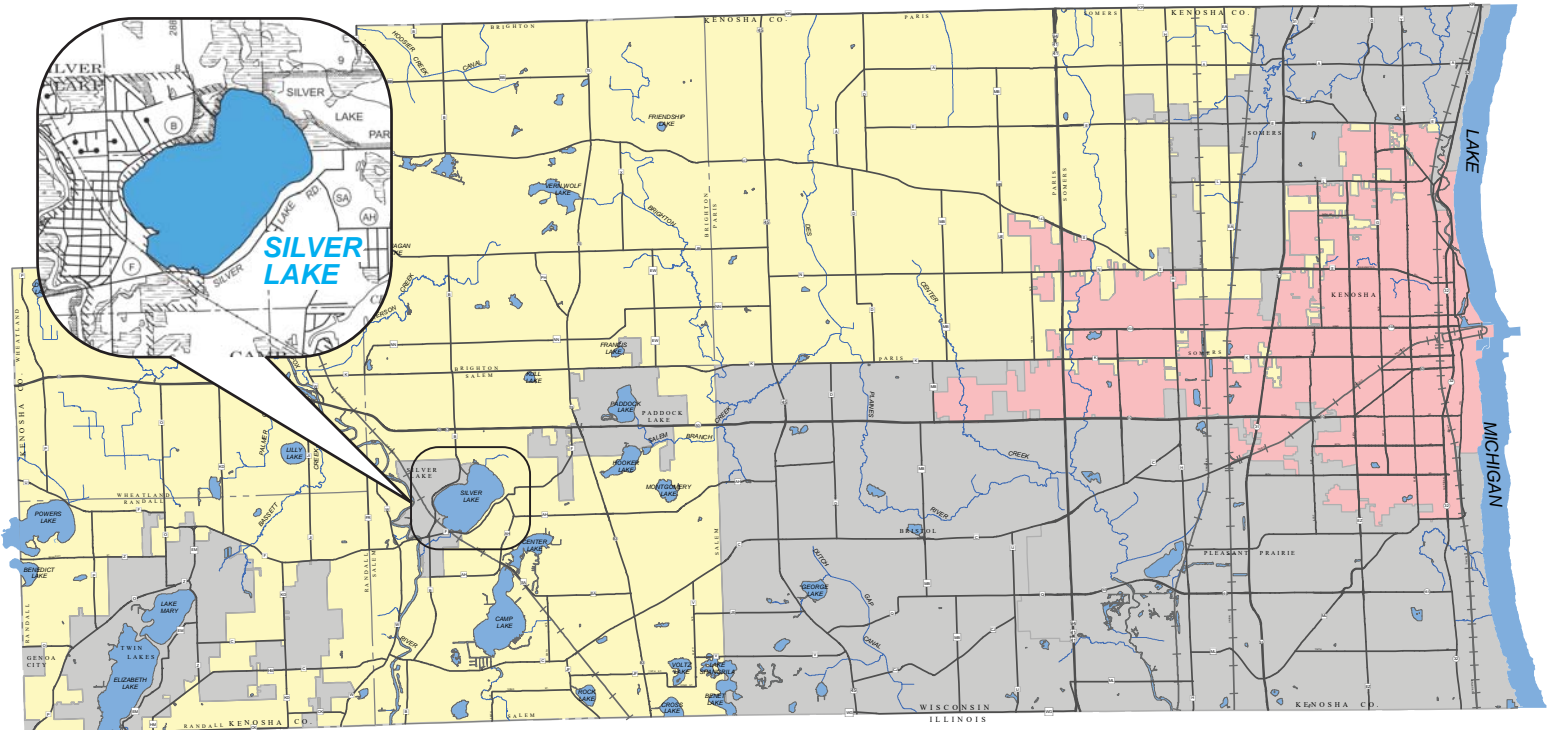


SILVER LAKE USE REPORT UPDATE LR-11

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. Silver Lake was the subject of one such report.² This report updates the earlier Lake Use Report.

In addition to the original 1968 Lake Use Report, Silver Lake was the subject of an aquatic plant management plan developed in 2013 by the Silver Lake Protection Association (SLPA).³ Silver Lake also was the subject of a WDNR Sensitive Area Designation in 2006,⁴ and was part of a 2017 lake and stream classification project developed for Kenosha County by Southeastern Regional Planning Commission (SEWRPC).⁵

The SLPA maintains a website (www.silverlakeprotectionassociation.com/). The website is used to post a wide variety of information Lake users may find interesting.

INTRODUCTION

Silver Lake is located in the Village of Salem Lakes, Kenosha County, Wisconsin. 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 contiguous marshlands provide noteworthy fish and wildlife habitat. The Lake provides significant value to local ecology.

PHYSICAL DESCRIPTION

Lake Characteristics

Based upon recent orthophotography, Silver Lake has a surface area of 528 acres.⁶ As shown on Map 1, Silver Lake has a loosely hour-glass shaped basin with a northeast-southwest orientation and a maximum depth of 44 feet. According to 1963 depth soundings published by the WDNR, Silver Lake contains 5,824 acre-feet of water. Twenty-two percent of Silver Lake is three feet deep or less, yielding an average depth of only 10 feet.⁷ Additional information regarding Silver Lake's hydrology and morphometry is summarized in Table 1.

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

² Wisconsin Department of Natural Resources (WDNR), Silver Lake, Kenosha County, An Inventory with Planning Recommendations, Lake Use Report No. FX-11, Prepared by the WDNR for SEWRPC, 1968.

³ Silver Lake Protection Association, DRAFT Aquatic Plant Management Plan for Silver Lake, Kenosha County, Wisconsin, February 2013, Revised March 2013.

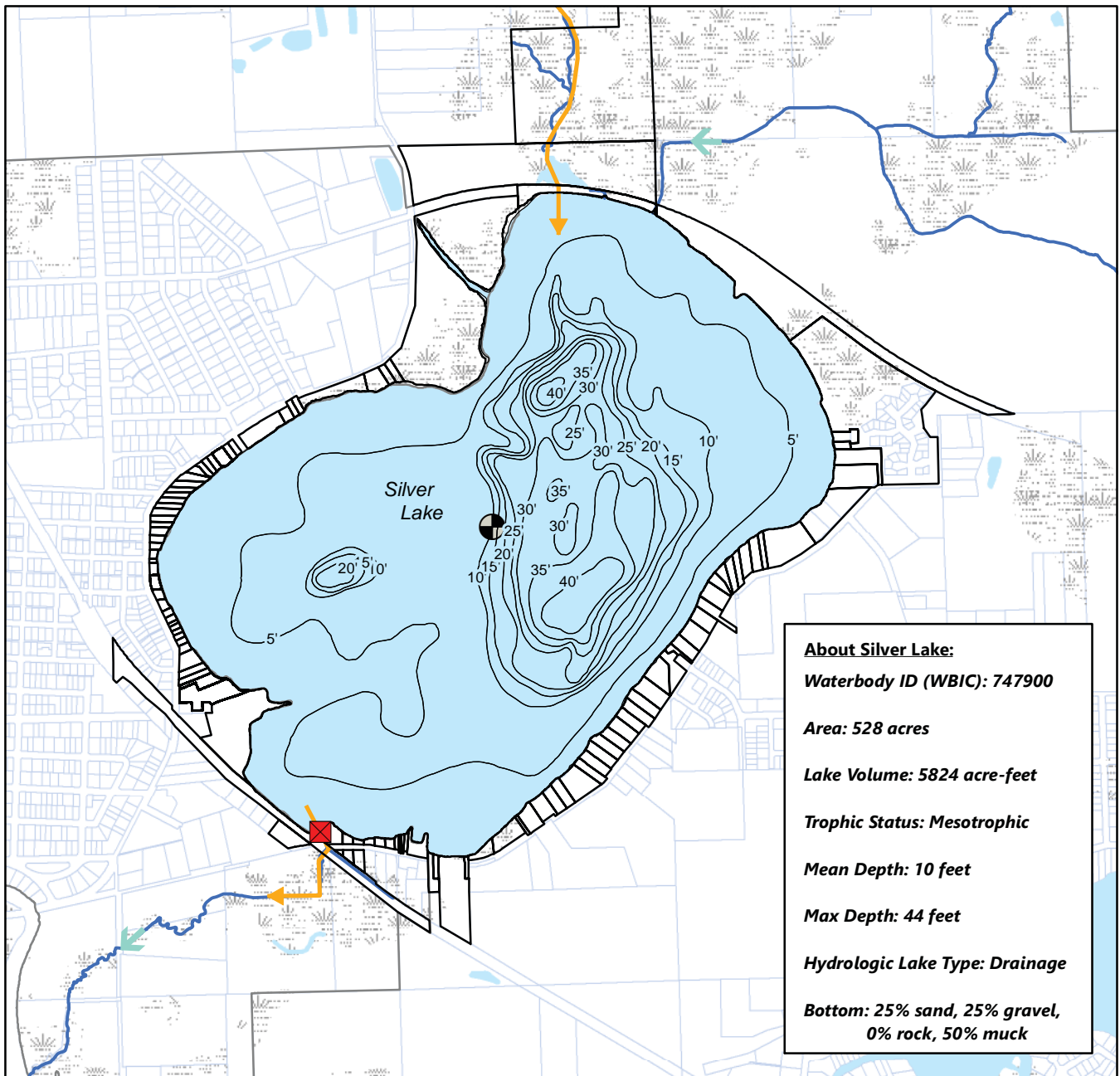
⁴ WDNR, Silver Lake (Kenosha County, Wisconsin) Integrated Sensitive Area Report, July 2010.










⁵ SEWRPC Memorandum Report No. 222, Lake and Stream Resources Classification Project for Kenosha County, Wisconsin: 2017.

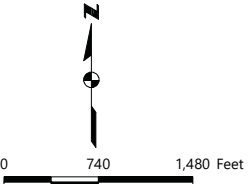
⁶ Reported lake areas commonly fluctuate over time and between documents. The apparent size of a lake depends upon the lake's water level at time of measurement, the type and condition of shoreline vegetation, and the accuracy of available tools and techniques. For example, nearly all lakes are larger 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.

⁷ SEWRPC Memorandum Report No. 222, op cit.

Map 1
Silver Lake



-  LAKE OUTLET STRUCTURE
-  DEEP HOLE WATER QUALITY SAMPLING LOCATION
-  SURFACE WATER FLOW PATH
-  STREAM AND FLOW DIRECTION
-  —15'— WATER DEPTH CONTOUR IN FEET
-  RIPARIAN PARCEL BOUNDARY
-  PARCEL BOUNDARY
-  SURFACE WATER
-  WETLAND



Source: Wisconsin Department of Natural Resources and SEWRPC

According to WDNR records, Silver Lake's bottom sediments are composed of 25 percent sand, 25 percent gravel, and 50 percent muck.⁸ The sand and gravel are predominantly located around the shoreline of Silver Lake.

Hydrology

Based upon its depth and the topography of surrounding lands, WDNR classifies Silver Lake as a deep lowland lake. It receives most of its water supply from surface-water runoff and discharges most of its water via a surface outlet, a situation also classifying the Lake as a drainage lake. The WDNR uses these parameters to set water quality goals for the Lake. Water level is also supplemented by some groundwater input and small tributaries that drain wetlands north of the Lake.

Lake water level is controlled by a small dam at the south end of Silver Lake. From there, water drains from Silver Lake to the Fox River through a small stream (Map 1).

Watershed Characteristics and Land Use

Silver Lake's 2,780 acre watershed lies primarily to the northeast and north of the Lake. A lake's watershed is the physical area from which surface-water runoff can drain to a lake. Silver Lake has a modest-sized watershed for its size, with a watershed to lake area ratio of 5.3:1. Lakes with ratios above 10:1 tend to develop water-quality problems.⁹ Lakes with large watersheds are comparatively more vulnerable to human disturbance.

Some moderate land development has occurred around Silver Lake since the writing of the previous lake use report (see Figures 1 and 2). Map 2 and Table 2 show the 2010 land uses in the Silver Lake watershed. Agricultural lands comprise approximately 41 percent of watershed land use. Wetlands and woodlands comprise another 12 and 18 percent of watershed land use, respectively. Urban uses account for only 19 percent of the watershed with low-density single-family residential areas accounting for most of the residential land use. Projected 2035 land use (Table 2) indicates significant changes within the Silver Lake watershed. Currently, projections indicate that almost all agricultural lands within the watershed will be converted to residential areas, resulting in a 53 percent decrease in rural lands, and a 226 percent increase in urban lands.

Table 1
Hydrology and Morphometry of the Silver Lake

Parameter	Measurement
Size	
Lake Surface Area ^a	528 acres
Watershed Area ^b	2,780 acres
Lake Volume	5,824 acre-feet
Shape	
Length	1.2 miles
Width	0.8 mile
Shoreline Length	3.9 miles
Shoreline Development Factor ^c	1.2
General Lake Orientation	NE-SW
Depth	
Maximum Depth	44 feet
Mean Depth	10 feet
Area under 3 feet	22 percent
Area over 15 Feet	21 percent

^aSurface 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. Various sources have reported Silver Lake's surface area to be as low as 464 acres and as high as 528 acres. Reported lake surface area varies widely by source and over time. Some of the reasons why this may happen include 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.

^bExcludes Silver Lake.

^cShoreline development factor is the ratio of the shoreline length 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, Aron and Associates, Inc., and SEWRPC.

⁸ dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=747900&page=facts

⁹ Uttormark, Paul D. and Mark L. Hutchins, 1978, Input Output Models as Decision Criteria for Lake Restoration, University of Wisconsin-Madison, Wisconsin Water Resources Center, Technical Report No. 78-03, pg. 61.

Figure 1
1970 Aerial Photograph of Silver Lake



Date of Photography: 1970

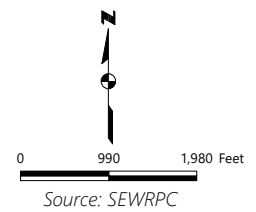
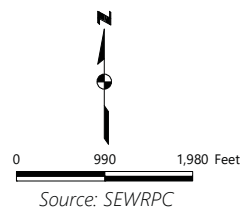


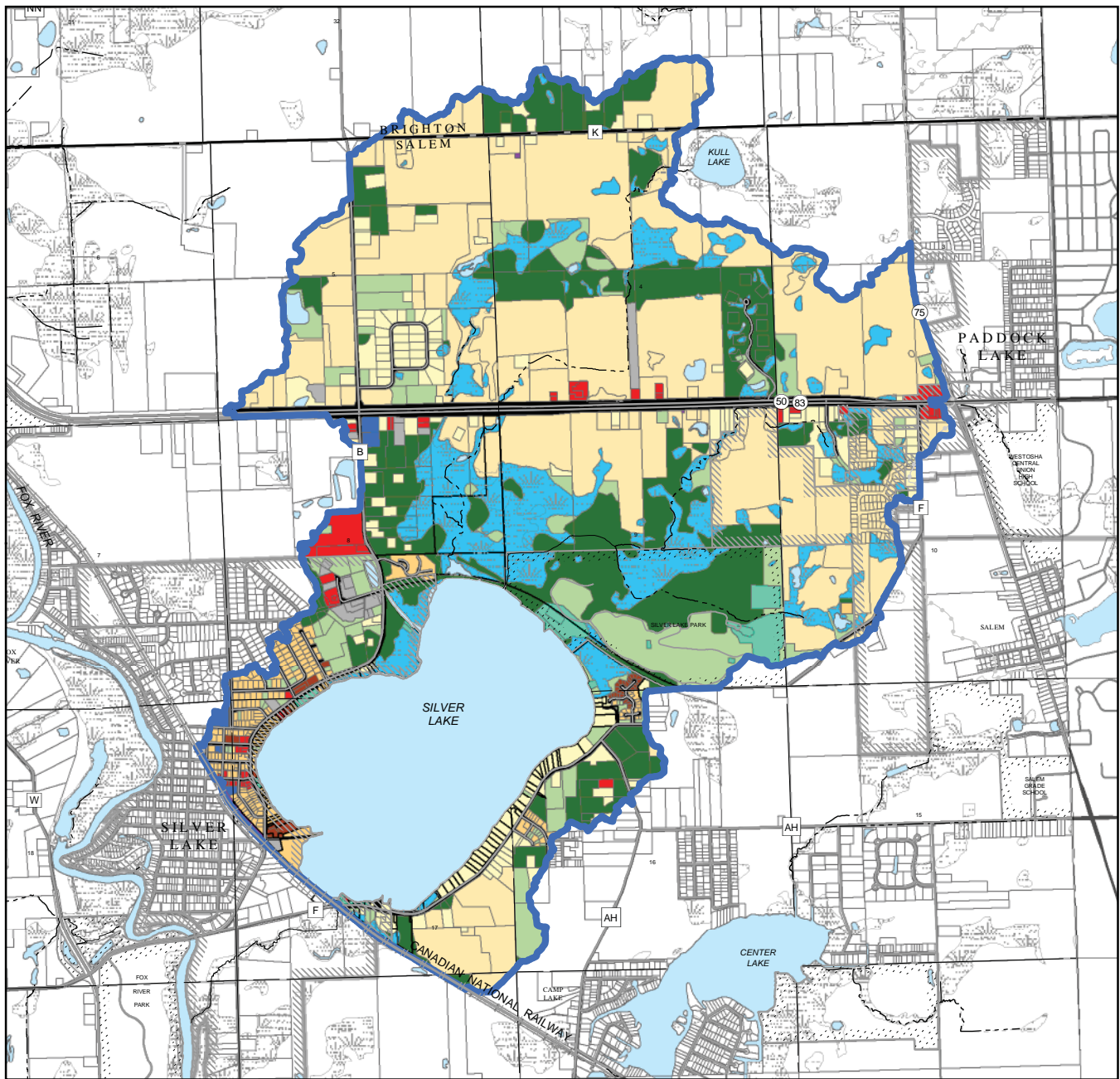
Figure 2
2015 Orthophotograph of Silver Lake


















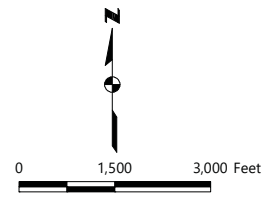
Date of Photography: 2015



Map 2
2010 Land Uses Within the Silver Lake Watershed



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



Source: SEWRPC

Table 2
Existing and Planned Land Use Within the Silver Lake Watershed: 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	--	--	--	--	--	--
Single-Family, Low Density	176.0	6.32	1,191.0	42.79	1,015.0	576.7
Single-Family, Medium Density	72.1	2.59	165.1	5.93	93.0	128.9
Single-Family, High Density	--	--	--	--	--	--
Multi-Family	10.3	0.37	--	--	-10.3	-100.0
Commercial	42.0	1.51	42.0	1.51	0.0	0.0
Industrial	25.4	0.91	37.3	1.34	11.9	46.9
Governmental and Institutional	7.4	0.27	7.4	0.27	0.0	0.0
Transportation, Communication, and Utilities	163.8	5.88	163.8	5.88	0.0	0.0
Recreational	35.5	1.28	129.7	4.66	94.2	265.4
Subtotal	532.5	19.13	1,736.3	62.38	1,203.8	226.1
Rural						
Agricultural	1,140.5	40.97	53.9	1.94	-1,086.6	-95.3
Other Open Lands	243.7	8.76	126.5	4.54	-117.2	-48.1
Wetlands	345.3	12.41	345.3	12.41	0.0	0.0
Woodlands	502.4	18.05	502.4	18.05	0.0	0.0
Water ^b	18.9	0.68	18.9	0.68	0.0	0.0
Extractive	--	--	--	--	--	--
Landfill	--	--	--	--	--	--
Subtotal	2,250.8	80.87	1,047.0	37.62	-1,203.8	-53.5
Total	2,783.3	100.00	2,783.3	100.00	0.0	--

Note: This land use summary table includes internally drained areas. Internally drained areas do not contribute surface-water runoff to the Lake and are therefore not included in the Lake's watershed area listed in Table 1.

^a Parking included in associated use

^b Excludes Silver Lake

Source: SEWRPC

WATER QUALITY

The WDNR re-evaluated Silver 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.¹⁰

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, water quality data was collected at Silver Lake starting with a few baseline measurements taken by the WDNR in 1967. From the late 1980s to the present (2017), Lake residents have 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.¹¹

¹⁰ Wisconsin Department of Natural Resources, Silver Lake, Kenosha County website, "conditions" dnr.wi.gov/water/waterDetail.aspx?wbic=747900.

¹¹ Water quality data and other information about Silver Lake can be found at the WDNR Lakes page: dnr.wi.gov/lakes/LakePages/LakeDetail.aspx?wbic=747900.

Figure 3
Measuring Water Clarity with a Secchi Disk



Source: www.burnsville.org and SEWRPC

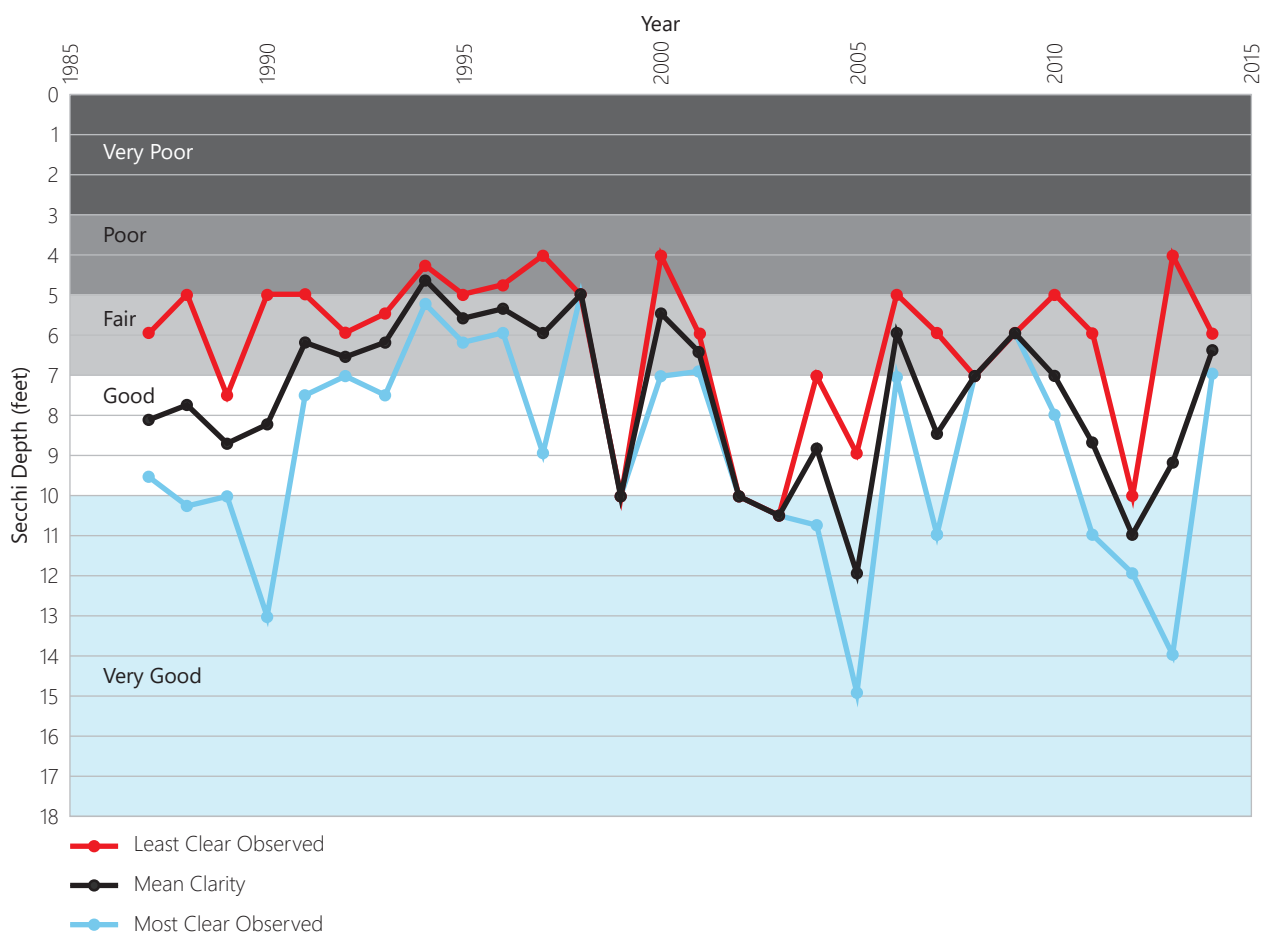
Water clarity is a commonly used and easily understood surrogate for perceived water quality. Many people equate “clear” water with “clean” water. While this is not always true, methods have been developed to allow lake water clarity to be compared and contrasted. Water clarity is measured with a Secchi disk (Figure 3). “Secchi depth” is the distance below the water surface that a Secchi disk can be seen under carefully prescribed conditions. Water clarity, measured with a Secchi disk between June and August from 1987 through 2014 (Figure 4), indicates fairly steady water clarity that averages approximately 9 feet with periodic fluctuations most likely influenced by yearly difference in precipitation and temperatures; such data is indicative of good water clarity. Water clarity data estimated from satellite imagery,¹² generally agrees with values actually measured on the Lake. Based upon the available information, Silver Lake’s water clarity is generally good 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.

Silver Lake’s TSI values are plotted over time in Figure 5. As can be seen from this graphic, TSI values collected between 1973 and 2017 show an average Trophic State Index of 49, which indicates that the Lake is mesotrophic (Figure 5). Such lakes typically support an abundance of aquatic plant growth, although

¹² *Environmental Remote Sensing Center data and information about the program can be found at Lakesat.org.*

Figure 4
Summer (June Through August) Secchi Depth Ranges for Silver Lake



Source: Wisconsin Department of Natural Resources and SEWRPC

generally not to nuisance levels, and support productive fisheries. Many Southeastern Wisconsin lakes are classified as mesotrophic.

Historic temperature and dissolved oxygen data indicate that Silver Lake thermally stratifies in summer months at approximately 18 feet. As a result, waters below 18 feet can become anoxic, or void of oxygen.¹³

NATURAL RESOURCES

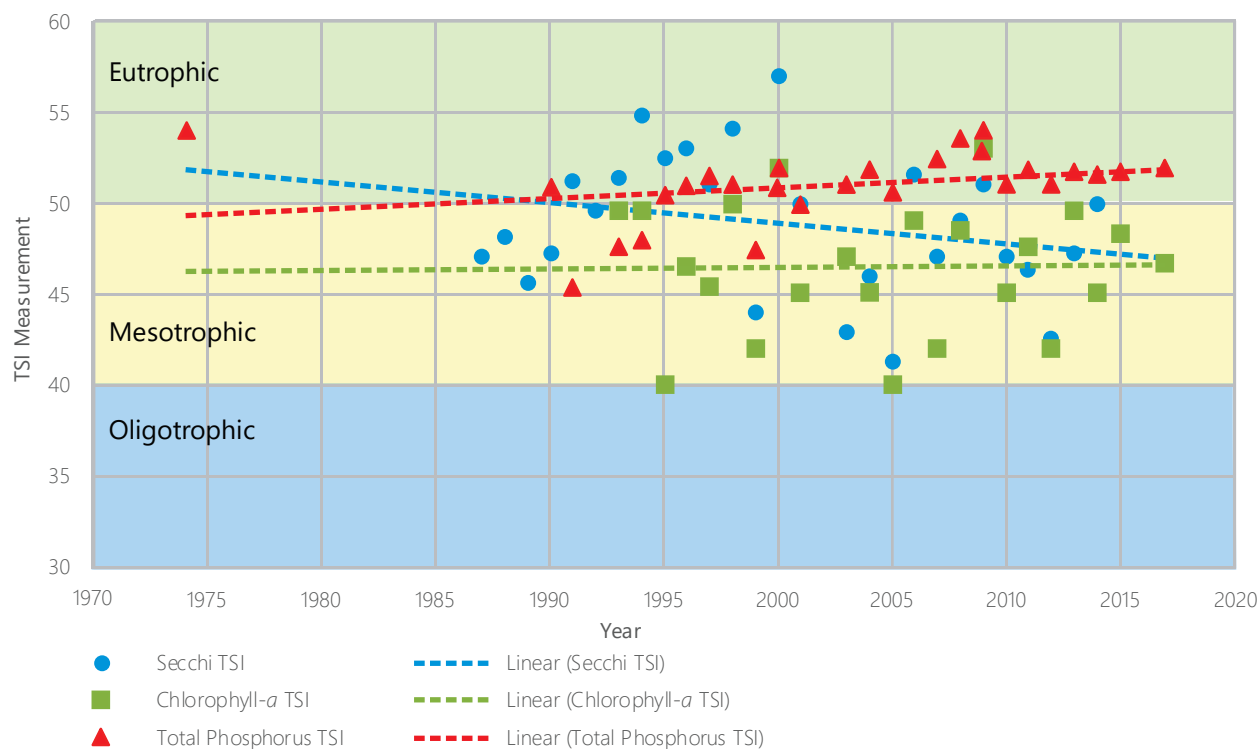
Aquatic Plants

Silver Lake’s aquatic plant community was examined during July 1967, June 2006, and September 2012. 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 survey indicated that muskgrasses (*Chara spp.*) were the most dominant species, followed by Sago pondweed (*Suckenia pectinata*) and stoneworts (*Nitella spp.*). Overall, twenty native aquatic plant species were found that year. The 2006 survey indicated that the most abundant plant species was again muskgrass followed by Illinois pondweed (*Potamogeton illinoensis*) and water celery (*Vallisneria americana*). A total of twenty-two native aquatic plant species were observed and documented within Silver Lake in 2006. During the 2012 survey, Eurasian water milfoil (*Myriophyllum spicatum*) was found to be the dominant species, however muskgrass and water celery were also abundant throughout the Lake. A total of twenty-four native

¹³ WDNR Lake Use Report No. FX-11, op cit.

Figure 5
Summer (June Through August) Annual Average Trophic State Indices (TSI) for Silver Lake



Note: June-August data of each year was averaged to produce the resultant values.

Source: Wisconsin Department of Natural Resources and SEWRPC

aquatic plant species were found during the survey. These native species provide a variety of benefits, including food for wildfowl and fish, and shelter for fingerling fish such as trout, bluegill, and bass. All of the plants found were species commonly observed in lakes within the Region.

A diverse array of native aquatic plant species is generally indicative of a healthy aquatic plant community. The substantial number of native submerged plant over the years indicates a healthy native aquatic plant community. Twelve high-value species are identified under Chapter NR 107, "Aquatic Plant Management," of the *Wisconsin Administrative Code* as plants that contribute important ecosystem services to lakes. Seven have recently been found in Silver Lake (water celery, Sago pondweed, clasping-leaf pondweed, white-stem pondweed, Illinois pondweed, soft-stem bulrush, and watershield).

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 6). 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 hybrids 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

Table 3
Silver Lake Aquatic Plant Surveys: 1967, 2006, and 2012

Aquatic Plant Species	1967 (July) ^a	2006 (June) ^b	2012 (September) ^b
Floating Plants			
<i>Brasenia schreberi</i> (water shield)	Sparse	0.28	--
<i>Lemna minor</i> (small duckweed)	--	--	present ^d
<i>Nuphar variegata</i> (spatterdock)	Sparse	--	0.57
<i>Nymphaea odorata</i> (white water lily)	Sparse	0.28	0.86
<i>Wolffia columbiana</i> (common watermeal)	--	--	present ^d
Emergent Plants			
<i>Lythrum salicaria</i> (purple loosestrife)	--	--	present ^d
<i>Pontederia cordata</i> (pickerelweed)	Scattered	0.28	0.29
<i>Sagittaria latifolia</i> (common arrowhead)	--	--	present ^d
<i>Scirpus validus</i> (soft stem bulrush)	Scattered	--	present ^d
<i>Sparganium eurycarpum</i> (bur reed)	Sparse	--	--
<i>Typha</i> spp. (cattails)	Sparse	--	--
Submerged Plants			
<i>Ceratophyllum demersum</i> (coontail)	Sparse	9.94	21.14
<i>Chara</i> spp. (muskgrass)	Heavy ^c	67.90	57.14
<i>Elodea canadensis</i> (common waterweed)	--	--	0.29
<i>Heteranthera dubia</i> (water stargrass)	--	7.95	8.86
<i>Myriophyllum sibiricum</i> (native milfoil)	Scattered	8.52	--
<i>Myriophyllum spicatum</i> (Eurasian water milfoil)	--	22.44	60.86 ^e
<i>Myriophyllum verticillatum</i> (whorled water milfoil)	Scattered	8.52	present ^d
<i>Najas flexilis</i> (bushy pondweed)	--	11.65	12.86
<i>Najas marina</i> (spiny, or brittle, naiad)	Scattered	6.82	9.43
<i>Najas</i> sp. (naiad)	--	0.85	--
<i>Nitella</i> spp. (stonewort)	Moderate	2.84	2.29
<i>Potamogeton crispus</i> (curly-leaf pondweed)	Sparse	1.14	--
<i>Potamogeton foliosus</i> (leafy pondweed)	--	0.57	--
<i>Potamogeton friesii</i> (Fries' pondweed)	--	1.14	1.14
<i>Potamogeton gramineus</i> (variable pondweed)	Scattered	0.28	--
<i>Potamogeton illinoiensis</i> (Illinois pondweed)	--	26.42	0.86
<i>Potamogeton illinoiensis hybrid</i> (Illinois pondweed hybrid)	--	--	24.86
<i>Potamogeton natans</i> (floating leaf pondweed)	Sparse	--	present ^d
<i>Potamogeton nodosus</i> (long-leaf pondweed)	Sparse	0.28	2.29
<i>Potamogeton praelongus</i> (white-stem pondweed)	--	--	2.00
<i>Potamogeton Richardsonii</i> (clasping-leaf pondweed)	--	1.42	--
<i>Potamogeton zosteriformis</i> (flat-stem pondweed)	Sparse	--	--
<i>Stuckenia pectinata</i> (Sago pondweed)	Moderate	23.86	27.71
<i>Utricularia minor</i> (small bladderwort)	Sparse	0.28	--
<i>Utricularia resupinata</i> (small purple bladderwort)	--	23.86	--
<i>Utricularia vulgaris</i> (common bladderwort)	Sparse	0.28	0.57
<i>Vallisneria americana</i> (water celery)	Scattered	25.85	34.57

Notes: 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.

Floating-leaved and emergent vegetation were not statistically measured

^aAbundance was visually appraised by describing relative abundance of plants in the Lake and assigning a rating of 1 through 4, where 1=sparse, 2=scattered, 3=moderate, 4=heavy.

^bData represents **Frequency of Occurrence**. Frequency of Occurrence is the number of occurrences of a species divided by the number of samplings with vegetation, expressed as a percentage. It is the percentage of times a particular species occurred when there was aquatic vegetation present.

^cDescribed by Wisconsin Department of Natural Resources staff as the most dominant plant in the Lake at that time (July 1967).

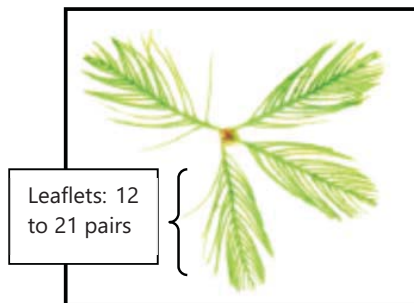
^dAquatic plant species visually observed but not collected during grid-point aquatic plant survey.

^eSamples of Eurasian water milfoil sent to Grand Valley State University for testing were confirmed to be a hybrid.

Source: Wisconsin Department of Natural Resources, Mayer Tracey, Aquatic Plant Management Plan for Silver Lake, Kenosha County, WI, Silver Lake Protection Association, Revised Draft, March 19, 2013, and SEWRPC

Figure 6
Eurasian Water Milfoil (*Myriophyllum spicatum*)

Identifying Features	Ecology
<ul style="list-style-type: none"> • 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) <p>Eurasian water milfoil is similar to northern water milfoil (<i>M. sibiricum</i>). However, northern water milfoil has five to 12 pairs of leaflets per leaf and stouter white or pale brown stems</p>	<ul style="list-style-type: none"> • 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 Forests*, 2nd Edition, Wausau, Wisconsin, USA: Self-Published



that are commonly used to manage EWM.¹⁴ Both EWM and EWM/native milfoil hybrids¹⁴ have been identified in Silver Lake. EWM has been one of the most frequently occurring plants in the Lake. The presence of invasive milfoil species is a management concern. The SLPA 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.

Curly-leaf Pondweed (*Potamogeton crispus*)

Curly-leaf pondweed (see Figure 7) is a plant that thrives in cool water and exhibits an early-season growth cycle that helps give it a competitive advantage over native plants. However, curly-leaf pondweed begins to die off during the summer when lake water temperatures start to peak. Therefore, it is not normally considered a nuisance during summer months. Furthermore, curly-leaf pondweed was present only in small quantities during the 1967 and 2006 surveys; it was not observed at all during the 2012 survey, but this may be because the survey was conducted late in the summer. However, curly-leaf pondweed does not appear to be a management issue in Silver Lake.

¹⁴ T. Groves, P. Hausler, and P. Tynning, *Water Resources Group, Progressive AE, Hybrid Milfoil: Management Implications and Challenges, The Michigan Riparian, Winter 2015.*

Figure 7
Curly Leaf Pondweed (*Potamogeton crispus*)

<p style="text-align: center;">Identifying Features</p> <ul style="list-style-type: none"> • Stems slightly flattened and both stem and leaf veins often somewhat pink • Leaf margins very wavy and finely serrated • Stipules (3.0 to 8.0 millimeters long) partially attached to leaf bases, disintegrating early in the season • Produces pine cone-like overwintering buds (turions) <p>Curly-leaf pondweed may resemble claspingleaf pondweed (<i>P. richardsonii</i>), but the leaf margins of the latter are not serrated</p>	<p style="text-align: center;">Ecology</p> <ul style="list-style-type: none"> • Found in lakes and streams, both shallow and deep • Tolerant of low light and turbidity • Disperses mainly by turions • Adapted to cold water, growing under the ice while other plants are dormant, but dying back during mid-summer in warm waters • Produces winter habitat, but mid-summer die-offs can degrade water quality and cause algal blooms • Maintaining or improving water quality can help control this species, because it has a competitive advantage over native species when water clarity is poor
<p>Photo credit: Zofia Noe, SEWRPC.</p> 	<p>Photo credit: Zofia Noe, SEWRPC.</p> 

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

Purple loosestrife (*Lythrum salicaria*)

Purple loosestrife (see Figure 8) 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 noxious weed in the State of Wisconsin and is subject to an ongoing control program. Purple loosestrife is present in the extensive marshland areas of Silver Lake (Map 3 and 4) would be especially suitable habitat for Purple loosestrife to gain a foothold. Unfortunately, this species has become widespread throughout wetland areas in southeastern Wisconsin. Purple loosestrife is known to spread profusely, outcompeting native plant species and reducing the quality of fish and wildlife habitat while adding little ecological benefit. This species is a declared weed in the State of Wisconsin and is subject to an ongoing eradication program.

Spiny naiad (*Najas marina*)

Spiny naiad (see Figure 9) is a plant that is native to other states, including Minnesota, but is introduced in Wisconsin. It has been documented that spiny naiad can grow to nuisance levels in northern Wisconsin, hard-water lakes with poor water quality.¹⁵ The species was added to Chapter NR 40 of the *Wisconsin*

¹⁵ Personal communication with southeastern Wisconsin Water Resources Specialist.

Figure 8
Purple Loosestrife (*Lythrum salicaria*)

Identifying Features

- Terrestrial or semi-aquatic, emergent forb
- Stems often angled with four, five, or more sides, and growing one to two m tall
- Flowers deep pink or purple, six-parted, 12 to 25 mm wide, and in groups
- Leaves lance-like, four to 11 cm 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 cm long), leaves mostly alternate (only lower leaves opposite), and flowers mostly held singly in the leaf axils rather than in pairs or groups

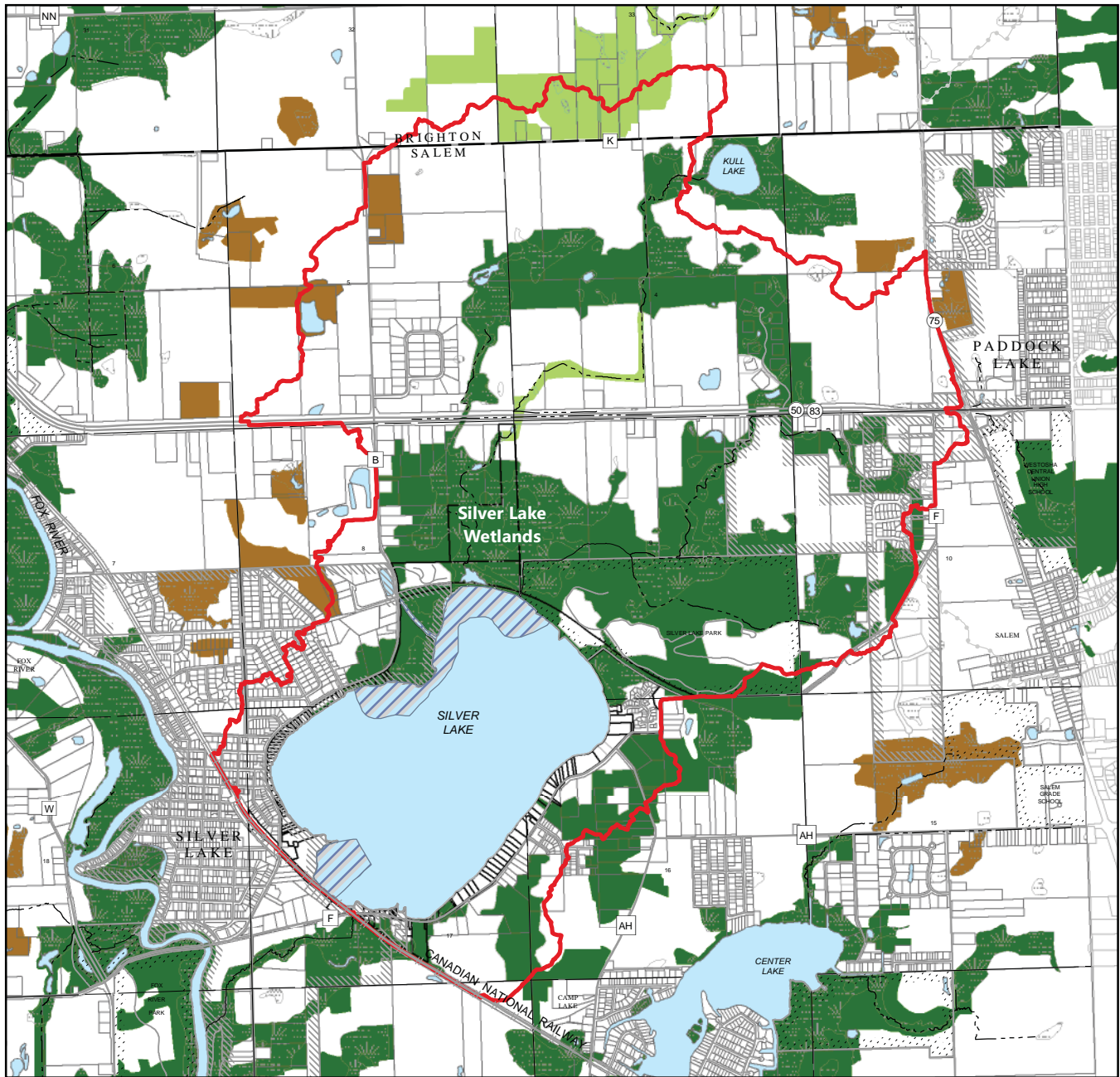
Ecology/Control








- 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, but they subsequently should be placed in a landfill or burned. Several herbicides are effective, but application near water may require permits and aquatic-use formulas

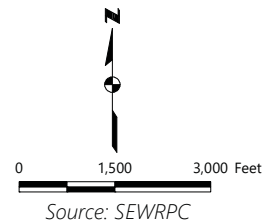


Source: The Nature Conservancy and SEWRPC

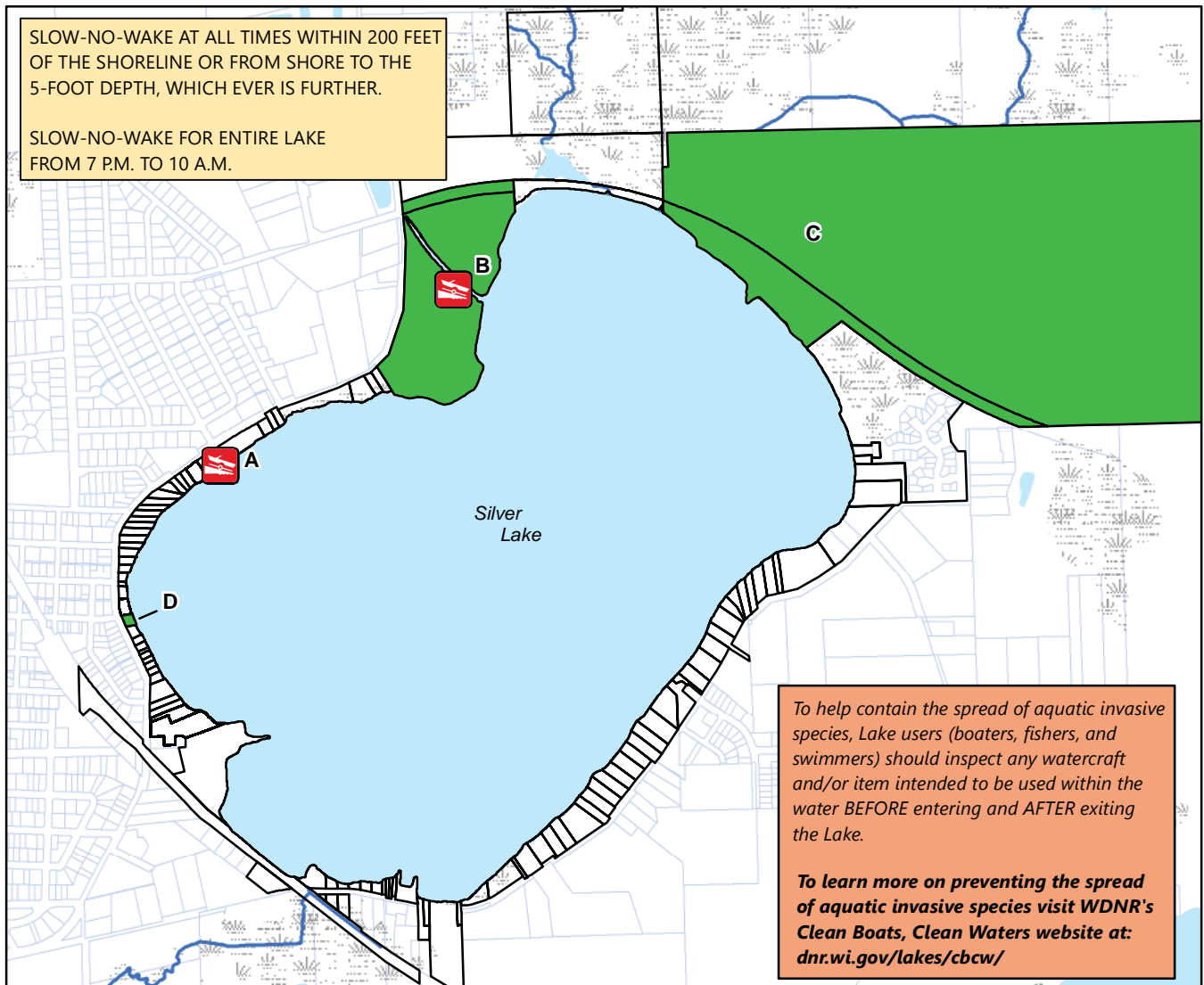
Map 3
Environmentally Significant Areas Within the Silver Lake Watershed: 2015



- | | |
|--|---|
|  SURFACE WATER |  PRIMARY ENVIRONMENTAL CORRIDORS |
|  WATERSHED BOUNDARY |  SECONDARY ENVIRONMENTAL CORRIDORS |
|  WDNR DESIGNATED SENSITIVE AREA |  ISOLATED NATURAL RESOURCE AREA |
| |  WETLANDS |



Map 4
Recreational Use on Silver Lake: 2015



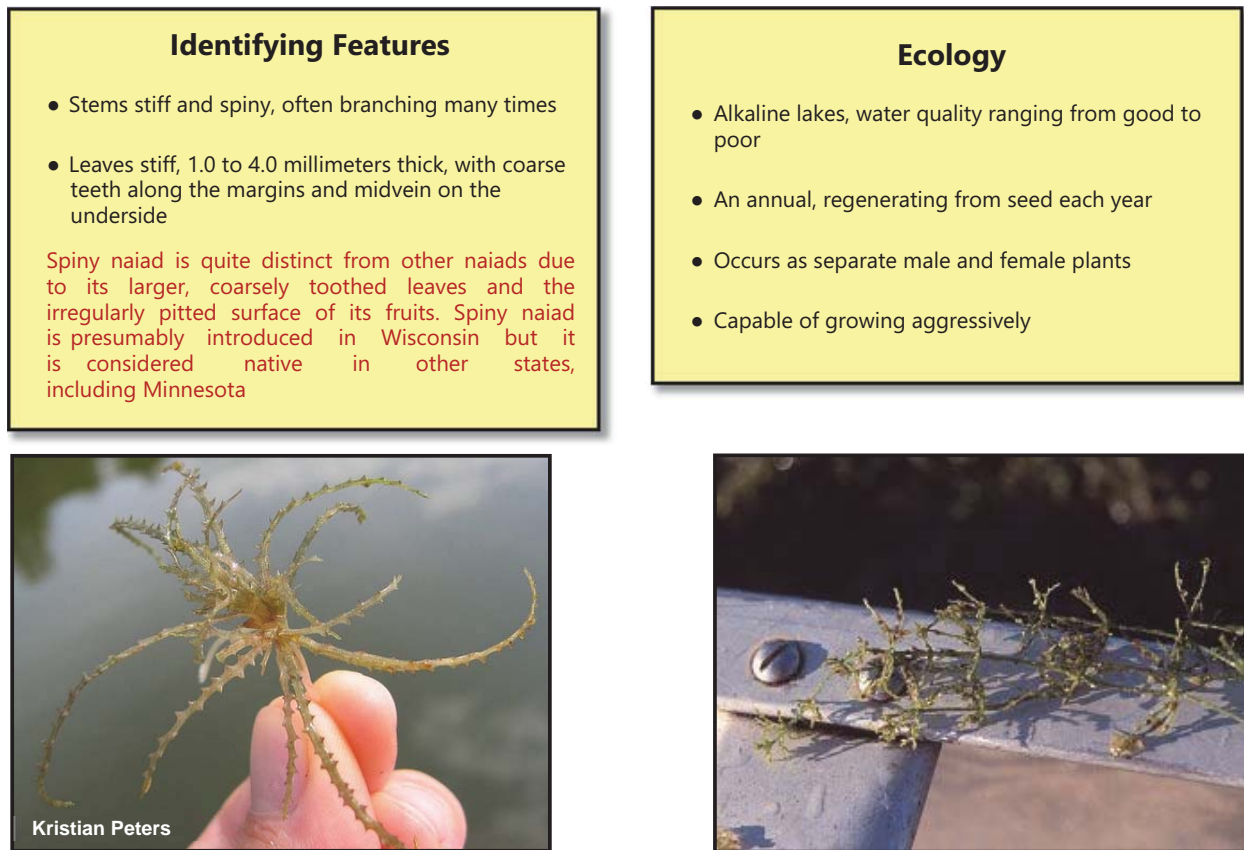
Map ID	Description	Facilities								
		Boat Ramp	Fee	Car-trailer Parking	Car Parking	Pier	Swim Beach	Picnic Area	Shelter	Playground
A	Village of Silver Lake Boat Launch	Yes	Yes	No	No	No	No	No	No	No
B	WDNR Boat Launch and Land	Yes	No	Yes	Yes	Yes	No	No	No	No
C	Kenosha County – Silver Lake Park	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
D	Village of Silver Lake – Dewitt Park	No	No	No	No	No	Yes	Yes	No	No

PARCEL BOUNDARY ALONG SHORELINE
 SURFACE WATER
 WETLAND
 STREAM

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

Figure 9
Spiny Naiad (*Najas marina*)



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

Administrative Code in 2015.¹⁶ Although spiny naiad was found in Silver Lake in 1967, 2006, and 2012, it was only found in small numbers and does not appear to be a management issue.

Zebra mussel (*Dreissena polymorpha*)

The WDNR also verified the presence of the invasive animal species zebra mussel (*Dreissena polymorpha*, Figure 10) in 1994. Zebra mussels have known negative impacts on native benthic organism populations that can disrupt aquatic food chains. The mussels also can cause a significant increase in water clarity that can fuel nuisance algae and aquatic plant growth. Water clarity was not significantly different in Silver Lake in 1994 or the years immediately following the verification of zebra mussels. However, water clarity has shown more variability from year to year since then.

Fisheries and Wildlife

According to several fish surveys conducted by the WDNR, Silver Lake supports a diverse fishery.¹⁷ Forty-two fish species have been documented in Silver Lake, including muskellunge (*Esox masquinongy*), northern pike (*Esox lucius*), walleye (*Sander vitreus*), largemouth bass (*Micropterus salmoides*), white bass (*Morone chrysops*), smallmouth bass (*Micropterus dolomieu*), channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), rock bass (*Ambloplites rupestris*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), longnose gar (*Lepisosteus osseus*), grass pickerel (*Esox americanus vermiculatus*), bowfin (*Amia calva*), white sucker

¹⁶ The NR 40 list is a compilation of species (both flora and fauna, terrestrial and aquatic) that are non-native to the State of Wisconsin and are, therefore, listed as either restricted or prohibited. For more information or for the list of species go to dnr.wi.gov/topic/invasives/classification.html.

¹⁷ WDNR, Silver Lake (Kenosha County, Wisconsin) Integrated Sensitive Area Report, op cit.

Figure 10
Zebra Mussels (*Dreissena polymorpha*)



- Shell has distinct dark stripes
- Hitchhikes rides to lakes on boats and in water buckets
- Infestations are often followed by abnormally clear waters



Source: Wisconsin Department of Natural Resources, Vic Ramey, University of Florida, Minnesota Sea Grant, Ohio Sea Grant, Texasinvasives.org, and SEWRPC

(*Catostomus commersoni*), golden shiner (*Notemigonus crysoleucas*), blackchin shiner (*Notropis heterodon*), emerald shiner (*Notropis atherinoides*), spotfin shiner (*Cyprinella spiloptera*), blacknose shiner (*Notropis heterolepis*), sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), bluntnose minnow (*Pimephales promelas*), brook silverside (*Labidesthes sicculus*), logperch (*Percina caprodes*), tadpole madtom (*Noturus gyrinus*), central mudminnow (*Umbra limi*), fantail darter (*Etheostoma flabellare*), Iowa darter (*Etheostoma exile*), johnny darter (*Etheostoma nigrum*), brown (*Ameiurus nebulosus*), yellow (*Ameiurus natalis*), and black bullheads (*Ameiurus melas*), and common carp (*Cyprinus carpio*).

WDNR designated sensitive areas associated with wetlands, species rich aquatic plant beds, and undeveloped shorelines around Silver Lake as spawning ground for many fish species (Map 3). In addition, Silver Lake is periodically stocked with muskellunge, walleye, and northern pike to maintain populations.

Silver Lake contains the pugnose shiner (*Notropis anogenus*), a State-Threatened species of fish; two State Special Concern fish species, the lake chubsucker (*Erimyzon sucetta*), and least darter (*Etheostoma microperca*); and two species formerly listed as Special Concern but recently removed from the list – the pugnose minnow (*Opsopoeodus emiliae*) and banded killifish (*Fundulus diaphanus*), (see Figure 11).

Environmentally Significant Areas

The Silver 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 1,000 acres of land and water area (including the Lake itself) in the Lake's watershed area, much of it in close proximity to the Lake. Preserving these areas is critically important to maintaining the ecological integrity of the Lake.

Silver Wetlands abuts the north shore of Silver Lake. This 100 acre wetland tract is designated as a natural area of county-wide or regional significance.

Silver 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.¹⁸ The Lake is considered an aquatic area of local significance, important to the overall health of aquatic plants and animals.

Aesthetic Features

Even though Silver Lake is located in a densely populated area, significant amounts of undeveloped shoreline are present. A majority of the eastern lakeshore is wooded which helps to conceal the homes and developed appearances of the properties that encircle the Lake. The north shore, owned by the WDNR and Kenosha County, is dominated by marsh land and offers opportunities for wildlife and bird watching.

¹⁸SEWRPC Planning Report Number 42, A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, September 1997.

Figure 11
Threatened and Special Concern Fish Species in Silver Lake



Banded Killifish
Special Concern



Least Darter
Special Concern



Pugnose Minnow
Special Concern



Lake Chubsucker
Special Concern



Pugnose Shiner
Threatened

Source: Wisconsin Department of Natural Resources and SEWRPC

LAKE USE

Recreational Use

During summer and winter 2014, SEWRPC staff conducted recreational surveys to examine public lake use. The surveys showed that high-speed cruising and water skiing/tubing were the most popular on-water activities during the summer (see Figure 12). Other popular summer activities included fishing, kayaking and canoeing, and swimming. Ice fishing was the most popular winter activity observed, although it can be expected that snowmobiling is a popular pastime, as well (see Figure 13).

Figure 12
Typical Summer Activities on Silver Lake



Source: SEWRPC

Figure 13
Typical Winter Activities on Silver Lake



Source: SEWRPC

Public Access

There are two public boat launches located on Silver Lake, one on the northwestern shore of the Lake managed by the Village of Silver Lake, and one on the north shore managed by the WDNR (see Map 4). The northwest site offers two paved launch lanes, one to five vehicle parking spots, and 21 to 25 vehicle/

trailer parking spots. The WDNR site has two paved launch lanes, 10 car parking spots, and 15 vehicle/trailer parking spots. Therefore, the WDNR deems the Lake to have adequate public recreational boating access pursuant to standards set forth in Chapter NR 1 of the *Wisconsin Administrative Code*. There is also a launch located on the south shore that is managed by a private marina but is open to the public.

In addition, public walk in access is provided along the entire north shore of the lake through DNR and County owned lands. Dewitt Park, a public beach, is located on the western shore of Silver Lake.

Table 4
Population and Households in the Silver Lake Watershed: 1960-2035

Year	Population	Households
1960	597	187
1970	632	199
1980	848	294
1990	1,071	382
2000	1,278	476
2010	1,284	510
Planned 2035	2,812	1,099

Source: U.S. Bureau of Census and SEWRPC

Cottages and Homesites

According to recent records, 113 lakefront lots abut Silver Lake. Lot sizes are generally small, averaging 0.1 acres and ranging from a minimum of less than 0.1 acre to a maximum of 1.9 acres. The population and number of households in the Silver Lake watershed are projected to double by 2035 (Table 4).

EXISTING PROTECTIVE MEASURES

Sewage Disposal

All riparian residential lands in the Silver 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

Silver 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 35 percent of the shoreline of Silver Lake remains in a natural state without manmade shoreline protective structures such as riprap or bulkhead. Many of these natural areas are managed by the WDNR and by Kenosha County as part of their Parks Department. Only a few areas of shoreline erosion were recorded along the western shoreline of Silver Lake during a survey conducted by SEWRPC in August 2014.¹⁹

Land Use Regulations

Comprehensive zoning ordinances are one of the most important tools available to local units of government for directing the proper use of lands within their area of jurisdiction. Silver Lake and its watershed are subject to ordinances and regulations developed jointly by Kenosha County and the Village of Salem Lakes and the Village of Silver Lake, Kenosha County. Table 5 shows the general and special-purpose zoning ordinances for the civil divisions that are part of the Silver Lake watershed.

Water Use Regulations

Silver Lake is subject to a Water Use Ordinance promulgated jointly by the Village of Salem Lakes and the Village of Silver Lake, Kenosha County, as Chapter 20 of the Town Code of Ordinances. 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 Silver Lake within the jurisdiction of the Villages and limits the times during which boats may operate on Silver Lake. The ordinance also allows for the enactment and enforcement of boating restrictions and limitations. The Village of Silver Lake has set an additional ordinance, Ordinance No. 307, pertaining specifically to Silver Lake that further denotes use of the Lake, and two addendums to Ordinance No. 307 that modify section 10.11, denoting restrictions and requirements for buoys, piers, and rafts on Silver Lake.

¹⁹ SEWRPC Memorandum Report No. 222, op.cit.

Map 5
Shoreline Survey of Silver Lake: 2014

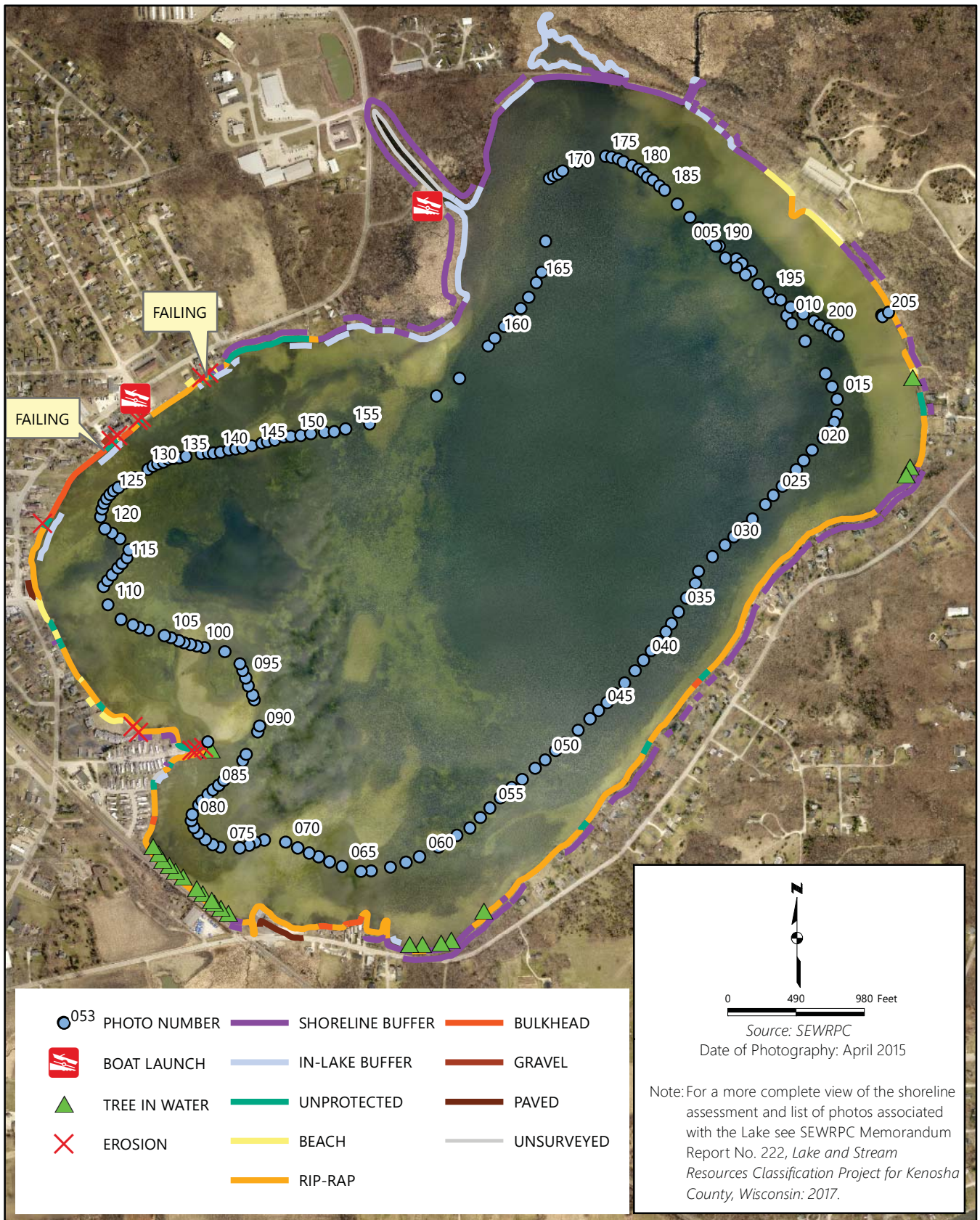


Table 5
Land Use Regulations Within the Silver Lake Watershed in Kenosha County by Civil Division: 2016

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

^aThe Village of Silver Lake has adopted a Shoreland-Wetland Overlay Zoning District to comply with the requirements of Chapter NR 117 of the Wisconsin Administrative Code. Section 61.353 of the Wisconsin Statutes, which relates to zoning for annexed or incorporated shorelands, does not apply to the Village since it has not annexed any areas since May 1982.

^bBoth the Kenosha County and Village of Salem Lakes subdivision ordinances and erosion control and stormwater management ordinances apply within the Village of Salem Lakes. In the event of conflicting regulations, the more restrictive regulation applies.

Source: SEWRPC