# Aquatic Plant Management Plan

## Wilke Lake

### Town of Schleswig Sanitary District #2

**December 17, 2010**

**Project Number 004010-09001-0**

**WDNR Grant Number LPL-1305-09**

Bonestroo

1203 Storbeck Drive
Waupun, WI 53963

Tel 920-324-8600
Fax 920-324-3023

www.bonestroo.com

Bonestroo

# AQUATIC PLANT MANAGEMENT PLAN
# WILKE LAKE

December 17, 2010

Prepared for:

Mr. Brian Lennie
Town of Schleswig Sanitary District #2
10618 Sunny Vista Lane
Kiel, Wisconsin 53042

Prepared by:

Bonestroo
1203 Storbeck Drive
Waupun, Wisconsin 53963

Project Number: 004010-09001-0

James T. Scharl
Graduate Scientist

# Table of Contents

# Table of Contents (continued)



## FIGURES



## TABLES



## APPENDICES

# 1.0 Executive Summary

The Town of Schleswig Sanitary District #2 (TSSD) was formed in 1980 to address resource management concerns on Wilke Lake. The Committee has been active in a number of lake management activities on Wilke Lake including: aquatic plant management, water quality sampling, invasive species sampling, and community education activities. The District contracted Bonestroo to help develop an aquatic plant management (APM) plan for Wilke Lake. The Wilke Lake APM Plan includes a review of available lake information, an aquatic plant survey, and an evaluation of feasible physical, mechanical, biological, and chemical management alternatives if deemed appropriate. The APM plan also recommends specific prevention activities for aquatic invasive species (AIS) in the lake system; which are discussed below.

Bonestroo completed an aquatic plant survey on Wilke Lake in 2009, which identified nine aquatic plant species. The most abundant aquatic plants identified during the survey were elodea or common muskgrss (*Chara sp.*), Eurasian water-milfoil (*Myriophyllum spicatum* - EWM), and variable pondweed (*Potamogeton gramineus*). The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Wilke Lake exhibited an FQI of 17.01, below the state median of 22.1.

### RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

Two aquatic invasive plants were found during the aquatic plant survey in 2009; Eurasian water-milfoil (EWM) and curly-leaf pondweed (*Potamogeton crispus* – CLP). Both species have been previously identified within the lake and have been actively managed for. EWM is present on a large scale basis and ongoing management and control efforts are highly recommended. This will help prevent spread of this AIS, along with CLP, to other lakes. Because of this, the following Recommended Action Plan focuses on AIS control and public education.

The following Active Goals form the structure of the Wilke Lake Aquatic Plant Management Plan:

**Active Goal**: To continue active management activities of AIS by use of mechanical control at current levels while exploring early season 2,4-D treatments for EWM.

**Active Goal**: To provide visitors with educational information concerning the potential impact their activities could have on introduction of aquatic invasive species, wildlife, habitats and Wilke Lake water quality.

**Active Goal:** To continue and expand the Wilke Lake comprehensive water quality monitoring program through the WDNR Citizen Lake Monitoring Network. The program would include Water Clarity Monitoring and Water Chemistry Monitoring.

**Active Goal:** To support the identification and preservation of critical species and critical habitat lands, and wetlands within the watershed. (These are areas with rare vegetation, important habitat for wildlife, or important spawning and nursery areas for fish. Preservation of these lands has a direct impact on the water quality of the lake).

**Active Goal**: To provide education and information to shoreline property owners regarding how native aquatic plant protection and shoreline management can slow the spread of aquatic invasive plants, improve the lake fishery, improve wildlife habitat and affect the quality of the water in the lake.

**Active Goal:** To meet on a regular basis with local government agencies and representatives of lakes located within the Town of Schleswig, to identify essential and new lake management issues and determine collaborative solutions.

# 2.0 Introduction

Wilke Lake is a 95 acre seepage lake located in south-western Manitowoc County. The lake has a 595 acre watershed. Wilke Lake exhibits average water clarity and according to the Wisconsin Trophic State Index, is a Eutrophic lake.

Lake residents have become concerned about the dense aquatic plant growth and presence of two AIS in Wilke Lake. This APM Plan includes strategies for detection, monitoring, and management/reduction of EWM and CLP within Wilke Lake.

This document is the APM Plan for Wilke Lake and discusses the following:

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2009 baseline aquatic plant survey
- Feasible aquatic plant management alternatives
- Selected suite of aquatic plant management options

# 3.0 Baseline Information

### 3.1 LAKE HISTORY AND MORPHOLOGY

Wilke Lake is located in the Town of Schleswig in the south-western Manitowoc County, Wisconsin. Figure 1 depicts the lake location. The following summarizes the lake's physical attributes:

| | |
|---|---|
| Lake Name | Wilke |
| Lake Type | Seepage |
| Surface Area (acres) | 95 |
| Maximum depth (feet) | 21 |
| Mean depth (feet) | 9 |
| Shoreline Length (miles) | 1.7 |
| Public Landing | Yes |

Source: Wisconsin Lakes, WDNR 2005 and WDNR Lake Survey map, 1969

Figure 2 illustrates the lake bathymetries. Wilke Lake provides year-round recreation activities ranging from, fishing, swimming, waterskiing, pleasure boating, snowmobiling, and more.

### 3.2 WATERSHED OVERVIEW

The Wilke Lake watershed encompasses approximately 595 acres in south-western Manitowoc County and is primarily agricultural. The Wilke Lake area consists mainly of Houghton, Hochheim, and Lutzke soil types. Houghton soils are very poorly drained, muck soils formed in depressions and old glacial lakes. This soil is nearly level and is poorly suited for any kind of use or development and often contains wetlands. Hochheim soils are loam soils that are well drained and are formed on drumlins or ground moraines. These soils are well suited for use in agriculture. Lutzke soils are well grained, sandy loam soils formed on outwash plains. This soil is suited for development while most areas of the soil are farmed (USDA, 1980).

Wilke Lake has a low watershed to lake ratio of 6.2:1, meaning any impacts from landuse practice or changes will have a profound effect on the lake itself. These include increase in runoff and nutrient loading through agricultural changes or development and leading to a further decrease in water clarity. Wetland complexes within a lake's watershed play an important role in cleaning such runoff before entrance into the lake. Wilke Lake has a WDNR owned wetland complex along its north-east shoreline. This area should be maintained as-is to insure the health of Wilke Lake into the future.

### 3.3 WATER QUALITY

WDNR Lake Water Quality Database indicates that the following water quality information is available

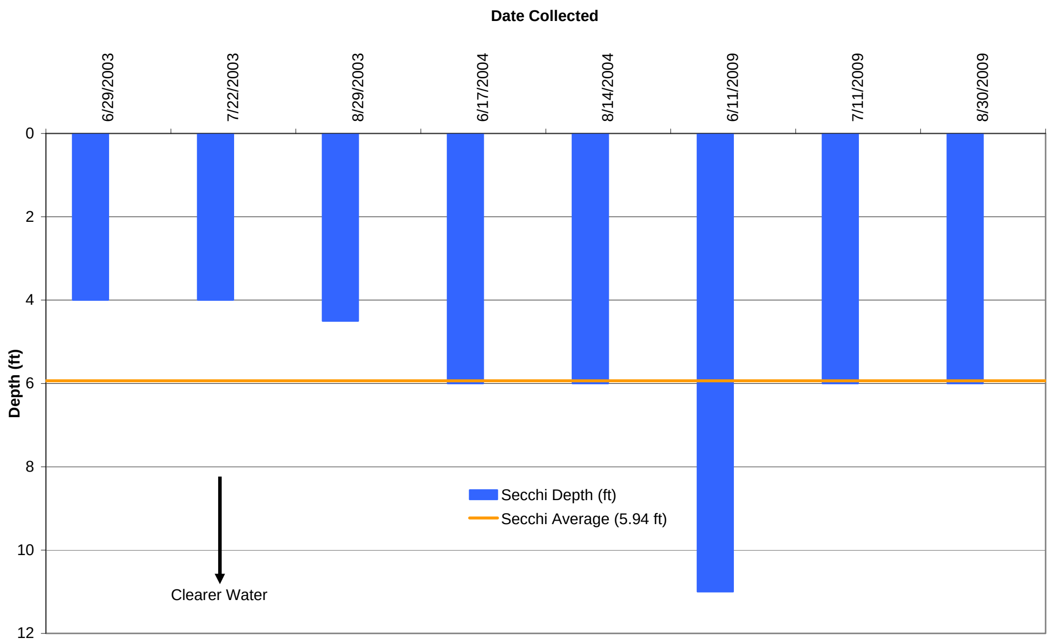
- Water clarity (Secchi depth) 2003-2004 (Citizen Lake Monitoring)
- Total phosphorus – 2003-2004 (Citizen Lake Monitoring)
- Chlorophyll a –2003-2004 (Citizen Lake Monitoring)

The above referenced data was used in creating the Wilke APM Plan. Higher Secchi depth readings indicate clearer water and deeper light penetration. Total Phosphorus is a measure of nutrients available for plant growth. Chlorophyll *a* is green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae suspended in the water column of a lake. Chlorophyll *a* is used as a common indicator of water quality (Shaw et al, 2004). Higher chlorophyll *a* values indicate lower water qualities

### 3.3.1 WATER CLARITY

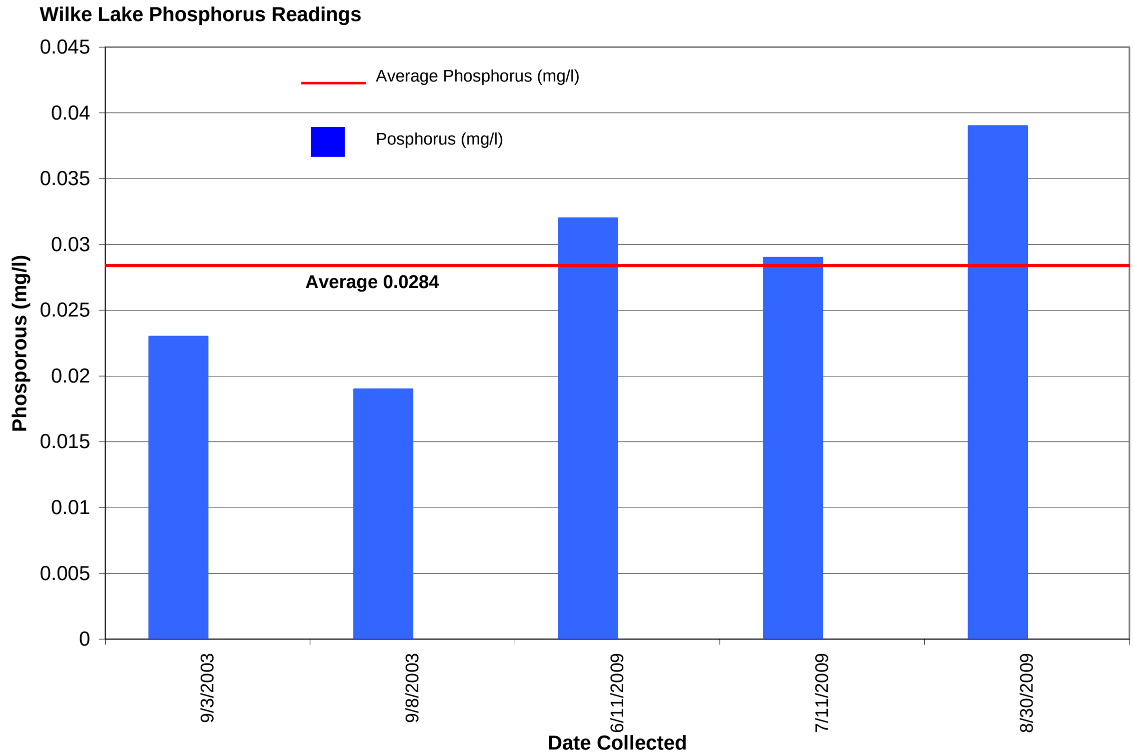
The historical water clarity average based on Secchi Disk readings is 5.94 feet (2.28 meters) and ranges from four to 11 feet. The Wisconsin average Secchi Disk reading in 2005 was 10 feet (Larry Bresina, The Secchi Disk and Our Eyes - Working Together To Measure Clarity of Our Lakes; internet document). The following graph illustrates the historical water clarity measurements on Wilke Lake; data collected in 2009 is included.

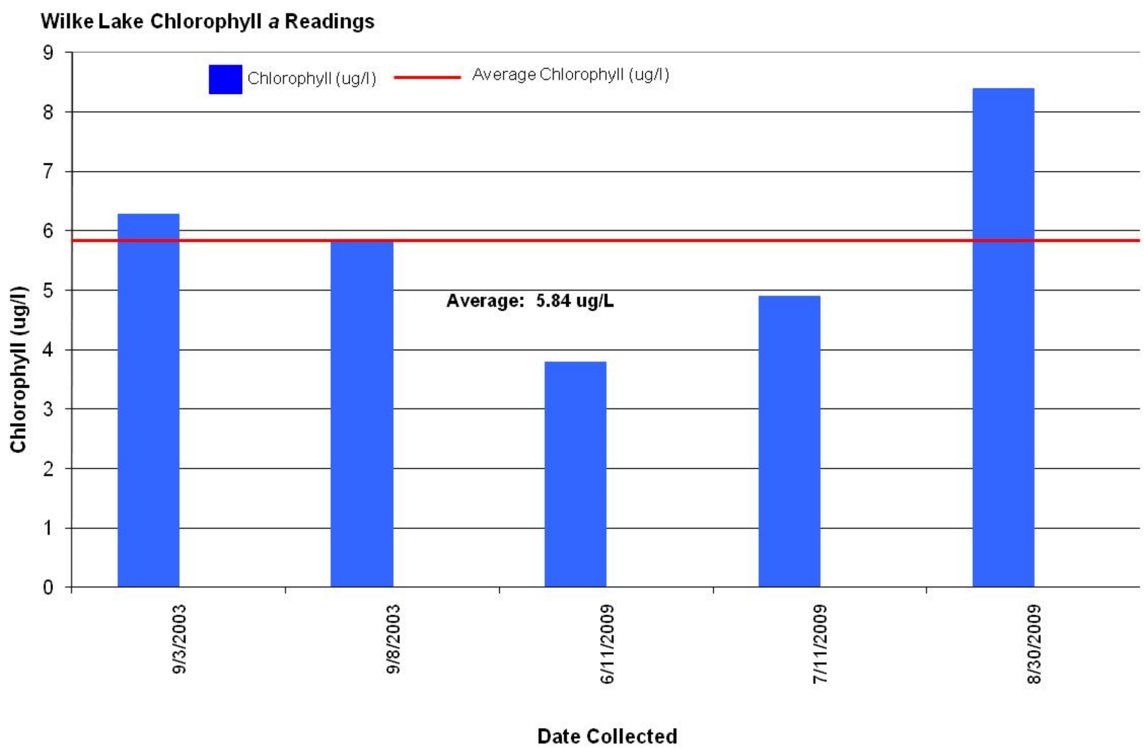
**Wilke Lake Secchi Readings**




### 3.3.2 TOTAL PHOSPHORUS AND CHLOROPHYLL *A*

Historically, Wilke Lake has had an average phosphorus reading of .0284 milligrams per litter (mg/L - parts per million). The total phosphorus has varied from 0.019 mg/L to 0.029 mg/L. Chlorophyll *a* data has an average of 5.84 micrograms per liter (ug/L - parts per billion). Data ranged from 3.8 ug/L to 8.41 ug/L. The following graphs illustrate the historical phosphorus and chlorophyll *a* measurements on Wilke Lake. Data collected in 2009 is included.


Wilke Lake Phosphorus Readings
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Average Phosphorus (mg/l)
Posphorus (mg/l)
Average 0.0284
Phosporous (mg/l)
9/3/2003
9/8/2003
6/11/2009
7/11/2009
8/30/2009
Date Collected


Wilke Lake Chlorophyll *a* Readings
9
8
7
6
5
4
3
2
1
0
Chlorophyll (ug/l)
Average Chlorophyll (ug/l)
Average: 5.84 ug/L
Chlorophyll (ug/l)
9/3/2003
9/8/2003
6/11/2009
7/11/2009
8/30/2009
Date Collected

### 3.3.3 TROPHIC STATE INDEX

Trophic State Index (TSI) values are assigned to a lake based on total phosphorus, chlorophyll *a*, and water clarity values. The TSI is a measure of a lake's biological productivity. The TSI used for Wisconsin lakes is described below.

| **Category** | **TSI** | **Lake Characteristics** | **Total P *(mg/l)*** | **Chlorophyll *a (mg/l)*** | **Water Clarity *(feet)*** |
|---|---|---|---|---|---|
| Oligotrophic | 1-40 | Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes. | < 12 | <2.6 | >13 |
| Mesotrophic | 41-50 | Moderately clear; increasing probability of low to no oxygen in bottom waters. | 12 to 24 | 2.6 to 7.3 | 13 to 6.5 |
| Eutrophic | 51-70 | Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive. | > 24 | >7 | <6.5 |
| **Wilke Lake** | **50.59** | **Eutrophic** | **28.4** | **5.84** | **5.94** |

Adopted from Carlson 1977, Lillie and Mason, 1983, and Shaw 1994 et. al.

The historical water clarity, total phosphorus, and chlorophyll a data indicate that Wilke Lake is a eutrophic lake. Data collected during by Citizen Lake Monitors and during the 2009 aquatic plant survey is included in the above averages. Wilke Lake has had a history of heavy aquatic plant growth requiring management actions with an emphasis on harvesting. The eutrophic nature of Wilke Lake only exacerbates the problem by providing additional nutrients, especially phosphorus, and resources for plant growth.

### 3.4 SUMMARY OF LAKE FISHERY

The following table identifies the fish species the WDNR lists as being present in Wilke Lake.

| Fish Species | Present | Common | Abundant |
|---|---|---|---|
| Muskellunge | | | |
| Northern Pike | X | | |
| Walleye | X | | |
| Largemouth Bass | | X | |
| Smallmouth Bass | | | |
| Panfish | | | X |

Source: WDNR Wisconsin Lakes Publication # PUB-FH-800, 2005

The WDNR website presents records of fish stocked in Wilke Lake (WDNR Fish stocking website, 2009).

| Year | Tiger Musky | Walleye |
|---|---|---|
| 1976 | 400 | |
| 1977 | 400 | |
| 1978 | 400 | |
| 1979 | 400 | |
| 1989 | | 4493 |
| 1992 | | 2412 |
| 1994 | | 2368 |
| 1995 | | 2379 |
| 1999 | | 9500 |
| 2001 | | 9500 |
| 2003 | | 9500 |
| 2005 | | 4700 |

All tiger muskellunge stocked were fingerlings. Walleye were stocked as fry in 1989, fingerlings from 1992 – 1995, and as small fingerling for the remainder of the stockings. All fishing regulations and bag limits for Wilke Lake are concurrent with standard WDNR regulations

In May, 2010 the WDNR conducted a fisheries survey in Wilke Lake to asses the fisheries for potential changes in stocking practices. All species found in 2005 were also sampled in 2010, with the addition of two new species, bullhead and walleye being sampled in 2010. Though populations of all fish species sampled increased except for bluegill and pumpkinseed (see table below). The 2005 survey was conducted in October while the 2010 survey was conducted in May and because of the different use patterns of fish species during those times of the year a conclusion on the change of the fishery between 2005 and 2010 cannot be made. At the time of this survey, the DNR did not have any recommendation on changing stocking practices on Wilke Lake.

| Species | 2010 | | 2005 | |
|---|---|---|---|---|
| | Number | Size Range | Number | Size Range |
| **Largemouth Bass** | 39 | 6-17" | 17 | 3-17" |
| **Northern Pike** | 6 | 17-22" | 2 | 17-19" |
| **Walleye** | 2 | 19-24" | 0 | |
| **Bluegill** | 185 | 3-7" | 241 | 3-8" |
| **Yellow Perch** | 101 | 3-6" | 31 | 3-9" |
| **Pumpkinseed** | 10 | 4-7" | 24 | 2-7" |
| **Black Crappie** | 8 | 3-8" | 6 | 6-10" |
| **Bullhead** | 2 | -- | 0 | |
| **Minnows** | 3 | -- | 8 | |
| **Carp** | 3 | -- | 1 | |
| **Number** | **359** | | **339** | |
| **Fish/Mile** | **276.2** | | **260.8** | |

### 3.5 LAKE MANAGEMENT HISTORY

The Town of Schleswig Sanitary District #2 has completed several management activities on Wilke Lake including a lake management plan (1995), developing past aquatic plant management (APM) plans, managing aquatic invasive species (AIS), and harvesting nuisance aquatic plants. Wilke Lake's most recent aquatic plant survey and APM plan were completed in 2003-2004.

Management of aquatic plants in Wilke Lake began in the early 1960s with chemical applications. In the late 1960s, a small plant cutter was used to deal with nuisance vegetation. In the 1970s management did not occur and plant growth became excessive, limiting boat traffic and recreational uses. The Town of Schleswig Sanitary District #2 (TSSD) was formed in 1980 with authority to control and manage aquatic plants. Soon after, the first APM plan was developed with an aquatic plant harvester purchased in 1981. A larger harvester was purchased in 1993 to replace the previous one. Updates to the APM plan were completed in 1992 as part of a lake management plan and again in 2003. Since the first APM plan, the Town of Schleswig Sanitary District #2 has been actively harvesting plants within approximately 80-acres of Wilke Lake corresponding to the Eurasian water-milfoil beds with incidental harvest of native plants within these areas. In 2010, the TSSD harvested approximately 360 cubic yards of plants under their permit. This was completed in accordance with their 2003 APM plan.

### 3.6 GOALS AND OBJECTIVES

TSSD identified the following goals for aquatic plant management on Wilke Lake.

- Maintain and improve recreational opportunities
- Protect and improve fish and wildlife habitat
- Preserve native aquatic plants
- Effectively manage EWM and CLP through harvesting
- Identify sources of financial assistance for aquatic plant management activities
- Coordinate sound aquatic plant management practices where needed within Wilke Lake
- Educate the Wilke Lake community on proper AIS identification and prevention efforts
- Gather citizen input
- Increase citizen participation in lake management

# 4.0 Project Methods

To accomplish the project goals, the TSSD needs to make informed decisions regarding APM on the lake. To make informed decisions, TSSD proposed to:

- Collect, analyze, and interpret basic aquatic plant community data
- Recommend practical, scientifically-sound aquatic plant management strategies

Offsite and onsite research methods were used during this study. Offsite methods included a thorough review of available background information on the lake, its watershed, and water quality. An aquatic plant community survey was completed onsite to provide the data needed to evaluate aquatic plant management alternatives.

## 4.1 EXISTING DATA REVIEW

Bonestroo researched a variety of information resources to develop a thorough understanding of the ecology of the Lake. Information sources included:

- Local and regional geologic, limnologic, hydrologic, and hydrogeologic research
- Discussions with lake members
- Available topographic maps and aerial photographs

These sources were essential to understanding the historic, present, and potential future conditions of the lake, as well as to ensure that previously completed studies were not unintentionally duplicated. Specific references are listed in Section 8.0 of this report.

## 4.2 AQUATIC PLANT SURVEY AND ANALYSIS

The aquatic plant community of the lake was surveyed on June 11, 2009 by Bonestroo. Any harvesting activities were delayed until completion of the survey. The survey was completed according to the point intercept sampling method described by Madsen (1999) and as outlined in the WDNR draft guidance entitled “Aquatic Plant Management in Wisconsin” (WDNR, 2005).

WDNR research staff determined the sampling point resolution in accordance with the WDNR guidance and provided a base map with the specified sample point locations. The sample resolution was a 40 meter grid with 235 pre-determined intercept points (Figure 3). Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix A). Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by tossing a specialized, weighted rake on a rope and dragging the rake along the bottom sediments. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus or species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets.

The point intercept method was used to evaluate the existing emergent, submergent, floating-leaf, and free-floating aquatic plants. If a species was not collected at a specific point, the space on the datasheet was left blank. For the survey, the data for each sample point was entered into the WDNR “Worksheets” (i.e., a data-processing spreadsheet) to calculate the following statistics:

- **Taxonomic richness** (the total number of taxa detected)
- **Maximum depth of plant growth**
- **Community frequency of occurrence** (number of intercept points where aquatic plants were detected divided by the number of intercept points shallower than the maximum depth of plant growth)
- **Mean intercept point taxonomic richness** (the average number of taxa per intercept point)
- **Mean intercept point native taxonomic richness** (the average number of native taxa per intercept point)
- **Taxonomic frequency of occurrence within vegetated areas** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points where vegetation was present)
- **Taxonomic frequency of occurrence at sites within the photic zone** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points which are equal to or shallower than the maximum depth of plant growth)
- **Relative taxonomic frequency of occurrence** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the sum of all species' occurrences)
- **Mean density** (the sum of the density values for a particular species divided by the number of sampling sites)
- **Simpson Diversity Index (SDI)** is an indicator of aquatic plant community diversity. SDI is calculated by taking one minus the sum of the relative frequencies squared for each species present. Based upon the index of community diversity, the closer the SDI is to one, the greater the diversity within the population.
- **Floristic Quality Index (FQI)** (This method uses a predetermined Coefficient of Conservatism (C), that has been assigned to each native plant species in Wisconsin, based on that species' tolerance for disturbance. Non-native plants are not assigned conservatism coefficients. The aggregate conservatism of all the plants inhabiting a site determines its floristic quality. The mean C value for a given lake is the arithmetic mean of the coefficients of all native vascular plant species occurring on the entire site, without regard to dominance or frequency. The FQI value is the mean C times the square root of the total number of native species. This formula combines the conservatism of the species present with a measure of the species richness of the site.

### 4.3 PUBLIC INVOLVEMENT AND PLAN REVIEW

On September 6, 2009 the preliminary results of the APM plan and sampling were presented to the Wilke Lake Advancement Association at their annual meeting. A lengthy discussion on harvesting, indentifying native versus invasive aquatic plants, and harvesting expectations was conducted following the presentation of the data. Lake residents expressed a desire to continue harvesting while forgoing the use of herbicides for and EWM treatments.

Results of the APM study were then presented a publicly noticed public meeting on September 8th at the Town of Schleswig Sanitary District #2 meeting at the Town Hall. Comments received at this time were similar to those expressed at the Association meeting with a strong desire to continue harvesting.

Following received comments, in October of 2009, draft copies of the APM Plan for Wilke Lake were submitted to the TSSD for comments. Comments from TSSD were received, applied, and a copy of this draft was sent into the WDNR for further comments.

### 4.4 WATER QUALITY METHODS

In June, July, and August, 2009 water samples were collected. Water clarity is measured by lowering an 8-inch disk with alternating black and white quadrants called a Secchi disk. The Secchi disk is lowered into the water until it is no longer visible and the depth is recorded. The Secchi disk is then raised until it is again visible and that depth is recorded. The two readings are averaged providing the Secchi depth or water clarity measurement. This is used to determine how far sunlight can penetrate into water.

Chlorophyll *a* and Phosphorus were both collected with a grab sample at one point over the deep hole of the lake and sent to a lab for analysis. All procedures were completed in accordance with Citizen Lake Monitoring protocols.

# 5.0 Discussion of Project Results

## 5.1 AQUATIC PLANT ECOLOGY

Aquatic plants are vital to the health of a water body. Unfortunately, people all too often refer to rooted aquatic plants as "weeds" and ultimately wish to eradicate them. This type of attitude, and the misconceptions it breeds, must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants (macrophytes) are extremely important for the well being of a lake community and possess many positive attributes. Despite their importance, aquatic macrophytes sometimes grow to nuisance levels that hamper recreational activities. This is especially prevalent in degraded ecosystems. The introduction of certain aquatic invasive species (AIS), such as EWM, often can exacerbate nuisance conditions, particularly when they compete successfully with native vegetation and occupy large portions of a lake.

When "managing" aquatic plants, it is important to maintain a well-balanced, stable, and diverse aquatic plant community that contains high percentages of desirable native species. To be effective, aquatic plant management in most lakes must maintain a plant community that is robust, species rich, and diverse. Appendix B includes a discussion about aquatic plant ecology, habitat types and relationships with water quality.

## 5.2 AQUATIC INVASIVE SPECIES

Aquatic Invasive Species (AIS) are aquatic plants and animals that have been introduced by human action to a location, area, or region where they did not previously exist. AIS often lack natural control mechanisms they may have had in their native ecosystem and may interfere with the native plant and animal interactions in their new "home". Some AIS have aggressive reproductive potential and contribute to a decline of a lake's ecology and interfere with recreational use of a lake. Common Wisconsin AIS include:

- Eurasian Watermilfoil
- Curly Leaf Pondweed
- Zebra Mussels
- Rusty Crayfish
- Spiny Water Flea
- Purple Loosestrife

Appendix C provides additional information on these AIS.

## 5.3 2009 AQUATIC PLANT SURVEY

The survey was carried out June 11, 2009, and included sampling at 235 intercept points. The aquatic macrophyte community of the Lake included nine floating leaved, emergent, and submerged aquatic vascular plant species during 2009. Table 2 lists the taxa identified during the 2009 aquatic plant survey. Figures 4a through Figure 4c illustrate the locations of each species identified. A sample of each plant species present was preserved and submitted to the Town of Schleswig to be kept at the Town Hall.

Vegetation was identified to a maximum depth of 13 feet (photic zone). Aquatic vegetation was detected at 89.64 percent (%) of photic zone intercept points. The Simpson Diversity Index value of the community was 0.72. The taxonomic richness was nine species and there was an average of 1.32 species identified at points that were within the photic zone. There was an average of 1.48 species present at points with vegetation present. Table 3 summarizes these overall aquatic plant community statistics.

The most abundant aquatic plant identified during the aquatic plant survey was muskgrass *(Chara sp.*), a macroalgae. It exhibited a 68.47% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected). It was present at 76.38% of the sites with vegetation, and had a 51.7% relative frequency of occurrence. Table 4 includes the abundance statistics for each species.

*Chara sp.* (Muskgrass / Chara) looks like a vascular plant; it actually is a multi-celled alga (macroalgae). Muskgrass is usually found in hard waters and prefers muddy or sandy substrate and can often be found in deeper water than other submergent plants. Muskgrass beds provide valuable habitat for small fish and invertebrates. Muskgrass is also a favorite waterfowl food. Its rhizoids slow the movement and suspension of sediments and benefit water quality in the ability to stabilize the lake bottom (Borman, et al., 1997). It can easily be identified by its characteristic "musty" odor.

Chara sp.
Source: UW Herbarium Website

Eurasian water-milfoil (*Myriophyllum spicatum*), was the second most abundant species occurring at 32.88% of the photic zone. It was present at 36.68% of the sites with vegetation and had a 24.83% relative frequency of occurrence.


Eurasian watermilfoil
Source: UW Herbarium Website

*Myriophyllum spicatum* (Eurasian watermilfoil or EWM) is a submersed aquatic plant native to Europe, Asia and northern Africa. It was introduced to the United States by early European settlers. EWM was first detected in Wisconsin lakes during the 1960's. Because of its potential for explosive growth and its incredible ability to regenerate, EWM can successfully out-compete most native aquatic plants, especially in disturbed areas.

Variable pondweed (*Potamogeton gramineus*) was the third most abundant vascular plant species occurring at 10.81% of the photic zone. It was present at 12.06% of the sites with vegetation and had an 8.16% relative frequency of occurrence.

*Potamogeton gramineus* (Variable Pondweed) is usually found in more firm sediment in water that is about 3 feet deep. Variable pondweed overwinters by hardy rhizomes and winter buds. Flowering usually occurs early in the growing season and fruit is produced during mid summer. The fruits and tubers are grazed by waterfowl and the extensive network of leafy branches offers invertebrate habitat and foraging opportunities for fish (Borman, et al., 1997).

Variable Pondweed
Source: UW Herbarium Website

### 5.3.1 FLOATING-LEAF PLANTS

No floating-leaf aquatic plant species were identified at sample points during the 2009 aquatic plant survey.

### 5.3.2 SUBMERGENT PLANTS

The following eight submergent aquatic plant species were identified during the 2009 aquatic plant survey.

- *Ceratophyllum demersum* (coontail)
- *Chara sp.* (chara or muskgrass) [algal]
- ***Myriophyllum spicatum* (Eurasian water-milfoil) AIS**
- ***Potamogeton crispus* (curly-leaf pondweed) AIS**
- *Potamogeton gramineus* (variable pondweed)
- *Potamogeton illinoensis* (Illinois pondweed)
- *Potamogeton praelongus* (white-stem pondweed)
- *Utricularia vulgaris* (common bladderwort)

### 5.3.3 EMERGENT PLANTS

The following emergent aquatic plant specie was identified during the 2009 aquatic plant survey.

- *Sagittaria sp.* (arrowhead)

Table 2 lists the species identified. Appendix D includes brief descriptions of all aquatic plants identified.

### 5.3.4 HISTORICAL PLANT COMMUNITIES

Aquatic plant surveys have been complete on Wilke Lake in 1992, 2003, and 2009 in accordance with APM plans. In 1992, thirteen species were sampled with four not present during the 2009 sampling period. In 2003, 17 species were sampled with six of them not observed during the 2009 survey. Five species (cattail, bulrush, bushy pondweed, spatterdock, and white water lily) were not directly sampled during the 2009 plant survey but were observed growing in Wilke Lake. Table 5 contains presence or absence of species found throughout the surveys.

The 2009 survey was completed in June before harvesting began for the year to allow for an undisturbed plant community. Though timing of the survey was not ideal, all plants within the lake were growing and large enough to be identified correctly. The survey was delayed as long as possible until the EWM growth became a nuisance for lake users and harvesting was needed. Any species not present during the 2009 survey that were present during previous surveys and vice versa are attributed to the random nature of pre-determined survey locations. These species are likely still within Wilke Lake, but were not present at sampling locations.

## 5.4 FLORISTIC QUALITY INDEX

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts. FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2 (WDNR, 2005). The FQI calculated from the 2009 aquatic plant survey data was 17.01. This FQI value is lower than Wisconsin's average of 22.2 and suggests that Wilke Lake exhibits poor water quality with a high level of disturbance when using aquatic plants as an indicator. Table 4 summarizes the FQI values.

## 5.5 WATER QUALITY SAMPLING

2009 collected water samples were tested and showed an average phosphorus reading of 0.033 mg/L and an average chlorophyll *a* reading of 5.7 ug/L. Secchi readings were taken at the same time and averaged 7.77 feet. Only the total phosphorus results are concurrent with the eutrophic status of the lake. Both the secchi and chlorophyll a readings indicate a mesotrophic status. Though the lake is borderline eutrophic, it is important to remember that all samples encompass only a small time frame. Continued sampled is needed to more accurately determine the trophic status of the lake as the TSI value is just 0.59 points into the Eutrophic classification.

# 6.0 Management Alternatives and Recommendations

Based on the goals of the stakeholders as mentioned in section 3.6, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives is included in Appendix E. The following management alternatives are based on the approaches commonly accepted by the WDNR, and incorporate recommendations of Bonestroo.

## 6.1 AQUATIC PLANT MAINTENANCE ALTERNATIVES

These maintaenance alternatives do not manipulate the current aquatic plant community within a lake and are protection-oriented management alternatives. These alternatives can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community.

### 6.1.1 AQUATIC INVASIVE SPECIES MONITORING

Bonestroo recommends completing lake-wide aquatic plant surveys every 5 years (essentially repeating the 2009 point intercept aquatic plant survey) to monitor changes in the overall aquatic plant community and the effects of the APM activities. Aquatic plant communities may change with varying water levels, water clarity, nutrient levels, and aquatic plant management actions.

### 6.1.2 CLEAN BOATS/CLEAN WATERS CAMPAIGN

Measures for the prevention of the spread of AIS from the lake should be a priority. To prevent the spread of AIS into and from Wilke Lake, a monitoring program such as Clean Boats/Clean Waters is an excellent choice. There is one public landing on Wilke Lake and lake residents are currently not participating in Clean Boats/Clean Waters (CB/CW) program. This program is carried out by trained volunteers who inspect the incoming boats at public launches. Signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of the public, along with private property and resort owners, about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations. Contact with lake users at this time is a great way to distribute other educational materials. Institution of this program is recommended and should be promoted by the current coordinator on the lake.

### 6.1.3 AQUATIC PLANT PROTECTION AND SHORELINE MANAGEMENT

Protection of the native aquatic plant community is needed to slow the spread of EWM from lake to lake and within a lake once established. Therefore, riparian landowners should refrain from removing native vegetation. Additionally, EWM can thrive in nutrient (phosphorus and nitrogen) enriched waters or where nutrient rich sediments occur. Two simple actions can prevent excessive nutrients and sediments from reaching the lake.

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. Native plants can also be purchased from nurseries for restoration efforts. Shoreline restoration has the added benefits of providing wildlife habitat and erosion prevention. A vegetated buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake.

An avenue to fund shoreland restoration is the WDNR Lake Protection Grant program. This program offers 75% of the project cost covered by the state up to $200,000. For more information on the Lake Protection Grant program contact the Lake Management Coordinator at the WDNR Green Bay Service Center by calling (920) 662-5100.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. Phosphorus free fertilizers should be used when possible. The fertilizers commonly used for lawns and gardens have three major plant macronutrients: Nitrogen, Phosphorus, and Potassium. These are summarized on the fertilizer package by three numbers. The middle number represents the amount of phosphorus. Since most Wisconsin lakes are “Phosphorus limited”, meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Landowners should be encouraged to use phosphorus free fertilizers on lakeshore lawns. Local retailers and lawn care companies can provide soil test kits to determine a lawn’s nutrient needs. Of course, properties with an intact natural buffer require very little maintenance, and no fertilizers.

Another possible source of nutrients to a lake is the septic systems surrounding the lake. Septic systems should be properly installed and maintained in order to prevent improperly treated wastewater, which carries a lot of nutrients, from reaching the lake. Property owners who are not sure if their septic system is adding nutrients to the lake should contact a professional inspector and have their system assessed.

#### 6.1.4 Public Education and Involvement

The TSSD should continue to keep abreast of current AIS issues throughout the County. The County Land and Water Resource Conservation Department, WDNR Lakes Coordinator, and the UW Extension are good sources of information. Many important materials can be ordered at the following website:

http://www.uwsp.edu/cnr/uwexlakes/publications/

Appendix G includes resources for further information about public education opportunities.

If the above hyperlink to web address becomes inactive, please contact Bonestroo for appropriate program and contact information.

### 6.2 AQUATIC PLANT MANAGEMENT ALTERNATIVES

These management alternatives may be used when aquatic plants present some sort of problem that must be dealt with or manipulated by human action. The following alternatives are based on the assumption that the TSSD will meet in consultation with the WDNR before pursuing manipulation of AIS populations.

#### 6.2.1 Manual Removal

Native plants may be found at nuisance levels at individual properties. Manual removal efforts, including hand raking or hand pulling unwanted plants, are allowed under Wisconsin law, to a maximum width of 30 feet (recreational zone). The intent is to provide pier, boatlift or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed this 30-foot recreation zone (manual removal of any native aquatic vegetation beyond the 30-foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code, see Appendix F). However manual removal is **not** recommended unless interfering with boat docking or swimming because it could open a niche for non-native invasive aquatic plants to occupy. Removal of native plants also destroys habitat for fish and wildlife.

Manual removal of aquatic plants can be quite labor intensive and time consuming. This technique is well suited for small areas in shallow water. Hiring laborers to remove aquatic vegetation is an option, but also increases cost. Scuba divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal by property owners include low cost compared to chemical control methods, quick containment of pioneering (new) populations of invasive aquatic plants, and the ability for a property owner to slowly and consistently work on active management. The drawback of this alternative is that pulling aquatic plants include the challenge of working in the water, especially deep water, the threat of letting fragments escape and colonize a new area, and the fact that control of any significant sized population is quite labor intensive. Again, hiring laborers to remove aquatic vegetation is an option, but also increases cost.

Landowners removing plants manually should learn to identify the aquatic plant species. If an individual has questions about a particular aquatic plant or what level of manual removal is allowed, they should talk to their Wisconsin Department of Natural Resources lakes coordinator. Appendix F includes additional resources for plant identification.

### 6.2.2 Aquatic Invasive Plant Species Chemical Herbicide Treatment

Since Wilke Lake is heavily populated with EWM and CLP, a chemical herbicide treatment may be an appropriate way to conduct restoration of native plants. Before any specific course of action is undertaken the WDNR must be consulted. At the time of this report, consultation would begin with Mary Gansberg, Lakes Management Coordinator in Green Bay, (920) 662-5489. All herbicide treatments must be undertaken with a WDNR issued permit (NR 107 Wisconsin Administrative Code).

When using chemicals to control AIS it is a good idea to re-evaluate the lake and the extent of the AIS conditions before, during and after chemical treatment. The WDNR may require another whole-lake plant survey and will certainly require a proposed treatment area survey. Along with the above mentioned survey, pre and post treatment monitoring should be included for all aquatic plant treatments and is typically a WDNR requirement.

The science regarding what chemicals are most effective and how they can be used is constantly being updated. Currently EWM is the most common aquatic invasive plant species targeted for chemical treatment. At present, granular 2,4-D is the most common herbicide used on EWM in Wisconsin. In order to decrease damage to native plants and be as selective as possible for EWM, treatments are completed in the spring when native plant growth is minimal.

Chemical treatment is usually a long term commitment and requires a specific plan with a goal set for “tolerable” levels of the relevant AIS. One such landmark might be 10% or less of the littoral area being occupied by aquatic invasive plants. WDNR recommends conducting a whole-lake point-intercept survey on a five year bases (for Wilke Lake the next would be 2014). Such a survey may reveal a new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

Advantages of herbicides include broader control than hand pulling. Disadvantages include negative public perception of chemicals in natural lakes, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year) and water use restrictions after application may be necessary.

### 6.2.3 MECHANICAL AQUATIC PLANT HARVESTING

Continued harvesting is also a management option. This technology allows easy treatment of large areas of nuisance aquatic plant stands. Though the results are immediate, continued harvesting throughout the growing season is required. A downfall of harvesting is its non-selective process. It targets both native and invasive species and may encourage the spread of Eurasian water-milfoil if all fragments of the plant are not removed when harvested. Any mechanical harvesting requires a permit and the operator may harvest only in areas designated on the permit.

# 7.0 Conclusion and Recommended Action Plan

Two aquatic invasive plants were found during the aquatic plant survey in 2009; Eurasian water-milfoil, *Myriophyllum spicatum* (EWM), and curly-leaf pondweed, *Potamogeton crispus* (CLP). Both species have been previously identified within the lake and have been actively managed for. EWM is present on a large scale basis and ongoing management and control efforts are highly recommended. This will help prevent spread of this AIS, along with CLP, to other lakes. Because of this, the following Recommended Action Plan focuses on AIS control and public education.

## 7.1 RECOMMENDED ACTIVE GOALS

The recommended action plan includes actions for Wilke Lake based on combination of the alternatives listed above in Section 6. It will be up to residents of Wilke Lake and the TSSD to determine the actions, find the funding, and gather the individuals needed to implement the active goals.

**Active Goal**: To continue active management activities of AIS by use of mechanical harvesting at current levels while exploring early season 2,4-D treatments for EWM.

**Active Goal**: To provide visitors with educational information concerning the potential impact their activities could have on introductions aquatic invasive species, wildlife, habitats and Wilke Lake water quality.

**Active Goal:** To continue and expand the Wilke Lake comprehensive water quality monitoring program through the WDNR Citizen Lake Monitoring Network. The program would include Water Clarity Monitoring and Water Chemistry Monitoring.

**Active Goal:** To support the identification and preservation of critical species and critical habitat lands, and wetlands within the watershed. (These are areas with rare vegetation, important habitat for wildlife, or important spawning and nursery areas for fish. Preservation of these lands has a direct impact on the water quality of the lake).

**Active Goal**: To provide education and information to shoreline property owners regarding how native aquatic plant protection and shoreline management can slow the spread of aquatic invasive plants, improve the lake fishery, improve wildlife habitat and affect the quality of the water in the lake.

**Active Goal:** To meet on a regular basis with local government agencies and representatives of lakes located within the Town of Schleswig, to identify essential and new lake management issues and determine collaborative solutions.

## 7.2 RECOMMENDED AQUATIC PLANT MANAGEMENT

Since 1992, both AIS Eurasian water-milfoil and curly-leaf pondweed have been present in Wilke Lake. Management of plants in the lake has been limited to chemical treatment and harvesting. The current regime of harvesting does not address the elimination of these AIS within Wilke Lake, but rather is a maintenance technique and helps maintain active recreation without nuisance aquatic plant growth in active navigational areas of the lake.

Curly-leaf pondweed was present within approximately 4.24 acres of Wilke Lake. Because CLP does not spread through fragmentation like EWM, these areas can and should be harvested. CLP spreads through reproductive structures called turions. Continued harvesting of CLP can prevent the formation of turions and further spread of this invasive species.

Use of 2,4-D herbicides to treat areas of EWM have shown success within Wisconsin when applied to areas of EWM. Currently, there are approximately 17 nearly contiguous acres of EWM within Wilke Lake (Figure 5). This provides a good opportunity for chemical treatment treatment. Though 2,4-D applications would reduce the presence of EWM they will not fully address the nuisance aquatic plants growth by other species because of the lake's eutrophic nature and harvesting would likely still be required to provide relief.

However, the TSSD recently purchased a new harvester and plans to renew their harvesting permit, which expired in 2009. Because of these recent expenditures, the TSSD does not wish to pursue vacating use of the harvester at this time. It is recommended that the TSSD continue harvesting in Wilke Lake in 2010 and beyond while exploring early season liquid 2,4-D application in conjunction with continuing to provide nuisance relief by remaining species only where necessary through mechanical harvesting.

Heavy aquatic plant growth requiring management by mechanical harvesting is encouraged further by the nutrient rich waters of Wilke Lake. EWM causes a majority of the nuisance and composes the bulk of harvested materials. Very little EWM and nuisance growth is present within the near-shore, shallow water areas of Wilke Lake because of heavy muskgrass growth. Though muskgrass does grow densely in some areas of Wilke Lake, it does so well below the water's surface and does not produce a nuisance nor limit any recreational activities. Preventing harvesting within these near-shore areas will also protect the valuable emergent and floating-leaved species within the lake while removing some phosphorus locked up in the plant material from the lake. Areas to be harvested will coincide with and not exceed those historically harvested, approximately 52 acres, with near-shore harvesting avoided (Figure 7).

Harvesting operations run in similar fashion to that executed in the past are recommended for Wilke Lake. Harvesting should not start until Memorial Day weekend to provide adequate habitat and time for spawning fish. Harvesting should continue with cuttings as needed until plants begin to die off or stop growing in mid to late September at depths up to four feet below the waters surface. Past harvesting operations were completed 2-4 times weekly according to plant growth and weather permitting with a yearly total of approximately 150 hours of harvesting. An increase in harvesting rates and amount is not expected for Wilke Lake. Lake residents have been hand collecting loose cuttings from the harvester and placing them on the ends of their docks to be picked up weekly. Continuation of this practice is encouraged, but mechanical harvesting of near-shore shallow (4 feet of depth or less) areas should be avoided.

### 7.3 CLOSING

This APM Plan was prepared in cooperation with the Town of Schleswig Sanitary District #2. It includes the major components outlined in the WDNR Aquatic Plant Management guidance. The "Recommended Action Plan" section of this report can be used as a stand alone document to facilitate EWM and CLP management activities for the lake. This section outlines important monitoring and management activities. The greater APM Plan document and appendices provides a central source of information for the lake's aquatic plant community information, the overall lake ecology, and sources of additional information. If there are any questions about how to use this APM Plan or its contents, please contact Bonestroo.

This APM Plan should be updated periodically to reflect current aquatic plant problems, and the most recent acceptable APM methods. Information regarding aquatic plant management and protection is available from the WDNR website:
http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm or from Bonestroo upon request.

# 8.0 References

While not all references are specifically cited, the following resources were used in preparation of this report.

Borman, Susan, Robert Korth, and Jo Temte, *Through the Looking Glass, A Field Guide to Aquatic Plants*, Wisconsin Lakes Partnership, 1997

Carlson, R. E., A trophic state index for lakes. Limnology and Oceanography, 22:361-369, 1977

Fassett, Norman C., *A Manual of Aquatic Plants*, The University of Wisconsin Press, Madison, Wisconsin, 1975

Getsinger, Kurt D., and H.E. Westerdahl, *Aquatic Plant Identification and Herbicide Use Guide, Volume II Aquatic Plants and Susceptibility to Herbicides*, U.S. Bonestroo Waterways Experiments Station, Technical Report A-88-9, 1988

Jester, Laura, Bozek, Michael, Helsel, Daniel, and Sheldon, Sallie, *Euhrychiopsis lecontei Distribution, Abundance, and Experimental Augmentation for Eurasian watermilfoil Control in Wisconsin Lakes*, Journal Aquatic Plant Management, 38:88-97

Madsen, John, *Point Intercept and Line Intercept Methods for Aquatic Plant Management, Aquatic Plant Control Technical Note MI-02*, February 1999

Nichols, Stanley A. *Distribution and habitat descriptions of Wisconsin lake plants*, Wisconsin Geological and Natural History Survey Bulletin 96, 1999

North America Lake Management Society of Aquatic Plant Management Society (NALMS), *Aquatic Plant Management in Lakes and Reservoirs,* 1997

Prescott, G.W., *How to Know the Aquatic Plants,* Wm. C. Brown Publishers, Dubuque, Iowa, 1980

United States Department of Agriculture, *Soil Survey of Calumet and Manitowoc Counties, Wisconsin*. 1980

United States Geological Survey, *Heafford Junction, Wisconsin Quadrangle, 7.5 minute (Topographic) Series*, 1982

United States Geological Survey, Nonindigenous Aquatic Species, (http://nas.er.usgs.gov/queries/collectioninfo.asp?), Accessed November 13, 2007

Welsh, Jeff, *Guide to Wisconsin Aquatic Plants,* Wisconsin Department of Natural Resources Publication WR 173, 1992 revised

Wetzel, Robert G., *Limnology*, 1983

Wisconsin Department of Natural Resources, *Aquatic Plant Management in Wisconsin DRAFT,* April 25 2005

Wisconsin Department of Natural Resources, *Aquatic Invasive Species Website* *(*http://dnr.wi.gov/invasives/aquatic/), Accessed April 2009

Wisconsin Department of Natural Resources, *Listing of Wisconsin Waters with Eurasian Water-Milfoil (current as of 01/02/2007)*, 2007

Wisconsin Department of Natural Resources, *Fish Stocking Website*

(http://infotrek.er.usgs.gov/doc/wdnr_biology/Public_Stocking/StateMapHotspotsAllYears.htm), Accessed September, 2009

Wisconsin Department of Natural Resources, *Wisconsin Lakes,* Publication # PUB-FH-800, 2005

# Appendix A - Point Intercept Sample Coordinates

# Appendix B – Importance of Aquatic Plants to Lake Ecosystem

Bonestroo

## AQUATIC PLANT TYPES AND HABITAT

Aquatic plants can be divided into two major groups: microphytes (phytoplankton and epiphytes) composed mostly of single-celled algae, and macrophytes that include macro algae, flowering vascular plants, and aquatic mosses and ferns. Wide varieties of microphytes co-inhabit all habitable areas of a lake. Their abundance depends on light, nutrient availability, and other ecological factors.

In contrast, macrophytes are predominantly found in distinct habitats located in the littoral (i.e., shallow near shore) zone where light sufficient for photosynthesis can penetrate to the lake bottom. The littoral zone is subdivided into four distinct transitional zones: the eulittoral, upper littoral, middle littoral, and lower littoral (Wetzel, 1983).

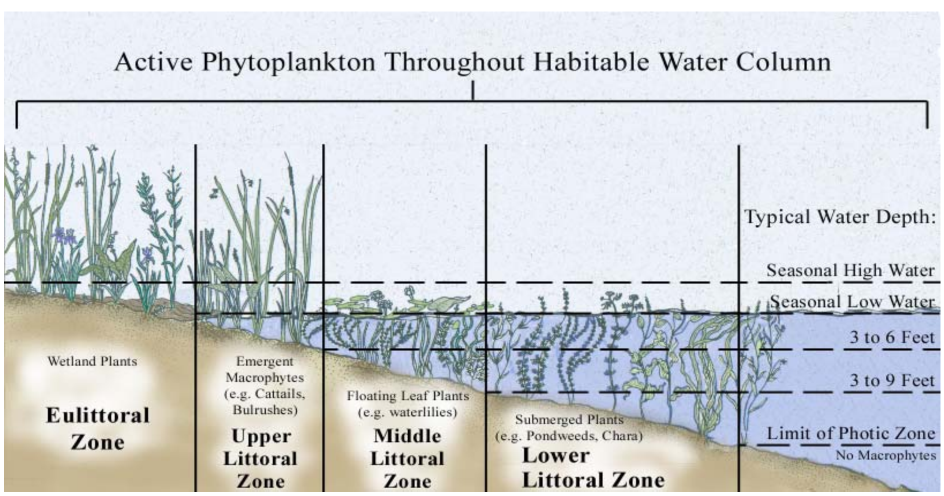
**Eulittoral Zone**: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

**Upper Littoral Zone**: Dominated by emergent macrophytes and extends from the shoreline edge to water depths between 3 and 6 feet.

**Middle Littoral Zone**: Occupies water depths of 3 to 9 feet, extending deeper from the upper littoral zone. The middle littoral zone is often dominated by floating-leaf plants.

**Lower Littoral Zone:** Extends to a depth equivalent to the limit of the photic zone, which is the maximum depth that sufficient light can support photosynthesis. This area is dominated by submergent aquatic plant types.

The following illustration depicts these particular zones and aquatic plant communities.




**Aquatic Plant Communities Schematic**

The abundance and distribution of aquatic macrophytes are controlled by light availability, lake trophic status as it relates to nutrients and water chemistry, sediment characteristics, and wind energy. Lake morphology and watershed characteristics relate to these factors independently and in combination (NALMS, 1997).

## AQUATIC PLANTS AND WATER QUALITY

In many instances aquatic plants serve as indicators of water quality due to the sensitive nature of plants to water quality parameters such as water clarity and nutrient levels. To grow, aquatic plants must have adequate supplies of nutrients. Microphytes and free-floating macrophytes (e.g., duckweed) derive all their nutrients directly from the water. Rooted macrophytes can absorb nutrients from water and/or sediment. Therefore, the growth of phytoplankton and free-floating aquatic plants is regulated by the supply of critical available nutrients in the water column. In contrast, rooted aquatic plants can normally continue to grow in nutrient-poor water if lake sediment contains adequate nutrient concentrations. Nutrients removed by rooted macrophytes from the lake bottom may be returned to the water column when the plants die. Consequently, killing too many aquatic macrophytes may increase nutrients available for algal growth.

In general, a direct relationship exists between water clarity and macrophyte growth. That is, water clarity is usually improved with increasing abundance of aquatic macrophytes. Two possible explanations are postulated. The first is that the macrophytes and epiphytes out-compete phytoplankton for available nutrients. Epiphytes derive essentially all of their nutrient needs from the water column. The other explanation is that aquatic macrophytes stabilize bottom sediment and limit water circulation, preventing re-suspension of solids and nutrients (NALMS, 1997).

If aquatic macrophyte abundance is reduced, then water clarity may suffer. Water clarity reductions can further reduce the vigor of macrophytes by restricting light penetration. Studies have shown that if 30 percent or less of a lake areas occupied by aquatic plants is controlled, water clarity will generally not be affected. However, lake water clarity will likely be reduced if 50 percent or more of the macrophytes are controlled (NALMS, 1997).

Aquatic plants also play a key role in the ecology of a lake system. Aquatic plants provide food and shelter for fish, wildlife and invertebrates. Plants also improve water quality by protecting shorelines and the lake bottom, improving water quality, adding to the aesthetic quality of the lake and impacting recreational activities.

# Appendix C – Aquatic Invasive Species

## INVASIVE AQUATIC PLANTS

Invasive species have invaded our backyards, forests, prairies, wetlands, and waters. Invasive species are often transplanted from other regions, even from across the globe. "A species is regarded as invasive if it has been introduced by human action to a location, area, or region where it did not previously occur naturally (i.e., is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans, and spreads widely throughout the new location " (Source: WDNR website, Invasive Species, 2007). AIS include plants and animals that affect our lakes, rivers, and wetlands in negative ways. Once in their new environment, AIS often lack natural control mechanisms they may have had in their native ecosystem and may interfere with the native plant and animal interactions in their new "home". Some AIS have aggressive reproductive potential and contribute to ecological declines and problems for water based recreation and local economies. AIS often quickly become a problem in already disturbed lake ecosystems (i.e. one with relatively few native plant species). While native plants provide numerous benefits, AIS can contribute to ecological decline and financial constraints to manage problem infestations.

### EURASIAN WATERMILFOIL (MYRIOPHYLLUM SPICATUM)

EWM is the most common AIS found in Wisconsin lakes. EWM was first discovered in southeast Wisconsin in the 1960's. During the 1980's, EWM began to spread to other lakes in southern Wisconsin and by 1993 it was common in 39 Wisconsin counties. EWM continues to spread across Wisconsin and is now found in the far northern portion of the state including Manitowoc County.

Unlike many other plants, EWM does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist (WDNR website, 2007).

Once established in an aquatic community, EWM reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, EWM is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl (WDNR website, 2007).

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by EWM may lead to deteriorating water quality and algae blooms of infested lakes (WDNR website, 2007).

**CURLY-LEAF PONDWEED (POTAMOGETON CRISPUS)**

Curly-leaf pondweed (CLP) spreads through burr-like winter buds (turions), which are moved among waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making CLP one of the first nuisance aquatic plants to emerge in the spring.

The leaves of curly-leaf pondweed are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. The plant usually drops to the lake bottom by early July.

CLP becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out-compete native plants in the spring. CLP forms surface mats that interfere with aquatic recreation in mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches (WDNR website, 2007).

**PURPLE LOOSESTRIFE (LYTHRUM SALICARIA)**

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth form. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. Low densities in most areas of the state suggest that the plant is still in the pioneering stage of establishment. Areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River drainage systems.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers. Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000

seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months (WDNR website, 2007).

### OTHER AQUATIC INVASIVE SPECIES

The following AIS are not plants, but are mentioned here because they also can significantly disrupt healthy aquatic ecosystems.

**Rusty Crayfish *(Orconectes rusticus)*** are large crustaceans that feed aggressively on aquatic plants, small invertebrates, small fish, and fish eggs. They can remove nearly all the aquatic vegetation from a lake, offsetting the balance of a lake ecosystem. More information about this invader can be found at http://dnr.wi.gov/invasives/fact/rusty.htm.

**Zebra Mussels *(Dreissena polymorpha)*** are small freshwater clams that can attach to hard substrates in water bodies, often forming large masses of thousands of individual mussels. They are prolific filter feeders, removing valuable phytoplankton from the water, which is the base of the food chain in an aquatic ecosystem. More information about this invader can be found at

http://dnr.wi.gov/invasives/fact/zebra.htm.

**Spiny Water Fleas (*Bythotrephes cederstoemi)*** are predatory zooplankton (tiny aquatic animals) that have a barbed tail making up most of their body length (one centimeter average). They compete with small fish for food supplies (zooplankton) and small fish cannot swallow the spiny water flea due to the long spiny appendage. More research is being completed to determine the potential impacts of the spiny water flea. More information about this invader can be found at http://dnr.wi.gov/invasives/fact/spiny.htm.

# Appendix D – Descriptions of Aquatic Plants

# Appendix E – Summary of Aquatic Plant Management Alternatives

# Appendix F – NR 107 and NR 109 Wisconsin Administrative Code

# Appendix G – Resource for Additional Information