4-90-006,* The Lake and Reservoir Restoration Guidance Manual, *2nd Edition, August 1990; and its technical supplement, U.S. Environmental Protection Agency, Report No. EPA-841/ R-93-002,* Fish and Fisheries Management in Lakes and Reservoirs: Technical Supplement to the Lake and Reservoirs Restoration Guidance Manual, *May 1993; 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 Middle Genesee Lake, Wisconsin, Using Analytic Elements and Parameter Estimation, *2000.*

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

Proper design and application of urban nonpoint source control measures such as grassed swales, detention basins, and infiltration basins requires the preparation of a detailed stormwater management system plan that addresses stormwater drainage problems and controls nonpoint sources of pollution. Based upon preliminary evaluation, however, it is estimated that few practices would be effective in the areas within the immediate vicinity of Middle Genesee Lake. Management measures that can be applied within the Town of Summit in the immediate vicinity of Middle Genesee Lake are limited largely to good urban housekeeping practices and grassed swales. However, the application of more effective structural measures should be considered for installation as part of the development process in urbanizing areas within the drainage area to Middle Genesee Lake, specifically within the lands currently occupied by the Pabst Farms, Inc.

Within the proposed Pabst Farms, Inc., development, current design drawings indicate the intention that the development be served by a stormwater management system primarily comprised of grassed swales draining to wetland-based infiltration areas. Portions of the development also would be serviced by storm sewers draining to wet detention basins that, in turn, would discharge to surface waters. The southwestern portion of the proposed Pabst Farms, Inc., development is indicated to drain through such basins to Middle Genesee Lake, while the larger portion of the development, primarily situated north of IH 94, is proposed to be serviced by infiltration basins that will discharge stormwater into the groundwatershed of Middle Genesee Lake. While the surface drainage area tributary to Middle Genesee Lake encompasses much of the wetland area proposed to be utilized for stormwater infiltration purposes, the groundwatershed draining to Middle Genesee Lake extends beneath the proposed commercial and residential developments located to the northeast of the Lake. Therefore, the potential exists that contaminants carried within stormwater runoff from the proposed urban-density development could negatively affect Middle Genesee Lake. Thus, stormwater management measures within these developing areas are an important measure for the protection of water quality in Middle Genesee Lake.

In addition, developing areas can generate significantly higher pollutant loadings than established areas of similar size. These areas include a wide array of activities, including individual site development within the existing urban area, and new land subdivision development. As previously noted, additional urban development is presently occurring and/or planned within the drainage area tributary to Middle Genesee 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.

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

The Town of Summit applies construction site erosion controls as currently provided in Section Comm 21.125, Erosion Control Procedures of Uniform Dwellings, of the *Wisconsin Administrative Code*. These controls include temporary measures taken to reduce pollutant loadings from construction sites during stormwater runoff events, in a manner consistent with the provisions set forth in the construction site management handbook developed by the

Wisconsin Department of Natural Resources in cooperation with the Wisconsin League of Municipalities.[14] Likewise, the City of Oconomowoc, which jurisdiction includes portions of the watershed draining to Middle Genesee Lake, has adopted a construction site erosion control ordinance that is administered and enforced by the City in both the shoreland and nonshoreland areas of the City of Oconomowoc. This ordinance also is based upon the model ordinance developed by Wisconsin Department of Natural Resources in cooperation with the League of Wisconsin Municipalities.

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 Middle Genesee Lake. Estimated phosphorus and sediment loadings from croplands, woodlots, pastures, and grasslands in the drainage area tributary to Middle Genesee Lake were presented in Chapter II. These loadings are recommended to be reduced to the target level of agricultural erosion control of three tons per acre per year identified in the Waukesha County agricultural soil erosion control plan as the tolerable levels that can be sustained without impairing productivity. As set forth in Chapter II, much of the remaining agricultural lands within the drainage area tributary to Middle Genesee 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 Middle Genesee Lake, this benefit maybe offset by the fact that urban lands contribute a wider range of contaminants to surface waters and generally result in increased rates of surface runoff.

Public Informational Programming

Additional actions can be undertaken to minimize nutrient and pollutant loadings from source areas within the drainage area tributary to Middle Genesee Lake. Based upon the aforereferenced findings of the U.S. Geological Survey, residential lawns can form a major source of phosphorus to watercourses in urban areas. In some cases, this phosphorus source is enhanced as a consequence of the lawn care practices employed by householders within the drainage area. For this reason, informational programming directed at alternative and appropriate lawn care practices should be provided within this rapidly urbanizing drainage area. Such programming should be predicated upon a knowledge of the soil chemistry and soil nutrient requirements for urban residential lawns and gardens. These nutrient requirements can be determined through a relatively simple soil testing procedure conducted by the University of Wisconsin-Extension. Soil test results allow householders to apply appropriate levels of fertilization to their gardens, generally saving the householder some level of expense and effort, while providing additional protections to the Lakes. In addition, distribution of lawn care pamphlets within the drainage area, providing information on composting, yard care, and maintenance of the grassed swale stormwater system, would apprise householders of alternative means of maintaining their properties for water quality purposes.[15]

Programming should also be developed to keep the householders in Middle Genesee 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 Middle Genesee

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[14]*Wisconsin League of Municipalities and Wisconsin Department of Natural Resources,* Wisconsin Construction Site Best Management Practices Handbook, *November 1993.*

[15]*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.*

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. Regular reports on the results of these studies have been featured at the annual meetings of the Middle Genesee Lake Management District and should be continued as one means of informing residents of the current state of the Lake.

Recommended Control Measures

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

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

2. The stormwater and construction site erosion control ordinances adopted by Waukesha County, the City of Oconomowoc, and the Town of Summit should be strictly enforced to reduce sediment and contaminant loadings from the urbanizing areas in the tributary drainage area to Middle Genesee Lake. Likewise, implementation of the stormwater management plan for the Pabst Farms Inc., should minimize pre- and post-construction surface water quantity and water quality impacts on Middle Genesee Lake. Furthermore, urban stormwater pollutants such as salts and metals can infiltrate into the shallow groundwater aquifer affecting groundwater quality in the Middle Genesee Lake area, and should be monitored to minimize the risk to the Lake associated with these contaminants. Horizontal hydraulic conductivity and recharge of 112 feet per day and 6.7 inches per year, respectively, making this groundwatershed extremely susceptible to potential contamination from land use activities.[16]

3. The proposed stormwater management system within the Middle Genesee Lake drainage area should be maintained so as to minimize the nutrient and sediment loads delivered to the Genesee Lakes, especially where Middle Genesee Lake is directly affected by the quality of water entering the lake through direct stormwater runoff. Stormwater detention basins providing water quality benefits are recommended for those areas draining to the Lake.[17]

4. Continuation of the U.S. Geological Survey TSI monitoring program, including periodic sampling of groundwater quality, is recommended so as to identify potential in-lake water quality problems that might arise due to nutrient and other inputs from private onsite sewage disposal systems, and possible

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[16] *R.J. Hunt, Y. Lin, J.T. Krohelski, and P.F. Juckem*, op. cit.

[17] *Creation of a Stormwater Utility District for long-term maintenance of stormwater conveyance, detention, and infiltration facilities within the proposed Pabst Farms, Inc., development has been proposed.*

wetland impacts, especially during high water level periods. Conduct of this monitoring is recommended to be carried out at intervals of approximately three to five years. Water level data should be collected on an ongoing basis, including both lake stage and groundwater level data.

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

SHORELINE PROTECTION

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

Array of Protection Measures

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

Two alternative shoreline erosion control techniques are considered potentially viable: vegetated buffer strips and rock revetments or riprap. These alternatives, as shown in Figure 5, were considered because they can be constructed, at least partially, by local residents; because most of the construction materials involved are readily available; because the techniques would, in many cases, enable the continued use of the immediate shoreline; and because the measures are visually "natural" or "semi-natural" and should not significantly affect the aesthetic qualities of the lake shoreline. These measures may be combined with selected regrading of the eroded banks and accumulated soils, designed to facilitate navigation and recreational boating access, on a site-by-site basis. These management measures require permits from the WDNR pursuant to Chapter 30 of the *Wisconsin Statutes*.

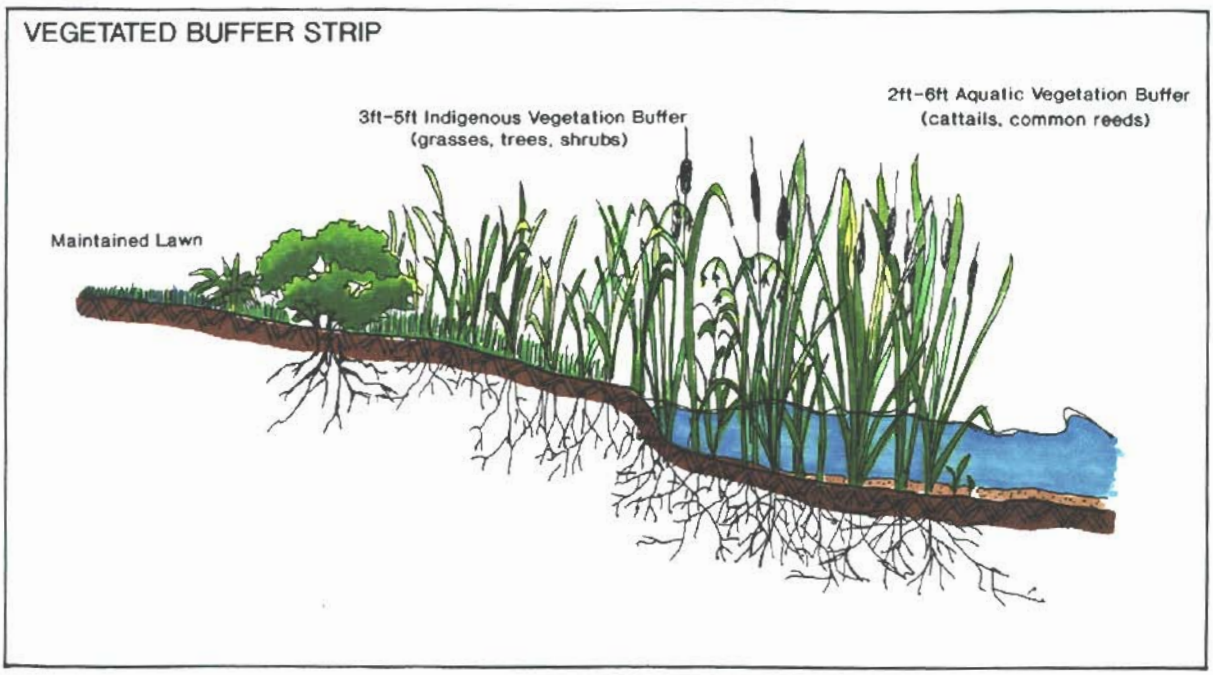
In addition to these structural shoreland protection measures, consideration could be given to adoption of a refined recreational boating ordinance, as discussed above. The proposed slow-no-wake zone within the shallow areas on the southern side of the Lake, those areas with a water depth of less than five feet, should be considered to further protect sensitive shorelines from erosion and human disturbances.

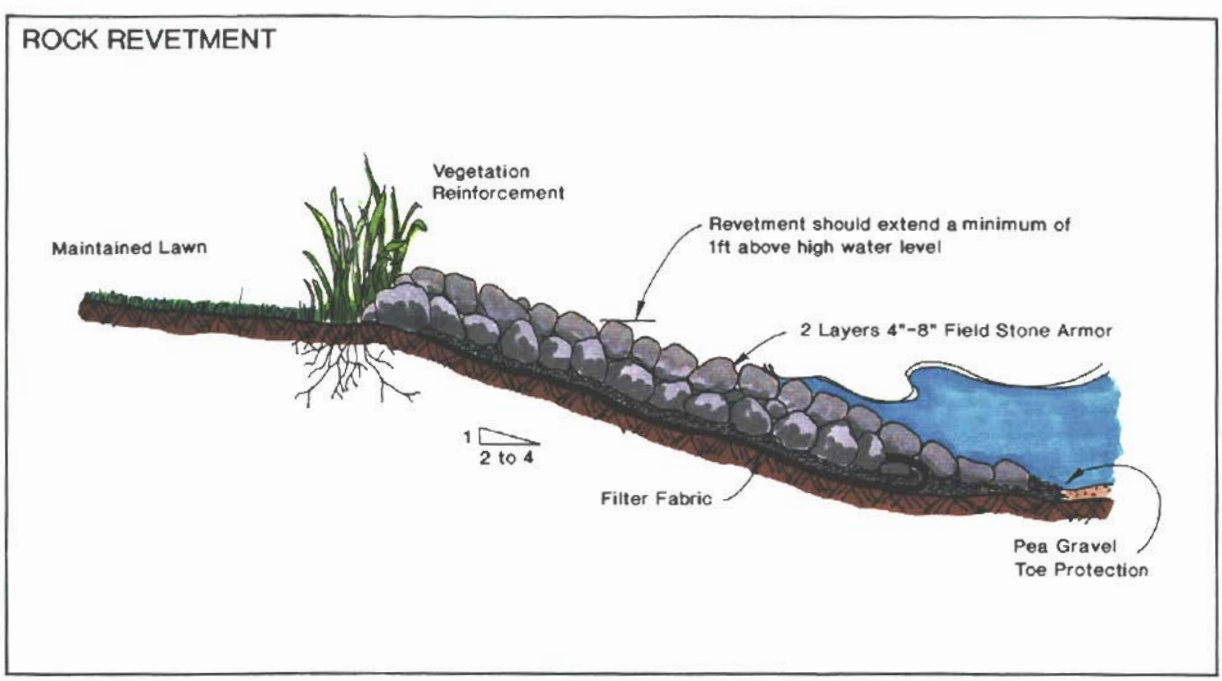
Recommended Protection Measures

It is recommended that the Middle Genesee 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 5

RECOMMENDED ALTERNATIVES FOR SHORELINE EROSION CONTROL FOR MIDDLE GENESEE LAKE





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

Source: SEWRPC.

LAKE LEVELS AND GROUNDWATER QUANTITY AND QUALITY

As discussed in Chapter III, fluctuations in the surface water elevations of Middle Genesee Lake consequent to fluctuations in groundwater levels in Middle Genesee Lake affect recreational lake users and boating use on the Lake. In addition, concerns have been expressed by the community regarding the impacts of extreme fluctuations in water levels on shoreline erosion and aquatic shoreline vegetation, and over the potential for water quality impacts on Middle Genesee Lake from groundwater-borne contaminants.

Array of Protection Measures

Natural Fluctuations

The variations in year-to-year rainfall amounts and the distribution of rainfall and associated runoff within the tributary drainage area will result in variations in groundwater inflow volumes to the Genesee chain of Lakes, and consequently, to variations in lake levels. Without interventions, the levels of the Lakes will vary as a result of the changes in precipitation, groundwater levels, and, to a lesser extent, stormwater runoff. Provision of a high level, passive overflow structure to minimize the impacts of flooding on Lower and Middle Genesee Lakes has been mooted. Recommendations to construct a passive overflow relief structure are set forth in the Phase I lake management planning program, confirming earlier recommendations prepared by the Regional Planning Commission, as has been noted above. Notwithstanding, floodproofing of riparian structures, especially those riparian to Lower Genesee Lake where the land and water elevations are less than along Middle Genesee Lake, would be recommended to affected homeowners. In addition, septic systems adjacent to portions of the Lower Lake are well below adjacent lake levels. During the recent past, these properties have been negatively impacted by high water level problems. In Middle Genesee Lake, community concerns have focused more on low water levels arising as a consequence of periodic drought years, given the relatively higher elevations of the riparian lands. Currently the lake levels were not perceived as presenting a problem for the Middle Genesee Lake community.

Water Level Control and Outlet Channel

A total of five alternative outlet structures were considered for the potential control of high water levels in Middle and Lower Genesee Lakes. The first study, conducted by the Regional Planning Commission and Ruckert & Mielke for the Town of Summit, identified three options for the mitigation of high water level impacts on the Lakes, as set forth in Appendix F. As an outcome of this initial study, two refined alternatives were developed by Welch, Hansen & Associates. The first and second alternatives would divert floodwaters through an outlet control structure by ditching and or piping to three interconnected wetlands just south of Lower Genesee Lake. The third alternative would pump floodwaters from the Lake west across Dousman Road and south to the large wetland complex tributary to the Bark River. The fourth alternative, designated as Alternative No. 1 in the Welch, Hansen & Associates study, would divert floodwaters through an outlet control structure and pipe the water to the west, across Dousman Road, through an easement in the Genesee Lake Farms Subdivision to the large wetland complex tributary to the Bark River. The fifth alternative—designated as Alternative No. 2 in the Welch, Hansen & Associates study—would divert floodwaters through an outlet control structure and pipe the water to the west, across Dousman Road, to the south and west before discharging it directly into the Bark River. The first, second, fourth and fifth alternatives would divert the floodwaters through an outlet control structure and away from the Lakes by gravity flow. The third alternative would require that the floodwaters be pumped from the Lake. Of these, the fourth alternative—designated as Alternative No. 1 in the Welch, Hansen & Associates study—was considered by Welch, Hansen & Associates to be the most acceptable in regard cost and environmental impacts.

Lake Water Level Augmentation

As noted, the major concern expressed by the Middle Genesee Lake community relative to lake level management was a concern about low lake level conditions. Because of the greater shoreland relief within the drainage area directly tributary to Middle Genesee Lake, the problems experienced on Lower Genesee Lake relative to high water levels are rarely experienced on the Middle Lake. In contrast, the Middle Genesee Lake community indicated that their recreational and aesthetic use of that Lake was limited by low water level conditions. Thus, augmentation of lake levels through groundwater pumpage was proposed as a means of moderating the often times severe fluctuations in lake surface elevation. A similar groundwater augmentation system is in place and has

been operated at Pretty Lake in the Town of Ottawa, Waukesha County, by the Pretty Lake Protection and Rehabilitation District for some time.[18]

Groundwater Protection

Groundwater is the principal source of potable water to households in the Middle Genesee Lake study area. In addition, groundwater recharge and discharge is an important component to the surface water system of Middle Genesee Lake. As described in Chapter III, the problems associated with groundwater result from the potential contamination of groundwater sources by onsite sewage disposal systems, stormwater management, and land use activities. Groundwater resource protection can best be accomplished through the protection of ecologically valuable areas which include, in part, groundwater recharge and discharge areas, and by managing onsite sewage disposal systems and nonpoint sources of pollution.

Recommended Protection Measures

Under each of the five water level control alternatives considered for the Middle Genesee-Lower Genesee Lakes system, floodwaters would be diverted from Lower Genesee Lake to wetland areas either south or southwest of the Lower Lake. All of these options would drain to an approximately 2,000-acre wetland complex tributary to the Bark River, or be piped directly to the Bark River. Under the water level augmentation alternative, deep groundwater would be pumped from the sandstone aquifer to maintain a more constant lake level in Middle Genesee Lake. A further alternative, that of taking no action to either add or remove water from the Middle and Lower Genesee Lakes, is also possible. Under this scenario, as noted above, an additional option to be considered would be the floodproofing of buildings, onsite sewage disposal systems, and wells prone to flooding. Such floodproofing could potentially be accomplished by enlarging the existing berm near the southeastern shoreline of Lower Genesee Lake or constructing an additional berm that would protect riparian buildings and their associated onsite sewage disposal systems and wells from floodwaters. As noted in the analyses set forth in Appendix F, the alternative of placing a passive overflow control structure within Lower Genesee Lake and conveying flood waters through a ditch and culvert system to the wetlands located to the southwest of the Genesee Lakes remains the most cost-effect approach and is recommended for further consideration as appropriate. To this end, it is recommended that lake stage and groundwater levels be monitored on a regular basis.

In addition to the foregoing measures affecting groundwater quantity and lake levels, measures to protect groundwater quality include the following actions:

1. The Middle Genesee Lake Management District, in conjunction with the Town of Summit, should assume the lead in the development of a public educational and informational program for the residents around and in the immediate vicinity of Middle Genesee Lake, which will encourage the implementation of good urban housekeeping practices including pesticide and fertilizer use management, improved pet waste and litter control, and yard waste management, for groundwater quality protection. It is recommended that informational programming related to nonpoint source pollution abatement measures for groundwater protection be included at the annual meetings of the Middle Genesee Lake Management District.

2. The Middle Genesee Lake Management District, in conjunction with the Waukesha County Department of Land Conservation, U.S. Department of Agriculture Natural Resources Conservation Service, University of Wisconsin-Extension, and other relevant agencies, promote sound farmland management practices within the drainage area directly tributary to Middle Genesee Lake, including pesticide and fertilizer use management, and improved animal waste and agricultural waste management for groundwater quality protection.

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[18]*See SEWRPC Memorandum Report No. 122,* A Lake Protection Plan for Pretty Lake, Waukesha County, Wisconsin, *April 1998.*

3. The private property owners and Waukesha County retain primary responsibility for onsite sewage disposal systems, as is currently the case; however, the Middle Genesee Lake Management District should work with the Waukesha County Department of Parks and Land Use, Environmental Health Division, to develop a public informational and educational program to encourage property owners to have all onsite systems riparian to the Lake inspected and maintained as necessary.

It is further recommended that information on the responsible storage and use of household and agricultural chemicals be included in the overall lake management public informational and educational program.

In addition, ongoing monitoring of the Lake, and periodic monitoring of groundwater quality, especially for chloride concentration, is recommended. Participation in the WDNR Self-Help Monitoring Program is recommended, and periodic participation in the U.S. Geological Survey TSI monitoring program should be considered to supplement the citizen monitoring program on a three- to five-yearly basis. Lake stage and groundwater level data should be acquired as part of these ongoing monitoring programs.

SUMMARY

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

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

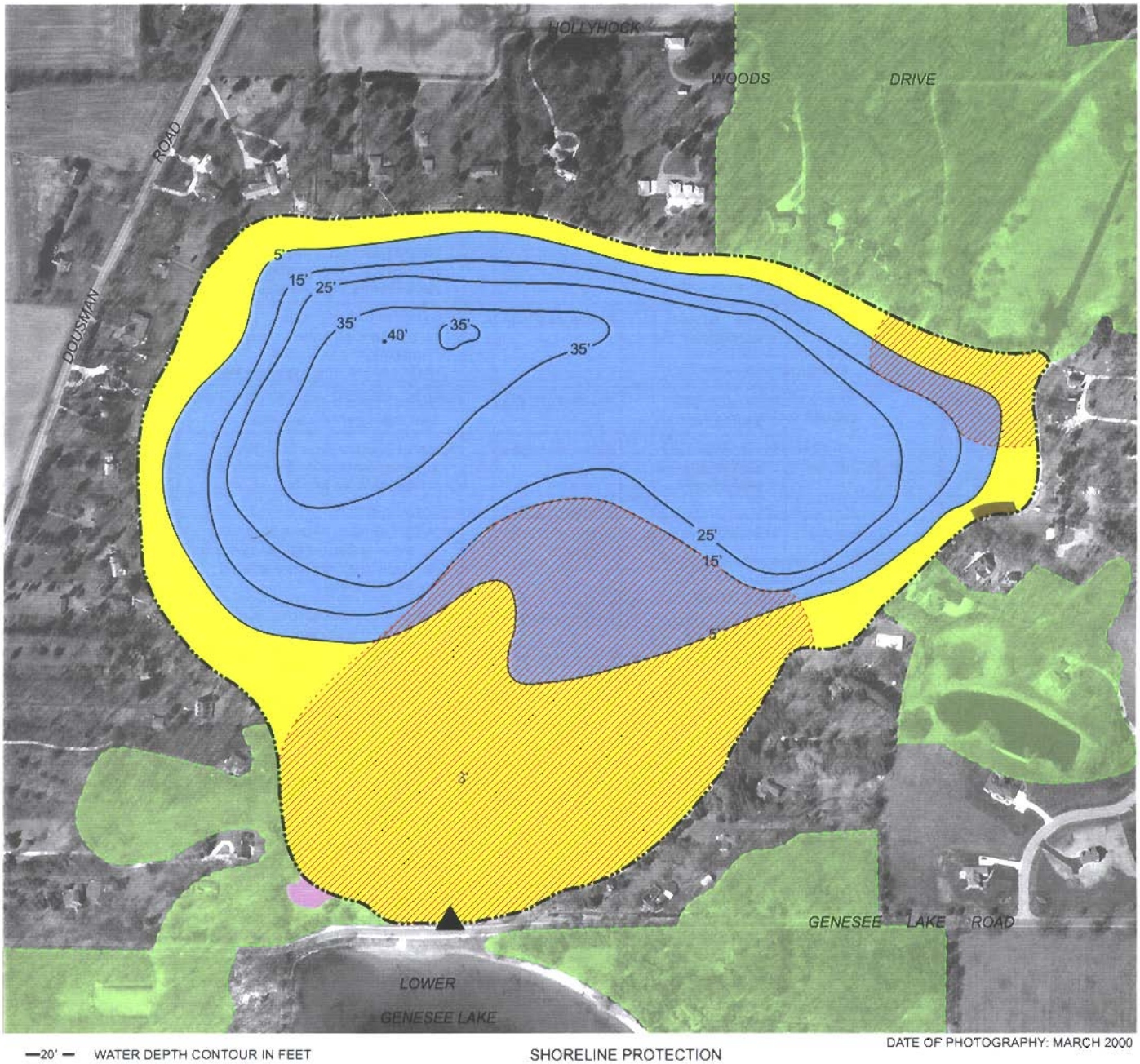
The Middle Genesee Lake protection and recreational use plan, summarized on Map 17 and in Table 8, recommends actions be taken to limit further human impacts on the in-lake macrophyte beds and reduce human impacts on the ecologically valuable areas adjacent to the Lake and in its watershed. The plan 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 Lakes 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, lake stage, groundwater levels, and groundwater quality are recommended as part of this program.

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

Map 17

RECOMMENDED LAKE MANAGEMENT PLAN FOR MIDDLE GENESEE LAKE



DATE OF PHOTOGRAPHY: MARCH 2000

—20' — WATER DEPTH CONTOUR IN FEET

▲ PUBLIC BOAT ACCESS

OPEN WATER RECREATIONAL AREA

MANAGEMENT ZONES

EURASIAN WATER MILFOIL CONTROL AREA
CHEMICALS: LIMITED

EURASIAN WATER MILFOIL WATCH AREA

SHALLOW WATER HABITAT AREA
- SLOW-NO-WAKE OR SPEED RESTRICTION AREA
- LIMIT DISTURBANCE OF LAKE BOTTOM

LAND USE MANAGEMENT

PROTECT ENVIRONMENTAL CORRIDOR LANDS

SHORELINE PROTECTION

UNSTABLE SHORELINE EROSION DUE TO UNDER CUT BANK

- MAINTAIN EXISTING STRUCTURES
- PROTECT UNSTABLE AREA, RESTORE SHORELINE VEGETATION BUFFERS

MONITORING PROGRAM

- CONTINUE WATER QUALITY MONITORING
- CONTINUE AQUATIC PLANT MONITORING
- CONDUCT FISH SURVEY

WATERSHED MANAGEMENT

- ENFORCE CONSTRUCTION SITE EROSION CONTROL AND STORMWATER POLLUTION ORDINANCE

PUBLIC INFORMATION AND EDUCATION

- CONTINUE PUBLIC AWARENESS PROGRAMS

GRAPHIC SCALE
0 250 500 FEET

Source: SEWRPC.

Table 8

RECOMMENDED PROTECTION PLAN ELEMENTS FOR MIDDLE GENESEE LAKE

Issue	Plan Element	Subelement	Location	Management Measures	Management Responsibility
Ecologically Valuable Areas and Aquatic Plants	Land use management	Land use plan implementation	Entire watershed	Support implementation set forth in the regional land use plan and in the development plan for Waukesha County	Town of Summit and Waukesha County
	Watershed land management	Construction site erosion control	Entire watershed	Continue to enforce existing erosion control and water quality protection ordinances; refine ordinances where necessary; implement stormwater management plan for Pabst Farms inc. development	City of Oconomowoc, Town of Summit and Waukesha County
		Urban nonpoint source controls	Entire watershed	Implement and maintain recommended good urban housekeeping practices, maintenance of grassed swales	Middle Genesee Lake Management District and Town of Summit
		Rural nonpoint source controls	Entire watershed	Implement and maintain rural land best management practices	Town of Summit
		Environmentally sensitive lands protection	Entire watershed	Support preservation of primary environmental corridor lands and critical species habitat	Middle Genesee Lake Management District and Town of Summit
	Aquatic plant management	Manual harvesting	Areas of nuisance growth	Harvest nuisance plants, including Eurasian water milfoil and purple loosestrife, as required around docks and piers	Middle Genesee Lake Management District
		Nuisance species monitoring program	Entire watershed	Monitor lakes and surrounding wetlands for the presence or spread of nuisance species, including Eurasian water milfoil, purple loosestrife, and zebra mussel Monitor lakes for the presence or spread of the aquatic weevil (*Eurhychiopsis lecontei*)	Middle Genesee Lake Management District
Lake Water Levels	Flood management	Residential flooding issues	Middle and Lower Genesee Lakes	Consider the future provision of an outlet at Lower Genesee Lake to regulate floodwaters Obtain drainage and discharge easements	Town of Summit, Genesee Lakes Association, and Middle Genesee Lake Management District
	Lake level augmentation	Mitigation of low water levels during dry periods	Middle Genesee Lake	Consider the feasibility of augmenting water levels by pumping of groundwater into the Lake	Middle Genesee Lake Management District and Wisconsin Department of Natural Resources
	Water quantity management	Lake and groundwater level monitoring	Middle Genesee Lake and entire watershed	Install and regularly monitor water levels using the lake stage gauge and groundwater piezometers	Middle Genesee Lake Management District and U.S. Geological Survey
Fisheries	Fisheries management	Fisheries survey	Entire lake	Conduct fisheries survey to determine the current status of the fishery; implement recommendations as necessary	Wisconsin Department of Natural Resources, and Middle Genesee Lake Management District
		Develop a fishery enhancement program based upon survey	Entire lake	Review survey data and develop fishing regulations and habitat protection measures for improved fisheries as needed	Wisconsin Department of Natural Resources, and Middle Genesee Lake Management District

Table 8 (continued)

Issue	Plan Element	Subelement	Location	Management Measures	Management Responsibility
Nonpoint Source Pollution Controls and Surface Water Quality	Water quality management	Water quality control	Entire lake	Implement specific actions within the Pabst Farms Inc., stormwater management plan for the reduction of nonpoint source pollutant loadings that may affect the surface water quality of Middle Genesee Lake	City of Oconomowoc and Town of Summit
		Water quality monitoring	Entire lake	Continue to participate in the DNR Self-Help Monitoring Program	Middle Genesee Lake Management District
	Groundwater quality and quantity	Water quality protection	Entire watershed	Implement and maintain recommended good urban housekeeping practices Encourage proper onsite sanitary sewer maintenance, and flood-proofing as appropriate	Middle Genesee Lake Management District, Town of Summit and Waukesha County
Shoreland Protection	Maintain structures	Shoreline erosion	Entire Lake	Construct, maintain and repair structures where needed Encourage maintaining or reestablishing native shoreline vegetation	Middle Genesee Lake Management District
Informational Program	--	Public informational programming	Entire watershed	Continue public awareness and information programming Encourage householders to adopt environmentally sustainable land management practices Participate in soil testing program offered by UW-Extension	Middle Genesee Lake Management District and Town of Summit

[a]*Costs to be determined.*

Source: SEWRPC.

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: March 9, 1999

FILE REF: 3600

TO: Randy Schumacher

FROM: Sue Beyler and Steve Gospodarek

SUBJECT: Middle Genesee Lake Electrofishing Survey - May 19, 1998. WBIC 0778300

SUMMARY

During our single-night electrofishing survey on Middle Genesee Lake, we found a primarily largemouth bass/bluegill fishery. Bluegill size structure, with PSD of 18 percent, was slightly below the target range of 20 to 40 percent. Largemouth PSD, at only 23 percent, is well below the target range of 40 to 70 percent. Low bass and bluegill PSD is likely the result of excessive harvest of quality size fish.

Although May is not a good time of year to assess northern pike, we were still surprised to not see any northerns. Middle Genesee has northern pike spawning habitat in the marsh adjacent to the inlet. Also, Lower Genesee Lake, which during high water is connected to Middle Genesee via a culvert, supports a quality northern pike population. Stocking of northern pike, to supplement the apparently low density population, is warranted.

Carp, mostly large individuals, do not appear to have reached a problem level at this point. We did not see evidence of carp reproduction (young-of-year, or other small carp) in any part of the lake. Young carp produced by these large adults are being eaten by the many bass and bluegills in the lake. Maintaining predator density, and efforts by individuals to harvest carp, may keep the carp population under control for a while longer.

METHODS

On May 19, 1998 we conducted a single-night electrofishing survey on 108 acre Middle Genesee Lake to assess the fish population. The last survey on Middle Genesee was a two-night fyke net survey done in 1965. That survey showed the lake to be dominated by bluegills slightly below the average growth rate. Largemouth bass reproduction and growth rate was good.

The present survey consisted of a single circuit of the entire lake shoreline. We did a 20 minute timed-run, in which we attempted to collect all fish, along the east shoreline (Figure 1). For the remainder, we captured only gamefish. Because the lake residents were concerned about the carp population, we also counted carp seen in the electrical field during the gamefish run.

Fish captured from each station were processed separately. All fish were identified and measured to the nearest tenth-inch.

Weather on May 19 was clear and calm. Water temperature was 74°F.

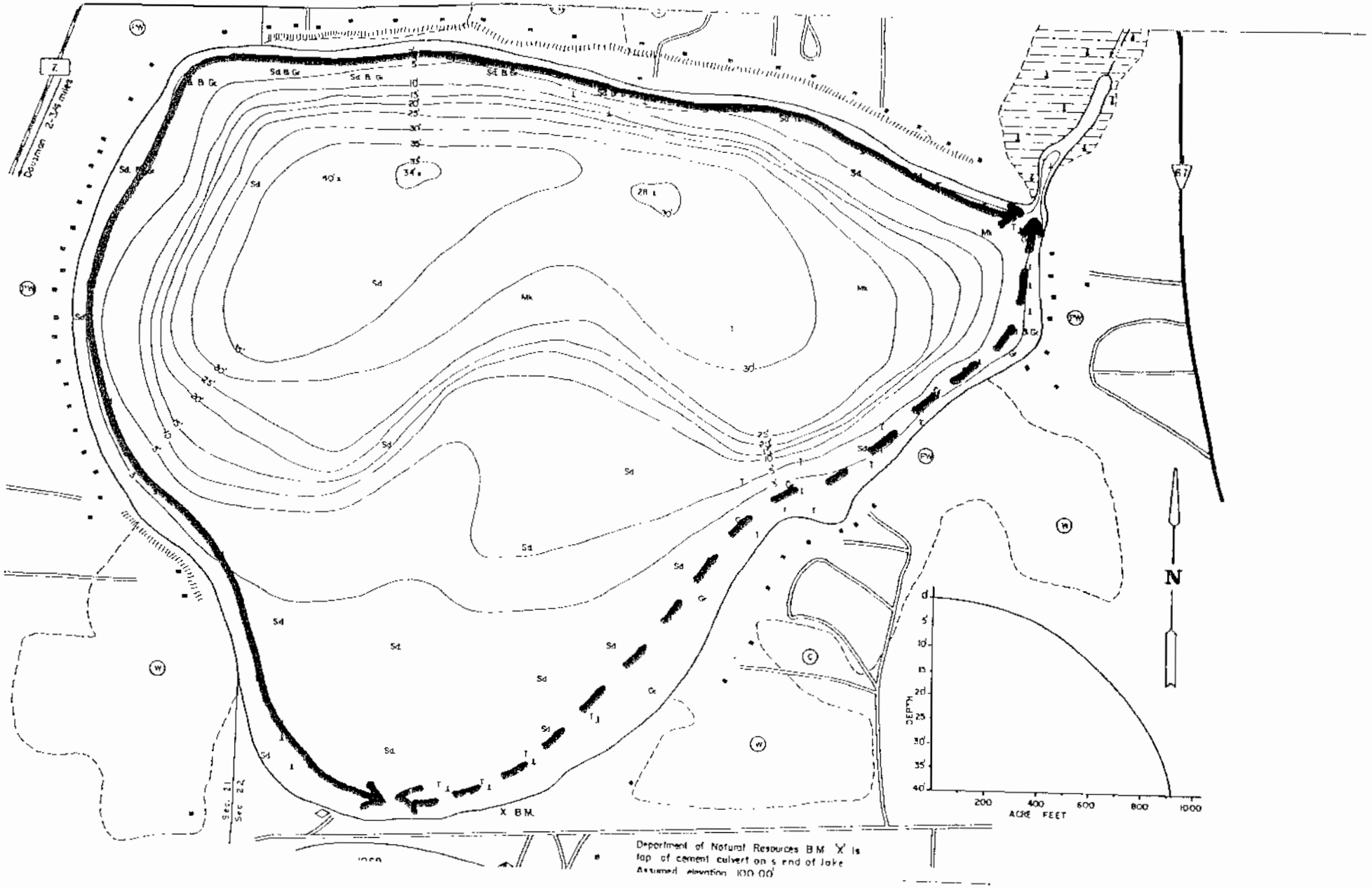


Figure 1. Lake survey map of Middle Genesee Lake showing the timed-run station (0.53 mile) and the gamefish station (1.03 mile).

RESULTS

The predominant species in our random sample was largemouth bass, followed by bluegill (Table 1). A total of five species were sampled.

Table 1. Fish captured by electrofishing from the timed-run station of Middle Genesee Lake on May 19, 1998. Station length = 0.53 mile. Shocking time = 0.33 hour.

Species	Number Captured	Catch/Mile	Mean Length	Std. Dev.
Largemouth Bass	47	88.7	8.7	2.76
Bluegill	38	71.7	5.0	1.42
Yellow Perch	7	13.2	6.0	0.40
Yellow Bullhead	2	3.8	10.6	2.12
Carp	2	3.8	29.5	0.49

An additional 84 largemouth were captured from the gamefish station, averaging 9.5 inches in length (Table 2). Other than largemouth, the only gamefish captured was a single walleye, measuring 20.1 inches long.

Table 2. Fish captured by electrofishing from the gamefish station of Middle Genesee Lake on May 19, 1998. Station length = 1.03 mile. Shocking time = 0.52 hour.

Species	Number Captured	Catch/Mile	Mean Length	Std. Dev.
Largemouth Bass	84	81.6	9.5	2.89
Walleye	1	1.0	20.1	-

Largemouth from both the timed-run and gamefish stations, combined, ranged from 4 to 16 inches in length. The length mode (Figure 2) is at 8 to 9 inches with secondary peaks at 5, and 11 inches. Proportional Stock Density (PSD) of bass, based on a stock length of 6 inches and a quality length of 12 inches, is 23 percent. Anderson (1980) recommends a bass PSD of 40 to 70 percent for a well balanced population. Low PSD values indicate excessive natural reproduction, or excessive harvest of quality sized bass, or both.

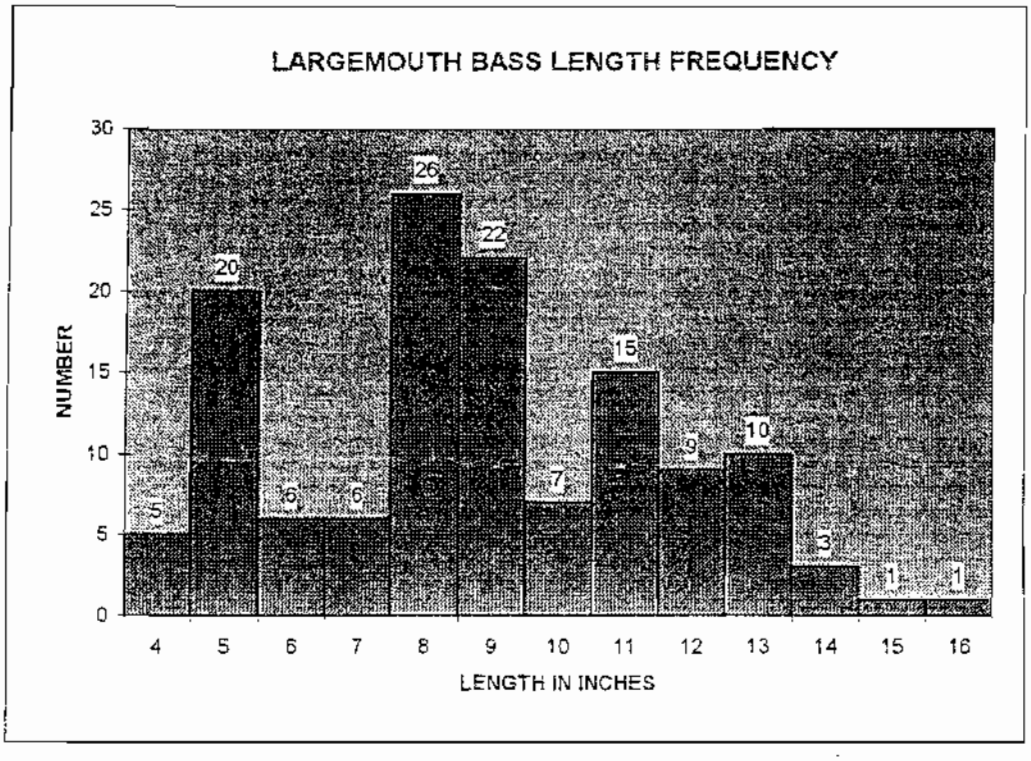


Figure 2. Length frequency of largemouth bass captured by electrofishing from the timed-run and gamefish stations of Middle Genesee Lake, May 19, 1998.

Bluegills in our random sample ranged from 1 to 10 inches in length. The length mode (Figure 3) is at 4 inches. Bluegill PSD, based on a stock length of 3 inches and quality length of 6 inches, is 19 percent. Target range for bluegills associated with well balanced bass populations is 20 to 40 percent. Low bluegill PSD is likely due to over harvest of quality size bluegills.

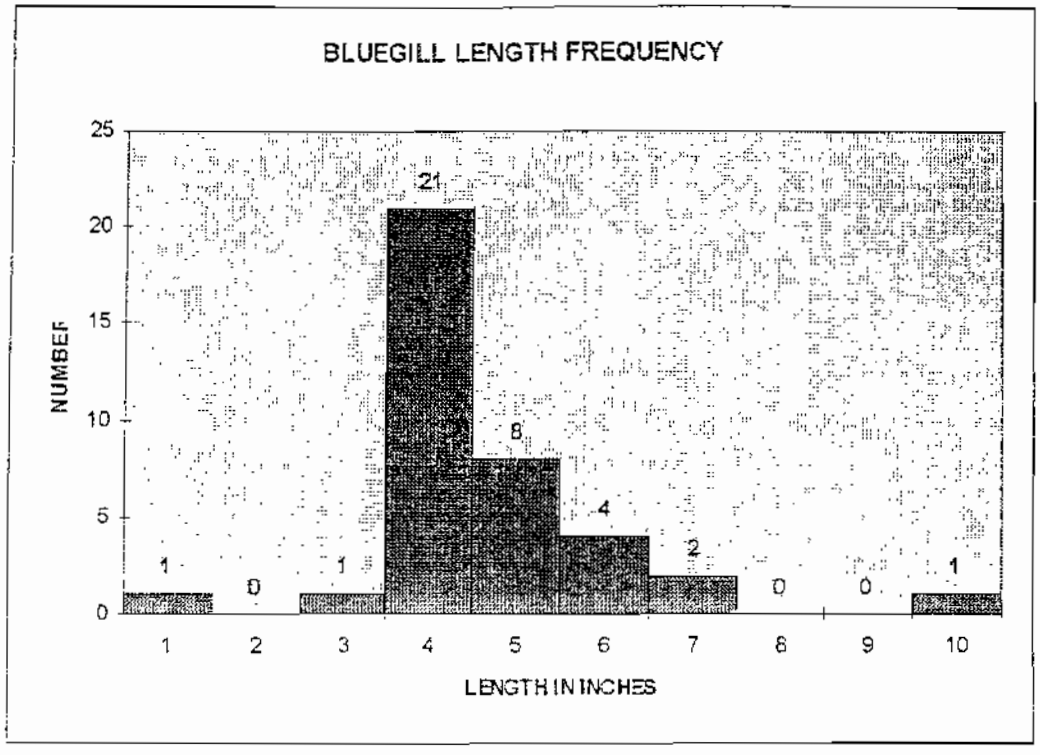


Figure 3. Length frequency for bluegills captured by electrofishing from the timed-run station of Middle Genesee Lake, May 19, 1998.

In addition to the two carp captured in the timed-run, we counted 20 carp in the gamefish station. All were large carp, similar to those seen in the timed-run. Most were observed on the north side, near the marsh inlet from Upper Genesee Lake.

DISCUSSION

Active management of Middle Genesee Lake has been virtually absent in recent years. The last survey done on this lake was a two-night fyke net study done in June, 1964. That survey revealed a slightly slow-growing bass and bluegill population; age groups of bass and bluegills were about 1 inch shorter than average. Bass, common panfish species and bullheads were captured, but no carp.

Despite abundant marsh habitat along the inlet channel, no northern pike were observed in our survey or in the 1964 survey. June fyke netting and May electrofishing are poor methods for assessing northern pike, but their total absence indicates a low density population, at best. Stocking northern pike fingerlings, at the rate of 5 per acre, is justified at this time to enhance the remnant population. Addition of this predator may curb largemouth bass numbers and increase their growth rate.

It appears that carp have increased in number since 1964, but do not yet pose a threat to the fishery. The lake association has expressed concern that carp may be taking over the lake. The relatively low number of carp, and the fact that they were all very large, indicates that they are not a dominant species in the fish community. At this point, the bass and bluegills are still successfully repressing the carp. However, a major change in water quality or shift in the aquatic plant community could tip the scales in favor of carp. Aquatic habitat and watershed protection should be a major goal of the lake association to prevent this from happening.