CAMP LAKE USE REPORT UPDATE LR-2

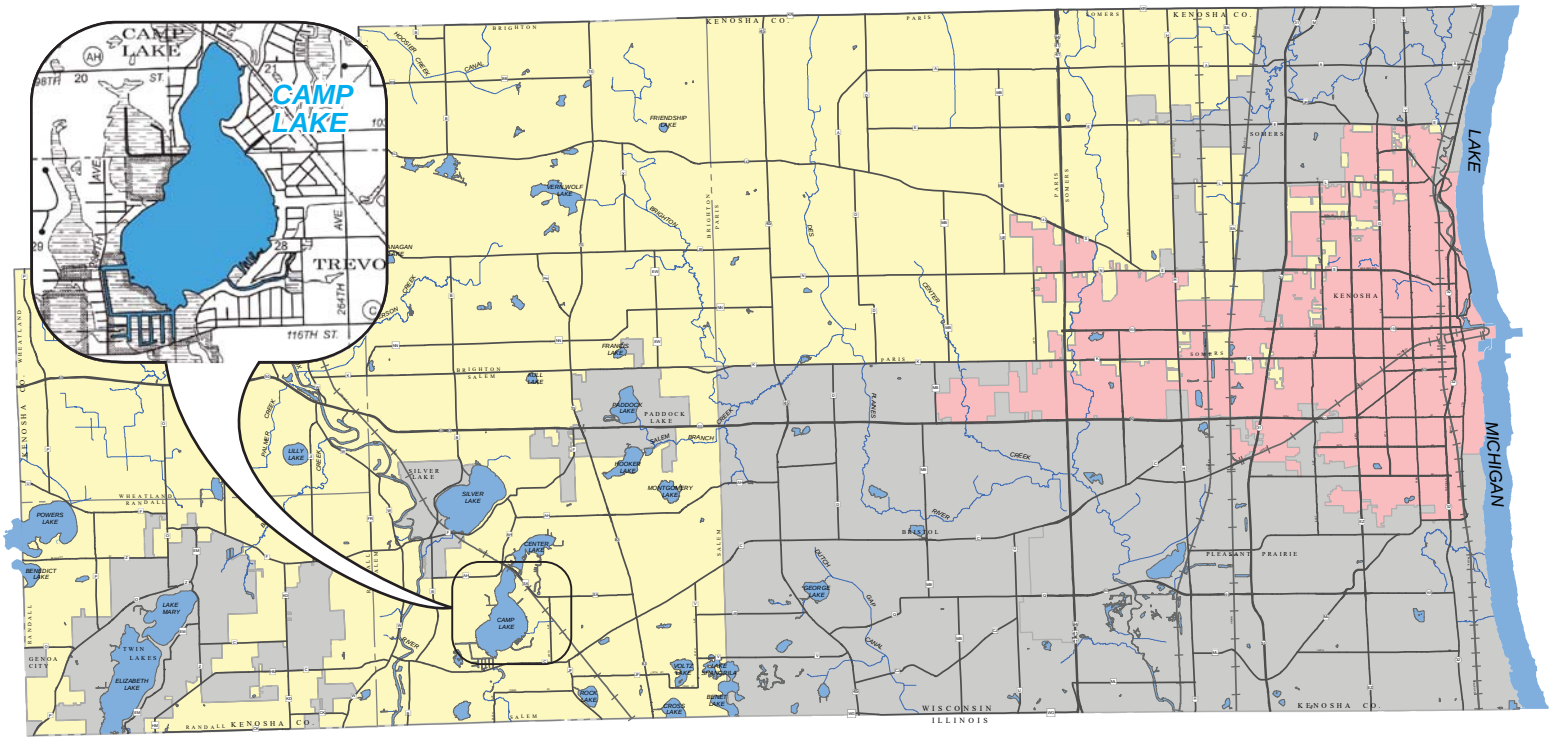
Prepared by the

Southeastern Wisconsin Regional Planning Commission

for

Kenosha County, Wisconsin

October 2017



This Lake Use Report Update is a product of the Lake and Stream Resources Classification Project for Kenosha County Wisconsin: 2017. This report is available online at co.kenosha.wi.us.

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BACKGROUND

Kenosha County's lakes are vital natural resource assets adding significant value to the aesthetic and ecological value of the County and Region. The Lakes are enjoyed by large numbers of lakeshore residents and local citizens as well as those seeking water-based recreation living in nearby urban areas such as Milwaukee, Racine, Kenosha, and Chicago. Kenosha County has 34 named Lakes ranging in size from about two to about 640 acres.[1] Of the 20 that are considered "major lakes" (i.e., lakes with a surface area of 50 acres or more), 12 lie in unincorporated or recently incorporated portions of the County. Between 1968 and 1970, the Wisconsin Department of Natural Resources (WDNR) produced a series of individual Lake Use Reports for each of the 12 named major lakes within Kenosha County. Camp Lake was the subject of one such report.[2] This report updates the earlier Lake Use Report.

In addition to the original 1969 Lake Use Report, Camp Lake was the subject of a number of other studies. These studies include a WDNR Fish Management Division report developed in 1964 and two County-wide surface water resources reports published in 1961 and 1982 prepared by the Wisconsin Conservation Department (now the WDNR).[3,4,5] Several consulting firms have also been retained over the years by the Camp and Center Lakes Rehabilitation District (CCLRD) to study water quality, the aquatic plant community, and lake management.[6,7,8,9,10,11] The CCLRD maintains a website (www.cclrd.org). The website is used to post a wide variety of information Lake users may find interesting. In addition to the above report, Camp Lake was also part of a 2017 lake and stream classification project developed for Kenosha County by Southeastern Regional Planning Commission (SEWRPC).[12]

INTRODUCTION

Camp Lake is located in the Village of Salem Lakes, Kenosha County, Wisconsin. Despite its relatively shallow depth, the Lake's fishery, natural beauty, and location give it significant local economic and recreational value. In addition, its healthy and relatively diverse aquatic plant community and large contiguous marshlands provide noteworthy fish and wildlife habitat. The Lake provides significant value to local ecology.

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[1] *Wisconsin Department of Natural Resources Publication No. PUB-FH-800 2005,* Wisconsin Lakes, 2005.

[2] *Wisconsin Department of Natural Resources (WDNR),* Camp Lake, Kenosha County, An Inventory with Planning Recommendations, Lake Use Report No. FX-12, *Prepared by the WDNR for SEWRPC, 1969.*

[3] *Wisconsin Conservation Department, Fish Management Division Lake Use Report No. 1,* Suggested Long-Range Development Camp Lake, Kenosha County, *July 1964.*

[4] *Wisconsin Conservation Department,* Surface Water Resources of Kenosha County, *1961.*

[5] *Wisconsin Department of Natural Resources,* Surface Water Resources of Kenosha County, 1*982.*

[6] *The CCLRD is a Chapter 33,* Wisconsin Statutes *public inland lake protection and rehabilitation district that oversees management of both Camp and Center Lakes; the District's website is: www.cclrd.org*

[7] *Hey and Associates, Incorporated,* Aquatic Plant Survey and Aquatic Plant Management Plan: Camp and Center Lakes, Kenosha County, Wisconsin, *October 1995.*

[8] *Hey and Associates, Incorporated,* Aquatic Plant Management Plan for Camp and Center Lakes, Kenosha County, Wisconsin, *May 2006.*

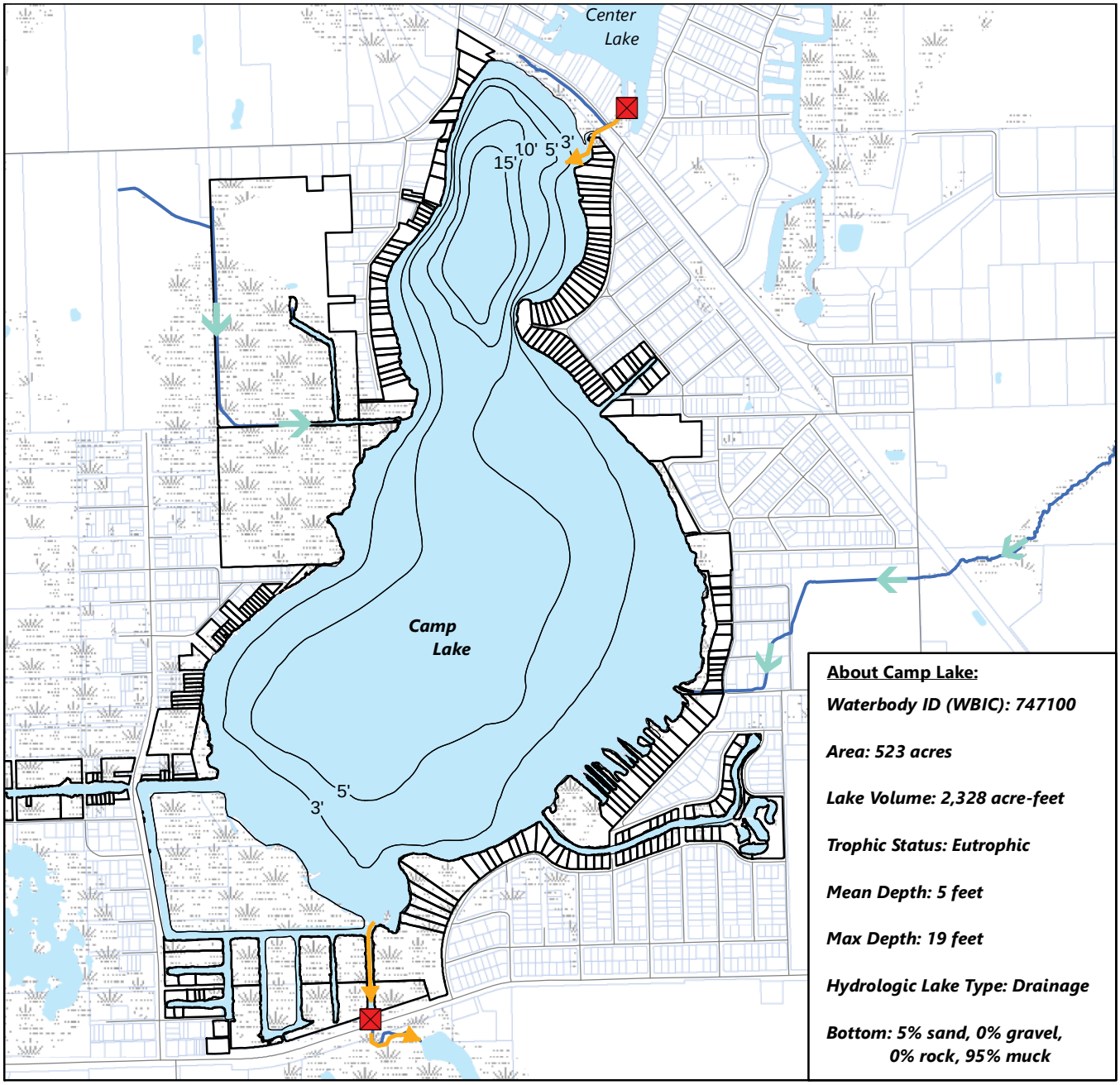
[9] *R. A. Smith and Associates, Incorporated,* Draft Report Camp and Center Lakes – Kenosha County, Water Quality Monitoring Project for Camp and Center Lakes Rehabilitation District, 1998.

[10] *Lake and Pond Solutions Company,* Aquatic Plant Management Plan for Camp and Center Lakes, *April 18, 2012.*

[11] *Lake and Pond Solutions Company,* Aquatic Plant Management Plan Update, Camp and Center Lakes, *February 7, 2017.*

[12] *SEWRPC Memorandum Report No. 222,* Lake and Stream Resources Classification Project for Kenosha County, Wisconsin: 2017.

Map 1
Camp Lake



Source: Wisconsin Department of Natural Resources and SEWRPC

PHYSICAL DESCRIPTION

Lake Characteristics

Based upon recent orthophotography, Camp Lake has a surface area of 523 acres.[13] As shown on Map 1, Camp Lake has an elongated basin with a north-south orientation and a maximum depth of 19 feet. According to 1960 depth soundings published by the WDNR, Camp Lake contains 2,328 acre-feet of water. Fifty-three percent of Camp Lake is three feet deep or less, yielding an average depth of only five feet.[14] The Lake has normal water surface elevation of approximately 742 feet above National Geodetic Vertical Datum, 1929 adjustment.[15] Additional information regarding Camp Lake's hydrology and morphometry is summarized in Table 1.

According to WDNR records, Camp Lake's bottom sediments are composed almost entirely of muck. Nevertheless, two areas of sandy shoreline in the southeastern and northeastern parts of the Lake account for about 17 percent of the Lake's shoreline length. A number of channels were dug through the extensive marshlands abutting the Lake. Most channels were dug at the southwest corner of the Lake, although a few are also found along the west and southeast shorelines. As evidenced by historical aerial photographs, most of these channels were excavated sometime before 1937. The 4.85 miles of shoreline listed in Table 1 does not include these artificial channels.[16]

Hydrology

Based upon its depth and the topography of surrounding lands, WDNR classifies Camp Lake as a shallow lowland lake. Such lakes are relatively shallow and are therefore less likely to stratify during summer. Furthermore, shallow lowland lakes receive most of their water supply from surface runoff and discharge most of their water via an outlet stream, a situation also classifying the Lake as a drainage lake. The WDNR uses these parameters to set water quality goals for the Lake.

Table 1
Hydrology and Morphometry of Camp Lake

Parameter	Measurement
Size	
Lake Surface Area[a,b]	523 acres
Watershed Area[c]	5,066 acres
Lake Volume	2,328 acre-feet
Residence Time[d]	0.65 years
Shape	
Length	1.5 miles
Width	0.9 mile
Shoreline Length	4.85 miles
Shoreline Development Factor[e]	1.6
General Lake Orientation	North-south
Depth	
Maximum Depth	19 feet
Mean Depth	5 feet
Area under 3 feet	53 percent
Area over 15 Feet	3 percent

[a] *The lake surface area used in this study was believed by SEWRPC to best represent the present ordinary high water mark open water area of the Lake. It generally includes connected channels and sparsely vegetated marsh, and therefore tends toward the larger side of published values.*

[b] *Various sources have reported Camp Lake's surface area to be as low as 439 acres and as high as 523 acres. Reported lake surface area varies widely by source and over time. Some of the reasons why this may happen includes water elevation changes, differences in vegetation over the years, inclusion or exclusion of fringing marsh, and inclusion or exclusion of channels leading off the main body of the lake, or actual changes in the lake shoreline over the 60-year period of record.*

[c] *Excludes Camp Lake, but includes Center Lake and Center Lake's watershed.*

[d] *Residence time is the estimated time period required for a volume of water equivalent to the volume of the lake to enter and be discharged from the lake during years of normal precipitation.*

[e] *Shoreline development factor is the ratio of the Lake's actual shoreline length compared to the circumference of a circular lake of the same area. The closer to a value of 1.0, the more nearly circular a lake is.*

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

[13] *Reported lake areas commonly fluctuate over time and between documents. The apparent size of a lake depends upon the lake's water level at time of measurement, the type and condition of shoreline vegetation, and the accuracy of available tools and techniques. For example, nearly all lakes are larger when water levels are higher. Conversely, lakes can appear smaller on aerial photographs when shorelines are covered by dense tree canopy. See Table 1 for more detail.*

[14] *Wisconsin Department of Natural Resources, Lake Use Report No. FX-12, op cit.*

[15] *Wisconsin Department of Natural Resources, Detailed Information for Dam Camp Lake, 2019 https://dnr.wi.gov/damsafety/damSearch.aspx.*

[16] *Wisconsin Department of Natural Resources, Lake Use Report No. FX-12, op cit.*

Figure 1
Surface Water Draining From Center Lake to Camp Lake

Note: The outlet dam in the foreground is used to control Center Lake's Elevation. After leaving Center Lake, water passes under County Trunk Highway SA and the Canadian National Railroad before reaching Camp Lake

Source: SEWRPC

Several intermittent and perennial tributary streams enter the Lake. Much of the water entering Camp Lake first passes through Center Lake, a separate waterbody lying a short distance to the north of Camp Lake. A low-head dam is located in the channel leading from Center Lake to Camp Lake (Figure 1, Map 1). Flow from Center Lake to Camp Lake may likely be imperceptible during extended dry weather due to the small elevation difference between the Lakes and low flow volume. Some groundwater also discharges to Camp Lake and its tributary streams.

Some water leaves the Lake as surface water outflow at the south end of the Lake. Historically, water leaving the Lake likely flowed along a diffuse path through wetlands. The Lake's level and outflow is now regulated by an artificial spillway (see Figure 2, Map 1) located at the end of an excavated channel and that passes under County Trunk Highway (CTH) C. Camp Lake has little surface discharge under fair and dry weather conditions. Wetlands and the outlet stream south of CTH C discharge to Channel Lake and Lake Katherine in Illinois.

Watershed Characteristics and Land Use

Camp Lake's 5,066 acre watershed lies primarily to the north and east of the Lake. A lake's watershed is the physical area from which surface-water runoff can drain to a lake. Camp Lake has a modest-sized watershed for its size, with a watershed to lake area ratio of 9.7:1. Lakes with watershed/lake area ratios greater than 10:1 are more prone to develop water-quality problems.[17] Lakes with large watersheds are comparatively more vulnerable to human disturbance.

About half of Camp Lake's total watershed (2,502 acres) drains through 146-acre Center Lake before reaching Camp Lake. The remaining 2,564 acres of land draining to the Lake are referred to in this report

[17] *Uttormark, Paul D. and Mark L. Hutchins,* Input Output Models as Decision Criteria for Lake Restoration, *University of Wisconsin-Madison, Wisconsin Water Resources Center Technical Report Number 78-03, 1978.*

Figure 2
Camp Lake Outlet Structure

Source: SEWRPC

as Camp Lake's direct tributary area.[18] Camp Lake's direct tributary area is relatively flat and marshy. Areas to the northeast of Camp Lake Road have slightly hillier terrain. Physicochemical processes (e.g., sediment deposition, nutrient sequestration) active in Center Lake should improve the quality of stormwater from the upper reaches of the watershed before it enters Camp Lake. For more information about the portion of Camp Lake's watershed that first drains through Center Lake, please consult the Center Lake Use Report Update LR-3, which is also available free online at www.co.kenosha.wi.us.

Land use immediately adjacent to Camp Lake has not significantly changed since 1970 (see Figures 3 and 4). Land use as of 2010 in the Camp Lake direct tributary area is illustrated on Map 2 and summarized in Table 2. As of 2010, agricultural lands accounted for over 40 percent of the Lake's direct tributary area land use. Wetlands and woodlands covered another 19 and 5 percent, respectively, of the total direct tributary area. Urban uses accounted for about 27 percent of the Lake's direct tributary area, with residential and transportation/communication/utility land uses accounting for nearly 90 percent of the urban land use total. Planned 2035 land use (Table 2) suggests significant changes within the Camp Lake direct tributary area. The forecast suggests that essentially all agricultural lands within the Lake's direct tributary area will be converted to residential use, resulting in a 56 percent decrease in rural land use and a 154 percent increase in urban land use. Low-density residential and industrial uses account for most of the planned increase in urban land use.

WATER QUALITY

The WDNR re-evaluated Camp Lake's water quality as part of the recent impairment listing cycle and found that the Lake's water quality clearly meets State thresholds for recreation as well as fish and aquatic life uses.[19]

[18] *Does not include the Lake's open-water surface area.*

[19] *Wisconsin Department of Natural Resources, Camp Lake, Kenosha County website, "conditions" dnr.wi.gov/water/waterDetail.aspx?wbic=747100.*

Figure 3
1970 Aerial Photograph of Camp Lake

Date of Photography: 1970

N

0 740 1,480 Feet

Source: SEWRPC

Figure 4
2015 Orthophotograph of Camp Lake

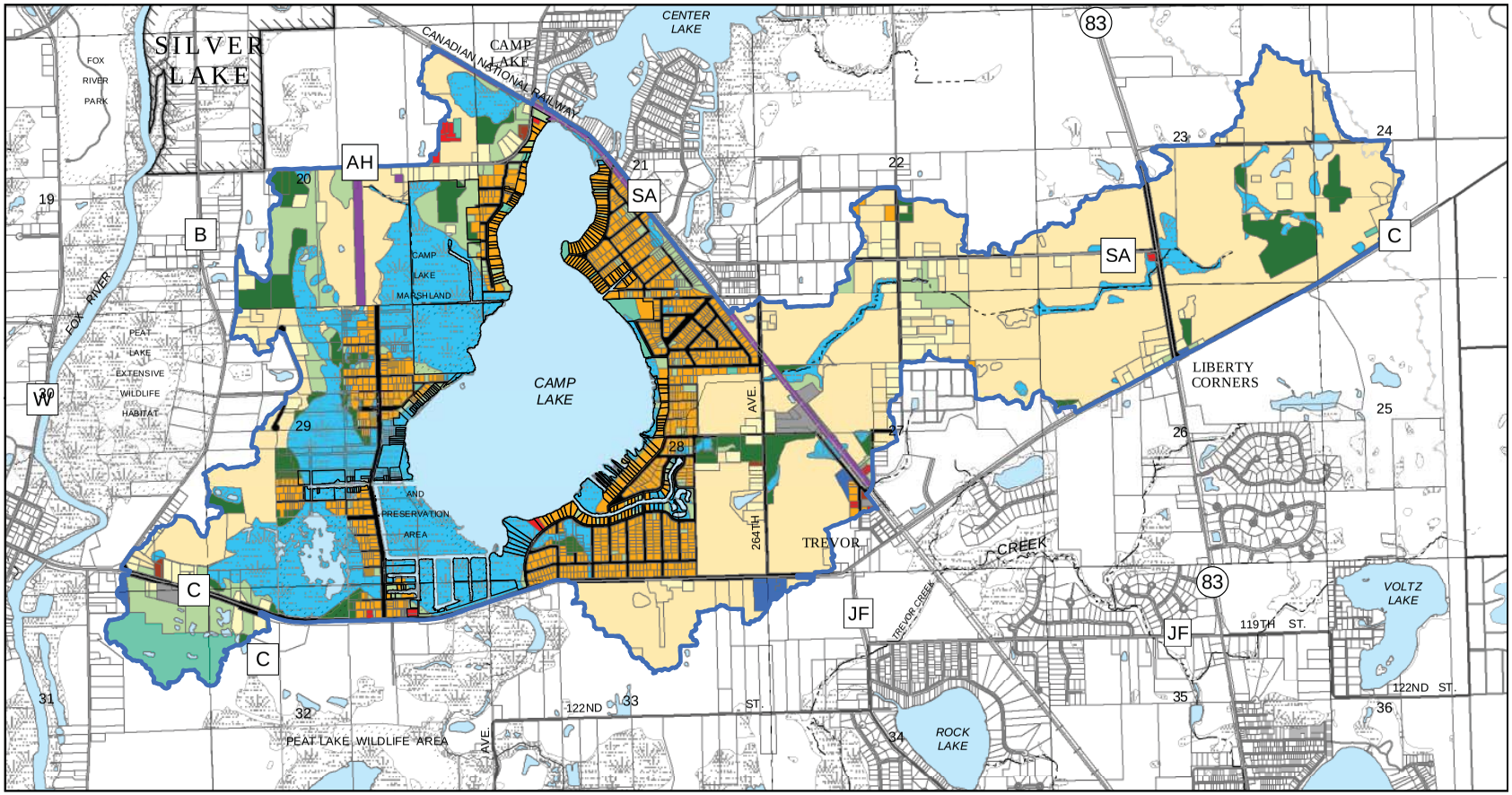
Date of Photography: 2015

N

0 740 1,480 Feet

Source: SEWRPC

Map 2
2010 Land Use Within the Area Directly Tributary to Camp Lake



- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MULTI-FAMILY RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- TRANSPORTATION, COMMUNICATIONS, AND UTILITIES
- STREETS AND HIGHWAYS
- GOVERNMENT AND INSTITUTIONAL
- AGRICULTURAL
- OTHER OPEN LANDS
- RECREATION
- WETLANDS
- WOODLANDS
- SURFACE WATER
- LAKE-DIRECT WATERSHED BOUNDARY

N

0 1,500 3,000 Feet

Source: SEWRPC

Table 2
Existing and Planned Land Use Within the Area Directly Tributary to Camp Lake: 2010 and 2035

Land Use Categories [a]	2010		2035		Change: 2010-2035	
	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent
Urban						
Residential						
Single-Family, Suburban Density	3	0.1	13	0.5	10	333.3
Single-Family, Low Density	120	4.6	787	30.1	667	555.8
Single-Family, Medium Density	273	10.4	359	13.7	86	31.5
Single-Family, High Density	--	--	--	--	--	--
Multi-Family	3	0.1	23	0.9	20	666.7
Commercial	8	0.3	86	3.3	78	975.0
Industrial	14	0.5	170	6.5	156	1114.2
Governmental and Institutional	11	0.4	11	0.4	0	0.0
Transportation, Communication, and Utilities	215	8.2	215	8.2	0	0.0
Recreational	53	2.0	118	4.5	65	122.6
Subtotal	700	26.6	1,781	68.1	1,081	154.4
Rural						
Agricultural	1,110	42.4	66	2.5	-1,044	-94.1
Other Open Lands	164	6.3	127	4.8	-37	-22.6
Wetlands	505	19.3	505	19.3	0	0.0
Woodlands	124	4.7	124	4.7	0	0.0
Water [b]	15	0.6	15	0.6	0	0.0
Extractive	--	--	--	--	--	--
Landfill	--	--	--	--	--	--
Subtotal	1,918	73.3	837	31.9	-1,081	-56.3
Total	2,618	100.0	2,618	100.0	0	--

Note: Rounded values can introduce small discrepancies in totals.

[a] *Parking included in associated use*

[b] *Excludes Camp Lake*

Source: SEWRPC

Historical water quality gives insight into changes that may be occurring within the Lake and its watershed. By comparing data and evaluating trends, causes for change may be identified and management actions can be taken to help protect the Lake. Historically, only limited water quality data was collected at Camp Lake, starting with a few baseline measurements taken by the WDNR in 1966. From the late 1980s through the 1990s, Lake residents participated in the University of Wisconsin Extension (UWEX) Citizen Lakes Monitoring Network (CLMN). Citizen volunteers measured lake water quality parameters such as water clarity, phosphorus concentrations, and dissolved oxygen concentrations. The CLMN is an extremely useful program to provide long-term water quality data. Water quality data is compiled and is available on the WDNR Lakes page.[20]

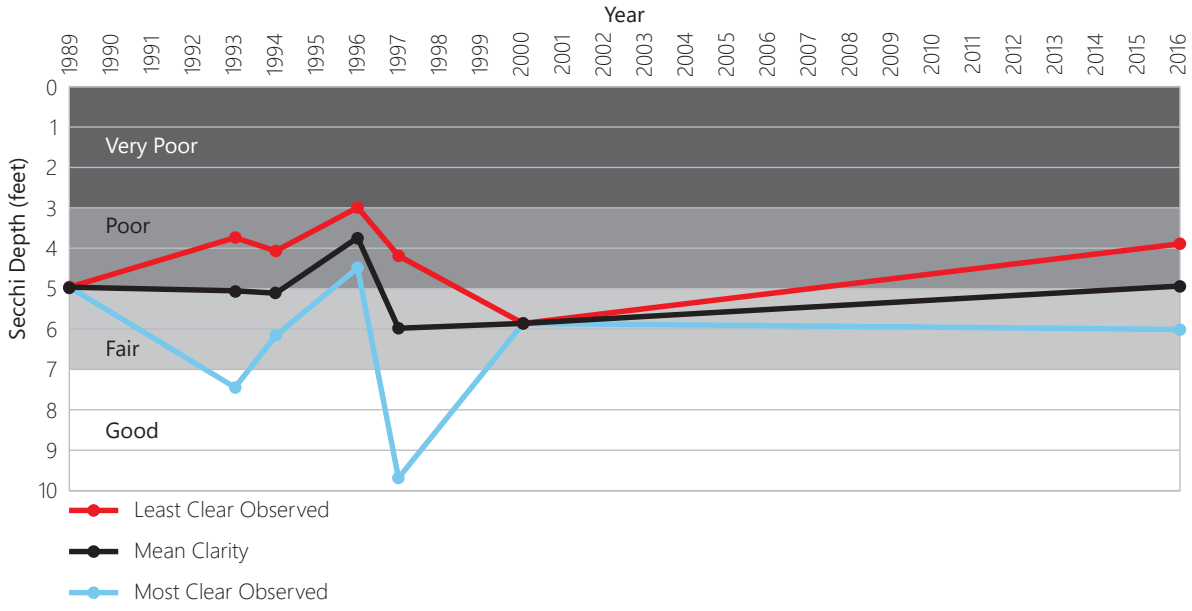
Figure 5
Measuring Water Clarity with a Secchi Disk

Source: www.burnsville.org and SEWRPC

Water clarity is a commonly used and easily understood surrogate for perceived water quality. Many people equate "clear" water with "clean" water. While this is not always true, methods have been developed to

[20] *Water quality data and other information about Camp Lake can be found at the WDNR Lakes page: dnr.wi.gov/lakes/LakePages/LakeDetail.aspx?wbic=747100.*

Figure 6
Summer (June Through August) Secchi Depth Ranges for Camp Lake



Source: Wisconsin Department of Natural Resources and SEWRPC

allow lake water clarity to be compared and contrasted. Water clarity is measured with a Secchi disk (Figure 5). "Secchi depth" is the distance below the water surface that a Secchi disk can be seen under carefully prescribed conditions. Secchi depth has been occasionally measured in the Lake and the results over time are summarized graphically in Figure 6. On average, water clarity has been rather poor, with Secchi depth readings ranging between three and six feet and typically averaging around four to five feet.[21] Water clarity has also been estimated from satellite imagery,[22] averaging 3.7 feet between 2003 and 2011, which generally agrees with values actually measured on the Lake. Furthermore, more recent remote sensing techniques suggest that the Lake is fairly turbid in most areas.[23] Based upon the available information, Camp Lake's water clarity is rather poor and has not changed significantly since monitoring began.

Lake trophic state index (TSI) is calculated using physical and chemical indicators of lake nutrient enrichment. Lakes with low numeric scores (i.e., less than 40) generally have clear water of excellent quality and are termed oligotrophic. Lakes with TSI values between 50 and 60 are termed eutrophic and have limited water clarity, fewer algal species, overly-abundant aquatic plant growth, and deep areas that are commonly devoid of oxygen during summer. Mesotrophic lakes (TSI values between 40 and 50) have conditions intermediate between oligotrophic and eutrophic lakes, while hypereutrophic lakes (TSI values above 70) commonly can experience algal blooms, poor water clarity, and, in extreme cases, summer fish kills. Hypereutrophic conditions rarely occur in nature and are generally associated with human activity.

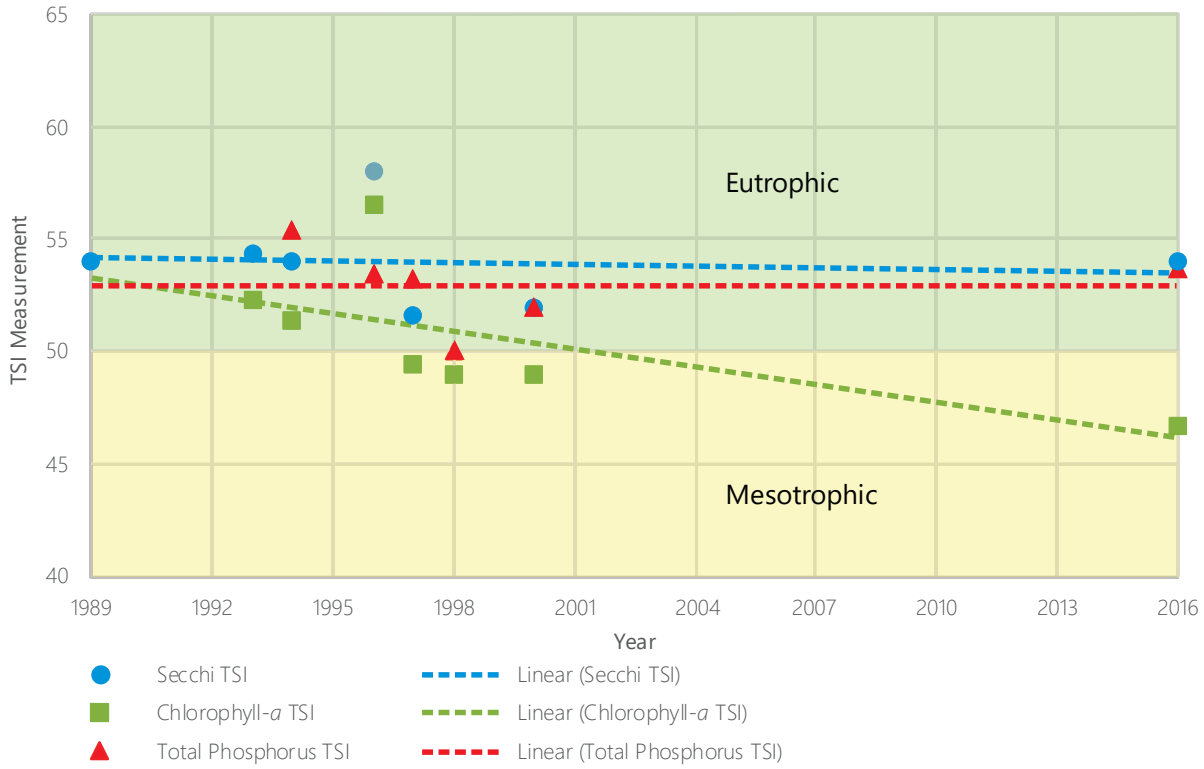
Camp Lake's TSI values are plotted over time in Figure 7. As can be seen from this graphic, TSI values based upon Secchi depth and phosphorus concentrations have changed very little since 1989, however, TSI values based upon chlorophyll-a abundance have significantly improved. This condition suggests that water clarity is no longer controlled by algal abundance, but is instead now partially controlled by suspended particulate matter or water color. The decrease in summer chlorophyll-*a* concentrations over time is consistent with

[21] *A secchi depth reading of 17 feet is reported to have been measured on July 8, 1989, during a period of time when the Lake is described as "green and impaired". The secchi depth two weeks later was found to be 5 feet, a value agreeing with all subsequent values. The 17 foot secchi depth reading is assumed to be a typographical error and was not considered in our analyses.*

[22] *Environmental Remote Sensing Center data and information about the program can be found at Lakesat.org.*

[23] *Water clarity information for 2013, 2014, 2015, 2016 is available at the WDNR's Lakes and AIS Viewer website: dnrmaps.wi.gov/H5/?viewer=Lakes_AIS_Viewer.*

Figure 7
Summer (June Through August) Annual Average Trophic State Indices (TSI) for Camp Lake



Note: Comparatively little data was available for Camp Lake. June-August data of each year was averaged to produce the resultant values.

Source: Wisconsin Department of Natural Resources and SEWRPC

the observed decreasing spring and fall concentrations of total phosphorus from 2008 through 2016.[24] This decrease in spring and fall total phosphorus concentrations also is occurring in the upstream Center Lake, which suggests that water quality is improving in this system. Other explanations are possible. For example, summer chlorophyll-*a* concentrations often decrease in lakes recently colonized by zebra mussels (*Dreissena polymorpha*) because they feed by filtering algae from the water column. Nonetheless, Zebra mussels have not been observed in Camp Lake as of the date of this report.

Camp Lake's shallow depth and extensive areas of shallow water create a situation where most portions of the Lake do not stratify. The deepest portion of the Lake weakly stratifies during summer. According to summer 2016 data, Lake waters deeper than approximately 10 feet often do not contain sufficient oxygen to fully support fish, while portions of the Lake deeper than 15 feet are devoid of oxygen.

NATURAL RESOURCES

Aquatic Plants

Camp Lake's aquatic plant community was examined during June/August 1967, July 1993, June/July 2004, August 2011, and August 2016. The 1967 survey was less detailed than subsequent surveys. Table 3 lists the frequency of occurrence of plant species noted in these studies.

The 1967 reconnaissance-level survey reported a continuous mat of plants covering the water surface over the southern two-thirds of the Lake. Widgeon grass (*Ruppia cirrhosa*, see Figure 8) was the most common species. Yellow pond lily (*Nuphar advena*) was the dominant floating leaf plant, and narrow-leaf cattail (Typha *angustfolia)* dominated the shoreline. Other common plant species were water milfoil

[24] *Lake and Pond Solutions Company, February 2017, op cit.*

Table 3
Camp Lake Aquatic Plant Surveys: 1967 Through 2016

Aquatic Plant Species	June, August 1967	Per Cent Frequency of Occurrence in Vegetated Areas			
		July 1993	June, July 2004	August 2011	August 2016
Floating Plants					
Lemna minor (small duckweed)	--	3.7	--	0.2	2.5
Lemna trisulca (forked duckweed)	--	--	--	--	0.5
Nuphar advena (yellow pond lily)	--	--	--	--	--
Nuphar spp.	moderate	2.8	--	--	--
Nuphar variegata (spatterdock)	--	0.9	--	3.4	7.6
Nymphaea odorata (white water lily)	--	22.9	--	14.1	27.9
Nymphaea spp.	scattered	--	--	--	--
Polygonum amphibium (water smartweed)	--	0.9	--	--[a]	--
Wolffia columbiana (common watermeal)	--	--	--	--	6.2
Emergent Plants					
Decodon verticillatus (swamp loosestrife)	sparse	--	--	--	--
Lythrum salicaria (purple loosestrife)	--	--	--	6.8	10.2
Phragmites australis (common reed)	--	--	--	--	0.5
Potendaria cordata (pickerelweed)	sparse	0.9	--	0.2	1.2
Sagittaria latifolia (common arrowhead)	--	--	--	--	0.2
Schoenoplectus tabernaemontani (soft-stem bulrush)	scattered	--	--	7.0	10.4
Scirpus acutus (hardstem bulrush)	--	2.8	--	--	--
Scirpus pungens (three-square bulrush)	--	0.9	--	--	--
Sparganium eurycarpum (common bur-reed)	--	0.9	--	--	--
Typha augustifolia (narrow-leaved cattail)	--	0.9	--	6.8	15.1
Typha spp.	moderate	--	--	--	--
Submerged Plants					
Ceratophyllum demersum (coontail)	sparse	81.7	44.9	19.3	11.1
Chara spp. (muskgrass)	sparse	10.1	26.5	55.1	42.3
Elodea canadensis (waterweed)	sparse	5.5	2.0	23.1	12.5
Heteranthera dubia (water stargrass)	--	9.2	8.2	0.9	4.9
Myriophyllum heterophyllum (various-leaved milfoil)	--	--	--	0.5	--
Myriophyllum sibiricum (northern water milfoil)	--	51.4	--		2.5
Myriophyllum spicatum (Eurasian water milfoil)	--	61.5	77.6	7.7	46.0
Myriophyllum verticillatum (whorled water milfoil)	--	2.8	--	--	--
Myriophyllum spp.	moderate	--	24.5	--	--
Najas flexilis (bushy pondweed)	sparse	0.9	22.4	49.0	40.4
Najas guadalupensis (southern naiad)	--	17.4	--	--	--
Najas marina (spiny naiad)	sparse	--	--	1.4	0.5
Potamogeton amplifolius (large-leaf pondweed)	--	4.6	--	--	--
Potamogeton crispus (curly-leaf pondweed)	--	0.9	4.1	0.5	0.2
Potamogeton foliosus (Leafy Pondweed)	--	--	--	--	0.5
Potamogeton friesii (fries pondweed)	--	--	--	--	0.2
Potamogeton gramineus (variable pondweed)	--	5.5	2.0	--	33.5
Potamogeton illinoensis (Illinois pondweed)	--	--	--	27.7	24.3
Potamogeton natans (floating-leaf pondweed)	--	4.6	6.1	4.8	13.6
Potamogeton nodosus (long-leaf pondweed)	--	2.8	--	3.9	9.7
Potamogeton praelongis (white-stem pondweed)	--	--	--	5.9	4.4
Potamogeton richardsonii (clasping-leaf pondweed)	--	10.1	--	--	--
Potamogeton robbinsii (robin's pondweed)	sparse	--	--	--	--
Potamogeton zosteriformis (flat-stem pondweed)	--	3.7	6.1	5.2	10.9
*Potamogeton pusillus (*small pondweed)	--	--	--	--	--
Potamogeton spp.	sparse	6.4	2.0	--	5.3
Ranunculus longirostria (water buttercup)	sparse	--	--	--	--
Ruppia cirrhosa (widgeon-grass)	heavy	91.7	53.1	53.7	46.2
Stuckenia pectinata (Sago pondweed)	sparse	15.6	24.5	7.0	32.6
Utricularia vulgaris (common bladderwort)	--	12.8	--	20.9	16.9
Utricularia minor (small bladderwort)	--	--	--	--	2.3
Vallisneria americana (water celery)	sparse	18.4	12.2	19.7	34.6
Zannichellia palustris (horned pondweed)	--	1.8	--	--	--

Notes: Frequency of occurrence of a species is derived from a combination of the number of occurrences of a species and the number of sampling sites that had some kind of vegetation present. It indicates dominance of a species within a plant community.

Nonnative species above are listed in red print; all other species are native.

NR107 *Wisconsin Administrative Code* high-value species are printed in green print.

[a] *Vegetation was noted as present but not statistically measured.*

Source: Belonger, Hey and Associates, Inc., R. A. Smith, Inc., Lake and Pond Solutions Co., and SEWRPC

Figure 8
Widgeon Grass (*Ruppia cirrhosa*)

Source: www.outdooralabama.com and SEWRPC

(Myriophyllum spp.), curly-leaf pondweed (*Potamogeton crispus*), large-leaf pondweed (*Potamogeton amplifolius*) and waterweed (*Elodea sp.*). Overall, 25 native plant species were found.[25] The WDNR also noted at the time that mechanical efforts to remove nuisance levels of vegetation were not long-lasting due to the shallowness and high nutrient content of the water.[26]

Quantitative plant surveys completed beginning in 1993 reveal gradual shifts in the abundance and diversity of Camp Lake's aquatic plants over time. Widgeon grass, an uncommon native species in Wisconsin, remains a prominent plant species in the Lake.[27] Other native aquatic plant species such as muskgrass (*Chara spp.*), bushy pondweed (*Najas flexilis*), variable pondweed (Potamogeton gramineus), Illinois pondweed (*Potamogeton illinoensis*), sago pondweed (*Stuckenia pectinata*), and water celery (*Vallisneria americana*) have gained prominence. Coontail (*Ceratophyllum demersum*) was very common in 1993 but has consistently decreased in abundance since that time. Invasive Eurasian water milfoil (EWM, *Myriophyllum spicatum*) is a serious management challenge. EWM's frequency of occurrence has fluctuated considerably over the past 25 years.

A diverse array of native aquatic plant species is generally indicative of a healthy aquatic plant community. The substantial decline in the number of native submerged plant species between 1993 and 2011 was a potential cause for concern but this concern is partially alleviated by the increasing number of native aquatic plant species noted as part of the 2016 survey. Moreover, the most recent aquatic plant sampling effort indicated that the Lake native aquatic plant community contains several high-value species and has been becoming increasingly diverse and widespread throughout the Lake. Twelve high-value species are

[25] *Belonger Brian J.,* Aquatic Plant Survey of Major Lakes in the Fox River (Illinois) Watershed, *Wisconsin Department of Natural Resources Researce Report Number 39, 1969.*

[26] *Wisconsin Department of Natural Resources Lake Use Report No. FX-12, op cit.*

[27] *Widgeon grass is listed as a threatened species in Michigan and is considered rare in Minnesota.*

identified under Chapter NR 107, "Aquatic Plant Management," of the *Wisconsin Administrative Code* as plants that contribute important ecosystem services to lakes. Five have recently been found in Camp Lake (water celery, sago pondweed, Illinois pondweed, soft-stem bulrush (*Schoenoplectus tabernaemontani*), and white-stem pondweed (*Potamogeton praelongis*)).

Aquatic plants have been noted to grow to depths ranging between 0.5 and 15 feet below the Lake surface. Since most of Camp Lake is relatively shallow, and since water depths exceeding the Lake's maximum plant rooting depth are very limited in extent, most of the Lake supports aquatic plants. Only small areas of the Lake have water depths exceeding the maximum observed aquatic plant rooting depth and are, therefore, free of aquatic plant growth.

Aquatic Invasive Species

The terms "nonnative" and "invasive" are often confused and incorrectly assumed to be synonymous. Nonnative (sometimes also referred to as "exotic") is an overarching term describing living organisms introduced to new areas beyond their native range with intentional or unintentional human help. Nonnative species may not necessarily harm ecological function or human use values in their new environments. Invasive species are the subset of nonnative species that damage the ecological health of their new environments and/or are commonly considered nuisances to human use values. In summary, invasive species are non-native but not all non-native species are invasive.

*Eurasian Water Milfoil (*Myriophyllum spicatum*) and Eurasian/Northern Water Milfoil Hybrids*

EWM, one of eight milfoil species found in Wisconsin, is the only milfoil species known to be exotic/nonnative (see Figure 9). This plant can grow profusely in nutrient-rich lakes impeding boating and recreational use. Because of this management concern, EWM is actively managed by mechanical and chemical means in many Southeastern Wisconsin lakes. In recent years, EWM/native northern milfoil hydrids have been observed in some Wisconsin lakes. These hybrids pose a difficult management problem: not only do hybrids grow quickly like EWM, but hybrids appear to be more tolerant to aquatic herbicides such as 2, 4-D and Endothall that are commonly used to manage EWM.[28] Both EWM and EWM/native milfoil hybrids have been identified in Camp Lake. EWM was positively identified as part of the 1993 survey, but likely was present earlier and simply identified as "water milfoil." EWM has commonly been one of the most frequently occurring plants in the Lake. The presence of invasive milfoil species is a management concern. The CCLRD manages nuisance aquatic vegetation using mechanical harvesters and herbicides. Increasing vigilance has been devoted to protecting native aquatic plants to promote their spread into areas infested with EWM. Aquatic plant harvest volume has significantly decreased over the past 15 years.

*Purple loosestrife (*Lythrum salicaria*)*

Purple loosestrife (see Figure 10) spreads profusely, outcompeting native plant species and reducing the quality of fish and wildlife habitat while adding little ecological benefit. This species is a declared a noxious weed in the State of Wisconsin and is subject to an ongoing control program. Purple loosestrife is present in wetlands fringing Camp Lake. Camp Lake's extensive marshlands (Figure 11) make large areas particularly susceptible to purple loosestrife infestation. Swamp loosestrife (*Decodon verticillatus*) was noted to be present in 1967. However, given the current presence of exotic purple loosestrife, one can speculate that purple loosestrife was already present on Camp Lake in 1967 but was mistakenly identified as swamp loosestrife.

Low populations of three other non-native aquatic invasive species are found in limited areas of the Lake. Curly-leaf pondweed (*Potamogeton crispus*), spiny naiad (*Najas marina*) and common reed (*Phragmites australis*) were identified as part of the 2016 aquatic plant survey.

Fisheries and Wildlife

Fish surveys were completed at Camp Lake several times during the past 60 years. Overall, fish populations remained fairly consistent and Camp Lake has been considered to have a moderately productive fishery. Fish growth and size were generally slower/smaller than regional averages over the period of record. The WDNR's lake page lists the Lake's northern pike (*Esox lucius*) population as "abundant," largemouth bass (*Micropterus salmoides*) and panfish as "common," and catfish and walleye (*Sander vitreus*) as "present."[29]

Bluegill, Black Crappie, Northern Pike, Largemouth Bass, and Walleye can be found in Camp Lake

[28] *T. Groves, P. Hausler, and P. Tyning, Water Resources Group, Progressive AE,* Hybrid Milfoil: Management Implications and Challenges, *The Michigan Riparian, Winter 2015.*

[29] *dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=747100.*

Figure 9
Eurasian Water Milfoil (*Myriophyllum spicatum*)

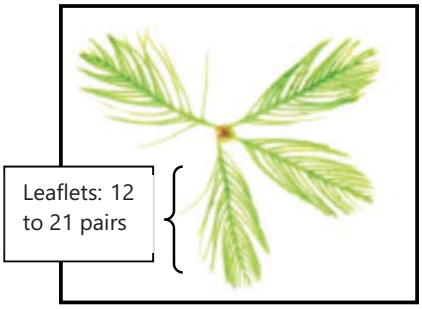
Identifying Features

- Stems spaghetti-like, often pinkish, growing long with many branches near the water surface
- Leaves with 12 to 21 pairs of leaflets
- Produces no winter buds (turions)

Eurasian water milfoil is similar to northern water milfoil (*M. sibiricum*). However, northern water milfoil has five to 12 pairs of leaflets per leaf and stouter white or pale brown stems

Ecology

- Hybridizes with native northern water milfoil, resulting in plants with intermediate characteristics
- Invasive, growing quickly, forming canopies, and getting a head-start in spring due to an ability to grow in cool water
- Grows from root stalks and stem fragments in both lakes and streams, shallow and deep; tolerates disturbed conditions
- Provides some forage to waterfowl, but supports fewer aquatic invertebrates than mixed stands of aquatic vegetation



Source: Wisconsin Department of Natural Resources and Skawinski, P. M. (2014). Aquatic Plants of the Upper Midwest: A Photographic Field Guide to Our Underwater Forest, 2nd Edition, Wausau, Wisconsin, USA: Self-Published.

The fish surveys completed before 1969 report that the Lake's fish community was comprised of panfish (mostly bluegill (*Lepomis macrochirus*) and black crappie (*Pomoxis nigromaculatus*)), northern pike, largemouth bass, walleye, white bass (*Morone chrysops*), and an unspecified type of catfish. Carp (presumably *Cyprinus carpio*) were considered "overabundant" and a contributor to the Lake's turbid water. Walleye were stocked beginning in 1961 and had reportedly established a naturally reproducing population. The Lake was noted to experience both summerkill and partial winterkill.[30]

A WDNR fish survey completed during July 2004 found 19 fish species including northern pike, largemouth bass, and various panfish. The panfish population was dominated by bluegill, but several other panfish were found including pumpkinseed (*Lepomis gibbosus*), yellow perch (*Perca flavescens*) and black crappie. Some rare species also were found including the State threatened species the pugnose shiner (*Notropis anogenus*, see Figure 12); two species of State special concern including the least darter (*Etheostoma microperca*), and the lake chubsucker (*Erimyzon sucetta*, see Figure 13); and three sensitive species that are becoming rare in Wisconsin — the blackchin shiner (*Notropis heterodon*), the blacknose shiner (*Notropis heterolepis*), and the Iowa darter (*Etheostoma exile,* see Figure 14).

[30] *Wisconsin Department of Natural Resources Lake Use Report No. FX-12, op cit.*

Figure 10
Purple Loosestrife (*Lythrum salicaria*)

Identifying Features

- Terrestrial or semi-aquatic emergent forb
- Stems often angled with four, five, or more sides
- Grow one to two meters tall
- Flowers deep pink or purple, six-parted, 12 to 25 millimeters wide, and in groups
- Leaves lance-like, four to 11 centimeters long and either opposite or in whorls of three

Purple loosestrife, if small, is similar to winged loosestrife (*Lythrum alatum*), but winged loosestrife differs in having leaves generally smaller (<5.0 centimeters long), leaves mostly alternate (only lower leaves opposite), and flowers mostly held singly in the leaf axils rather than in pairs or groups

Ecology/Control

- Found in shallows, along shores, and in wet to moist meadows and prairies
- Invasive and continues to escape from ornamental plantings
- Galerucella beetles have been successfully used to control purple loosestrife. Plants may also be dug or pulled when small, placed in a landfill, or burned. Several herbicides are effective, but application near water may require permits and aquatic-use formulas.

Source: The Nature Conservancy and SEWRPC

Figure 11
Marshlands at South End of Camp Lake: 2015

Note: The wetlands and aquatic plant beds of Camp Lake provide excellent waterfowl habitat.

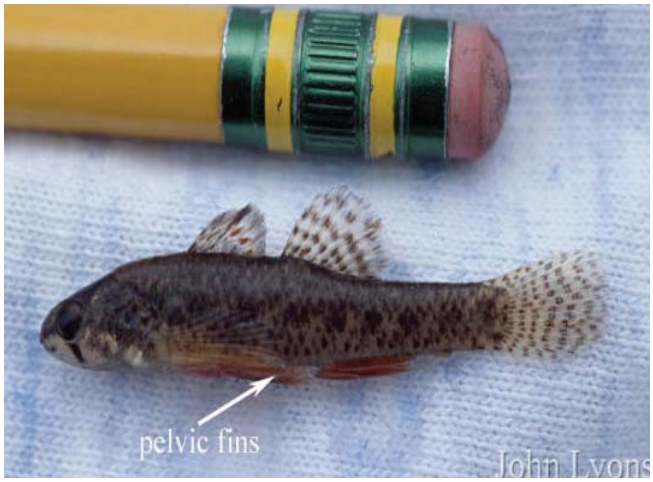
Source: SEWRPC

Figure 12
Threatened Species Found in Camp Lake

Pugnose Shiner
(Notropis anogenus)

Source: Wisconsin Department of Natural Resources and SEWRPC

Figure 13
Special Concern Species Found in Camp Lake



Least Darter
(Etheostoma microperca)

Lake Chubsucker
(Erimyzon sucetta)

Source: Wisconsin Department of Natural Resources and SEWRPC

The WDNR evaluated gamefish populations in the Lake during 2011 and 2017. Modest-sized largemouth bass and northern pike were found in reasonable abundance. A few walleye were also captured, some of which were relatively large, measuring well over 20 inches in overall length.

The southwest and west shorelines have been designated as excellent northern pike habitat while most of the rest of the Lake shoreline has been considered panfish and largemouth bass habitat. Gamefish have been stocked in Camp Lake for many years. Most gamefish populations are naturally reproducing. Walleye have reportedly been stocked since 1961, with more recent stockings in 1980, 2005, 2012, 2011, and 2013, 2015, and 2017. Northern pike were last stocked in the lake approximately 40 years ago.[31]

[31] *infotrek.er.usgs.gov/doc/wdnr_biology/Public_Stocking/StateMapHotspotsAllYears.htm*

Figure 14
Sensitive Species Found in Camp Lake

Blackchin Shiner
(Notropis heterodon)

Blacknose Shiner
(Notropis heterolepis)

Iowa Darter
(Etheostoma exile)

Source: Wisconsin Department of Natural Resources and SEWRPC

The wetlands and aquatic plant beds of Camp Lake provide excellent habitat for waterfowl, muskrats, pheasants, and various marsh and migratory birds. The Lake's shallow depth and dense aquatic plant growth make it ideal for waterfowl. Herons, sandhill cranes, blue-winged teal, mallards, and bitterns have been reported as commonly present. Large flocks of waterfowl are known to congregate on the Lake during migrations.[32] Non-migratory Canada geese that are so prevalent throughout southeastern Wisconsin are abundant.

Environmentally Significant Areas

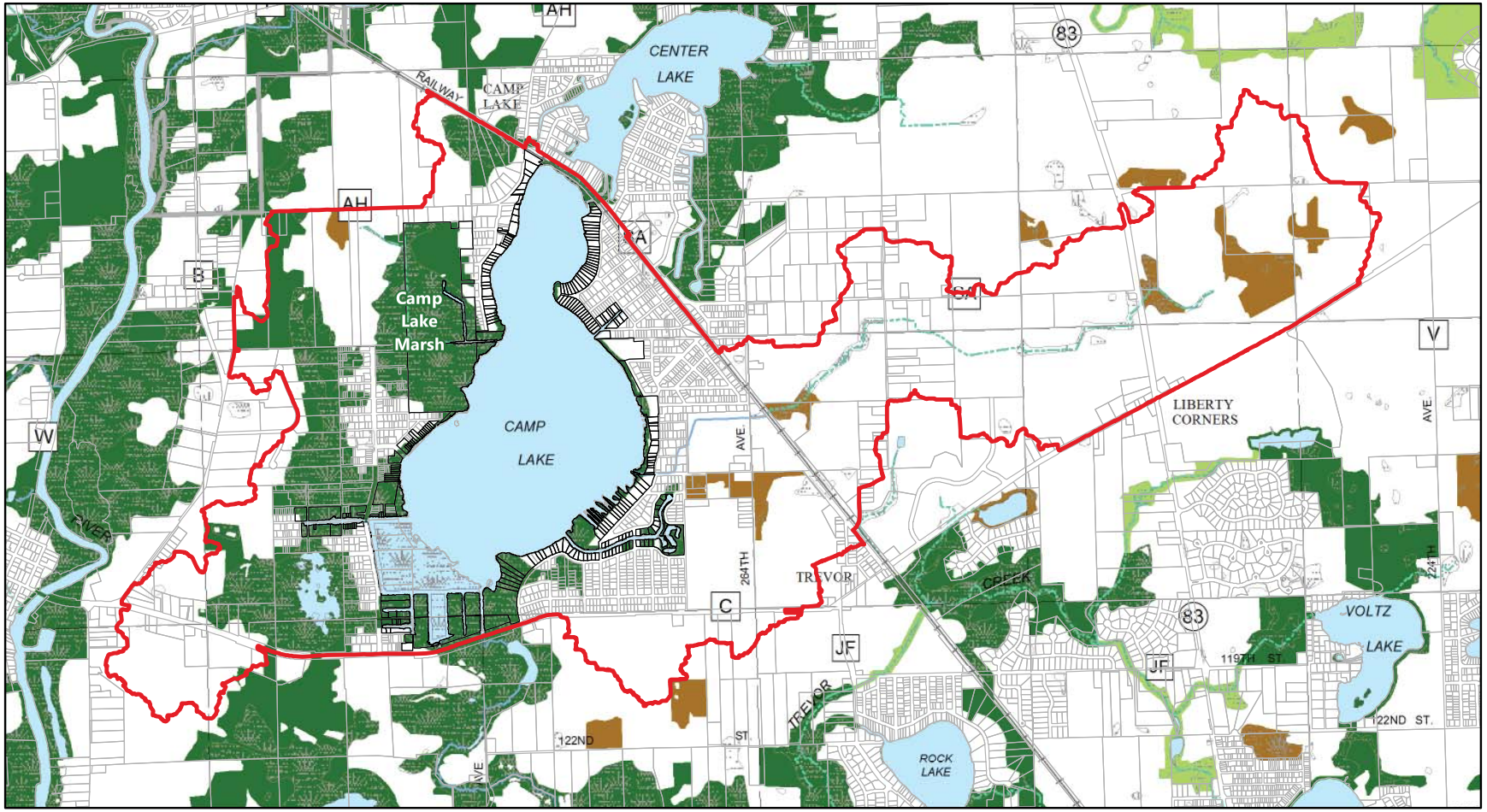
The Camp Lake watershed contains numerous environmentally significant areas. These areas generally represent the best remaining natural resource areas in the Lake's watershed. Many important interdependent relationships occur between living organisms and their environment in such areas. Destruction or deterioration of any one element of a natural environment may unravel the value and stability of the overall resource. Therefore, it is important to protect such areas.

As shown on Map 3, primary environmental corridor areas occupy nearly 1,070 acres of land and water area (including the Lake itself) in the Lake's direct tributary area, much of it in close proximity to the Lake. Preserving these areas is critically important to maintaining the ecological integrity of the Lake. Some of the woodland and wetland areas to the east and to the northwest of the Lake are among the 85 acres designated as isolated natural resource areas in the Lake's direct tributary area.

Camp Lake Marsh abuts the southwest corner of Camp Lake. This 293-acre wetland tract contains both deep and shallow marsh dominated by cattails and softstem bulrush. As noted above, Camp Lake itself is especially rich in aquatic plant growth. Camp Lake Marsh is designated as a natural area of county-wide or regional significance.

[32] *Hey and Associates, Incorporated, 2006, op. cit.*

Map 3
Environmentally Significant Areas Within the Area Directly Tributary to Camp Lake: 2015



SURFACE WATER
DIRECT TRIBUTARY AREA
PERENNIAL STREAM
INTERMITTENT STREAM
PRIMARY ENVIRONMENTAL CORRIDORS
SECONDARY ENVIRONMENTAL CORRIDORS
ISOLATED NATURAL RESOURCE AREA
WETLANDS

Additional areas tributary to Camp Lake first drain through Center Lake

N

0 1,500 3,000 Feet

Source: SEWRPC

Figure 15
Channels in the Camp Lake Marshlands

Source: SEWRPC

Camp Lake has been designated as a critical aquatic habitat area under the SEWRPC's Critical Habitat Designation program on the basis of its ability to provide ideal waterfowl, marsh wildlife, and critical fish species habitat.[33] The Lake is considered an aquatic area of local significance, important to the overall health of aquatic plants and animals.

Aesthetic Features

Even though Camp Lake is located in a densely populated area, significant amounts of undeveloped shoreline are present. Camp Lake's extensive marshlands in its southwest corner and southern end, along with the wildlife they attract, provide Lake users opportunity to experience the area's native beauty. The channels through marshlands allow boaters to access and explore natural areas in more intimate detail (Figure 15).

LAKE USE

Recreational Use

During summer and winter 2014, SEWRPC staff conducted recreational surveys to examine public lake use. The surveys reveal that fishing and water skiing/tubing were the most popular on-water activities during the summer (Figure 16). The most popular winter activity observed was ice fishing (Figure 17). Snowmobiling is also a popular local winter pastime.

Swimming is not particularly popular on Camp Lake due to abundant aquatic plant growth, marshy shorelines, and soft/organic bottom sediments. Sunset Oaks Park, a Village of Salem Lakes park on the east side of the Lake (see Map 4), has a small sand beach, however, no lifeguard is on duty.

[33] *SEWRPC Planning Report Number 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997*.

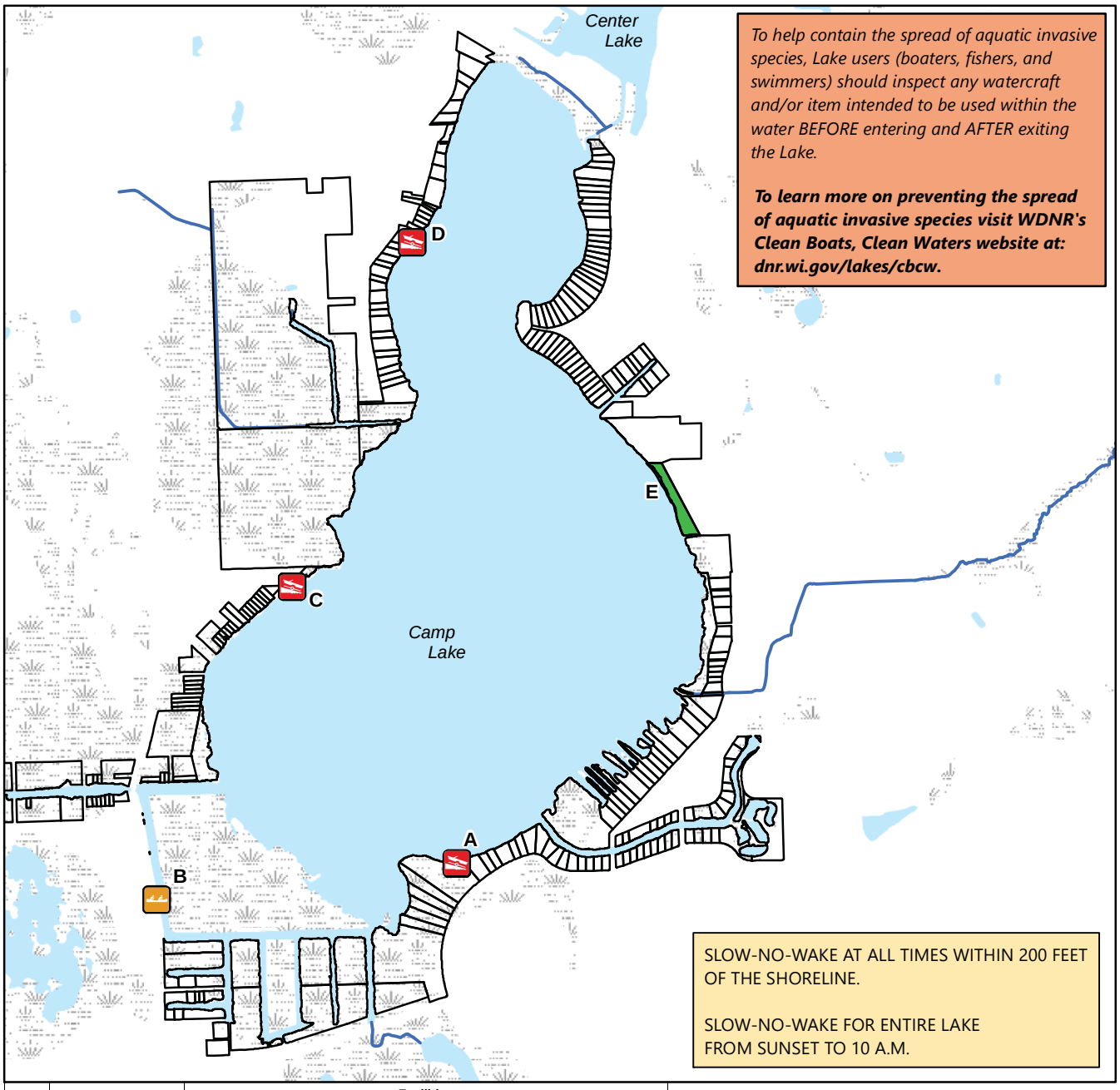
Figure 16
Typical Summer Activities on Camp Lake

Source: SEWRPC

Figure 17
Typical Winter Activities on Camp Lake

Source: SEWRPC

Map 4
Recreational Use on Camp Lake: 2015



Map ID	Description	Facilities							
		Boat Ramp	Fee	Car-trailer Parking	Pier	Swim Beach	Picnic Area	Shelter	Playground
A	WDNR Launch Site	Yes	No	Yes	Yes	No	No	No	No
B	Carry-In WDNR Launch Site	Carry-In	No	Yes, limited	No	No	No	No	No
C	Village of Salem Lakes Launch Site	Yes	No	Yes	No	No	No	No	No
D	Village of Salem Lakes Launch Site	Yes	No	Yes	No	No	No	No	No
E	Village of Salem Lakes - Sunset Oaks Park	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

RIPARIAN PARCEL BOUNDARY
SURFACE WATER
STREAM
WETLAND
N
0 750 1,500 Feet

Source: Wisconsin Department of Natural Resources and SEWRPC

Note: For additional lake information or boating regulations go to:
dnr.wi.gov/lakes/lakepages/Results.aspx

Public Access

Five public boat launch sites are located around Camp Lake (see Map 4). Four of these sites are paved or gravel launch ramp facilities with parking for vehicles and boat trailers. The remaining launch site only supports carry-in boats. Launch fees are charged at one site. The WDNR deems the Lake to have adequate public recreational boating access pursuant to standards set forth in Chapter NR 1, "Natural Resources Board Policies," of the *Wisconsin Administrative Code*. Launch or use fees are not charged at most of the Lake's public access sites.

Cottages and Homesites

According to recent records, 265 lakefront lots abut Camp Lake. Lot sizes average 1.0 acre and range from less than 0.1 acre to 64 acres.[34] The population and number of households in Camp Lake's direct tributary area is projected to increase by 2035 (Table 4).

Table 4
Population and Households in the Area Directly Tributary to Camp Lake: 1960-2035

Year	Population	Households
1960	713	247
1970	1,132	359
1980	1,283	461
1990	1,437	542
2000	2,171	765
2010	2,367	858
Planned 2035	2,903	1,094

Source: U.S. Bureau of Census and SEWRPC

EXISTING PROTECTIVE MEASURES

Sewage Disposal

All riparian residential lands in the Camp Lake watershed are served by public sanitary sewer systems. As such, water pollution from onsite septic systems is not an ongoing concern.

Shoreline Protection and Erosion Control

Camp Lake's shoreline includes stretches of protected shoreline (either man-made or natural) as well as some areas of unprotected shoreline, such as where a riparian owner mows lawn to the water's edge (see Map 5). About 81 percent of Camp Lake's shoreline is protected by natural features (69 percent) or manmade shoreline protective structures such as riprap or bulkhead (12 percent). Nevertheless, many actively eroding shoreline areas were noted as part of SEWRPC's August 2014 field survey.[35, 36]

Land Use Regulations

Comprehensive zoning ordinances are one of the most important tools available to local units of government for encouraging orderly development and land use that contributes to long-term human and environmental welfare. Camp Lake and its watershed are subject to ordinances and regulations adopted by the Village of Salem Lakes. The Village of Salem Lakes was incorporated on February 14, 2017, and, as an interim measure, continues to follow the ordinances adopted by the Town of Salem and Kenosha County. Table 5 summarizes general and special-purpose zoning ordinances for the civil divisions within the Camp Lake watershed.

Water Use Regulations

Camp Lake is subject to Village of Salem Lakes boating ordinances, which as mentioned in the previous paragraph, were originally adopted by the Town of Salem. These ordinances apply to persons, boats, watercraft, and objects upon, in, and under the waters of Camp Lake. This ordinance is consistent with Chapter 30 of the *Wisconsin Statutes* and applies to persons, boats, watercraft, and objects upon, in, and under the waters of Camp Lake within the jurisdiction of the Village and limits the times during which boats may operate on Camp Lake.

[34] *SEWRPC Memorandum Report No. 222, op. cit.*

[35] *Ibid.*

[36] *Digital versions of shoreline photographs taken during August 2014 are available through Kenosha County and SEWRPC.*

Map 5
Shoreline Survey of Camp Lake: 2014

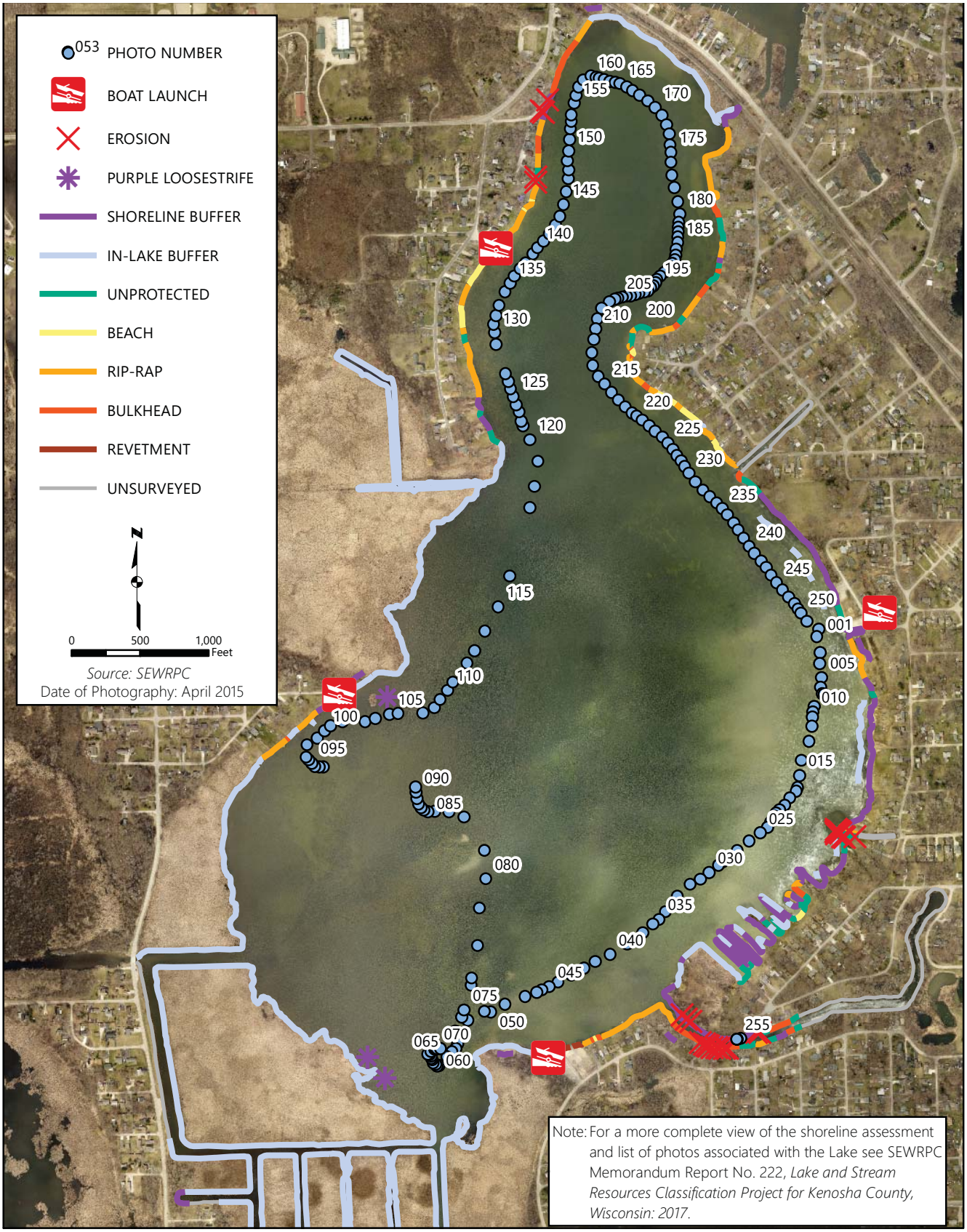


Table 5
Land Use Regulations Within the Area Directly Tributary to Camp Lake in Kenosha County by Civil Division: 2016

Type of Ordinance	Community	
	Kenosha County	Village of Salem Lakes
General Zoning	Adopted	Regulated under County ordinance
Floodplain Zoning	Adopted	Regulated under County ordinance
Shoreland Zoning	Adopted	Regulated under County ordinance
Subdivision Control	Adopted[a]	Adopted[a]
Construction Site Erosion Control and Stormwater Management	Adopted[a]	Adopted[a]

[a] *Both the Kenosha County and Village of Salem Lakes subdivision ordinances and erosion control and stormwater management ordinances apply within the Village. In the event of conflicting regulations, the more restrictive regulation applies*

Source: SEWRPC