LAKE SHANGRILA-BENET LAKE USE REPORT UPDATE LR-10

Prepared by the

Southeastern Wisconsin Regional Planning Commission

for

Kenosha County, Wisconsin

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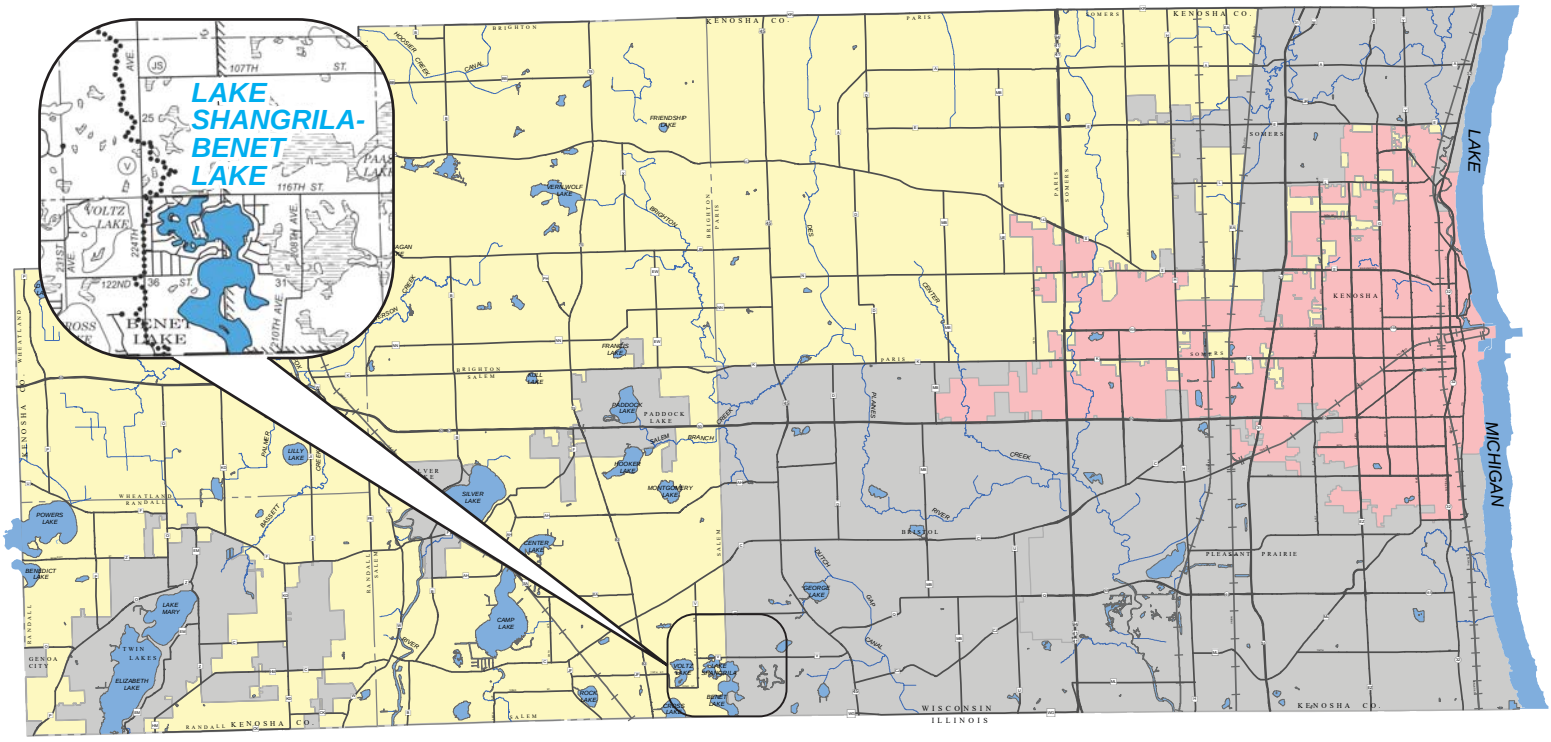

This Lake Use Report Update is a product of the Lake and Stream Resources Classification Project for Kenosha County Wisconsin: 2017. This report is available online at co.kenosha.wi.us.

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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. Even though the Lake Shangrila – Benet Lake system (commonly referred to as Lake Shangrila) was one of the 12 named major lakes, it was not included in the 1968 to 1970 reports. However, this report is being included as an update to the earlier reports to complete the set.

Lake Shangrila was the subject of an aquatic plant management plan developed by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in 2010 for the Lake Shangrila Woodlands Homeowners Association (LSWHA) and in cooperation with the Town of Salem (now the Village of Salem Lakes), as well as two County-wide surface water resources reports published in 1961 and 1982 prepared by the Wisconsin Conservation Department (now the WDNR).[2,3,4] The LSWHA maintains a website (https://www.lakeshangrila.com/). The website is used to post a wide variety of information Lake users may find interesting. In addition to the above report, Shangrila was also part of a 2017 lake and stream classification project developed for Kenosha County by Southeastern Regional Planning Commission (SEWRPC).[5]

INTRODUCTION

Shangrila 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 contiguous marshlands at the southern end provide noteworthy fish and wildlife habitat. The Lake provides significant value to local ecology.

PHYSICAL DESCRIPTION

Lake Characteristics

Based upon recent orthophotography, Shangrila has a surface area of 181 acres.[6] As shown on Map 1, Shangrila is oriented in a north-south direction with multiple basins, a maximum depth of 24 feet, and a mean depth of five feet. According to 1954 (revised 1966) depth soundings published by the WDNR, Shangrila contains 748 acre-feet of water. Thirty-two percent of Shangrila is three feet deep or less, yielding an average depth of only five feet.[7] Additional information regarding Shangrila's hydrology and morphometry is summarized in Table 1.

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

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

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

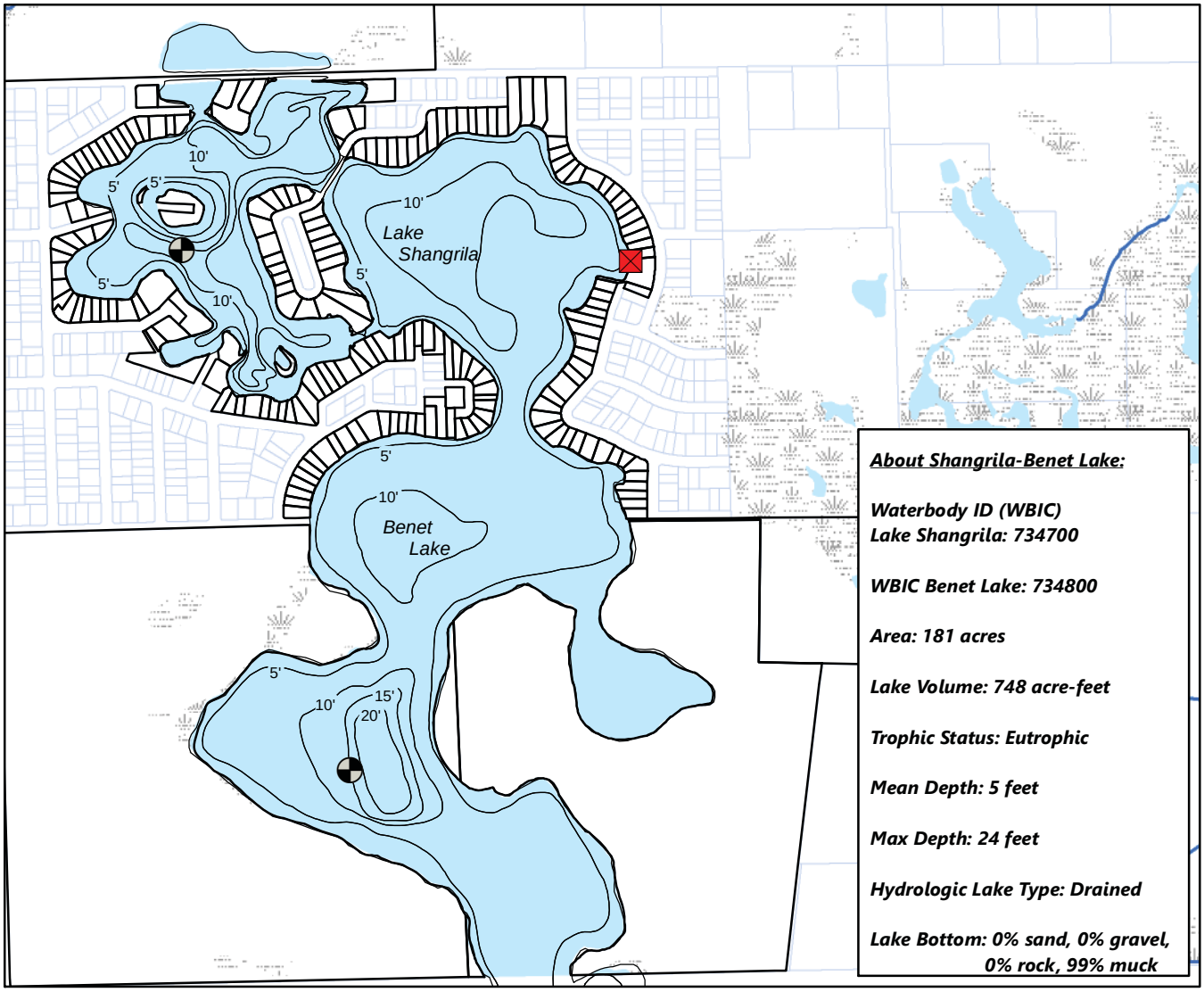
[4] *Wisconsin Department of Natural Resources,* Surface Water Resources of Kenosha County, *1982.*

[5] *SEWRPC Memorandum Report No. 222,* Lake and Stream Resources Classification Pro*ject* 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] *https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734700*

Map 1
Lake Shangrila-Benet Lake



DEEP HOLE WATER QUALITY SAMPLING LOCATION

LAKE OUTLET STRUCTURE

STREAM

15' WATER DEPTH CONTOUR IN FEET

RIPARIAN PARCEL BOUNDARY

PARCEL BOUNDARY

SURFACE WATER

WETLAND

N

0 500 1,000 Feet

Source: Wisconsin Department of Natural Resources and SEWRPC

According to WDNR records, Shangrila's bottom sediments are composed almost entirely of muck.[8]

Hydrology

Based upon its depth and the topography of surrounding lands, WDNR classifies Shangrila as a deep headwater lake. Deep headwater lakes are likely to stratify during summer. Furthermore, deep headwater 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 drained lake. The WDNR uses these parameters to set water quality goals for the Lake.

There is no defined, continually flowing inlet, but there is a more-or-less continuously flowing outlet. Additional water inflow to the Lakes may be occurring from springs reported by residents to be present in the Lakes' basins, and from intermittent streams located along the southern and southwestern shorelines of Benet Lake.

Water flowing out of the system exits through a timber stop log spillway which has a 13.2-foot-long crest and which discharges to four 24-inch-diameter pipes set in an earthen dam. The dam was originally constructed in 1927 along the northeastern shore of Lake Shangrila. It was reconstructed in the 1940s and again around 1993. There is also a gated 24-inch-diameter corrugated metal pipe that can provide additional hydraulic capacity. Outflowing water drains through a series of marshes and intermittent streams into the Dutch Gap Canal, a 4.1-mile-long waterway in Wisconsin which continues for about eight miles in Illinois where it eventually joins the Des Plaines River near Wadsworth, Illinois.

Table 1
Hydrology and Morphometry of the Lake Shangrila – Benet Lake System

Parameter	Measurement
Size	
Lake Surface Area[a]	181 acres
Watershed Area[b]	337 acres
Lake Volume	748 acre-feet
Residence Time[c]	1 year
Shape	
Length	1.1 miles
Width	0.6 mile
Shoreline Length	6.2 miles
Shoreline Development Factor[e]	3.1
General Lake Orientation	North-South
Depth	
Maximum Depth	24 feet
Mean Depth	5 feet
Area under 3 feet	32 percent
Area over 15 Feet	3 percent

[a] *Lake Shangrila's surface area has been historically combined with Benet Lake. 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 the Lake Shangrila – Benet Lake system surface area to be as low as 181 acres and as high as 200 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*

[b] *Excludes Lake Shangrila, Benet Lake, and portion in Illinois.*

[c] *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.*

[d] *Shoreline 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, U.S. Geological Survey, and SEWRPC

Watershed Characteristics and Land Use

Shangrila's 337 acre watershed lies somewhat more to the south and west of the Lake. A lake's watershed is the physical area from which surface-water runoff can drain to a lake. Shangrila has a small watershed for its size, with a watershed to lake area ratio of only 1.9:1. Lakes with ratios above 10:1 tend to develop water-quality problems.[9] Lakes with large watersheds are comparatively more vulnerable to human disturbance.

According to topographic maps, shoreline land slopes are steepest along the northern and western shores of Lake Shangrila and along much of the shoreline of Benet Lake. Low to moderate sloping shoreline is found along the rest of the Shangrila-Benet Lake system. Lands within the watershed are composed of slightly hilly terrain with moderate slopes.

[8] *https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734700&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.*

Significant land development has occurred around the Shangrila-Benet Lake system since the writing of the original series of lake use reports (see Figures 1 and 2). Map 2 and Table 2 show the 2010 land uses in the Shangrila-Benet Lake system watershed. In 2010, rural uses accounted for approximately 55 percent of total land uses; urban uses accounted for about 45 percent. The single largest rural land use was agricultural (23.8 percent), with woodlands being the next greatest rural land use at 19.8 percent. The single largest urban land use was medium-density, single-family residential at 26.4 percent.

Projected 2035 land use (Table 2) indicates modest changes within the Shangrila-Benet Lake system watershed. Currently, projections indicate that about two-thirds of the agricultural lands within the watershed will be converted mostly to residential areas (low-density, single-family) along with some medium-density, single family residential and government/institutional uses.

WATER QUALITY

The WDNR re-evaluated Shangrila's water quality as part of the 2018 impairment listing cycle and judged the general water quality to be "poor" and impaired due to eutrophication, excessive algae growth and total phosphorus levels. "Total phosphorus and chlorophyll-a sample data exceeded the 2018 WisCALM listing thresholds for the Recreation use and Fish and Aquatic Life use. This lake was proposed for total phosphorus listing in 2018." [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 were collected at two sites on the Lakes (see Map 1) by the Wisconsin Department of Natural Resources (WDNR), the deep hole on Benet Lake and the shallow hole on Lake Shangrila. Currently, Shangrila-Benet Lake system residents participate in the University of Wisconsin (UWEX) Citizen Lakes Monitoring Network (CLMN) under which citizen volunteers measure lake water quality parameters such as water clarity, phosphorus concentrations, and dissolved oxygen levels. CLMN is an extremely useful program to provide long-term water quality data. Water quality data are compiled and are available on the WDNR Lakes pages.[11]

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 2007 through 2017 (Figure 4), indicates fairly steady water clarity in Lake Shangrila that averages approximately 2.5 feet, indicative of very poor water quality. Secchi-disk values reported for Benet Lake for the period from 1990 through 1992 averaged only 2.3 feet in depth, and for the period from 2007 to 2017, averaged 2.4 feet (Figure 5). Water in both Lake Shangrila and Benet Lakes was often reported by monitoring volunteers as green in color, so it is possible that such poor Secchi readings were influenced by algal blooms, rather than turbidity from siltation or suspended solids.

Water clarity has also been estimated from satellite imagery,[12] averaging between 1.6 and 3.3 feet from 2000 and 2004, which generally agrees with values actually measured on the Lake.

[10] *https://dnr.wi.gov/water/waterDetail.aspx?wbic=734700*

[11] *Water quality data and other information about Benet Lake can be found at the WDNR Lakes page: http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734800. Water quality data and other information about Lake Shangrila can be found at the WDNR Lakes page: http://dnr.wi.gov/lakes/LakePages/LakeDetail.aspx?wbic=734700.*

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

Figure 1
1970 Aerial Photograph of Lake Shangrila-Benet Lake

Date of Photography: 1970

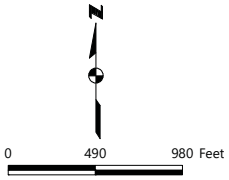
N

0 490 980 Feet

Source: SEWRPC

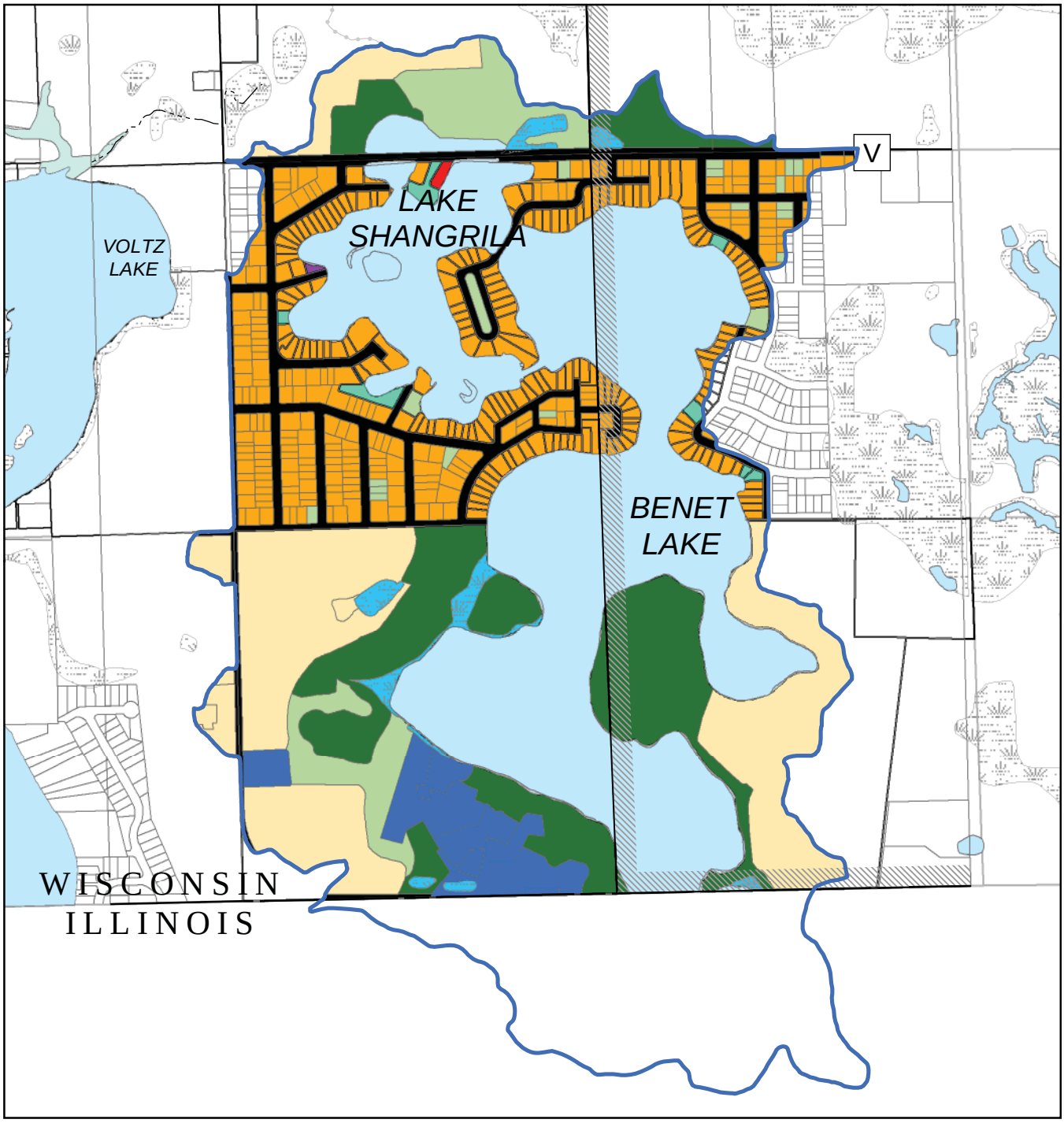
Figure 2
2015 Aerial Orthophotograph of Lake Shangrila-Benet Lake

Date of Photography: 2015



Source: SEWRPC

Map 2
2010 Land Use Within the Lake Shangrila-Benet Lake Watershed



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
WATERSHED BOUNDARY

N

0 540 1,080 Feet

Source: SEWRPC

Table 2
Existing and Planned Land Use Within the Lake Shangrila – Benet 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	--	--	32.5	9.65	32.5	--
Single-Family, Medium Density	89.0	26.40	96.5	28.63	7.5	8.4
Single-Family, High Density	--	--	--	--	--	--
Multi-Family	--	--	--	--	--	--
Commercial	0.4	0.12	0.4	0.12	0.0	0.0
Industrial	--	--	--	--	--	--
Governmental and Institutional	20.0	5.94	33.4	9.91	13.4	67.0
Transportation, Communication, and Utilities	39.9	11.84	39.9	11.84	0.0	0.0
Recreational	2.9	0.86	2.9	0.86	0.0	0.0
Subtotal	152.2	45.16	205.6	61.01	53.4	35.1
Rural						
Agricultural	80.2	23.80	26.8	7.95	-53.4	-66.6
Other Open Lands	26.5	7.86	26.5	7.86	0.0	0.0
Wetlands	7.7	2.28	7.7	2.28	0.0	0.0
Woodlands	66.8	19.83	66.8	19.83	0.0	0.0
Water [b]	3.6	1.07	3.6	1.07	0.0	0.0
Extractive	--	--	--	--	--	--
Landfill	--	--	--	--	--	--
Subtotal	184.8	54.84	131.4	38.99	-53.4	-28.9
Total	337.0	100.00	337.0	100.00	0.0	--

[a] *Does not include portion of Illinois*

[b] *Parking included in associated use*

[c] *Excludes Lake Shangrila and Benet Lake*

Source: SEWRPC

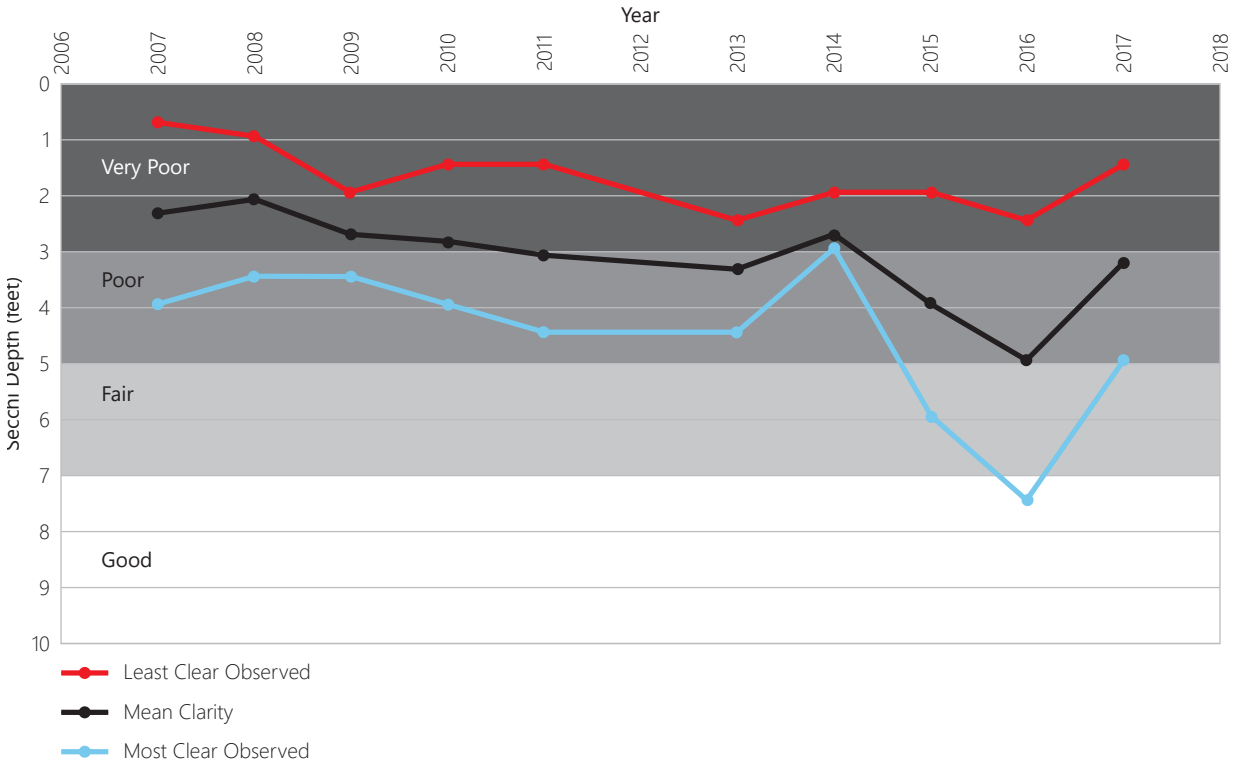
Lake trophic state index (TSI) is calculated using physical and chemical indicators of lake nutrient enrichment. Lakes with low numeric scores (i.e., less than 40) generally have clear water of excellent quality and are termed oligotrophic. Lakes with TSI values between 50 and 60 are termed eutrophic 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.

Figure 3
Measuring Water Clarity with a Secchi Disk

Source: www. burnsville.org and SEWRPC

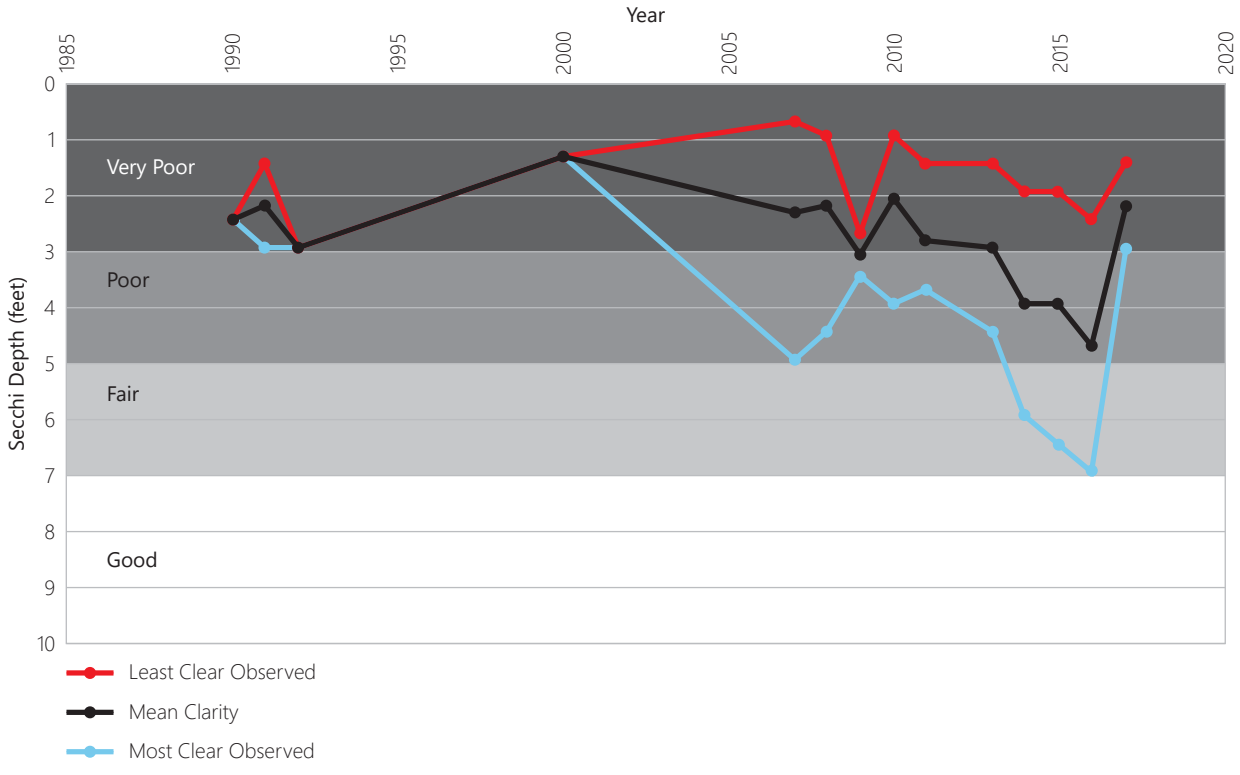
WDNR data collected between 2007 and 2015 in Lake Shangrila (Figure 6), and between 1990 and 2015 in Benet Lake (Figure 7) show Trophic State Indexes generally above 50, indicative of enriched, or eutrophic conditions. Eutrophic lakes can support high plant and algal growth, often to nuisance levels. The decomposition of these plants and algae can lead to high muck content and anoxic bottom water conditions.

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



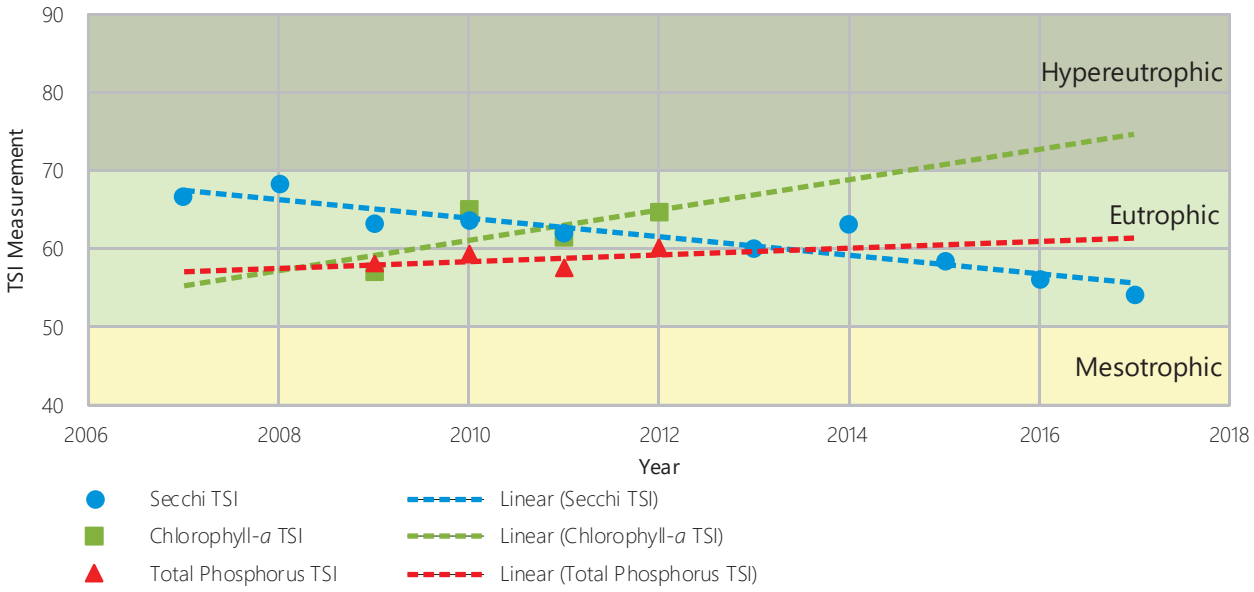
Source: Wisconsin Department of Natural Resources and SEWRPC

Figure 5
Summer (June Through August) Secchi Depth Ranges for Benet Lake



Source: Wisconsin Department of Natural Resources and SEWRPC

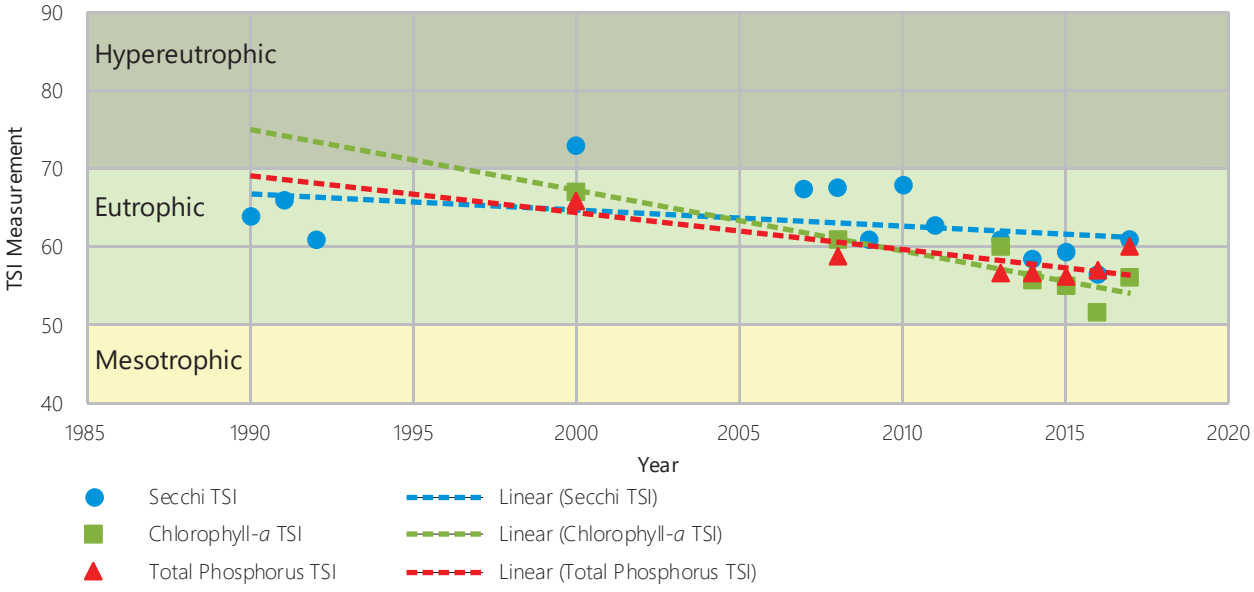
Figure 6
Summer (June Thorough August) Annual Average Trophic State Indices (TSI) for Lake Shangrila



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

Source: Wisconsin Department of Natural Resources and SEWRPC

Figure 7
Summer (June Thorough August) Annual Average Trophic State Indices (TSI) for Benet Lake



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

Source: Wisconsin Department of Natural Resources and SEWRPC

Historic dissolved oxygen and temperature measurements indicate that Benet Lake exhibits thermal stratification during summer months at between 12 to 15 feet.[13] Below this depth, oxygen levels could be

[13] *SEWRPC Memorandum Report No. 192,* op cit.

depleted to levels as low as 2.0 mg/L. A concentration of 5.0 mg/L is generally considered the minimum necessary to support fish and other forms of aquatic life. Dissolved oxygen and temperature measurements taken in Lake Shangrila in the late 2000s indicate that the Lake is generally too shallow to thermally stratify and does not exhibit depleted oxygen concentrations at bottom depths.

Finally, chlorophyll-*a* is the major photosynthetic (green) pigment in algae. The amount of chlorophyll-*a* present in the water is an indication of the amount of algae present in the water. Chlorophyll-*a* levels above about 10 micrograms per liter (µg/L) generally result in green coloration of the water that may become severe enough to impair recreational activities such as swimming or waterskiing.[14] Chlorophyll-*a* data were collected between 2000 and 2015 in Benet Lake and between 2009 and 2015 in Lake Shangrila. Chlorophyll-*a* levels were often much higher in Lake Shangrila, averaging 58 µg/L, while concentrations in Benet Lake averaged 38 µg/L.[15]

NATURAL RESOURCES

Aquatic Plants

Aquatic plant growth in the Shangrila-Benet Lake system was observed and documented during water quality sampling by WDNR staff in September 1973.[16] The submerged native aquatic species included muskgrass (*Chara vulgaris*), various-leaved water milfoil (*Myriophyllum heterophyllum*), and Sago pondweed (*Stuckenia pectinata*). White water lilies (*Nymphaea odorata*), yellow pond lilies (*Nuphar advena*), and cattails (*Typha* spp.) also were documented at that time. Densities and distribution of the species were not reported.

SEWRPC staff conducted a survey of the Lakes in July 2008 (Table 3).[17] At that time, the dominant species in both Lakes was Eurasian water milfoil (*Myriophyllum spicatum*), although coontail (*Ceratophyllum demersum*) also was present in fairly significant amounts. Overall, species richness was very low in both Lakes, with only eight native species in Lake Shangrila, and four native species in Benet Lake. Other native species found included Sago pondweed, muskgrass, water stargrass (*Heteranthera dubia*), bushy pondweed (*Najas flexilis*), and small pondweed (*Potamogeton pusillus*), although all were found in very small amounts. White water lilies and yellow pond lilies were also documented.

A diverse array of native aquatic plant species is generally indicative of a healthy aquatic plant community. A 2012 WDNR assessment of Lake Shangrila's aquatic plant community stated, "The aquatic plant communities observed during 2008 in the Lake Shangrila-Benet Lake system had limited biodiversity, with eight species recorded during the survey. Many lakes in the Region have a dozen or more species of aquatic plants. In comparison with these lakes, the Lake Shangrila-Benet Lake system has an impoverished aquatic plant flora, which limits the ability of these lakes to sustain fish and aquatic life and associated human uses, especially given that two of the observed aquatic plant species are declared nuisance species identified in Chapter NR 109 of the *Wisconsin Administrative Code*. A reduced species diversity is consistent with the enriched trophic states of the Lakes." [18] 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. Only one was found in the 2008 survey of Shangrila (Sago pondweed).

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[14] *J.R. Vallentyne, The Process of Eutrophication and Criteria for Trophic State Determination"* in Modeling the Eutrophication Process – Proceedings of a Workshop at St. Petersburg, Florida*, November 19-21, pp.57-67, 1969.*

[15] *Water quality data and other information about Benet Lake can be found at the WDNR Lakes page: http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734800. Water quality data and other information about Lake Shangrila can be found at the WDNR Lakes page: http://dnr.wi.gov/lakes/LakePages/LakeDetail.aspx?wbic=734700.*

[16] *SEWRPC Memorandum Report No. 192,* op cit.

[17] Ibid.

[18] *https://dnr.wi.gov/water/waterDetail.aspx?wbic=734700*

Table 3
Lake Shangrila – Benet Lake Aquatic Plant Survey: 2008

Aquatic Plant Species	Lake Shangrila (July)	Benet Lake (July)
Floating Plants		
Nuphar variegata (spatterdock)	1.7	--
Nymphaea odorata (white water lily)	31.7	27.9
Submerged Plants		
Ceratophyllum demersum (coontail)	56.7	65.1
Chara vuigaris (muskgrass)	3.3	2.3
Heteranthera dubia (water stargrass)	6.7	--
Myriophyllum spicatum (Eurasian water milfoil)	133.3	127.9
Najas flexilis (bushy pondweed)	1.7	--
Potamogeton crispus (curly-leaf pondweed)	1.7	--
Potamogeton pusillus (small pondweed)	5.0	--
Stuckenia pectinata (Sago pondweed)	16.7	2.3

Notes: Data above is for Dominance Factor. The Dominance Factor is the product of the Relative Frequency of Occurrence of a plant species in the lake (the number of sampling sites where the plant was found compared to the total number of sites where vegetation occurred) and the Relative Density (the average abundance of the plant at each site where the plant occurred), expressed as a percentage. It provides a method for determining the dominance of a species within a community; the higher the value, the more dominant the species.

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.

Source: SEWRPC

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 8). 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, including Shangrila. 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.[19] EWM/native milfoil hybrids were not identified in Shangrila in 2008. EWM was the most frequently occurring plant in the Lake in 2008 and, as such, has been a management concern. 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 9) 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 in the 2008 survey, so it did not appear to be a management issue in the Shangrila-Benet Lake system at that time.

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

Figure 8
Eurasian Water Milfoil (*Myriophyllum spicatum*)

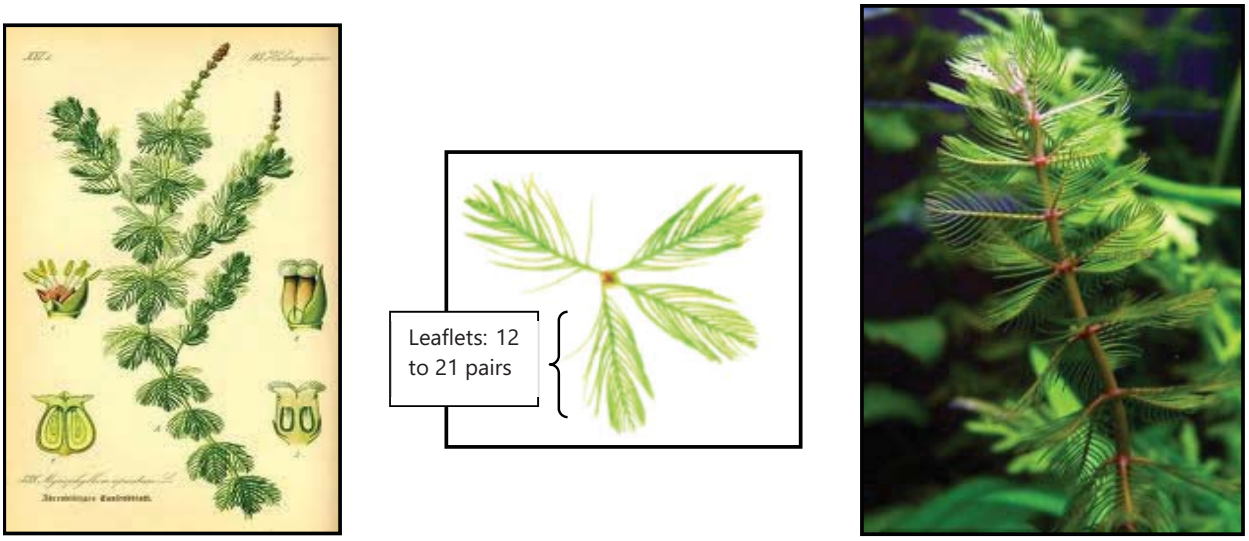
Identifying Features

- 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 Forests, 2nd Edition, Wausau, Wisconsin, USA: Self-Published

Fisheries and Wildlife

Lake Shangrila and Benet Lake have a direct hydraulic connection and can be thought of as one water body. Six fishery surveys from 1957 through 1979 reported a total of 25 species, including game species such as northern pike (*Esox lucius*), three species of bullhead (*Ameiurus spp.*), channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), and yellow perch (*Perca flavescens*). The WDNR lists northern pike, largemouth bass, and panfish as common and catfish as present in the Shangrila-Benet system.[20]20 The Shangrila-Benet Lake system also contains a Special Concern fish species, the lake chubsucker, *Erimyzon sucetta* (see Figure 10).

Environmentally Significant Areas

As shown on Map 3, the Shangrila-Benet Lake system watershed contains environmentally significant areas. These areas represent the last remaining areas of natural resources in the Lake's watershed. Many important interlocking and interacting relationships occur between living organisms and their environment in such areas. Destruction or deterioration of any one element of a natural environment may cause a chain reaction

[20] *dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734700 and dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=734800.*

Figure 9
Curly Leaf Pondweed (*Potamogeton crispus*)

Identifying Features

- 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)

Curly-leaf pondweed may resemble clasping-leaf pondweed (*P. richardsonii*), but the leaf margins of the latter are not serrated

Ecology

- 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

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.

of deterioration and destruction among other elements. Therefore, it is important to protect such areas.

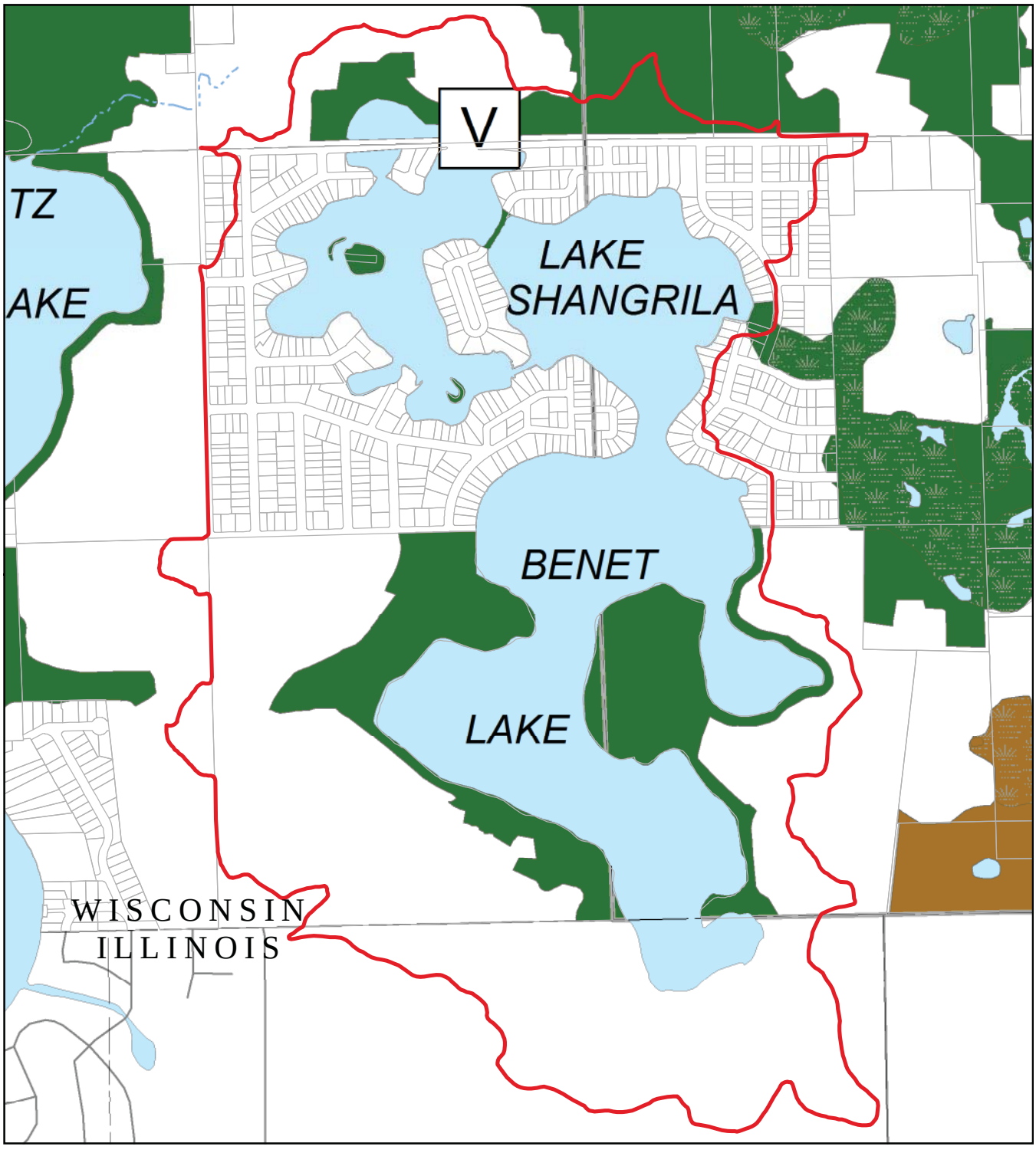
The primary environmental corridor areas along the Lake's shoreline, together with a large part of the Lake system itself, represents a total of over 260 acres of valuable natural areas. Additionally, the Shangrila-Benet Lake system has been designated as an aquatic area of local significance.

The cattail areas that dominate portions of the eastern and southern bays of Benet Lake provide good habitat for waterfowl, pheasants, muskrats, and beaver. The oak woodlands around Benet Lake support squirrels and other woodland birds and mammals. There is a variety of wildlife around the Shangrila-Benet Lake system, especially Benet Lake. Wood ducks commonly nest in the oak

Figure 10
Lake Chubsucker (Erimyzon sucetta)

Source: Wisconsin Department of Natural Resources and SEWRPC

Map 3
Environmentally Significant Areas Within the Lake Shangrila-Benet Lake Watershed: 2015



Source: SEWRPC

Figure 11
Typical Summer Activities on Lake Shangrila-Benet Lake

Source: SEWRPC

woodlands along the western shore at the southern end of the Lake; white-tail deer, fox, and coyotes have been observed along the shoreline; and a variety of songbirds, hawks, owls, herons, and cormorants are common around Benet Lake. The non-migratory species of Canada goose so prevalent throughout southeastern Wisconsin continues to be present in abundance.

Aesthetic Features

Benet Lake, with its undeveloped shoreline and cattail expanses in the bays at the southern end, along with the woodlands that populate most of the western, southern and eastern shorelines, offers scenic views for Lake users. Lake Shangrila, on the other hand, with its highly developed shoreline and small lot size, lacks the natural beauty found around Benet Lake. Despite the heavily developed shoreline of Lake Shangrila, weekday boat traffic on the Lakes is relatively light, even during summer. This is because a substantial portion of the homes and cottages around Lake Shangrila are primarily intended for seasonal use.

LAKE USE

Recreational Use

During the summers (Figure 11) and winters (Figure 12) of 2008 and 2014, SEWRPC staff conducted surveys to document recreational lake use in the Shangrila-Benet Lake system. The surveys showed that swimming, water skiing/tubing, and fishing were the most popular activities observed. During weekdays, both Lakes were fairly quiet in terms of boat activity, with fishing being the most popular boating activity in the mornings and water skiing/tubing becoming more dominant in the afternoons. On summer weekends, because of the increase in population due to the seasonality of many of the cottages/homes on the Lake, pleasure boating (both high speed and low speed) became much more prevalent, especially in the afternoons and evenings. Ice fishing was the most popular winter activity observed, although snowmobiling was a popular pastime, as well. Snowshoeing and cross-country skiing were also documented.

Figure 12
Typical Winter Activities on Lake Shangrila-Benet Lake

Source: SEWRPC

Public Access

There is one public boating access site on the Shangrila-Benet Lake system. A steep, unpaved launch site exists on the east side of Lake Shangrila on 121st Street (see Map 4). In addition, there is no parking at the launch site or anywhere along the streets throughout the entire Lake Shangrila subdivision, thereby severely limiting the ability of the general public to make use of the Lakes.

Cottages and Homesites

According to recent records, 196 lakefront lots abut Shangrila. Lot sizes average 2.1 acres and range from 0.12 acre to 154.8 acres.[21] However, these data are somewhat misleading as to the true nature of the residential lots in this lake system. This is due to the heavily-developed nature of the Lake Shangrila shoreline as opposed to the largely undeveloped shoreline of Benet Lake. As described above, the shoreline of Lake Shangrila is heavily developed for residential use with the majority of the lake shore lots ranging in widths from 40 to 60 feet. The population and number of households in the Shangrila-Benet Lake system watershed is projected to decrease slightly by 2035 (Table 4).

EXISTING PROTECTIVE MEASURES

Sewage Disposal

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

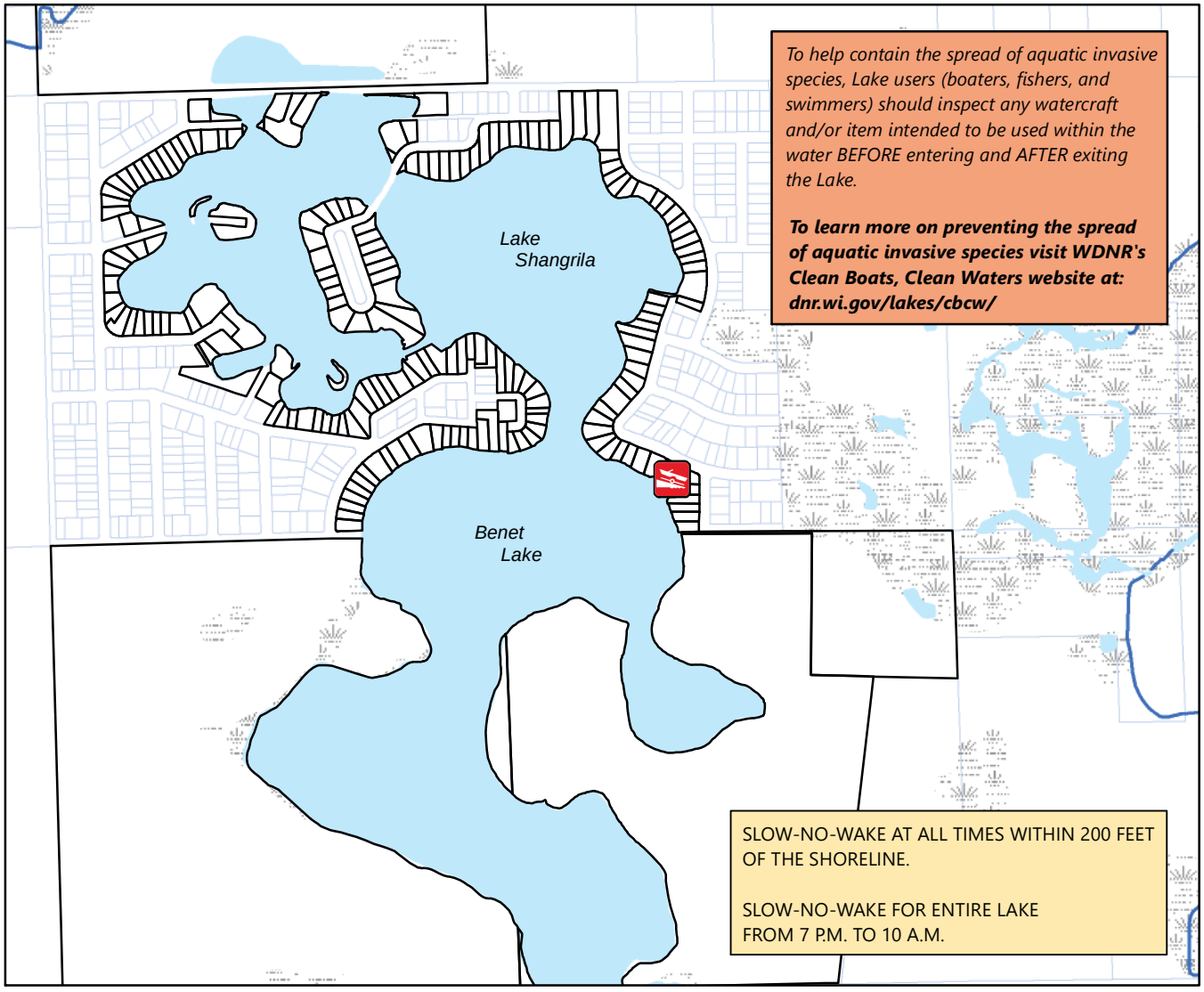
Shoreline Protection and Erosion Control

The shoreline of the Shangrila-Benet Lake system is comprised of stretches of protected shoreline (either man-made or natural), as well as some areas of unprotected shoreline, such as where riparian owners mow lawn to water's edge (see Map 5). No major areas of shoreline erosion were recorded during a survey conducted by SEWRPC in August 2014.[22]

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

[22] Ibid.

Map 4
Recreational Use on Lake Shangrila-Benet Lake: 2015



Map ID	Description	Facilities								
		Boat Ramp	Fee	Car-trailer Parking	Car Parking	Pier	Swim Beach	Picnic Area	Shelter	Playground
	Village of Bristol	Yes	No	No	No	No	No	No	No	No

PARCEL BOUNDARY ALONG SHORELINE

SURFACE WATER

WETLAND

STREAM

N

0 500 1,000 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

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. Shangrila 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 Shangrila watershed.

Table 4
Population and Households in the Lake Shangrila – Benet Lake Watershed: 1960-2035

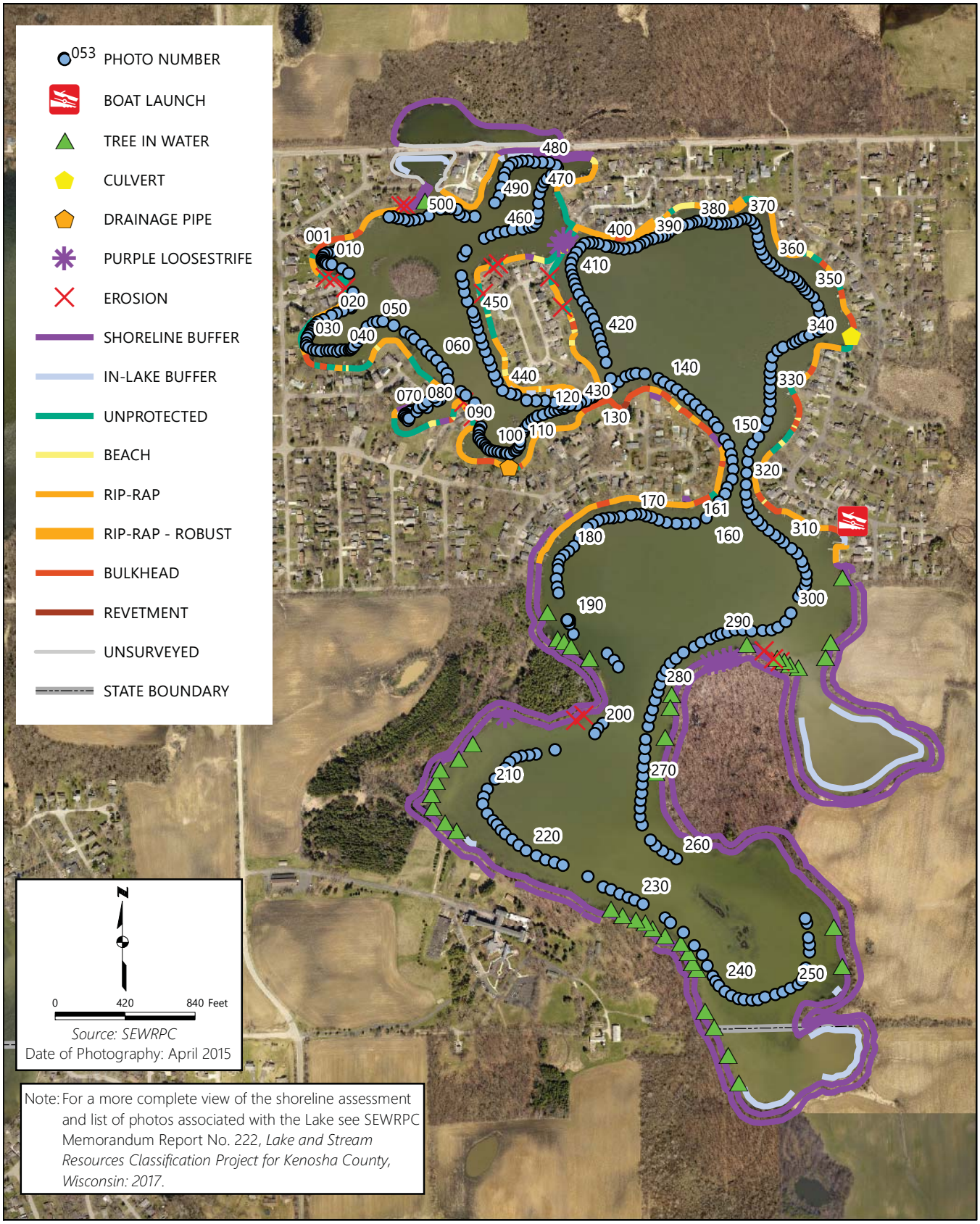
Year	Population	Households
1960	127	42
1970	461	127
1980	423	149
1990	611	203
2000	802	298
2010	858	318
Planned 2035	790	308

Source: U.S. Bureau of Census and SEWRPC

Water Use Regulations

Shangrila 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 Shangrila. 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 Shangrila within the jurisdiction of the Village and limits the times during which boats may operate on Shangrila.

Map 5
Shorline Survey of Lake Shangrila-Benet Lake: 2014



Note: For a more complete view of the shoreline assessment and list of photos associated with the Lake see SEWRPC Memorandum Report No. 222, *Lake and Stream Resources Classification Project for Kenosha County, Wisconsin: 2017*.

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

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

[a] *Both 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