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AQUATIC PLANT MANAGEMENT PLAN

BULLHEAD LAKE
MANITOWOC COUNTY, WISCONSIN

April 30, 2008

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1.0 EXECUTIVE SUMMARY

In 1978 Bullhead Lake property owners formed the Bullhead Lake Advancement Association Inc. (BLAAI) to address resource management concerns on Bullhead Lake. The BLAAI has been active in a number of lake management activities on Bullhead Lake including fisheries and algal levels management. The BLAAI contracted Northern Environmental to help develop an aquatic plant management (APM) plan for Bullhead Lake after aquatic invasive species were found in 2005. The 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 and recommended specific management activities for the aquatic invasive species (AIS) on Bullhead Lake, which are discussed below.

The Wisconsin Department of Natural Resources (WDNR) completed an aquatic plant survey on Bullhead Lake in August 2005, which identified thirteen aquatic plant species. The most abundant aquatic plants identified during the survey were forked duckweed (*Lemna trisulca*), coontail (*Ceratophyllum demersum*), and filamentous algae (*Algae sp*). The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Plants sensitive to disturbances in the lake ecosystem are assigned a higher value than plants which can tolerate disturbances. The values of all species present are used in a formula to determine the plant community's FQI. Bullhead Lake exhibited an FQI of 17.7, lower than the state average (22.2), indicating below average water quality.

Eurasian watermilfoil (*Myriophyllum spicatum* – EWM) was confirmed in Bullhead Lake in 2005 and was found during the survey along with curly-leaf pondweed (*Potamogeton crispus* – CLP). Both are aquatic invasive species (AIS). CLP was found at approximately 0.46 acres with EWM covering 0.23 acres according to survey data.

Since both EWM and CLP were found to cover relatively small acreages the overall objective is to maintain the aquatic plant community on Bullhead Lake. Management efforts should focus only on chemical treatments of AIS to reduce their coverage, or at a minimum prevent them from spreading. Since the total acreages are less than 10 percent (%) or 10 acres of the lake's total surface area, any treatments are considered small scale, as defined by Wisconsin Administrative Code NR 107.04(3).

However, due to the aggressive growth patterns of these AIS and the time between the survey and this writing, there may have been an increase in area covered by CLP and EWM. Highly used recreational areas and public boat launches or access points should be given priority when considering treatment locations due to a greater potential for EWM and CLP spread from these areas. The APM plan should be updated in 2012-2013 to evaluate the aquatic plant community and to assess the current management strategies

The APM Plan involved evaluating physical, mechanical, biological, and chemical management alternatives and outlines specific management activities for CLP and EWM on Bullhead Lake.

Recommended APM Plan

This APM plan is focused on control of the aquatic invasive species discovered to be present in Bullhead Lake. A diverse native species plant community is the best protection against AIS. Aquatic invasives tend to take over when the native community is disturbed. Proper shoreland management is important to maintaining a healthy lake and plant community. Without proper shoreland management nuisance plant control is only a temporary, and costly, solution.

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The proposed management of EWM and CLP should include manual removal in isolated shallow locations. No permit is required to remove EWM along a landowner's shoreline property, but removal of native plants is restricted to a 30 foot wide recreation zone (for pier, boatlift, or swim raft access). Additional native plant removal is not recommended and would require a permit from the WDNR.

Off shore areas should be spot treated to prevent the spread of the AIS to new areas and to maintain the current aquatic plant community in Bullhead Lake. EWM and CLP treatments should be completed in the spring when native plant growth is minimal to increase the selectivity of the herbicide. Pre and post treatment monitoring should be included for all aquatic plant treatments and is a permit requirement.

New AIS distribution data will be required to accurately assess problems before action is taken. Therefore, an updated evaluation of the aquatic plant community is needed to assess any spread of AIS since the 2005 survey to initiate proper management activities.

The APM Plan also includes prevention efforts, assigns responsibilities for APM activities, and outlines a monitoring protocol to evaluate the EWM and CLP treatment effectiveness and change in the lake's aquatic plant community, and water quality.

2.0 INTRODUCTION

Bullhead Lake is a 67 acre seepage lake located in western Manitowoc County. Bullhead Lake exhibits moderate to poor water clarity and according to the Wisconsin Trophic State Index is a eutrophic lake. Eurasian water-milfoils (EWM, *Myriophyllum spicatum*) and curly-leaf pondweed (CLP, *Potamogeton crispus*), aquatic invasive species (AIS), were confirmed on Bullhead Lake during the 2005 survey.

Lake residents have become concerned about the presence of EWM and other CLP in the aquatic plant community of Bullhead Lake.

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

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2005 baseline aquatic plant survey
- Feasible aquatic plant management alternatives
- Selected suite of aquatic plant management options

3.0 BACKGROUND INFORMATION

3.1 Lake History and Morphology

Bullhead Lake is a 67-acre seepage lake located in the Town of Rockland in western Manitowoc County, Wisconsin. The lake is part of the Manitowish River watershed in the Lakeshore Basin on Lake Michigan. Figure 1 and Figure 2 depict the lake location. The following summarizes the lake's physical attributes:

Lake Name	Bullhead Lake
Lake Type	Seepage
Surface Area (acres)	67
Maximum depth (feet)	40
Mean depth (feet)	13
Shoreline Length (miles)	1.27
Public Landing	Yes

Source: Wisconsin Lakes, WDNR 2005; WDNR Lake Survey Map

Figure 3 illustrates the lake bathymetries. Bullhead Lake provides year-round recreation activities ranging from, fishing, swimming, slow-no-wake boating, snowmobiling, and more.

3.2 Watershed Overview

The Bullhead Lake watershed encompasses approximately two square miles. The area is mostly agricultural and residential. The Wisconsin Department of Natural Resources carried out a paleoecological study of Bullhead Lake in 1991 (Garrison, PUB-SS1039 2008). A paleoecological study uses a core of the sediment of the deepest part of the lake to look at historical water quality indicators. This study used concentrations of lead, aluminum, calcium carbonate, phosphorus and nitrogen to re-build the lake history. Diatoms were identified for use as indicators of the historical lake productivity. The study indicates that in the mid-1880's, prior to European settlement, the lake was probably mesotrophic with a moderate rate of sediment accumulation. Sediment rates and nutrients increased in the early 1900's, probably due to agricultural activities and the accompanying erosion and runoff. These rates lowered again in the 1960's, but increased steadily into the 1990's, again possibly in relation to agricultural activities surrounding the lake and increased usage of fertilizers. The diatom community identified also indicates that an increase in the plant community occurred in the littoral zone at the time of settlement in Bullhead Lake in response to higher nutrient loads. This study confirms that inputs from the surrounding watershed have historically affected the lake's plant community.

The Bullhead Lake area is in the Kewaunee-Manawa-Poygan soil type association. They are well drained to poorly drained soils with clayey subsoil. These soils are found on ground moraines and are nearly level to slightly sloping. The major use of this soil association is for cultivated crops (USDA, 1980).

3.3 Water Quality

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

- Water clarity (secchi depth) –1986-2005, 2007 (Citizen Lake Monitoring)
- Total Phosphorous -1988, 1991-2005, 2007 (WDNR, CLMN)
- Chlorophyll A -1991-2005, 2007 (WDNR, CLMN)
- Paleolimnology study – 1991 (WDNR, we were unable to locate report)

Water clarity is measured by lowering an 8-inch disk (secchi disk) with alternating black and white quadrants into the water until it is no longer visible. The disk is raised until it is again visible. The two readings are averaged providing the secchi depth or water clarity measurement.

Total Phosphorus is a measure of nutrients available for plant growth and chlorophyll *a* is a measure of lake productivity taken by measuring the algal pigment in the water.

3.3.1 Water Clarity

Lake water clarity is usually measured with a secchi disk. The greater the water clarity, the greater the secchi depth reading. Water clarity can be negatively affected by stormwater runoff carrying sediment to a lake and by excessive algal and phytoplankton growth. Water clarity measurements are, therefore, traditional methods of interpreting a lake's trophic state.

Secchi depth readings at the lakes deepest point have been taken several times a month during the open water season since 1986 under the Citizen Lake Monitoring Network. The historical water clarity average is 8.86 feet (2.7 meters) with a minimum at about 2 feet and a maximum at about 18.5 feet. Historical secchi readings are graphed in figure 4.

3.3.2 Total Phosphorus and Chlorophyll *a*

Historically Bullhead Lake has had an average phosphorus concentration of 35 micrograms per liter (µg/L - parts per billion), with a minimum of less than 10 µg /L and a maximum of over 100 µg/L. The concentrations appear to be highly variable, with the higher readings reflecting excessive phosphorus inputs into the lake, possibly during rain events.

Chlorophyll *a* data has been kept sporadically starting in 1991 and continued through 2005, showing an average of 9.19 micrograms per liter (μg/L - parts per billion). The highest chlorophyll *a* measurements appear to correlate with higher phosphorus concentrations, indicating that lake productivity increases due to nutrient input. Eutrophication is accelerated lake productivity due to nutrient inputs that may be naturally occurring or may be due to human land use activities. Figure 5 illustrates the data for total phosphorus and chlorophyll *a*.

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* *(μg/l)***	**Water Clarity *(meters)***
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.	0.003 to 0.01	2 to 5	3.7 to 2.4
Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	0.018 to 0.027	8 to 10	1.8
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.	0.03 to 0.05	11 to 15	1.5 to 1.2 (less is hyper-eutrophic)

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

The historical water clarity, total phosphorus, and chlorophyll *a* data indicate Bullhead Lake is eutrophic.

3.4 Summary of Lake Fishery

The following table identifies the fish species that are present in Bullhead Lake. A 1999 fisheries report noted that Bullhead Lake experienced more fishing pressure than any of the nearby lakes.

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

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

The WDNR shows records of fish being stocked in Bullhead Lake according to the table below. (WDNR Fish stocking website, 2007).

Year	Species	Number Fish Stocked
1973	MUSKELLUNGE	300
1974	NORTHERN PIKE X MUSKELLUNGE	240
1976	NORTHERN PIKE X MUSKELLUNGE	300
1977	NORTHERN PIKE X MUSKELLUNGE	300
1978	NORTHERN PIKE X MUSKELLUNGE	300
1979	NORTHERN PIKE X MUSKELLUNGE	300
1980	NORTHERN PIKE X MUSKELLUNGE	300
1983	WALLEYE	3,350
1985	WALLEYE	3,500
1989	WALLEYE	3,094
1992	WALLEYE	1,774
1994	WALLEYE	1,776
1995	WALLEYE	1,677
1997	WALLEYE	1,675
1999	WALLEYE	6,700
2001	WALLEYE	6,700
2003	WALLEYE	6,695
2005	WALLEYE	3,335

3.5 Lake Management History

While there is no history of aquatic plant management in Bullhead Lake, there is a history of aluminum sulfite ("alum") treatments to lower high phosphorus levels. Bullhead Lake falls into the Class 1A (phosphorus sensitive) DNR phosphorus classification scheme. High levels of phosphorus were causing increased algal productivity. The lake was treated with alum in 1978 and 1988 in order to remove excess phosphorus from the water column.

The WDNR has conducted several fisheries management activities on Bullhead Lake. In 1957, toxaphene was used to eradicate the fish population so that it could be re-stocked. The WDNR then carried out numerous fish stockings on the lake as presented in Section 3.4.

3.6 Goals and Objectives

BLAAI identified the following goals for aquatic plant management on Bullhead Lake.

- Manage EWM and CLP in accordance with the best available technologies
- Maintain and improve recreational opportunities

- Protect and improve fish and wildlife habitat
- Preserve native aquatic plants
- Prevent the introductions of new AIS
- Identify and protect sensitive areas
- Identify and discuss various sources of financial assistance for aquatic plant management activities
- Coordinate sound aquatic plant management practices where needed within Bullhead Lake
- Educate the Bullhead Lake community
- Increase citizen participation in lake management

4.0 PROJECT METHODS

To accomplish the project goals, the Bullhead Lake Advancement Association, Inc. (BLAAI) needs to make informed decisions regarding APM on the lake. To make informed decisions, BLAAI 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 data needed to evaluate aquatic plant management alternatives.

4.1 Existing Data Review

Northern Environmental researched a variety of background 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
- Data from WDNR files
- Past lake study reports (if available)

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 August 17, 2005 by the WDNR. 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 30 meter grid with 306 pre-determined intercept points (Figure 6). 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 using a specialized rake on a pole 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 site)
- **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.

5.0 DISCUSSION OF PROJECT RESULTS

This section describes the results of the aquatic plant survey. Information on aquatic plant ecology, native plants and aquatic invasive plants is also provided.

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.

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". AIS have aggressive reproductive potential and can contribute to a decline in lake ecology and interfere with recreational use. Common Wisconsin AIS include:

- Eurasian water-milfoil
- Curly leaf pondweed
- Zebra mussels
- Rusty crayfish
- Spiny water flea
- Purple loosestrife

Appendix C provides information on these AIS.

Eurasian water milfoil (EWM) and curly leaf pondweed (CLP) were identified in Bullhead Lake in a 2005 plant survey by the Wisconsin Department of Natural Resources.

5.3 2005 Aquatic Plant Survey

The 2005 plant survey included sampling at 302 intercept points. The aquatic macrophyte community of the Lake included thirteen floating leaved, emergent, and submerged aquatic vascular plant species during 2005. Table 2 lists the taxa identified during the 2005 aquatic plant survey. Figures 7a through 7d illustrate the locations of each species identified.

Vegetation was identified to a maximum depth of 15 feet (photic zone). Aquatic vegetation was detected at 88.9% of photic zone intercept points. A diverse plant community inhabited the lake during 2005. The Simpson Diversity Index value of the community was 0.80. The taxonomic richness was thirteen species and there was an averages of 2.65 species identified at sample points. When using only native species, this average drops to 2.63 per sample point. Table 3 summarizes these overall aquatic plant community statistics. Table 4 includes the abundance statistics for each species.

The most abundant aquatic plant identified during the aquatic plant survey was forked duckweed *(Lemna trisulca)*. It exhibited a 76.4% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected). It was present at 85.9% of the sites with vegetation, and had a 28.8% relative frequency of occurrence. Table 3 includes the abundance statistics for each species.

Lemna trisulca (Forked duckweed) has a simple, flattened leaf with a single root. This variety of duckweed is easily distinguished from the others by its "rowboat and oars" shape. Like other duckweeds, forked duckweed is free floating and gets its nutrients directly from the water. These angular duckweeds are often tangled together and form a mass. As with other duckweeds, forked duckweed is a good food source for waterfowl while the masses provide cover for fish and invertebrates (Borman, et al., 1997).

Forked Duckweed
Source: UW Herbarium Website

Coontail (*Ceratophyllum demersum*) was the second most abundant vascular plant species. It exhibited a 72.2% frequency of occurrence. It was present at 81.3% of the sites with vegetation, and had a 27.2% relative frequency of occurrence.

Coontail
Source: UW Herbarium Website

Ceratophyllum demersum (coontail) is one of the most widely distributed aquatic plants within Wisconsin. The plant lacks true roots and can be found in water up to 16 feet deep. The leaves are arranged in a whorled fashion and are stiff and located closer together at the tip of the plant, giving it the appearance of a raccoon tail. Coontail is excellent habitat for invertebrates, especially in the winter when most other plants have died. The plant itself is food for waterfowl and provides shelter and foraging opportunities for fish (Borman, et al., 1997). Coontail may be mistaken for EWM.

Filamentous algae *(Algae sp.)* was the third most abundant vascular plant species. It exhibited a 43.1% frequency of occurrence. It was present at 48.4% of the sites with vegetation, and had a 16.2% relative frequency of occurrence.

Curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are both AIS and were found during the 2005 aquatic plant survey. CLP occurred at 2 sample points and exhibited a 1.39% frequency of occurrence, was present at 1.56% of the sites with vegetation, and had a 0.52% relative frequency of occurrence.

EWM occurred at 1 sample point and exhibited a 0.69% frequency of occurrence, was present at 0.78% of the sites with vegetation, and had a 0.26% relative frequency of occurrence. Based on the data collected, CLP covers approximately 0.46 acres while EWM covers 0.23 acres. See appendix C for additional information regarding these AIS.

5.3.1 Free-floating Plants

The following free-floating aquatic plant species was identified during the 2005 aquatic plant survey.

- *Lemna trisulca* (forked duckweed)

5.3.2 Floating-Leaf Plants

The following floating-leaf aquatic plant species was identified during the 2005 aquatic plant survey

- *Nuphar variegata* (Spatterdock)

5.3.3 Submergent Plants

The following nine submergent aquatic plant species were identified during the 2005 aquatic plant survey.

- *Algae sp.* (Filamentous algae) [alga]
- *Ceratophyllum demersum* (coontail)
- *Chara sp.* (chara or muskgrass) [algal]
- *Myriophyllum sibiricum* (northern water-milfoil)
- ***Myriophyllum spicatum* (Eurasian water-milfoil)**
- *Potamogeton amplifolius* (large-leaf pondweed)
- ***Potamogeton crispus* (curly-leaf pondweed)**
- *Potamogeton zosteriformis* (flat-stem pondweed)
- *Ranunculus aquatilis* (stiff water crowfoot)
- *Stuckenia pectinata* (sago pondweed)

5.3.4 Emergent Plants

The following two emergent aquatic plant species were identified during the 2005 aquatic plant survey.

- *Schoenoplectus acutus* (hard-stem bulrush)
- *Typha sp.* (cattail)

Table 1 lists the species identified. Appendix D includes brief descriptions of all aquatic plants identified.

5.4 Floristic Quality Index

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts. The 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 2005 aquatic plant survey data was 17.71. This FQI value is below Wisconsin's median of 22.2 and suggests that Bullhead Lake exhibits below average water quality when using aquatic plants as an indicator. Table 5 summarizes the FQI values.

6.0 MANAGEMENT ALTERNATIVES

Depending on the goals of the stakeholders, several alternatives are available for an aquatic plant management plan. Some general alternatives are discussed below. More information on management alternatives is included in Appendix E.

6.1 Maintenance Alternative

This alternative may be used at a lake in which a healthy aquatic plant community exists and invasive and non-native plant species are generally not present. The maintenance alternative is a protection-oriented management alternative as no significant plant concerns exist or no active management is required.

This alternative can include an education 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. Measures for the prevention of the introduction of AIS to the lake should also be included.

6.2 Management Alternatives

There are several alternatives available for management of nuisance aquatic plant growth or aquatic invasive plant species. The following are general descriptions of some of the more common alternatives.

6.2.1 Manual Removal

Manual removal efforts include hand raking or hand pulling individual unwanted plants from the water. Specialized rakes are available for this purpose. All aquatic plant material must be removed from the water to keep fragments from reestablishing plants in a new location. Portions of roots may remain in the sediments, so removal may need to be repeated periodically. This technique is well suited for small areas in shallow water. Snorkeling or diving with a mask is another technique often used for manual removal. Scuba divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal include low cost compared to other control methods. The drawback of this alternative is raking or pulling aquatic plants can be quite labor intensive. Hiring laborers to remove aquatic vegetation is an option, but also increases cost and requires a permit.

Manual removal of aquatic vegetation by individual landowners can be completed to a maximum width of 30 feet to provide pier, boatlift or swimming raft access (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. Removal of AIS only beyond the 30 foot recreation zone does not require a permit. 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 (NR 109). Appendix F includes a copy of NR 109. Additional native plant removal is not recommended as it may actually facilitate the encroachment of AIS.

Suction Assisted Harvesting

Suction assisted harvesting is considered manual harvesting, but WDNR is considering mechanical harvesting permits because the assistance of a powered device is involved. The suction system is run off a barge or modified pontoon boats with steps in this process completed as follows:

- Plants are fed into a suction tube by a diver making sure to follow the plant to its base and remove the roots.
- The plant mass is transported to a capture device (barrel) where the transport water is drained and returned to the lake while the plants remain.
- Plants are removed from the barrel, bagged, and properly disposed of.

A great benefit of this method is, if plants are identified properly, it exhibits a high degree of selectivity towards exotic species. However, the process is very labor intensive, expensive and is still in the early stages of development. As of this writing, the process is under review by the WDNR and awaiting approval as a management alternative.

6.2.2 Mechanical Harvesting

Mechanical harvesting is the removal of aquatic plants from a lake using a harvester machine that cuts the plants and collects them on the harvester for transport to the shoreline for off-site disposal. Harvesters have a cutting head that can be raised or lowered to a desired depth up to 5 feet. Large scale harvesting operations may involve additional equipment including a transport barge and shore conveyor. Harvesting is often used for large areas with dense monotypic AIS plant growth that significantly impedes boating or recreation on the lake. Advantages of this technology include: immediate relief to for recreation; removal of plant material; and the flexibility to move to problem areas and at multiple times of the year "as needed". Disadvantages of this method include: the limited depth of operation to shallow areas; continuous need to repeat harvesting an area throughout the summer; high initial equipment costs; maintenance, labor, and insurance costs; disposal site requirements; possibility of increasing the spread of AIS by creating fragments; the need for trained staff; and the fact that it will not restore native vegetation or reduce stem area of AIS on the lake bottom. A WDNR permit is required by NR 109 for aquatic plant harvesting.

6.2.3 Biological Controls - Milfoil weevils

The use of aquatic weevils (*Euhrychiopsis lecontei*) is a biological control option that has shown effective EWM control in some Wisconsin lakes. The aquatic weevil is native to Wisconsin and normally is present in healthy stands of northern water-milfoil. The weevils however, prefer to feed on EWM plants. The weevil burrows into the plant's stem, destroying plant tissue. Increasing a natural population of weevils can be a costly endeavor but EWM reductions can be observed if the weevil population is maintained. This management alternative is best suited for lakes with limited shoreline development because the insects need to over-winter on a shoreline with vegetation and adequate leaf litter.

Additional biological controls, such as grass carp, are commonly used in other states. Wisconsin law does not allow for the use of such controls; therefore they are not discussed in this APM plan.

6.2.4 Selective Aquatic Herbicides

Chemical herbicides or pesticides designed for aquatic use can be used to eliminate or significantly reduce the abundance of unwanted aquatic plant species. The United States Environmental Protection Agency (EPA) researches aquatic pesticides and determines what product can be registered for aquatic use. Aquatic pesticides registered for use in Wisconsin require a strict registration process and most demonstrate they are safe for the environment and do not pose a risk to human health when used according to label requirements. Numerous aquatic herbicides are registered for aquatic use and are designed to target specific plant types.

Herbicides can be grouped into two general categories, contact and systemic. A contact herbicide will kill any part of the plant it contacts. Plant tissue not exposed to the chemical may survive. A systemic herbicide is taken up within the plant tissue, translocated throughout the plant, and destroys the entire plant.

Herbicides are also categorized as broad based, ones that can kill many different plant species, and selective, ones that can kill a targeted plant species if applied correctly.

The WDNR requires a permit (Chapter NR 107. Wis. Adm. Code) for aquatic herbicide applications in public waters. Appendix F includes a copy of NR 107. The product must be approved for aquatic use in Wisconsin and the applicator must be certified with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP) and licensed by WDNR. Advantages of herbicides include better control in confined areas (e.g. around docks) than harvesters can achieve. Disadvantages include negative public perception of chemicals, 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.

7.0 RECOMMENDED ACTION PLAN

Excessive growth of filamentous algae in Bullhead Lake has caused concern for years. Unnaturally high levels of phosphorus are the most likely cause for this excessive growth. The discovery of the presence of EWM and CLP in 2005 prompted increased concern. WDNR informed BLAAI that an APM Plan should be developed for Bullhead Lake to obtain future permits for plant management. A necessary component of an APM Plan is an evaluation of chemical, mechanical, biological, and physical aquatic plant control methods. While there may be additional AIS control measures used elsewhere (e.g. grass carp, or alternative herbicides), only those options approved for use in Wisconsin are discussed here. Appendix E includes a comprehensive description of available APM techniques, including descriptions about the technology, benefits, and drawbacks.

This APM plan is focused on control of the aquatic invasive species discovered to be present in Bullhead Lake. However, a diverse native species plant community is the best protection against AIS. Aquatic invasives tend to take over when the native community is disturbed. Proper shoreland management is important to maintaining a healthy lake and plant community, therefore landuse practices that limit soil and nutrient runoff into the lake should be maintained or implemented.. Without proper shoreland management nuisance plant control is only a temporary, and costly, solution.

To accomplish the APM Plan goals, the BLAAI has developed an action plan. This plan selects appropriate aquatic plant management techniques for Eurasian Water Milfoil and Curly-leaf Pondweed growth on

Bullhead Lake based on the evaluations completed in Section 6. The specific management recommendations, including monitoring, responsibilities, protection of native aquatic plants, education, prevention efforts and funding, are discussed in the following sections.

This APM Plan should be updated periodically to reflect current aquatic plant problems as they are discovered through monitoring, and the most recent acceptable APM methods. Information is available from the WDNR website: http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm or from Northern Environmental upon request.

7.1 Manual Removal of AIS

Manual removal of aquatic plants is often used by riparian landowners to provide a small recreational clearing. Manual removal is also becoming an increasingly popular way of managing small AIS infestations. With the densities of CLP and EWM as low as they are on Bullhead Lake it is highly recommended that lake users hand remove the CLP or EWM they see. A diving mask is a good tool for this exercise. Landowners removing plants manually should learn to identify EWM and CLP and other look-alike native species. If an individual has questions about a particular aquatic plant or what level of manual removal is allowed, they should talk to BLAAI representative or a WDNR plant specialist. Appendix F includes additional resources for plant identification. Removing individual "pioneer" AIS plants is very important and can save a great deal of time and money down the road.

7.2 Update Available Data

Aquatic plant communities can vary greatly between years, especially with the presence of aggressive AIS. With both CLP and EWM present in Bullhead Lake, the 2005 survey may not accurately depict the current distribution of these AIS within the lake. A complete updated understanding of the aquatic plant community may be required to properly address AIS growth. The WDNR recommends complete plant surveys every 5 years. BLAAI should conduct a new survey in 2010.

If BLAAI chooses to initiate plant management activities, the following is recommended:

- AIS mapping for CLP and EWM populations according to WDNR pre- and post- treatment monitoring protocols
- Complete aquatic plant survey in 2010

7.3 Mechanical Harvesting

Mechanical harvesting is a non-selective aquatic plant management option. Harvesting can stress native plants while spreading EWM through un-collected fragments and is not recommended on Bullhead Lake.

7.4 Biological Controls - Milfoil Weevils

It is not recommended milfoil weevils be considered a management alternative for EWM control. No harm could be done by supplemental stocking of weevils but a great deal of money could be wasted. Supplemental stocking of weevils is also not recommended due to the small EWM acreage, limited native milfoil. These observations both indicate that natural weevil populations or weevil augmentation may not be a suitable EWM management option for Bullhead Lake. If control by weevils is highly desired by lake users then Northern Environmental recommends contacting the UW Extension Lakes Program to inquire about citizen based weevil surveys to assess current weevil presence as a first step.

7.5 Aquatic Herbicide

The WDNR requires a permit (Chapter NR 107. Wis. Adm. Code) for aquatic herbicide applications in public waters. Appendix F includes a copy of NR 107. The product must be approved for aquatic use in Wisconsin and the applicator must be certified with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP) and licensed by WDNR. Advantages of herbicides include better control in confined areas (e.g. around docks) than harvesters can achieve, as well as a targeted killing of plants rather than a pruning. Disadvantages include negative public perception of chemicals, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year) and possible water-use restrictions after application.

All treatments will need to be completed in accordance with a permit issued under NR 107, Wis. Adm. Code. No nuisance levels of native plants should be treated on a large scale. A commercial aquatic pesticide applicator, certified with the Wisconsin Department of Agriculture and Consumer Protection (DATCP) and licensed by the WDNR, should be hired to treat nuisance EWM and CLP beds as local funding allows. The applicator should specify in the NR 107 permit application the chemical application size, rate, and location of proposed treatment areas. A list of licensed applicators may be available from DATCP or on the "Lake List" located at UW Extension Lakes Program website at http://www.uwsp.edu/cnr/uwexlakes/lakelist/ where people can search for companies offering select APM services by company name or area of expertise

7.5.1 Herbicide Treatment

CLP was found at two sample points covering approximately 0.46 acres during the 2005 survey. New distribution data should be collected before any treatments begin (See 7.5.2). A few herbicides have demonstrated CLP control. The three WDNR-approved herbicides are Diquat, Endothall and Fluridone. Endothall and Diquat are both fast acting contact herbicides. Diquat binds to sediments readily and its effectiveness is reduced by turbid waters. Endothall is not readily transferred to other plants tissue, therefore re-growth can be expected and repeated treatments may be needed. Fluridone is capable of killing the roots of plants, producing a longer lasting effect. Fluridone and Endothall are effective for both EWM and CLP, both present in Bullhead Lake. Endothall is the recommended herbicide because of CLP's high susceptibility to this chemical, allowing for greater reduction in CLP coverage after the first treatment. Northern Environmental recommends that BLAAI look into a small-scale chemical treatment of areas occupied by CLP. The sooner pioneer infestations of CLP are brought under control the better and more cost effective control will be.

EWM was also found on Bullhead Lake at one sample point covering approximately 0.23 acres. EWM beds present beyond the 30 foot manual removal zone or too dense for effective hand removal efforts should be treated with an aquatic herbicide containing 2,4-D registered with the State of Wisconsin for use on public waters. 2,4-D products have demonstrated selective control of EWM if applied correctly. Northern Environmental recommends that BLAAI chemically treat the entire .23 acre area occupied by EWM with a granular form of 2,4-D or otherwise make sure the plants are destroyed. Again, the sooner pioneer infestations of EWM are brought under control the better and more cost effective control will be.
.
Northern Environmental has been experiencing great success using Endothall and liquid 2,4-D (Weedar) in tandem in areas where both CLP and EWM occur. The WDRN has been allowing this in some regions and the local managers are impressed with the results. If the CLP and EWM continue to increase in abundance this may be a good management choice for the lake.

Chemical treatment should occur once EWM has reached its active growth period (EWM begins active growth after CLP). However, one potential follow up "spot treatment" may also be needed which will be determined by completing a post-treatment aquatic plant survey one month after the initial treatment. All NR 107 public notice and water use restriction posting requirements should be followed if applicable. A public notice must be filed in the local newspaper if the treatment is greater than 10 acres or the treatment area is greater than 10% of the lake's area 10 feet deep or less (littoral zone), and a public hearing held if requested. All property owners within or adjacent to treatment areas should be notified with a copy of the permit application and map indicating the proposed treatment areas. A yellow sign describing the treatment must be posted by the dock or shoreline of any properties being treated.

Since both EWM and CLP were found to cover relatively small acreages the overall objective is to maintain the native aquatic plant community on Bullhead Lake. Management efforts should focus only on chemical treatments of AIS to reduce their coverage, or at a minimum prevent them from spreading. Since the total acreages are less than 10 percent (%) or 10 acres of the lake's total surface area, any treatments to these EWM and CLP bed would be considered small scale, as defined by Wisconsin Administrative Code NR 107.04(3).

Highly used recreational areas and public boat launches or access points should be given priority when considering treatment locations due to a greater potential for AIS spread from these areas. The APM plan should be updated in 2012-2013 to evaluate the aquatic plant community and to assess the current management strategies.

7.5.2 Herbicide Treatment Monitoring

Pre- and post-treatment, species specific vegetation mapping is required by WDNR for most herbicide treatment programs. If chemical treatment is pursued all known EWM and CLP beds targeted should be surveyed by WDNR or a hired professional such as Northern Environmental. GPS (preferably one with sub-meter accuracy) should be used to gather locational data, and the beds should be mapped.

The abovementioned verification of EWM beds should occur in late summer or early fall, when EWM will have achieved its maximum growth (the exiting aquatic plant survey will serve this purpose if treatment is implemented soon; check with local WDNR Lakes Coordinator). Surveys designed to capture CLP should be conducted earlier in the year before CLP starts decomposing (usually around the beginning of July). The permit application process should begin in the fall prior to the year of the proposed treatment. The aquatic plant survey should be used to determine potential treatment acreages. A spring EWM and CLP assessment or "pre-treatment survey" should be completed each year to verify and modify the permit application immediately prior to the actual EWM and CLP treatment. This pre-treatment survey allows the permit application to be modified to accurately reflect proposed treatment areas and current EWM and CLP locations/acreages. This modification request should be submitted in writing to WDNR along with a map of proposed treatment areas. Post-treatment monitoring will take place after the herbicide treatment has occurred as a way to evaluate the effectiveness of the chemical treatment.

7.6 Schedule of Events

The following table describes a schedule of required activities for the EWM and CLP treatment program on Bullhead Lake.

Activity	Frequency	Date
Littoral Zone Survey	One year	Summer, 2008
Mapping of EWM and/or CLP or Post-Treatment Survey*	Annually	CLP-No later than May 31st EWM-No later than September 30th
Establish Priority Treatment Areas	Annually	October 30th
Prepare NR 107 Permit Application for Grant and Conditional Permit Purposes	Annually	December 1st
Prepare DRAFT WDNR AIS Control Grant Application	Annually/Multi-year	January 1st, 2009
Submit WNDR AIS Control Grant Application	Annually	February 1st
Pre-treatment Survey	Annually	2 weeks after ice-out or when EWM plants are approximately 6 inches tall or prior to CLP turion formation
EWM and/or CLP Treatment or CLP Intensive Harvesting	Annually	Before May 31st or before water temperatures reach 60°F
BLAAI Budget Voting	Annually	??
Town Budget Voting	Annually	??
Lake wide Aquatic Plant Survey	Every 5 years	August, 2010
Update APM Plan	Every 5 years	December 1, 2010

7.7 Designation of Responsibility

The following table assigns responsibility for the EWM and CLP treatment program events listed above. When the BLAAI is identified as a responsible party, these entities should identify which individual, or committee should complete the specified activity.

Activity	Responsible Party
Littoral Zone Survey	Aquatic Plant Professional
Mapping of EWM and CLP or Post-Treatment Survey	Aquatic Plant Professional with assistance from trained volunteers
Establish Priority Treatment Areas	BLAAI WDNR and Aquatic Plant Professional
Prepare NR 107 Permit Application (*for grant purposes*)	Certified/Licensed Applicator or BLAAI
Prepare DRAFT WDNR AIS Control Grant Application	BLAAI or Aquatic Plant Professional
Submit WDNR AIS Control Grant Application	BLAAI or Aquatic Plant Professional

Pre-treatment EWM Survey	Aquatic Plant Professional
EWM/CLP treatment	Certified/Licensed Applicator
Lake District Budget Voting	BLAAI
Town Budget Voting	Town
Lake-wide Aquatic Plant Survey	Aquatic plant Professional hired by BLAAI or Town
Update APM Plan	Aquatic Plant Professional, BLAAI and WDNR

7.8 Prevention Efforts

The following sections discuss recommended activities to protect a healthy native plant community, and prevent the spread of new AIS into Bullhead Lake. Prevention efforts can also prevent the spread of AIS from Bullhead Lake into other area lakes.

7.8.1 Watercraft Inspection

A basic watercraft inspection program should be developed for Bullhead Lake. Education of the public, along with private property and resort owners, about inspecting watercraft for AIS before launching the boat or leaving access sites on other lakes could help prevent new AIS infestations. Proper signage at popular boat entry locations can also be useful. Training and signage are available through the Clean Boat/ Clean Waters (CB/CW) Program developed by the University of Wisconsin Extension Lakes Program. The CB/CW efforts involves providing information to lake users about what invasive species look like and what precautions they should take to avoid spreading them. It also involves visual inspection of boats to make sure they are "clean" and demonstration to the public of how to take the proper steps to clean their boats and trailers. For more information see the following website:

http://www.uwsp.edu/cnr/uwexlakes/CBCW/default.asp

Any volunteer hours accrued with the CB/CW program or any other AIS monitoring done by BLAAI members can be counted towards matching grant funds up to a maximum of $8.00 an hour. Essentially, this allows for more grant money to be awarded at no additional cost to BLAAI. Accordingly, use of personal equipment (boat, GPS, etc.) or expenses (postage, printing, or supplies) may also count towards matching funds. However, to be eligible a write-up of expected donated hours must accompany the grant application and hours volunteered prior to the grant project are not eligible for matching funds. It is recommended the DNR Lake coordinator be contacted for proper forms and help in determining the value of donated, volunteer time.

7.8.2 Aquatic Plant Protection and Shoreline Management

Protection of the native aquatic plant community is needed to slow the spread of EWM and CLP. Therefore, riparian landowners should refrain from removing native vegetation. Additionally, EWM and CLP, as well as algae, can thrive in nutrient (phosphorus and nitrogen) enriched waters or where nutrient rich sediments occur. Bullhead Lake was treated with alum in 1978 and 1988 in an effort to decrease availability of phosphorus in the water column. Two simple actions can prevent excessive nutrients and sediments from reaching the lake without chemical treatment.

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. Establishing natural shoreline vegetation can sometimes be as easy as not mowing to the waters edge. 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 shoreline buffer area can also prevent surface water runoff from roads, fields, parking areas and lawns from carrying nutrients into the lake.

The second easy nutrient prevention effort is to use lawn fertilizers only when soil tests show 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. Appendix G includes resources for further information about these AIS Prevention efforts.

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.

7.9 Public Education and Involvement

Public involvement and education efforts included a presentation by Northern Environmental with BLAAI members on August 18, 2007 to discuss the APM Plan project. One of the objectives of this meeting was to focus the APM Plan on the concerns of lakeshore landowners and lake users. Some landowners were concerned about excess algal growths and nuisance plant growth around their properties. The presentation included a discussion of some of the causes of excessive algal growth and prevention methods (included here in Section 7.8.2). There was greater concern over the existence of AIS in Bullhead Lake and the discussion included the possible affects of AIS on a lake’s ecology. Several attendees indicated that they would be interested in volunteer monitoring for AIS. The BLAAI has begun to research training possibilities for volunteers.

The BLAAI should continue to keep abreast of current AIS issues throughout the County and supply information to lake users. The County Land and Water Resource Conservation Department and the WDNR Lakes Coordinator, and the UW Extension are good sources of information and public education materials. Many useful documents 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.

The utilization of citizen volunteer monitoring and active Clean Boats/Clean Waters AIS prevention activities is recommended.

7.10 Monitoring

To evaluate the effectiveness of the APM Program, monitoring of multiple components should be completed. Some of these are discussed in the section(s) above related to a specific management activity, but are re-iterated here in the context of overall monitoring efforts.

7.10.1 Aquatic Plant Monitoring

In some lake systems, native aquatic plants "hold their own" and AIS never grow to nuisance levels, in others, however vigilant management is required. Areas that have not been treated or were treated in previous years should also be monitored to see if native plant communities have inhibited further spread of AIS. Additionally, the lake should be monitored for new or expanding AIS infestations.

Bullhead Lake should undergo complete pre-treatment and post-treatment EWM and CLP monitoring to gauge the effectiveness of herbicide treatments. See section 7.2 for monitoring dates and assignment of responsibility for herbicide treatment monitoring.

Several BLAAI members have expressed interest in volunteer monitoring. The BLAAI board has begun to take steps to get training for volunteers. To monitor for AIS, the lake should be split into sectors with 2 BLAAI members serving as monitors per sector. The monitors survey the sectors by boat from May through August looking for any sign and/or location of any AIS. If an AIS is located, the position is recorded via GPS and approximate size and density of the bed is taken as well. Monitors return to each recorded site during each survey period to check for any change in size or health of the located AIS. To assist in this monitoring, the table below outlines approximated dates for AIS monitoring split by species. Shaded cells indicate growth cycle period and best times to monitor for the respective species.

	April	May	June	July	August	September
Eurasian Water-Milfoil						
Sprout	■	■				
Growth		■	■	■		
Bloom				■	■	
Die Back						■
Curly-Leaf Pondweed						
Sprout	■					
Growth	■	■				
Bloom		■	■			
Die Back			■	■		
Purple Loosestrife						
Sprout		■				
Growth		■	■	■		
Bloom				■	■	
Die Back						■
Zebra Mussel		■	■	■	■	■
Rusty Crayfish			■	■	■	■
Spiny Water Flea			■	■	■	■

Source: Aquatic Invasive Species – A Guide for Proactive and Reactive Management, 2006.

WDRN also recommends completing complete aquatic plant surveys every 5 years (essentially repeating the 2005 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.

7.10.2 APM Technologies

The APM technologies listed in Appendix E should be re-visited periodically to evaluate if new or improved alternatives are available. The professional environmental science community includes universities, state natural resource agencies (e.g. WDNR), and federal agencies (e.g. EPA, United States Army Crops of Engineers [USACE]) are excellent sources for information. Appendix G includes resources for further information about APM alternatives and current research. This activity should be completed in conjunction with an overall APM Plan update effort, which includes a lake wide aquatic plant survey.

7.10.3 Lake Users

Periodically, the lake users should be polled to evaluate their perception of APM activities on the lake. A questionnaire, telephone interviews, face to face interviews, web-based online surveys, and focus groups are examples of polling tools.

7.10.4 Water Quality

Data provided on the WDNR citizen monitoring website suggest "Self Help" citizen monitoring of water clarity was last completed in 2005. Members of the lake should consider becoming an active Citizen Lake Monitor for water quality (secchi depth, total phosphorus and chlorophyll *a*). At a minimum, water clarity (secchi depth) monitoring is recommended. Secchi depth monitoring is an easy volunteer activity that yields useful information about lake health over the long term. For more information, please visit:

http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/shlmhowto.htm

7.11 Funding

Since both CLP and EWM were not identified on Bullhead Lake prior to the 2005 survey, they can be considered pioneer populations. This allows BLAAI to apply for an Aquatic Invasive Species Rapid Response Grant to help in funding any AIS control methods. This grant has no deadline and may be applied for at any time of the year up to a maximum state share of $10,000 at a 75% cost-share.

The BLAAI should evaluate if their existing and sustainable funding mechanisms are adequate for continued EWM and CLP management activities listed in this recommended action plan. First, all available volunteer roles should be filled if possible. Then, cost estimates or professional bids should be solicited for the remaining activities (e.g. monitoring and EWM/CLP) from professional firms. These cost estimates can be used to budget for needed activities.

One example of how funding APM efforts could work is individual lake association members can determine what individual property owners are willing to pay for AIS treatment and/or implementation of the suction assisted harvesting. This dollar amount can then be presented to the townships through a BLAAI/town liaison who can decide what the township may be willing to sponsor for additional management dollars. Collectively, these funds can then be used as local matching funds in combination with credit for volunteer activities to apply for cost sharing assistance from the WDNR AIS Control grant program. Qualified lake associations and local governments are both eligible applicants, but funding preference goes to local units of government. Eligible projects include monitoring, permit fees, and EWM treatment. The application deadlines are February 1st and August 1st annually. A proposed schedule and assignment of responsibility are provided in Section 7.2. For more detailed information about AIS Control grants, please visit:

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/invasivespecies.html

A second source for EWM and CLP control projects is the WDNR Recreational Boating Facilities (RBF) grant program. Projects are presented to the Wisconsin Waterways Commission (WWC) which meets approximately four times per year to review project presentations. This program funds 50 % of eligible activities.

http://www.dnr.state.wi.us/org/caer/cfa/Grants/recboat.html

If the above funding combinations appear woefully inadequate to fund the management activities, then additional sources should be considered. Other funding alternatives may include:

- Additional State grant assistance
- Private (landowner) funding
- Countywide sales or room tax
- Resource user fee (e.g. AIS boat sticker)
- Property tax or special assessment
- Federal invasive species management partnerships

These sources would require government action at the State and/or County levels

7.12 Closing

This APM Plan was prepared in cooperation with the BLAAI. 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 Northern Environmental.

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FIGURES

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TABLES

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APPENDIX A

POINT INTERCEPT SAMPLE COORDINATES

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APPENDIX B

IMPORTANCE OF AQUATIC PLANTS TO LAKE ECOSYSTEM

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).

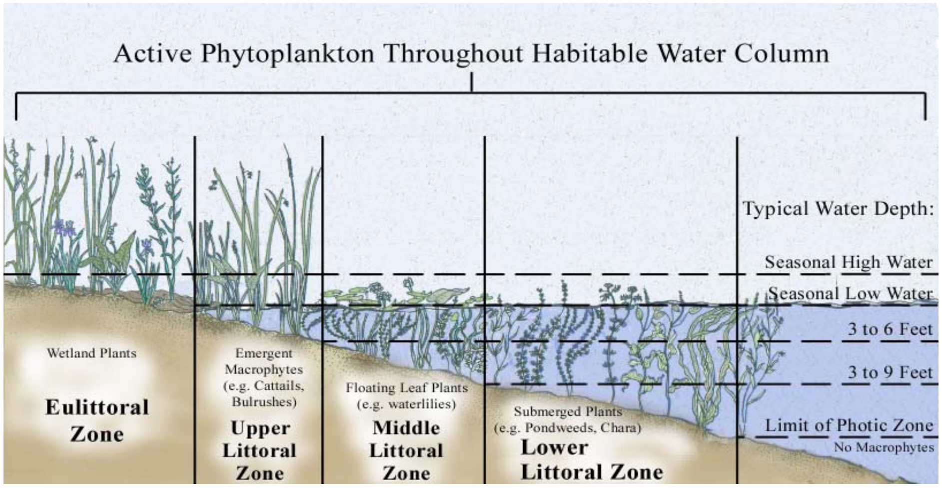
Eulittoral Zone: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

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

Middle Littoral Zone: BLAAIupies 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).

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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, an inverse 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 BLAAIupied 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.

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APPENDIX C

AQUATIC INVASIVE SPECIES

Invasive Aquatic Plants

Invasive species have invaded our backyards, Ocontos, 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 BLAAIur 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, 2005). 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 Water-milfoill *(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 Oconto and Oconto Counties.

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, 2005).

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, 2005).

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, 2005).

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, 2005).

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 seepage 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, 2005).

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 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 Flea (*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.

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APPENDIX D

DESCRIPTONS OF AQUATIC PLANTS

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APPENDIX E

SUMMARY OF AQUATIC PLANT MANAGEMENT ALTERNATIVES

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APPENDIX F

NR 107 AND NR 109 WISCONSIN ADMINISTRATIVE CODE

APPENDIX G

RESOURCE FOR ADDITIONAL INFORMATION

AQUATIC PLANT MANAGEMENT PLAN

BULLHEAD LAKE
MANITOWOC COUNTY, WISCONSIN

April 30, 2008

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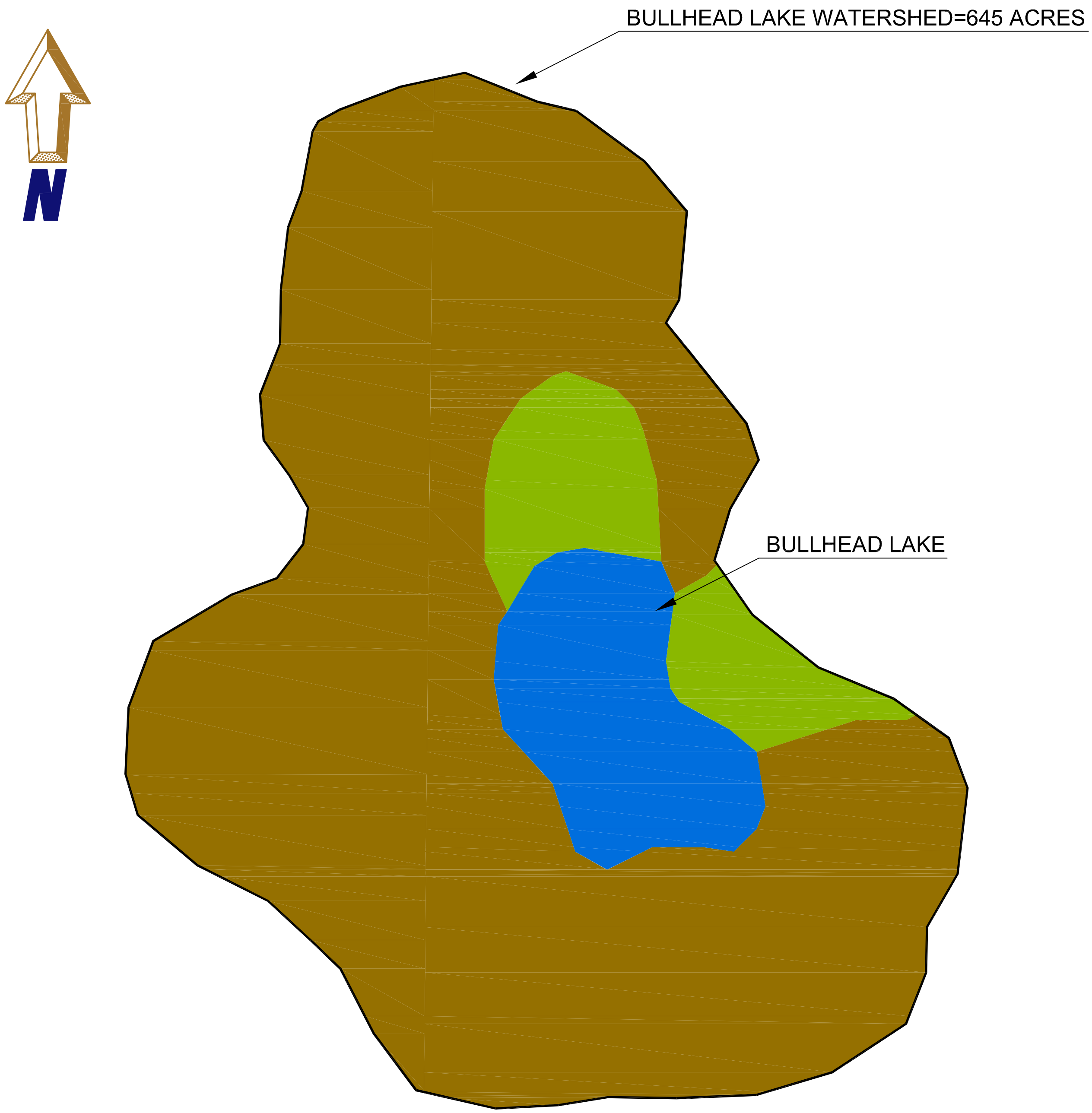
Lake Location Map

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

DATE: 11/07/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 1



LEGEND

(brown)	LEVEL 2 (AGRICULTRE)= 520 ACRES
(blue)	LEVEL 5 (OPEN WATER) = 66 ACRES
(green)	LEVEL 6 (WETLANDS) = 59 ACRES

TOTAL = 645 ACRES

Note: Landuse obtained from WDNR WISCLAND Data 1993

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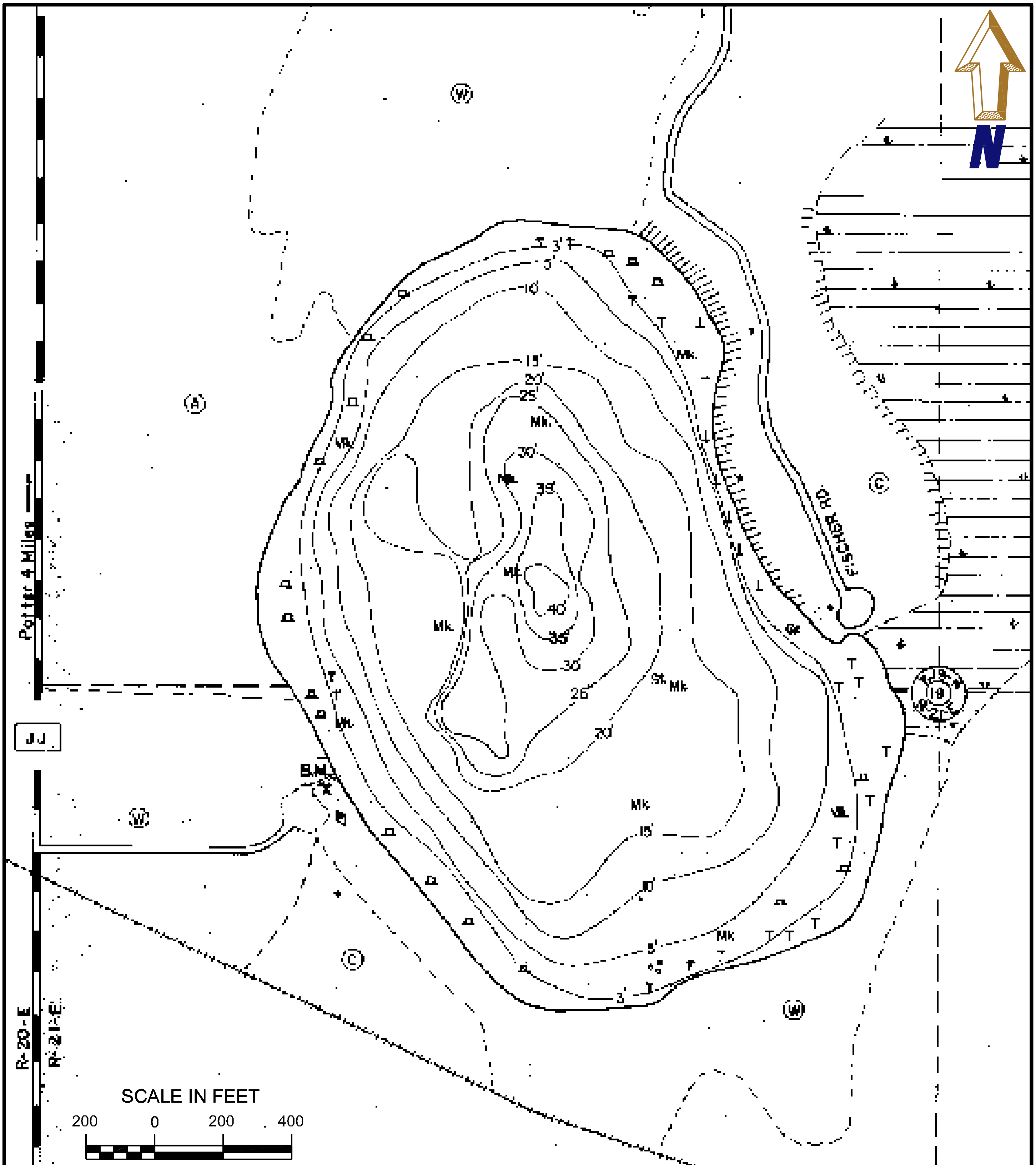
Lake Watershed and Landuse

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

DATE: 08/20/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 2



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Bathymetry Map

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

DATE: 08/20/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL-5500-0793	FIGURE 3

Figure 4: Bullhead Lake Secchi Readings

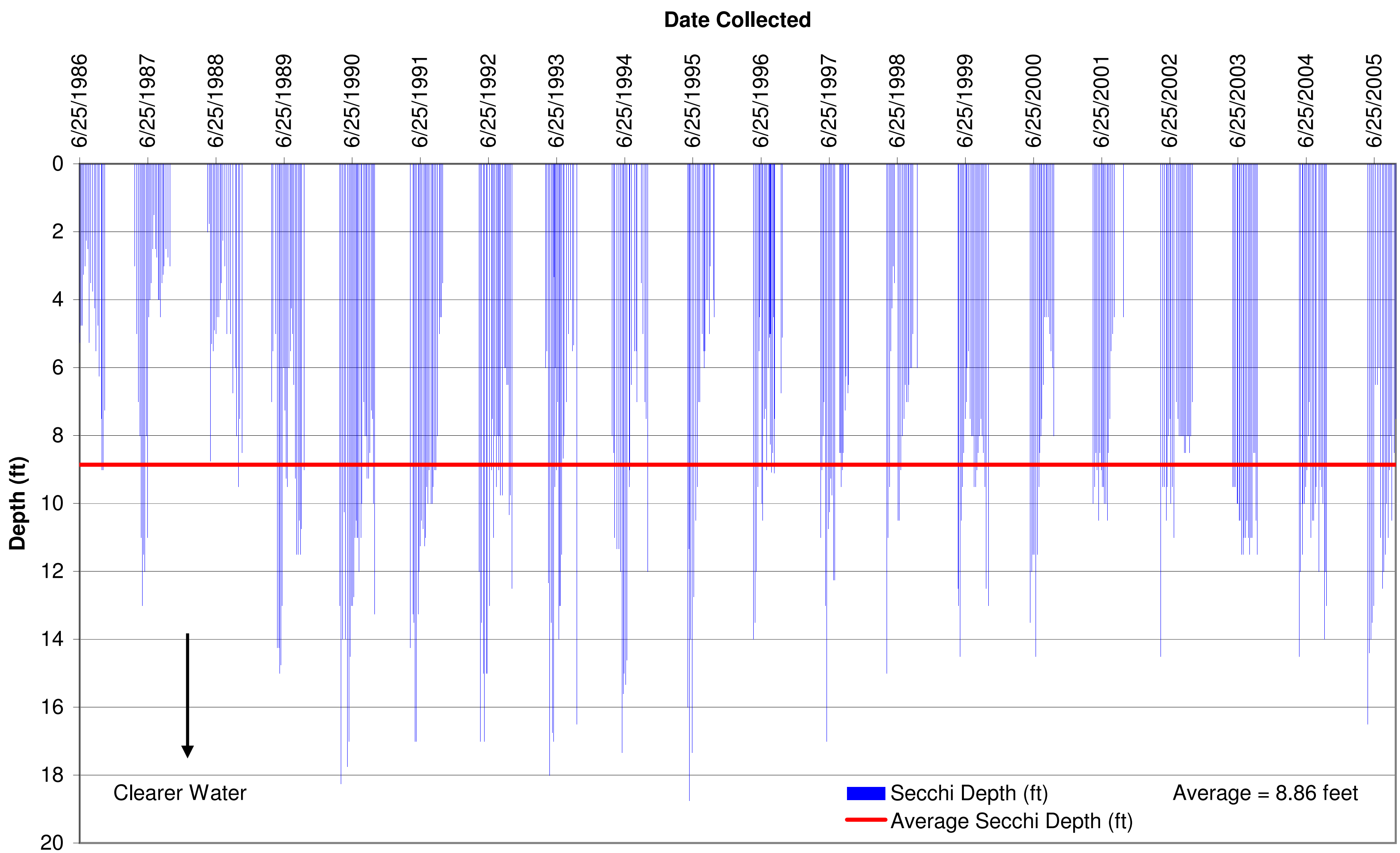
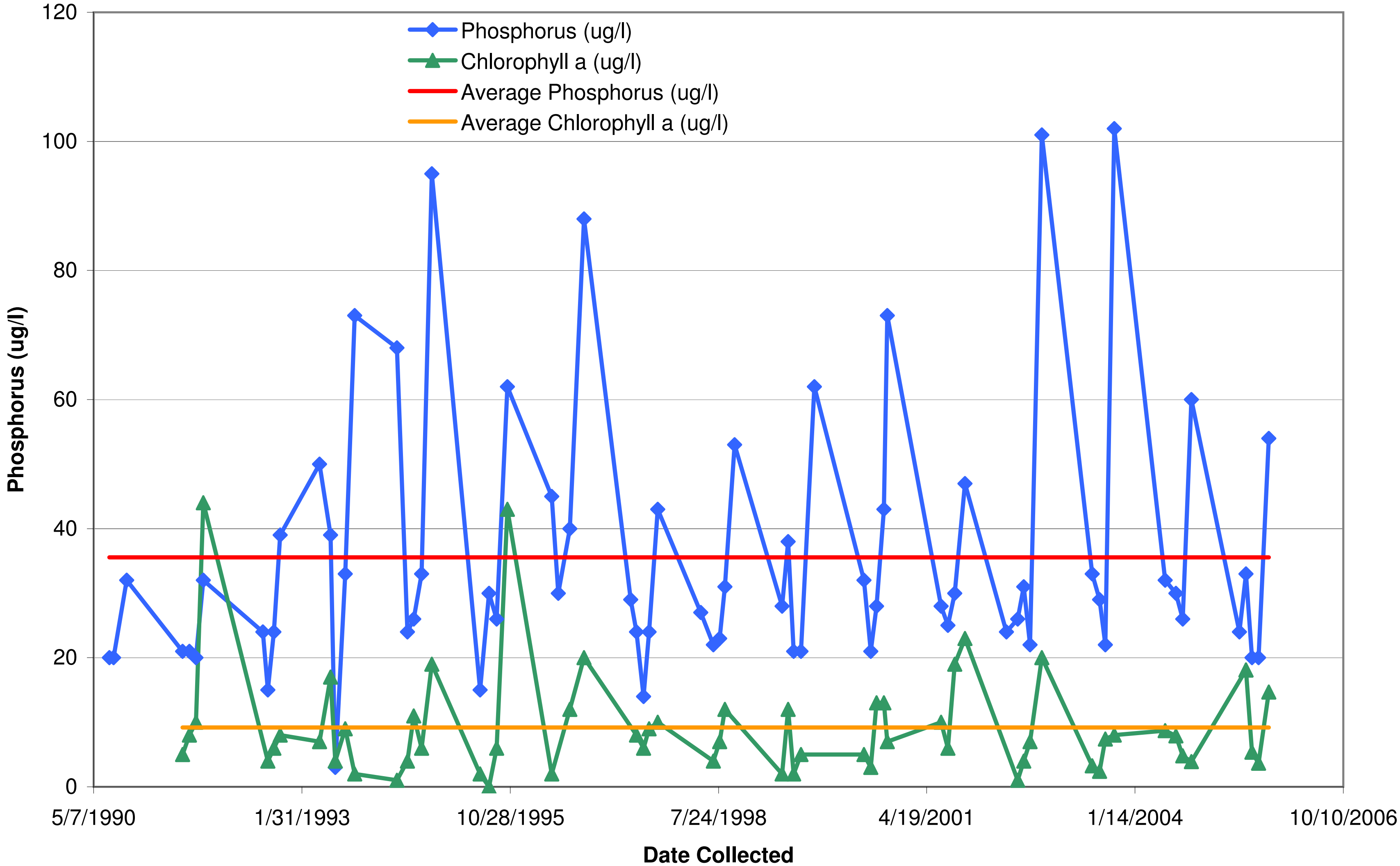
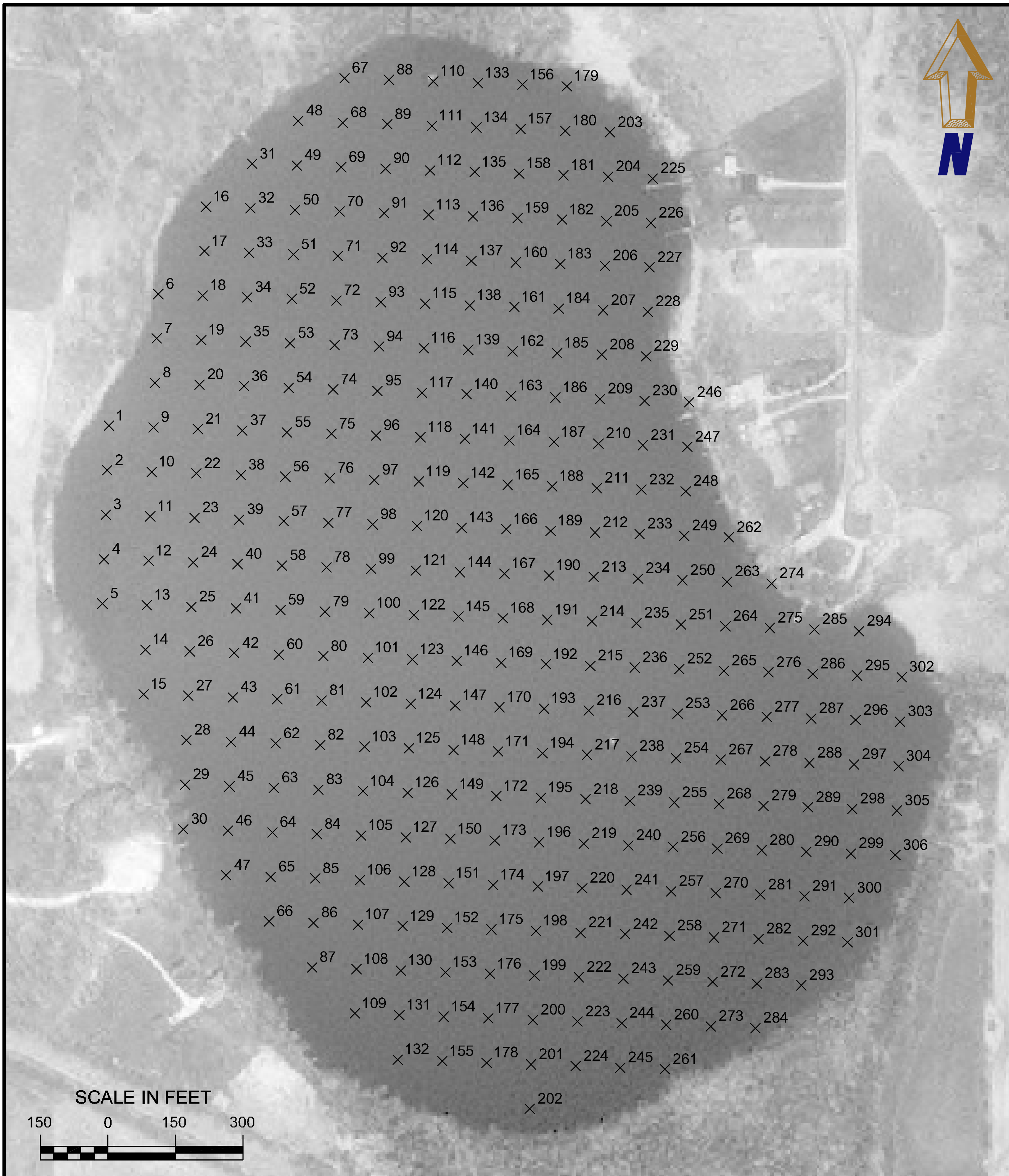


Figure 5: Bullhead Lake Chlorophyll *a* & Phosphorus





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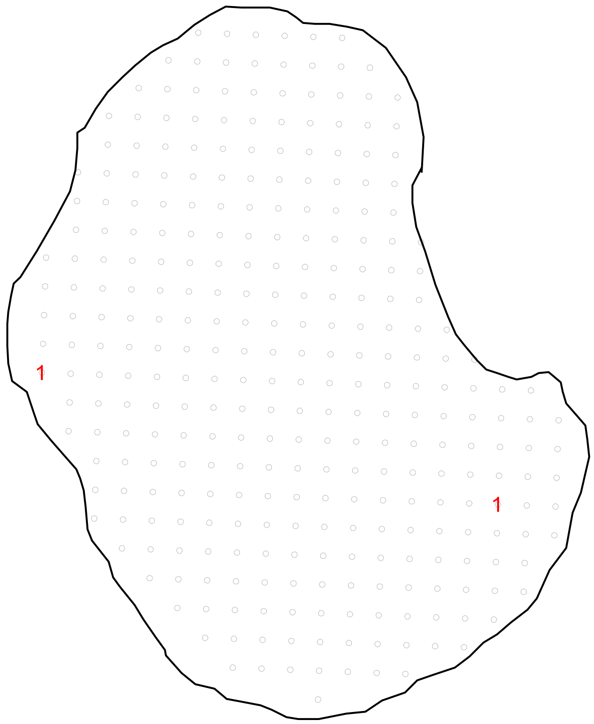
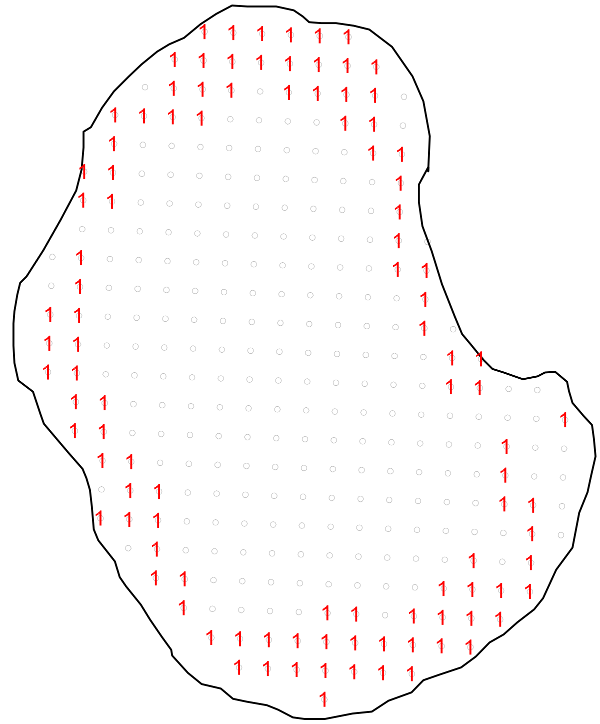
BULLHEAD LAKE SAMPLE POINTS

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

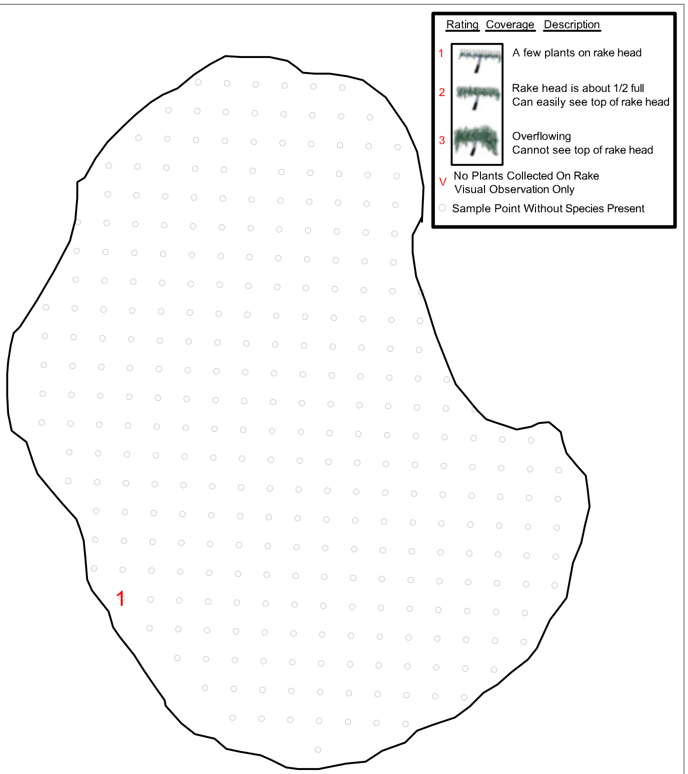
DATE:	08/20/07	DRAWN BY:	DDP	TASK NUMBER:	100	PROJECT NUMBER:	BHL08-5500-0793	FIGURE	6



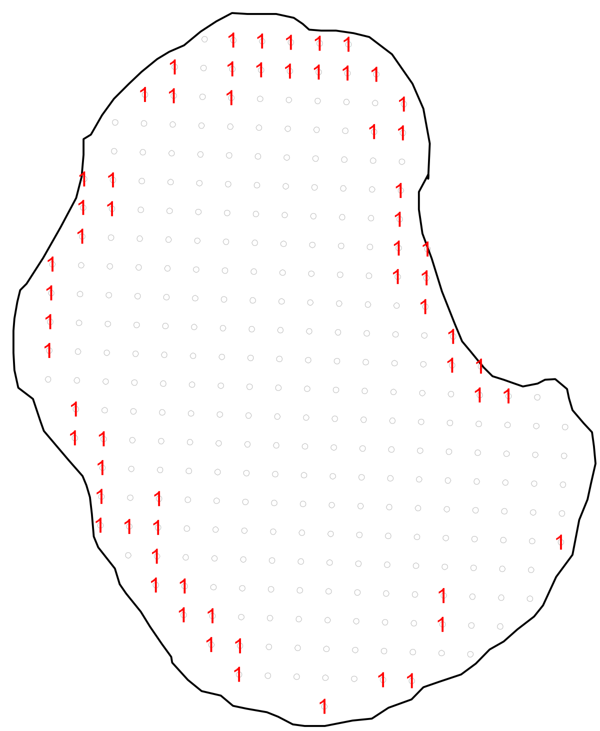
Potamogeton crispus,Curly-leaf pondweed



Ceratophyllum demersum,Coontail



Myriophyllum spicatum,Eurasian water-milfoil



Filamentous Algae

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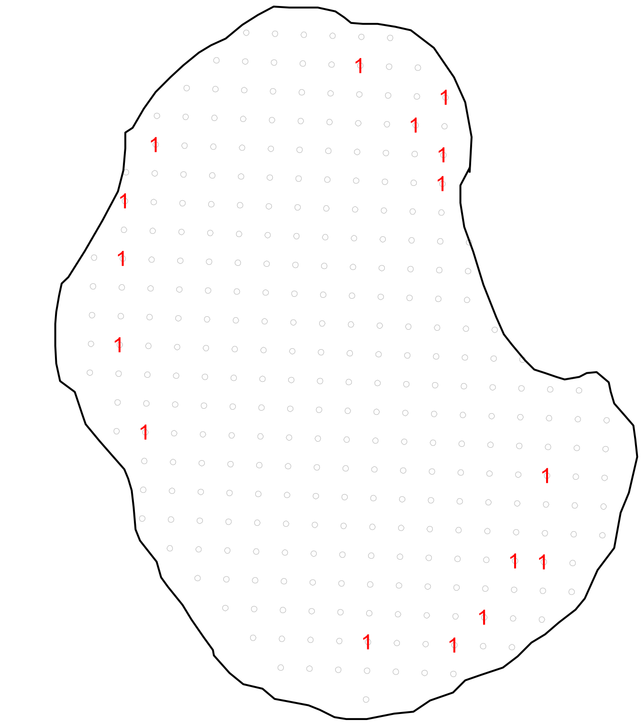
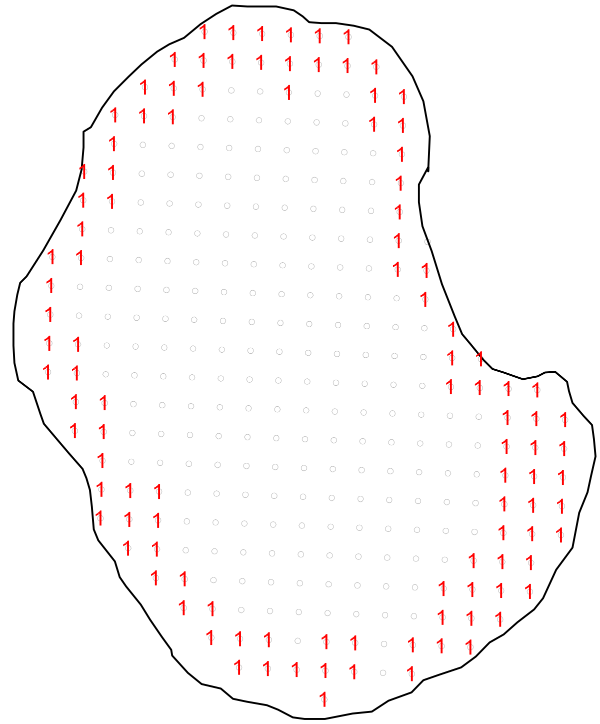
2005 AQUATIC PLANT DISTRIBUTION MAPS

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

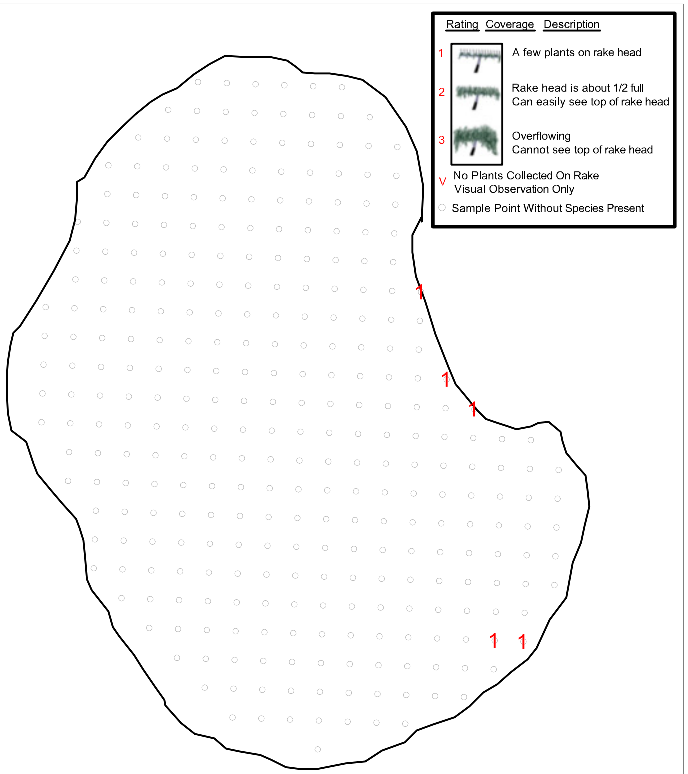
DATE: 08/08/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 7a



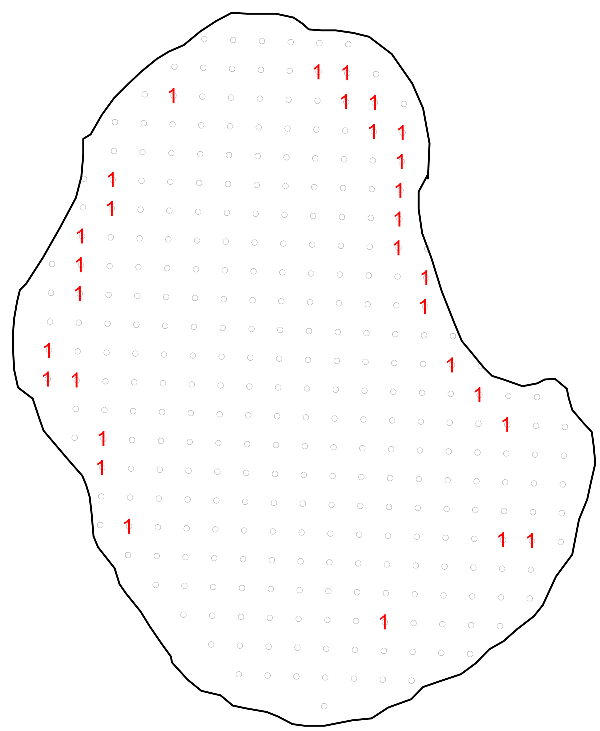
*Potamogeton zosteriformis,*Flat-stem pondweed



*Lemna trisulca,*Forked duckweed



*Schoenoplectus acutus,*Hardstem bulrush



*Potamogeton amplifolius,*Large-leaf pondweed

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2005 AQUATIC PLANT DISTRIBUTION MAPS

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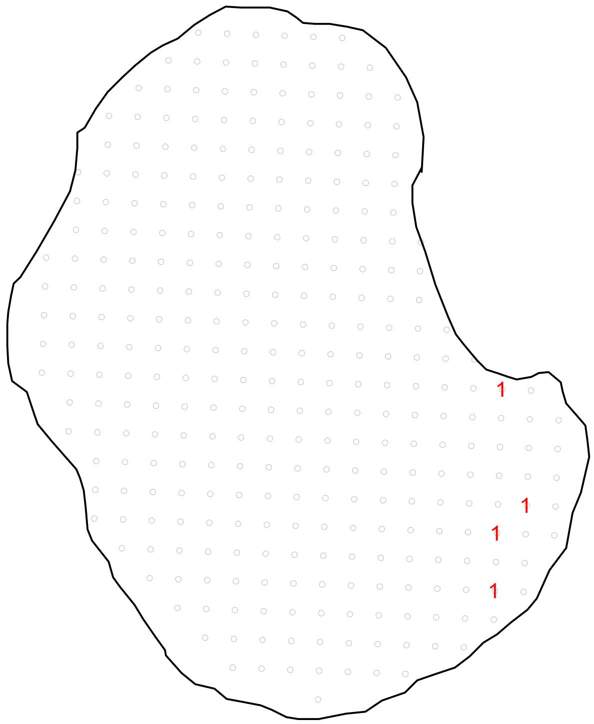
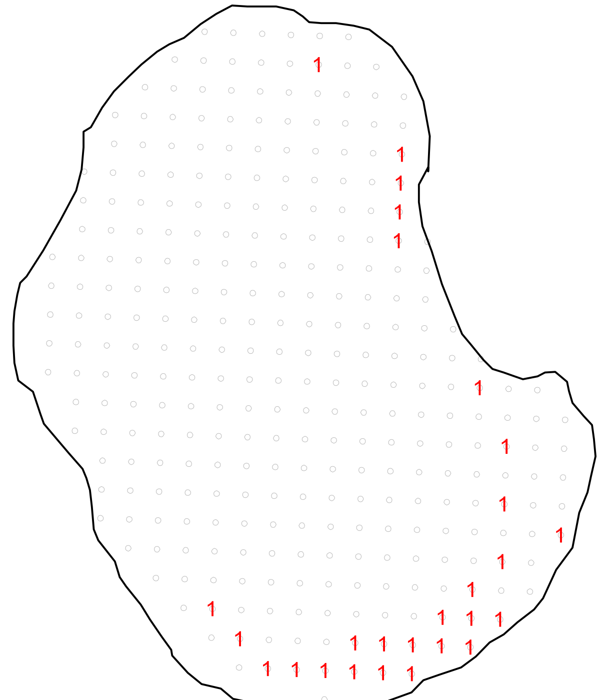
Manitowoc County, Wisconsin

DATE: 08/08/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 7b

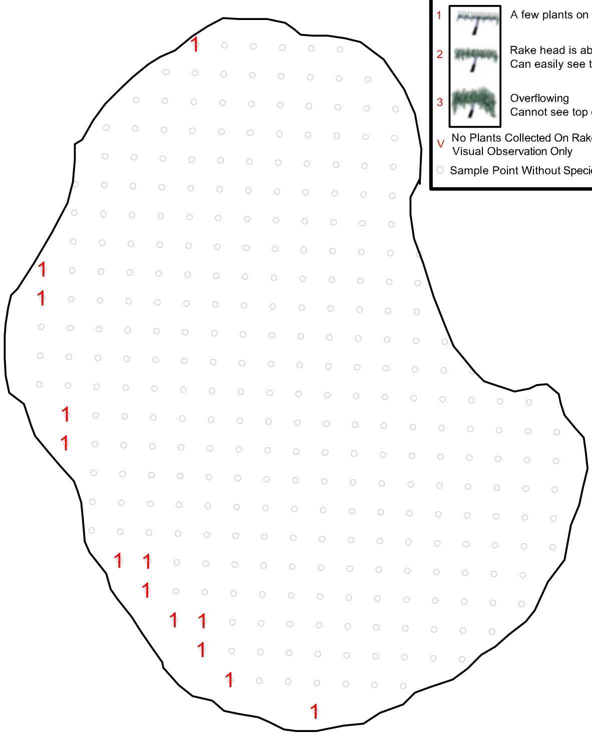


Chara ,Muskgrasses

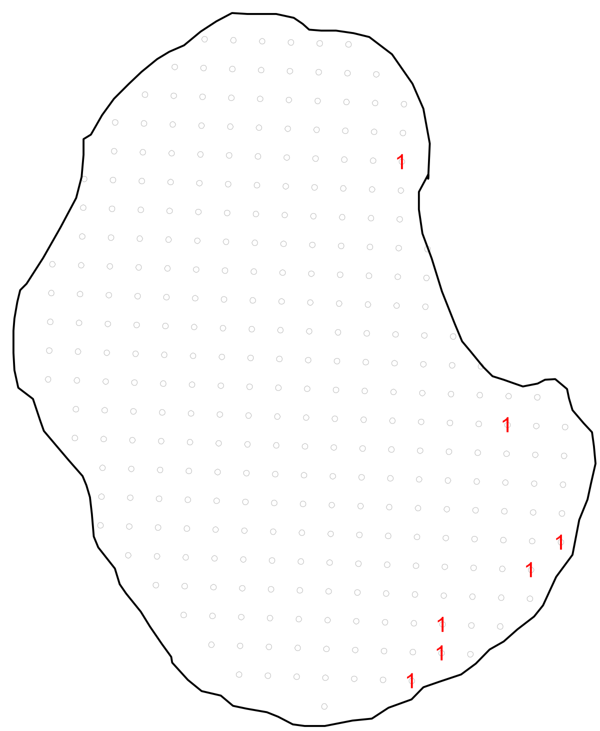


Myriophyllum sibericum,Northern water milfoil

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present



Nuphar variegata,Spatterdock



Ranunculus aquatilis,Stiff water crowfoot

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2005 AQUATIC PLANT DISTRIBUTION MAPS

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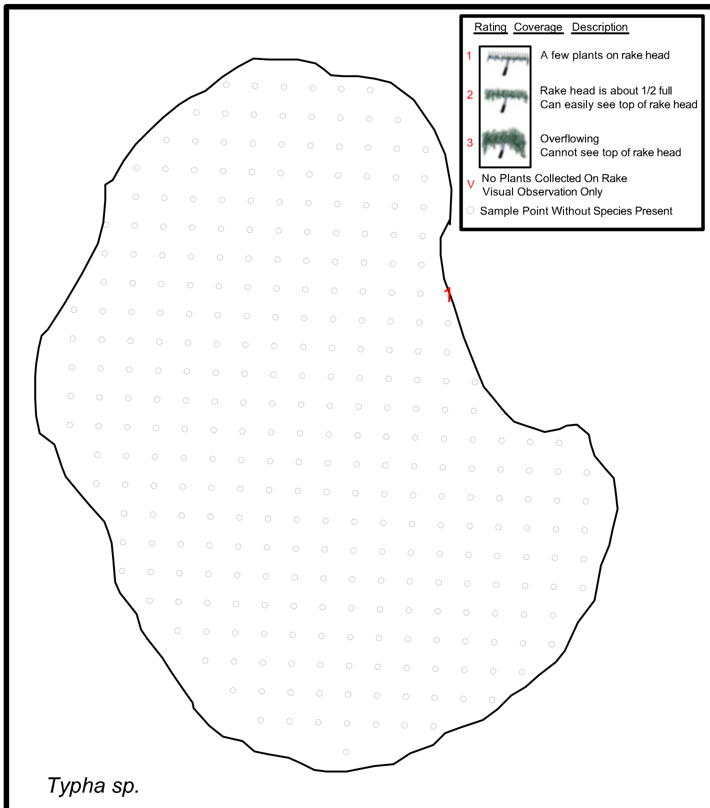
DATE: 08/08/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 7c



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2005 AQUATIC PLANT DISTRIBUTION MAPS

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Bullhead Lake
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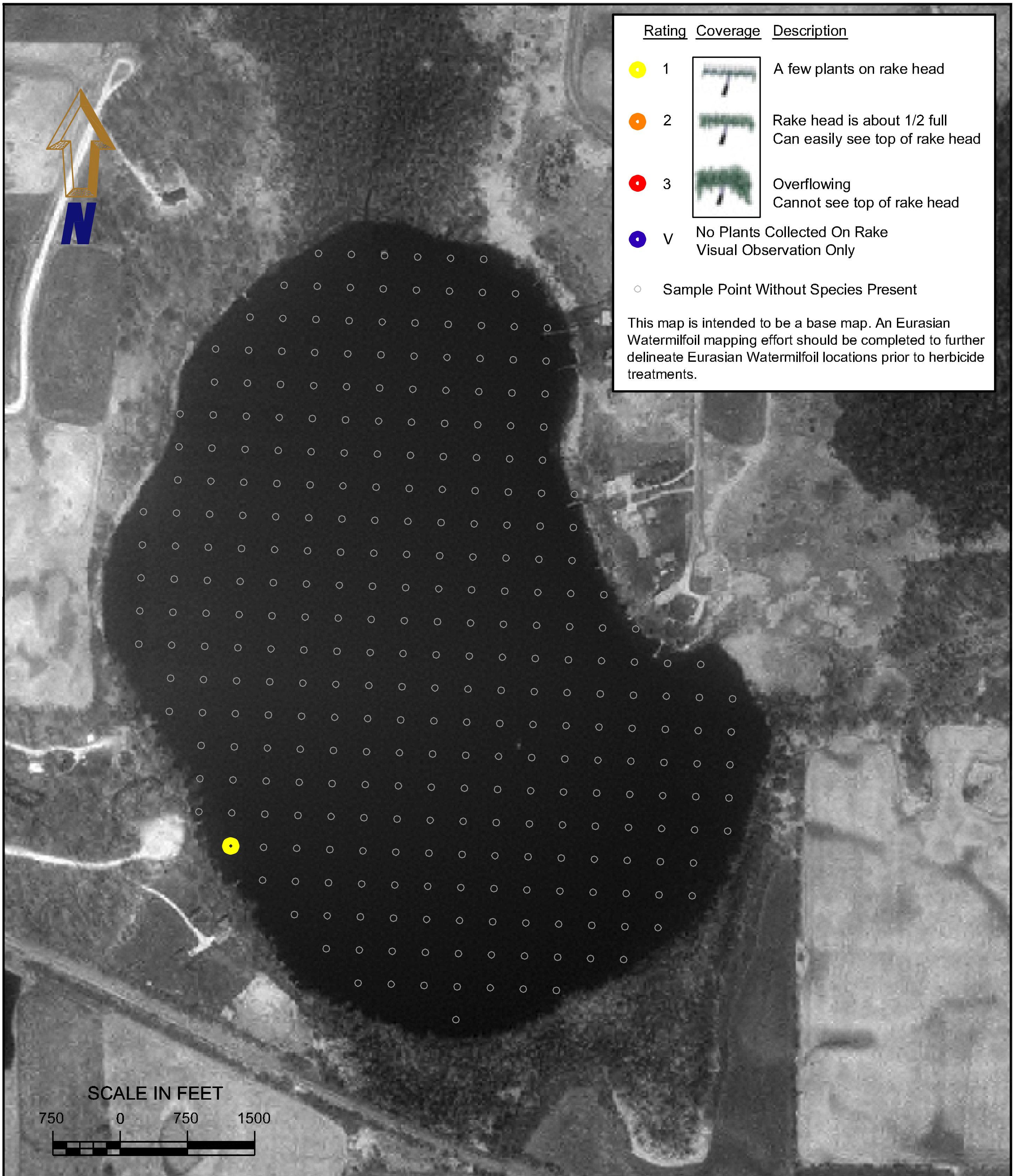
DATE: 08/08/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 7d



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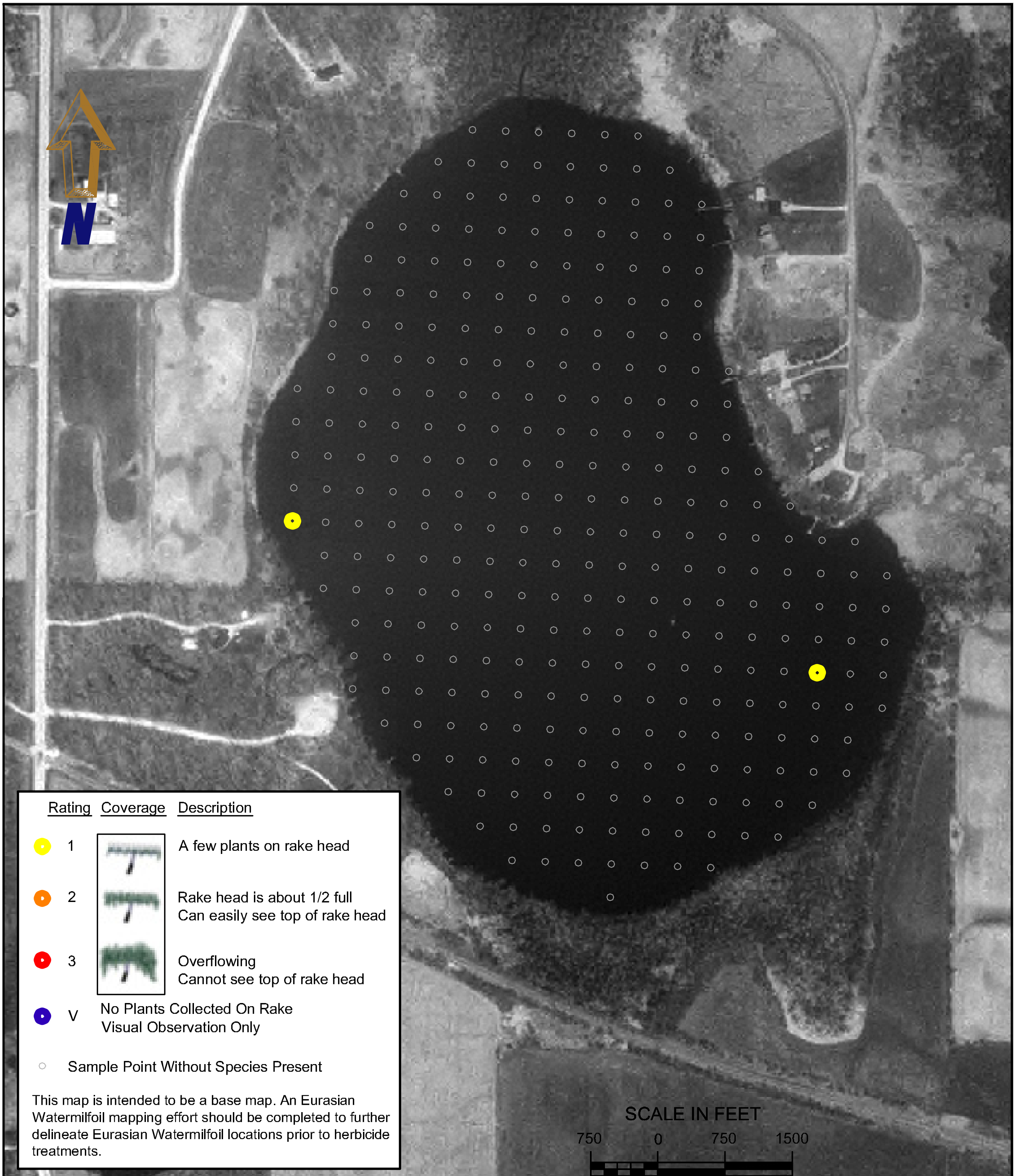
EURASIAN WATERMILFOIL 2005

Bullhead Lake Advancement Association
Bullhead Lake
Manitowoc County, Wisconsin

DATE: 08/16/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: BHL08-5500-0793	FIGURE 8



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CURLYLEAF PONDWEED 2005

Chute Pond Protection & Rehabilitation District
Chute Pond
Oconto County, Wisconsin

DATE: 08/16/07	DRAWN BY: DDP	TASK NUMBER: 100	PROJECT NUMBER: CHP08-5500-0848	FIGURE 9

Table 1: Taxa Detected During 2005 Aquatic Plant Survey, Bullhead Lake, Manitowoc County, Wisconsin

Genus	Species	ID	Common Name	Category
Algae	*sp.*	1	Filamentous algae	Submersed
Ceratophyllum	*demersum*	2	Coontail	Submersed
Chara	*sp.*	3	Muskgrass	Submersed
Lemna	*trisulca*	4	Forked duckweed	Free-floating
Myriophyllum	*sibiricum*	5	Northern water-milfoil	Submersed
Mriophyllum	*spicatum*	6	Eurasian water-milfoil	Submersed
Nuphar	*variegata*	7	Spatterdock	Floating leaf
Potamogeton	*amplifolius*	8	Large-leaf pondweed	Submersed
Potamogeton	*crispus*	9	Curly-leaf pondweed	Submersed
Potamogeton	*zosteriformis*	10	Flat-stem pondweed	Submersed
Ranunculus	*aquatilis*	11	Sitff water crowfoot	Submersed
Schoenoplectus	*acutus*	12	Hardstem bulrush	Emergent
Typha	*sp.*	13	Cattail	Emergent

Table 2 : 2005 Aquatic Plant Community Statistics, Bullhead Lake, Manitowoc County, Wisconsi

Aquatic Plant Community Statistics	2005
Frequency of occurrence at sites shallower than maximum depth of plants	88.90%
Simpson Diversity Index	0.80
Maximum Depth of Plants (Feet)	15
Taxonomic Richness (Number Taxa)	13
Average Number of Species per Site (sites less than max depth of plant growth)	2.65
Average Number of NATIVE Species per Site (sites less than max depth of plant growth)	2.63

Table 3: 2005 Aquatic Plant Taxa-Specific Statistics, Bullhead Lake, Manitowoc County, Wisconsin

Genus	Species	Common Name	Percent Frequency of Occurrence within vegetated areas	Percent Frequency of Occurrence at sites shallower than max depth of plants	Percent Relative Frequency of Occurrence	Number of Intercept Points Where Detected
Algae	*sp.*	Filamentous algae	48.44	43.06	16.23	62
Ceratophyllum	*demersum*	Coontail	81.25	72.22	27.23	104
Chara	*sp.*	Muskgrass	3.13	2.78	1.05	4
Lemna	*trisulca*	Forked duckweed	85.94	76.39	28.80	110
Myriophyllum	*sibiricum*	Northern water-milfoil	21.09	18.75	7.07	27
Mriophyllum	*spicatum*	Eurasian water-milfoil	0.78	0.69	0.26	1
Nuphar	*variegata*	Spatterdock	10.16	9.03	3.40	13
Potamogeton	*amplifolius*	Large-leaf pondweed	23.44	20.83	7.85	30
Potamogeton	*crispus*	Curly-leaf pondweed	1.56	1.39	0.52	2
Potamogeton	*zosteriformis*	Flat-stem pondweed	12.50	11.11	4.19	16
Ranunculus	*aquatilis*	Sitff water crowfoot	5.47	4.86	1.83	7
Schoenoplectus	*acutus*	Hardstem bulrush	3.91	3.47	1.31	5
Typha	*sp.*	Cattail	0.78	0.69	0.26	1

Table 4: 2005 Floristic Quality Index, Bullhead Lake, Manitowoc County, Wisconsin

Genus	Species	Common Name	Coefficient of Conservatism C	Present	Coefficient of Conservatism C
Ceratophyllum	*demersum*	Coontail	3	1	3
Chara	*sp.*	Muskgrass	7	1	7
Lemna	*trisulca*	Forked duckweed	6	1	6
Myriophyllum	*sibiricum*	Northern water-milfoil	6	1	6
Nuphar	*variegata*	Spatterdock	6	1	6
Potamogeton	*amplifolius*	Large-leaf pondweed	7	1	7
Potamogeton	*zosteriformis*	Flat-stem pondweed	6	1	6
Ranunculus	*aquatilis*	Sitff water crowfoot	8	1	8
Schoenoplectus	*acutus*	Hardstem bulrush	6	1	6
Typha	*sp.*	Cattail	1	1	1

N	10
Mean C	5.6
Floristic Quality Index (FQI)	**17.71**

Please note: There is no Coefficient of Conservatism for exotic species such as Eurasian Water-Milfoil.

Coefficient of Conservatism C

0-3 taxa found in wide variety of plant communities and very tolerant of disturbance.
4-6 taxa typically associated with specific plant communities and tolerate moderate disturbance.
7-8 taxa found in narrow range of plant communities and tolerate minor disturbance.
9-10 taxa restricted to a narrow range of synecological conditions, with low tolerance of disturbance.

Point ID	Latitude	Longitude
1	44.10438122	-88.040352
2	44.10411128	-88.0403609
3	44.10384134	-88.0403698
4	44.1035714	-88.0403788
5	44.10330145	-88.0403877
6	44.10518462	-88.0399506
7	44.10491468	-88.0399595
8	44.10464474	-88.0399684
9	44.10437479	-88.0399774
10	44.10410485	-88.0399863
11	44.10383491	-88.0399952
12	44.10356497	-88.0400041
13	44.10329503	-88.0400131
14	44.10302508	-88.040022
15	44.10275514	-88.0400309
16	44.10571807	-88.0395581
17	44.10544813	-88.039567
18	44.10517819	-88.039576
19	44.10490825	-88.0395849
20	44.10463831	-88.0395938
21	44.10436836	-88.0396027
22	44.10409842	-88.0396117
23	44.10382848	-88.0396206
24	44.10355854	-88.0396295
25	44.1032886	-88.0396384
26	44.10301865	-88.0396474
27	44.10274871	-88.0396563
28	44.10247877	-88.0396652
29	44.10220883	-88.0396741
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32	44.10571164	-88.0391835
33	44.1054417	-88.0391924
34	44.10517176	-88.0392013
35	44.10490182	-88.0392103
36	44.10463187	-88.0392192
37	44.10436193	-88.0392281
38	44.10409199	-88.039237
39	44.10382205	-88.039246
40	44.10355211	-88.0392549
41	44.10328216	-88.0392638
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44	44.10247234	-88.0392906
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46	44.10193245	-88.0393085
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134	44.10621935	-88.0372925
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137	44.10540952	-88.0373193
138	44.10513958	-88.0373282
139	44.10486964	-88.0373371
140	44.1045997	-88.0373461
141	44.10432976	-88.037355
142	44.10405982	-88.0373639
143	44.10378987	-88.0373729
144	44.10351993	-88.0373818
145	44.10324999	-88.0373907
146	44.10298005	-88.0373997
147	44.10271011	-88.0374086
148	44.10244017	-88.0374175
149	44.10217022	-88.0374265
150	44.10190028	-88.0374354
151	44.10163034	-88.0374443
152	44.1013604	-88.0374533
153	44.10109046	-88.0374622
154	44.10082052	-88.0374711
155	44.10055057	-88.0374801

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162	44.1048632	-88.0369625
163	44.10459326	-88.0369714
164	44.10432332	-88.0369804
165	44.10405338	-88.0369893
166	44.10378344	-88.0369983
167	44.10351349	-88.0370072
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185	44.10485676	-88.0365879
186	44.10458682	-88.0365968
187	44.10431688	-88.0366058
188	44.10404694	-88.0366147
189	44.103777	-88.0366236
190	44.10350705	-88.0366326
191	44.10323711	-88.0366415
192	44.10296717	-88.0366505
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197	44.10161746	-88.0366951
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200	44.10080764	-88.0367219
201	44.1005377	-88.0367309
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206	44.1053902	-88.0361954
207	44.10512026	-88.0362043

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215	44.10296073	-88.0362758
216	44.10269079	-88.0362848
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218	44.10215091	-88.0363027
219	44.10188097	-88.0363116
220	44.10161102	-88.0363205
221	44.10134108	-88.0363295
222	44.10107114	-88.0363384
223	44.1008012	-88.0363473
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230	44.10457394	-88.0358476
231	44.104304	-88.0358565
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233	44.10376411	-88.0358744
234	44.10349417	-88.0358833
235	44.10322423	-88.0358923
236	44.10295429	-88.0359012
237	44.10268435	-88.0359102
238	44.10241441	-88.0359191
239	44.10214446	-88.035928
240	44.10187452	-88.035937
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242	44.10133464	-88.0359549
243	44.1010647	-88.0359638
244	44.10079476	-88.0359727
245	44.10052482	-88.0359817
246	44.10456749	-88.035473
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248	44.10402761	-88.0354908
249	44.10375767	-88.0354998
250	44.10348773	-88.0355087
251	44.10321779	-88.0355177
252	44.10294785	-88.0355266
253	44.1026779	-88.0355356
254	44.10240796	-88.0355445
255	44.10213802	-88.0355534
256	44.10186808	-88.0355624
257	44.10159814	-88.0355713
258	44.1013282	-88.0355803
259	44.10105826	-88.0355892

260	44.10078831	-88.0355981
261	44.10051837	-88.0356071
262	44.10375123	-88.0351252
263	44.10348128	-88.0351341
264	44.10321134	-88.0351431
265	44.1029414	-88.035152
266	44.10267146	-88.0351609
267	44.10240152	-88.0351699
268	44.10213158	-88.0351788
269	44.10186164	-88.0351878
270	44.10159169	-88.0351967
271	44.10132175	-88.0352057
272	44.10105181	-88.0352146
273	44.10078187	-88.0352235
274	44.10347484	-88.0347595
275	44.1032049	-88.0347684
276	44.10293496	-88.0347774
277	44.10266501	-88.0347863
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279	44.10212513	-88.0348042
280	44.10185519	-88.0348132
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283	44.10104537	-88.03484
284	44.10077543	-88.0348489
285	44.10319845	-88.0343938
286	44.10292851	-88.0344028
287	44.10265857	-88.0344117
288	44.10238863	-88.0344207
289	44.10211869	-88.0344296
290	44.10184874	-88.0344386
291	44.1015788	-88.0344475
292	44.10130886	-88.0344565
293	44.10103892	-88.0344654
294	44.103192	-88.0340192
295	44.10292206	-88.0340282
296	44.10265212	-88.0340371
297	44.10238218	-88.0340461
298	44.10211224	-88.034055
299	44.1018423	-88.034064
300	44.10157236	-88.0340729
301	44.10130241	-88.0340818
302	44.10291561	-88.0336535
303	44.10264567	-88.0336625
304	44.10237573	-88.0336714
305	44.10210579	-88.0336804
306	44.10183585	-88.0336893

Free-Floating Plants

Lemna trisulca (Forked duckweed) has a simple, flattened leaf with a single root. This variety of duckweed is easily distinguished from the others by its "rowboat and oars" shape. Like other duckweeds, forked duckweed is free floating and gets its nutrients directly from the water. These angular duckweeds are often tangled together and form a mass. As with other duckweeds, forked duckweed is a good food source for waterfowl while the masses provide cover for fish and invertebrates (Borman, et al., 1997).

Forked Duckweed
Source: UW Herbarium Website

Floating-Leaf Plants

Spatterdock
Source: UW Herbarium Website

Nuphar variegata (Spatterdock) has a flexible stalk and an oval shaped leaf. It grows in water less than 6 feet deep and prefers soft sediment. Yellow flowers occur throughout the summer. Floating leaves provide cover and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

Submergent Plants

Ceratophyllum demersum (Coontail) is one of the most widely distributed aquatic plants within Wisconsin. The plant lacks true roots and can be found in water up to 16 feet deep. The leaves are arranged in a whorled fashion and are stiff and located closer together at the tip of the plant, giving it the appearance of a raccoon tail. Coontail is excellent habitat for invertebrates, especially in the winter when most other plants have died. The plant itself is food for waterfowl and provides shelter and foraging opportunities for fish (Borman, et al., 1997). Coontail may be mistaken for EWM.

Coontail
Source: UW Herbarium Website

Chara sp.
Source: UW Herbarium Website

Chara, sp. (Muskgrass / Chara) looks like a vascular plant; it actually is a multi-celled algae (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.

Northern watermilfoil
Source: UW Herbarium Website

*Myriophyllum sibiricum* (Northern watermilfoil) is usually found growing in soft sediment in fairly clear-water lakes. Leaves are divided like a feather, with five to twelve pairs of thread-like leaflets. Leaves are arranged in whorls. Northern watermilfoil is more desirable than its invasive cousin, Eurasian watermilfoil. Waterfowl eat the foliage and fruit, while beds of this plant provide cover and foraging opportunities for fish and invertebrates (Borman, et al., 1997).

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. In the past three decades, this AIS has significantly expanded its range to about 61 of Wisconsin's 72 counties and continues to infest new water bodies every year. 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.

Eurasian watermilfoil shows no substrate preference in most instances and can grow in water depths greater than 4 meters (Nichols, 1999). Dense beds of EWM are usually identified in soft/organic rich sediments in many lakes. Eurasian watermilfoil can reproduce by seeds, but its main form of reproduction is 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 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. Once established in an aquatic community, EWM reproduces from shoot fragments and stolons (runners that creep along the substrate).

EWM is an opportunistic species and is adapted for rapid growth early in spring which can 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 (DNR, 2002).

Potamogeton amplifolius (Large-leaf Pondweed) is also often referred to as musky weed or cabbage by anglers. Large leaf pondweed has robust stems and broad submersed leaves, which are slightly folded and lined with many veins. Floating leaves are oval and on long stalks. It is found mainly in soft sediments in water one to several feet deep and is sensitive to increased turbidity. The plant is commonly grazed by waterfowl, offers habitat for invertebrates, and foraging opportunities for fish (Borman, e al., 1997).


Large-leaf Pondweed
Source: UW Herbarium Website

Potamogeton crispus (Curly leaf pondweed) 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, 2006).

Potamogeton zosteriformis (Flat-Stem Pondweed) is a submergent pondweed with freely-branched flattened stems. Flat stem pondweed is commonly confused with water stargrass (*Zosterella dubia*) but Flat-stem Pondweed can be distinguished by its prominent mid-vein and many fine, parallel veins.


Flat- Stem Pondweed
Source: UW Herbarium Website


Stiff water crowfoot
Source: UW Herbarium Website

Ranunculus aquatilis (stiff water crowfoot) has long branching stems that are submersed. The alternate leaves are thread like. The flowers are held above water and usually bloom from June through August. The plant is usually found in water less than 7 feet deep.

Emergent Plants

Hardstem Bulrush
Source: UW Herbarium Website

Schoenoplectus acutus (Hardstem bulrush) has tall cyllindricxal olive-green sturdy stems. The firm stems are hard when pressed between ones fingers, while softstem bulrush can easily be crushed with the fingers. This plant is mainly found growing in water less than 2 meters and is an important food and habitat plant for investaebrats, northern pike, and marsh birds (Borman et al., 1997).

Typha latifolia (Broad-leaf Cattail) has pale green, sword-like leaves that are sheathed around one another at the base. Broad-leaved cattail can be distinguished from narrow-leaved cattail by somewhat wider and flatter leaves and the presence of male and female flower spikes immediately adjacent to each other,. Cattails can grow to nuisance levels, but do provide nesting habitat for many marsh birds and cover for small fish (Borman, et al., 1997).

Broad-leaf Cattail
Source: UW Herbarium Website

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
No treatment	N	Do not treat plants	Protects native species that can prevent spread of invasive or exotic species, enhance water quality, and provide habitat for aquatic fauna	May allow small population of invasive plants to become larger, more difficult to control later
			No financial cost	
			No system disturbance	
			No harmful effects of chemicals	
			Permit not required	
Mechanical Control	Required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season
		Wide range of techniques, from manual to highly mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase turbidity and nutrient release
a. Handpulling/Manual raking	Y/N	SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive
		Works best in soft sediments	Can be highly selective	Needs to be carefully monitored
			Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing EWM or CLP	Roots, runners, and even fragments of some species (including EWM) will start new plants, so all of plant must be removed
			Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species	Small-scale control only

b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting	Fragments of vegetation can re-root
			Usually minimal impact to the lake	Can remove some small fish and reptiles from lake
			Harvested lanes through dense weed beds can increase growth and survival of some fish	Initial cost of harvester expensive
			Can remove some nutrients from lake	
Biological Control	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year	Effectiveness will vary as control agent's population fluctates
			Lowers density of problem plant to allow growth of natives	Provides moderate control - complete control unlikely
				Control response may be slow
				Must have enough control agent to be effective
a. Weevils on EWM*	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem	Need to stock large numbers, even if some already present
			Selective control of target species	Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines
			Longer-term control with limited management	Bluegill populations decrease densities through predation
b. Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortalitiy	May be species specific	Largely experimental; effectiveness and longevity unknown
			May provide long-term control	Possible side effects not understood
			Few dangers to humans or animals	

c.	Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermilfoil growth	Initial transplanting slow and labor-intensive Spikerushes native to WI, and have not effectively limited EWM growth Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d.	Restoration of native plants	N; strongly recommend plan and consultation with DNR	Diverse native plant community established to repel invasive species	Native plants provide food and habitat for aquatic fauna Diverse native community more repellant to invasive species Supplements removal techniques	Initial transplanting slow and labor-intensive Nuisance invasive plants may outcompete plantings Largely experimental; few well-documented cases

Physical Control		Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a.	Drawdown	Y, May require Environmental Assessment	Lake water lowered; plants killed when sediment dries, compacts or freezes	Can be effective, especially when done in winter, provided drying and freezing occur. Sediment compaction is possible over winter	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
			Must have a water level control device or siphon	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced
			Season or duration of drawdown can change effects	Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality	May impact attached wetlands and shallow wells near shore
				Success for EWM, variable success for CLP*	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning
				Restores natural water fluctuation important for all aquatic ecosystems	Winter drawdawn must start in early fall or will kill hibernating reptiles and amphibians
					Controversial
b.	Dredging	Y	Plants are removed along with sediment	Increases water depth	Expensive
			Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
			For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
			Extensive planning required		Sediment testing is expensive and may be necessary
					Removes benthic organisms
					Dredged materials must be disposed of
					Severe impact on lake ecosystem

c.	Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity	Appropriate for very small water bodies
				Usually non-toxic, degrades naturally over a few weeks.	Should not be used in pond or lake with outflow
					Impairs aesthetics
					Affects to microscopic organisms unknown
d.	Mechanical circulation (Solarbees)	Y	Water is circulated and oxygenated	Reduces blue-green algae	Method is experimental; no published studies have been done
			Oxygenation of water decreases ammonium-nitrogen, which is a preferred nutrient source of EWM, theoretically limiting EWM growth (has not been demonstrated scientifically)	May reduce levels of ammonium-nitrogen in the water and at the sediment interface, which could reduce EWM growth	Although EWM prefers ammonium-nitrogen to nitrate, it will uptake nitrate efficiently, so EWM growth may not be affected
				Oxygenated water may reduce phosphorus release from sediments if mixing is complete	Units are aesthetically unpleasing
				Reduces chance of fish kills by aerating water	Units could be a navigational hazard
e.	Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use)	Attempts to correct source of problem, not treat symptoms	Results can take years to be evident due to internal recycling of already-present lake nutrients
				Could improve water clarity and reduce occurrences of algal blooms	Expensive
				Native plants may be able to compete invasive species better in low-nutrient conditions	Requires landowner cooperation and regulation
					Improved water clarity may increase plant growth

Chemical Control	Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae Results usually within 10 days of treatment, but repeat treatments usually needed	Some flexibility for different situations Some can be selective if applied correctly Can be used for restoration activities	Possible toxicity to aquatic animals or humans, especially applicators May kill desirable plant species, e.g. native water-milfoil or native pondweeds Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape Controversial
a. 2,4-D (Weedar, Navigate)	Y	Systemic[1] herbicide selective to broadleaf[2] plants that inhibits cell division in new tissue Applied as liquid or granules during early growth phase	Moderately to highly effective, especially on EWM Monocots, such as pondweeds (e.g. CLP) and many other native species not affected. Can be used in synergy with endotholl for early season CLP and EWM treatments Widely used aquatic herbicide	May cause oxygen depletion after plants die and decompose Cannot be used in combination with copper herbicides (used for algae) Toxic to fish
b. Endothall (Aquathol)	Y	Broad-spectrum[3], contact[4] herbicide that inhibits protein synthesis Applied as liquid or granules	Especially effective on CLP and also effective on EWM May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring Can be selective depending on concentration and seasonal timing Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds Limited off-site drift	Kills many native pondweeds Not as effective in dense plant beds Not to be used in water supplies Toxic to aquatic fauna (to varying degrees) 3-day post-treatment restriction on fish consumption

c.	Diquat (Reward)	Y	Broad-spectrum, contact herbicide that disrupts cellular functioning Applied as liquid, can be combined with copper treatment	Mostly used for water-milfoil and duckweed Rapid action Limited direct toxicity on fish and other animals	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads Toxic to aquatic invertebrates Needs to be reapplied several years in a row Ineffective in muddy or cold water (<50°F)
d.	Fluridone (Sonar or Avast)	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis; some reduction in non-target effects can be achieved by lowering dosage Must be applied during early growth stage Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107	Effective on EWM for 1 to 4 years with aggressive follow-up treatments Applied at very low concentration Slow decomposition of plants may limit decreases in dissolved oxygen Low toxicity to aquatic animals	Affects many non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations. These plants are important to combat invasive species Requires long contact time: 60-90 days Demonstrated herbicide resistance in hydrilla subjected to repeat treatments, EWM has the potential to develop resistance Unknown effect of repeat whole-lake treatments on lake ecology
e.	Glyphosate (Rodeo)	Y	Broad-spectrum, systemic herbicide that disrupts enzyme formation and function Usually used for purple loosestrife stems or cattails Applied as liquid spray or painted on loosetrife stems	Effective on floating and emergent plants such as purple loosestrife Selective if carefully applied to individual plants Non-toxic to most aquatic animals at recommended dosages	Effective control for 1-5 years Ineffective in muddy water Cannot be used near potable water intakes RoundUp is often illegally substituted for Rodeo Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians No control of submerged plants

f.	Triclopyr (Renovate)	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher doses (e.g. coontail)
			Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate	May be toxic to sensitive invertebrates at higher concentrations
				Results in 3-5 weeks	Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)
				Low toxicity to aquatic animals	Sensitive to UV light; sunlight can break herbicide down prematurely
				No recreational use restrictions following treatment	Relatively new management option for aquatic plants (since 2003)
g.	Copper compounds (Cutrine Plus)	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
			Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment	Short-term results
				Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Precipitates rapidly in alkaline waters
					Small-scale control only, because algae are easily windblown
					Toxic to invertebrates, trout and other fish, depending on the hardness of the water
					Long-term effects of repeat treatments to benthic organisms unknown
					Clear water may increase plant growth

h.	Lime slurry	Y	Applications of lime temporarily raise water pH, which limits the availablity of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP Prevents release of sediment phosphorus, which reduces algal growth Increases growth of native plants beneficial as fish habitat	Relatively new technique, so effective dosage levels and exposure requirements are not yet known Short-term increase in turbidity due to suspended lime particles High pH detrimental to aquatic invertebrates May restrict growth of some native plants
i.	Alum (aluminum sulfate)	Y	Removes phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus Dosage must consider pH, hardness and water volume	Most often used against algal problems Improves water clarity	Must not eat fish for 30 days from treatment area Minimal effect on aquatic plants, or increased light penetration may increase aquatic plants Toxic to aquatic animals, including fish at some concentrations

***EWM - Eurasian water-milfoil**
***CLP - Curly-leaf pondweed**
[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
[3]Broad-spectrum herbicide - Affects both monocots and dicots.
[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

	Option	How it Works	PROS	CONS
Biological Control				
a.	Carp	Plants eaten by stocked carp	Effective at removing aquatic plants	Illegal to transport or stock carp in Wisconsin
			Involves species already present in Madison lakes	Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels, and reduction of light penetration
				Widespread plant removal deteriorates habitat for other fish and aquatic organisms
				Complete alteration of fish assemblage possible
				Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants
b.	Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	Illegal to transport or stock crayfish in Wisconsin
				Control not selective and may decimate plant community
				Not successful in productive, soft-bottom lakes with many fish predators
				Complete alteration of fish assemblage possible
Mechanical Control				
a.	Cutting (no removal)	Plants are "mowed" with underwater cutter	Creates open water areas rapidly	Root system remains for regrowth
			Works in water up to 25 ft	Fragments of vegetation can re-root and spread infestation throughout the lake
				Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners
				Not selective in species removed
				Small-scale control only
b.	Rototilling	Sediment is tilled to uproot plant roots and stems	Decreases stem density, can affect entire plant	Creates turbidity
		Works in deep water (17 ft)	Small-scale control	Not selective in species removed
			May provide long-term control	Fragments of vegetation can re-root
				Complete elimination of fish habitat
				Releases nutrients
				Increased likelihood of invasive species recolonization

c.	Hydroraking	Mechanical rake removes plants from lake Works in deep water (14 ft)	Creates open water areas rapidly	Fragments of vegetation can re-root May impact lake fauna Creates turbidity Plants regrow quickly Requires plant disposal
Physical Control				
a.	Fabrics/ Bottom Barriers	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem May inhibit spawning by some fish Need maintenance or will become covered in sediment and ineffective Gas accumulation under blankets can cause them to dislodge from the bottom Affects benthic invertebrates Anaerobic environment forms that can release excessive nutrients from sediment

Aquatic Plant Management

Aquatic plants are a critical component in an aquatic ecosystem. Any management of an ecosystem can have negative or even detrimental effects on the whole ecosystem. Therefore, the practice of managing aquatic plants should not be taken lightly. The concept of Aquatic Plant Management (APM) is highly variable since different aquatic resource users want different things. Ideal management to one individual may mean providing prime fish habitat, for another it may be to remove surface vegetation for boating. The practice of APM is also highly variable. There are numerous APM strategies designed to achieve different plant management goals. Some are effective on a small scale, but ineffective in larger situations. Others can only be used for specific plants or during certain times of the growing season. Of course, the types of plants that are to be managed will also help determine which APM alternatives are feasible. The following paragraphs discuss the APM methods used today. The discussion is largely adopted from *Managing Lakes and Rivers, North American Lake Management Society, 2001*, supplemented with other applicable current resources and references. The methods summarized here are largely for management of rooted aquatic plants, not algae. While some methods may also have effects on nuisance algae blooms, the focus is submergent rooted aquatic macrophytes. This information is provided to allow the user to gain a basic understanding of the APM method, it is not designed to an all-inclusive APM decision-making matrix. APM alternatives can be divided into the following categories: Physical Controls, Chemical Controls, and Biological Controls.

Physical Controls

Physical APM controls include various methods to prevent growth or remove part or all of the aquatic plant. Both manual and mechanical techniques are employed. Physical APM methods include:

- Hand pulling
- Hand cutting
- Bottom barriers
- Light limitation (dyes, covers)
- Mechanical harvesting
- Hydroraking/rototilling
- Suction Dredging
- Dredging
- Drawdown

Each of these methods are described below. The costs, benefits, and drawbacks of each APM strategy are provided.

Hand Pulling: This method involves digging out the entire unwanted plant including stems and roots with a hand tool such as a spade. This method is highly selective and suitable for shallow areas for removing invasive species that have not become well established. This technique is obviously not for use on large dense beds of nuisance aquatic plants. It is best used in areas less than 3 feet, but can be used in deeper areas with divers using scuba and snorkeling equipment. It can also be used in combination with the suction dredge method. In Wisconsin, hand pulling may be completed outside a designated sensitive area without a permit but is limited to 30 feet of shoreline frontage. Removal of exotic species is not limited to 30 feet.

Advantages: This technique results in immediate clearing of the water column of nuisance plants. When a selective technique is desired in a shallow, small area, hand pulling is a good choice. It is also useful in sensitive areas where disruption must be minimized.

Disadvantages: This method is labor intensive. Disturbing the substrate may affect fish habitat, increase turbidity, and may promote phosphorus re-suspension and subsequent algae blooms.

Costs: The costs are highly variable. There is practically no cost using volunteers or lakeshore landowners to remove unwanted plants, however, using divers to remove plants can get relatively expensive. Hand pulling labor can range from $400 to $800 per acre.

Hand Cutting: This is another manual method where the plants are cut below the water surface. Generally the roots are not removed. Tools such as rakes, scythes or other specialized tools are pulled through the plant beds by boat or several people. This method is not as selective as hand pulling. This method is well suited for small areas near docks and piers. Plant material must be removed from the water. In Wisconsin, hand cutting may be completed outside a designated sensitive area without a permit but is limited to 30 feet of shoreline frontage. Removal of exotic species is not limited to 30 feet.

Advantages: This technique results in immediate clearing of the water column of nuisance plants. Costs are minimal.

Disadvantages: This is also a fairly time consuming and labor intensive option. Since the technique does not remove the entire plant (leaves root system and part of plant), it may not result in long-term reductions in growth. This technique is not species specific and results in all aquatic plants being removed from the water column.

Costs: The costs range from minimal for volunteers using hand equipment up to over $1,000 for a hand-held mechanized cutting implement. Hand cutting labor can range from $400 to $800 per acre.

Bottom Barriers: A barrier material is applied over the lake bottom to prevent rooted aquatics from growing. Natural barriers such as clay, silt, and gravel can be used although eventually plants may root in these areas again. Artificial materials can also be used for bottom barriers and anchored to the substrate. Barrier materials include burlap, nylon, rubber, polyethylene, polypropylene, and fiberglass. Barriers include both solid and porous forms. A permit is required to place any fill or barrier structure on the substrate of a waterbody. This method is well suited for areas near docks, piers, and beaches. Periodic maintenance may be required to remove accumulated silt or rooting fragments from the barrier.

Advantages: This technique does not result in production of plant fragments. Properly installed, it can provide immediate and multiple year relief.

Disadvantages: This is a non-selective option, all plants beneath the barrier will be affected. Some materials are costly and installation is labor intensive. Other disadvantages include limited material durability, gas accumulation beneath the cover, or possible re-growth of plants from above or below the cover. Fish and invertebrate habitat is disrupted with this technique. Anchored barriers can be difficult to remove.

Costs: A 20 foot x 60 foot panel cost $265, while a 30 foot x 50 foot panel cost $375 (this does not include installation costs). Costs for materials vary from $0.15 per square foot ($ft^2$) to over $0.35/ ft^2. The costs for installation range from $0.25 to $0.50/ ft^2. Barriers can cost $20,000 to $50,000 per acre.

Light Limitation: Limiting the available light in the water column can prevent photosynthesis and plant growth. Dark colored dyes and surface covers have been used to accomplish light limitation. Dyes are effective in shallow water bodies where their concentration can be kept at a desired concentration and loss through dilution is less. This method is well suited for small, shallow water bodies with no outlets such as private ponds.

Surface covers can be a useful tool in small areas such as docks and beaches. While they can interfere with aquatic recreation, they can be timed to produce results and not affect summer recreation uses.

Advantages: Dyes are non-toxic to humans and aquatic organisms. No special equipment is required for application. Light limitation with dyes or covers method may be selective to shade tolerant species. In addition to submerged macrophyte control, it can also control the algae growth.

Disadvantages: The application of water column dyes is limited to shallow water bodies with no outlets. Repeated dye treatments may be necessary. The dyes may not control peripheral or shallow-water rooted plants. This technique must be initiated before aquatic plants start to grow. Covers inhibit gas exchange with the atmosphere.

Costs: Costs for a commercial dye and application range from $100 to $500 per acre.

Mechanical Harvesting: Mechanical harvesters are essentially cutters mounted on barges that cut aquatic plants at a desired depth. Maximum cutting depths range from 5 to 8 feet with a cutting width of 6.5 to 12 feet. Cut plant materials require collection and removal from the water. Conventional harvesters combine cutting, collecting, storing, and transporting cut vegetation into one piece of equipment. Transport barges and shoreline conveyors are also available to remove the cut vegetation. The cut plants must be removed from the water body. The equipment needs are dictated by severity of the aquatic plant problem. Contract harvesting services are available in lieu of purchasing used or new equipment. Trained staff will be necessary to operate a mechanical harvester. To achieve maximum removal of plant material, harvesting is usually completed during the summer months while submergent vegetation is growing to the surface. The duration of control is variable and re-growth of aquatic plants is common. Factors such as timing of harvest, water depth, depth of cut, and timing can influence the effectiveness of a harvesting operation. Harvesting is suited for large open areas with dense stands of exotic or nuisance plant species. Permits are now required in Wisconsin to use a mechanical harvester.

Advantages: Harvesting provides immediate visible results. Harvesting allows plant removal on a larger scale than other options. Harvesting provides flexible area control. In other words, the harvester can be moved to where it is needed and used to target problem areas. This technique has the added benefit of removing the plant material from the water body and therefore also eliminates a possible source of nutrients often released during fall decay of aquatic plants. While removal of nutrients through plant harvesting has not been quantified, it can be important in aquatic ecosystem with low nutrient inputs.

Disadvantages: Drawbacks of harvesting include: limited depth of operation, not selective within the application area, and expensive equipment costs.

Harvesting also creates plant fragments, which can be a concern since certain plants have the ability to reproduce from a plant fragment (e.g. Eurasian watermilfoil). Plant fragments may re-root and spread a problem plant to other areas. Harvesting can have negative effects on non-target plants, young of year fish, and invertebrates. The harvesting will require trained operators and maintenance of equipment. Also, a disposal site or landspreading program will be needed for harvested plants.

Costs: Costs for a harvesting operation are highly variable dependant on program scale. New harvesters range from $40,000 for small machines to over $100,000 for large, deluxe models. Costs vary considerably, depending on the model, size, and options chosen. Specially designed units are available, but may cost more. The equipment can last 10 to 15 years. A grant for ½ the equipment cost can be obtained from the Wisconsin Waterways Commission and a loan can be obtained for the remaining capital investment. Operation costs include insurance, fuel, spare parts, and payroll. Historical harvesting values have been reported at $200 up to $1,500 per acre. A survey of recent Wisconsin harvesting operations reported costs to be between $100/acre and $200/acre.

A used harvester can be purchased for $10,000 to $20,000. Maintenance costs are typically higher.

Contract harvesting costs approximately $125/per hour plus mobilization to the water body. Contractors can typically harvest ¼ to ½ acre per hour for an estimated cost of $250 to $500/per acre.

Hydroraking/rototilling: Hydroraking is the use of a boat or barge mounted machine with a rake that is lowered to the bottom and dragged. The tines of the rake rip out roots of aquatic plants. Rototilling, or rotovation, also rips out root masses but uses a mechanical rotating head with tines instead of a rake. Harvesting may need to be completed in conjunction with these methods to gather floating plant fragments. This application would best be used where nuisance populations are well established and prevention of stem fragments is not critical. A permit would be required for this type of aquatic plant management and would only be issued in limited cases of extreme infestations of nuisance vegetation. In Wisconsin, this method is not looked upon favorably or at all by the WDNR.

Advantages: These methods have the potential for significant reductions in aquatic plant growth. These methods can remove the plant stems and roots, resulting in thorough plant disruption. Hydroraking/rototilling can be completed in "off season" months avoiding interference with summer recreation activities.

Disadvantages: Hydroraking/rototilling are not selective and may destroy substrate habitat important to fish and invertebrates. Suspension of sediments will increase turbidity and release nutrients trapped in bottom sediments into the water column potentially causing algal blooms. These methods can cause floating plant and root fragments, which may re-root and spread the problem. Hydroraking/rototilling are expensive and not likely to be permitted by regulatory agencies.

Costs: Bottom tillage costs vary according to equipment, treatment scale, and plant density. For soft vegetation costs can range from $2,000 to $4,000 per acre. For dense, rooted masses, costs can be up to $10,000 per acre. Contract bottom tillage reportedly ranges from $1,200 to $1,700 per acre (Washington Department of Ecology, 1994).

Suction Dredging: Suction dredging uses a small boat or barge with portable dredges and suction heads. Scuba divers operate the suction dredge and can target removal of whole plants, seeds, and roots. This method may be applied in conjunction with hand cutting where divers dislodge the plants. The plant/sediment slurry is hydraulically pumped to the barge through hoses carried by the diver. Its effectiveness is dependent on sediment composition, density of aquatic plants, and underwater visibility. Suction dredging may be best suited for localized infestations of low plant density where fragmentation must be controlled. A permit will be required for this activity.

Advantages: Diver suction dredging is species –selective. Disruption of sediments can be minimized. These methods can remove the plant stems and roots, resulting in thorough plant disruption and potential longer term control. Fragmentation of plants is minimized. This activity can be completed near and around obstacles such as piers or marinas where a harvester could not operate.

Disadvantages: Diver suction dredging is labor intensive and costly. Upland disposal of dredged slurry can require additional equipment and costs. Increased turbidity in the area of treatment can be a problem. Release of nutrients and other pollutants can also be a problem.

Costs: Suction dredging costs can be variable depending on equipment and transport requirements for slurry. Costs range from $5,000 per acre to $10,000 per acre.

Dredging

Sediment removal through dredging can work as a plant control technique by limiting light through increased water depth or removing soft sediments that are a preferred habitat to nuisance rooted plants. Soft sediment removal is accomplished with drag lines, bucket dredges, long reach backhoes, or other specialized dredging equipment. Dredging has had mixed results in controlling aquatic plant, however it can be highly effective in appropriate situations. Dredging is most often applied in a major restructuring of a severely degraded system. Generally, dredging is an activity associated with other restoration efforts. Comprehensive pre-planning will be necessary for these techniques and a dredging permit would be required.

Advantages: Dredging can remove nutrient reserves which result in nuisance rooted aquatic plant growth. Dredging, when completed, can also actually improve substrate and habitat for more desirable species of aquatic plants, fish, and invertebrates. It allows the complete renovation of an aquatic ecosytem. This method has the potential for significant reductions in aquatic plant growth. These methods can be completed in “off season” months avoiding interference with summer recreation activities.

Disadvantages: Dredging can temporarily destroy important fish and invertebrate habitat. Suspension of sediments usually increases turbidity significantly and can possibly releases nutrients causing algae blooms. Dredging is extremely expensive and requires significant planning. Dredged materials may contain toxic materials (metals, PCBs). Dredged material transportation and disposal of toxic materials are additional management considerations and are potentially expensive. It could be difficult and costly to secure regulatory permits and approvals.

Costs: Dredging costs depend upon the scale of the project and many other factors. It is generally an extremely expensive option.

Drawdown: Water level drawdown exposes the plants and root systems to prolonged freezing and drying to kill the plants. It can be completed any time of the year, however is generally more effective in winter, exposing the lake bed to freezing temperatures. If there is a water level control structure capable of drawdown, it can be an in-expensive way to control some aquatic plants. Aquatic plants vary in their susceptibility to drawdown, therefore, accurate identification of problem species is important. Drawdown is often used for other purposes of improving waterfowl habitat or fishery management, but sometimes has the added benefit of nuisance rooted aquatic plant control. This method can be used in conjunction with a dredging project to excavate nutrient-rich sediments. This method is best suited for use on reservoirs or shallow man-made lakes. A drawdown would require regulatory permits and approvals.

Advantages: A drawdown can result in compaction of certain types of sediments and can be used to facilitate other lake management activities such as dam repair, bottom barrier, or dredging projects. Drawdown can significantly impact populations of aquatic plants that propagate vegetatively. It is inexpensive.

Disadvantages: This method is limited to situations with a water level control structure. Pumps can be used to de-water further if groundwater seepage is not significant. This technique may also result in the removal of beneficial plant species. Drawdowns can decrease bottom dwelling invertebrates and overwintering reptiles and amphibians. Drawdowns can affect adjacent wetlands, alter downstream flows, and potentially impair well production. Drawdowns and any water level manipulation are often highly controversial since shoreline landowners access and public recreation are limited during the drawdown. Fish populations are vulnerable during a drawdown due to over-harvesting by fisherman in decreased water volumes.

Costs: If a suitable outlet structure is available then costs should be minimal. If dewatering pumps would be required or additional management projects such as dredging are completed, additional costs would be incurred. Other costs would include recreational losses and perhaps loss in tourism revenue.

Chemical Controls

Using chemical herbicides to kill nuisance aquatic plants is the oldest APM method. However, past pesticides uses being linked to environmental or human health problems have led to public wariness of chemicals in the environment. Current pesticide registration procedures are more stringent than in the past. While no chemical pesticide can be considered 100 percent safe, federal pesticide regulations are based on the premise that if a chemical is used according to its label instructions it will not cause adverse environmental or human health effects.

Chemical herbicides for aquatic plants can be divided into two categories, systemic and contact herbicides. Systemic herbicides are absorbed by the plant, translocated throughout the plant, and are capable of killing the entire plant, including the roots and shoots. Contact herbicides kill the plant surface in which in comes in contact, leaving roots capable of re-growth. Aquatic herbicides exist under various trade names, causing some confusion. Aquatic herbicides include the following:

- Endothall Based Herbicide
- Diquat Based Herbicide
- Fluridone Based Herbicide
- 2-4 D Based Herbicide
- Glyophosate Based Herbicide
- Triclopyr Based Herbicide
- Phosphorus Precipitation

Each of these methods are described below. The costs, benefits, and drawbacks of each chemical APM alternative are provided.

Endothall Based Herbicide: Endothall is a contact herbicide, attacking a wide range of plants at the point of contact. The chemical is not readily transferred to other plant tissue, therefore regrowth can be expected and repeated treatments may be needed. It is sold in liquid and granular forms under the trade names of Aquathol® or Hydrothol®. Hydrothol is also an algaecide. Most endothall products break down easily and do not remain in the aquatic environment. Endothall products can result in plant reductions for a few weeks to several months. Multi-season effectiveness is not typical. A permit is required for use of this herbicide.

Advantages: Endothall products work quickly and exhibit moderate to highly effective control of floating and submersed species. This herbicide has limited toxicity to fish at recommended doses.

Disadvantages: The entire plant is not killed when using endothall. Endothall is non-selective in the treatment area. High concentrations can kill fish easily. Water use restrictions (time delays) are necessary for recreation, irrigation, and fish consumption after application.

Costs: Costs vary with treatment area and dosage. Average costs for chemical application range between $400 and $700 per acre.

Diquat Based Herbicide: Diquat is a fast-acting contact herbicide effective on a broad spectrum of aquatic plants. It is sold under the trade name Reward®. Diluted forms of this product are also sold as private label products. Since Diquat binds to sediments readily, its effectiveness is reduced by turbid water. Multi-season effectiveness is not typical. A permit is required for use of this herbicide.

Advantages: Diquat works quickly and exhibit moderate to highly effective control of floating and submersed species. This herbicide has limited toxicity to fish at recommended doses.

Disadvantages: The entire plant is not killed when using diquat. Diquat is non-selective in the treatment area. Diquat can be inactivated by suspended sediments. Diquat is sometimes toxic to zooplankton at the recommended dose. Limited water used restrictions (water supply, agriculture, and contact recreation) are required after application.

Costs: Costs vary with treatment area and dosage. A general cost estimate for treatment is between $200 and $500 per acre.

Fluoridone Based Herbicide: Fluoridone is a slow-acting systemic herbicide, which is effectively absorbed and translocated by both plant roots and stems. Sonar® and Avast!® is the trade name and it is sold in liquid or granular form. Fluoridone requires a longer contact time and demonstrates delayed toxicity to target plants. Eurasian watermilfoil is more sensitive to fluoridone than other aquatic plants. This allows a semi-selective approach when low enough doses are used. Since the roots are also killed, multi-season effectiveness can be achieved. It is best applied during the early growth phase of the plants. A permit and extensive planning is required for use of this herbicide.

Advantages: Fluoridone is capable of killing roots, therefore producing a longer lasting effect than other herbicides. A variety of emergent and submersed aquatics are susceptible to this herbicide. Fluoridine can be used selectively, based on concentration. A gradual killing of target plants limits severe oxygen depletion from dead plant material. It has demonstrated low toxicity to aquatic fauna such as fish and invertebrates. 3 to 5 year control has been demonstrated. Extensive testing has shown that, when used according to label instructions, it does not pose negative health affects.

Disadvantages: Fluoridine is a very slow-acting herbicide sometimes taking up to several months for visible effects. It requires a long contact time. Fluoridine is extremely soluble and mixable, therefore, not effective in flowing water situations or for treating a select area in a large open lake. Impacts on non-target plants are possible at higher doses. Time delays are necessary on use of the water (water supply, irrigation, and contact recreation) after application.

Costs: Costs vary with treatment area and dosage. Treatment costs range from $500 to $2,000 per acre.

2,4-D Based Herbicide: 2,4-D based herbicides are sold in liquid or granular forms under various trade names. Common granular forms are sold under the trade names Navigate® and Aqua Kleen®. Common liquid forms include DMA 4® and Weedar 64®. 2,4-D is a systemic herbicide that affects broad leaf plants. It has been demonstrated effective against Eurasian watermilfoil, but it may not work on many aquatic plants. Since the roots are also killed, multi-season effectiveness may be achieved. It is best applied during the early growth phase of the plants. Visible results are evident within 10 to 14 days. A permit is required for use of this herbicide.

Advantages: 2,4-D is capable of killing roots, therefore producing a longer lasting effect than some other herbicides. It is fairly fast and somewhat selective, based on application timing and concentration. 2,4-D containing products are moderately to highly effective on a few emergent, floating, or submersed plants.

Disadvantages: 2,4-D can have variable toxicity effects to aquatic fauna, depending on formulation and water chemistry. 2,4-D lasts only a short time in water, but can be detected in sediments for months after application. Time delays are necessary on use of the water (agriculture and contact recreation) after application. The label does not permit use of this product in water used for drinking, irrigation, or livestock watering.

Costs: Costs vary with treatment area and dosage. Treatment costs range from $300 to $800 per acre.

Glyophosate Based Herbicide: Glyophosate has been categorized as both a contact and a systemic herbicide. It is applied as a liquid spray and is sold under the trade name Rodeo® or Pondmaster®. It is a non-selective, broad based herbicide effective against emergent or floating leaved plants, but not submergents. It's effectiveness can be reduced by rain. A permit is required for use of this herbicide.

Advantages: Glyophoshate is moderately to highly effective against emergent and floating-leaf plants resulting in rapid plant destruction. Since it is applied by spraying plants above the surface, the applicator can apply it selectively to target plants. Glyophosate dissipates quickly from natural waters, has a low toxicity to aquatic fauna, and carries no restrictions or time delays for swimming, fishing, or irrigation.

Disadvantages: Glyophoshate is non-selective in the treatment area. Wind can dissipate the product during the application reducing it's effectiveness and cause damage to non-target organisms. Therefore, spray application should only be completed when wind drift is not a problem. This compound is highly corrosive, therefore storage precautions are necessary.

Costs: Costs average $500 to $1,000 per acre depending on the scale of treatment.

Triclopyr Based Herbicide: Triclopyr is a systemic herbicide. It is registered for experimental aquatic use in selected areas only. It is applied as a liquid spray or injected into the subsurface as a liquid. Triclopyr is sold under the trade name Renovate® or Restorate®. Triclopyr has shown to be an effective control to many floating and submersed plants. It has been demonstrated to be highly effective against Eurasian watermilfoil, having little effect on valued native plants such as pondweeds. Triclopyr is most effective when applied during the active growth period of younger plants.

Advantages: This herbicide is fast acting. Triclopyr can be used selectively since it appears more effective against dicot plant species, including several difficult nuisance plants. Testing has demonstrated low toxicity to aquatic fauna.

Disadvantages: At higher doses, there are possible impacts to non-target species. Some forms of this herbicide are experimental for aquatic use and restrictions on use of the treated water are not yet certain.

Biological Controls

There has been recent interest in using biological technologies to control aquatic plants. This concept stems from a desire to use a "natural" control and reduce expenses related to equipment and/or chemicals. While use of biological controls is in its infancy, potentially useful technologies have been identified and show promise for integration with physical and chemical APM strategies. Several biological controls that are in use or are under experimentation include the following:

- Herbivorous Fish
- Herbivorous Insects
- Plant Pathogens
- Native Plants

Each of these methods are described below. The costs, benefits, and drawbacks of each biologic APM method are provided.

Herbivorous Fish: A herbivorous fish such as the non-native grass carp can consume large quantities of aquatic plants. These fish have high growth rates and a wide range of plant food preferences. Stocking rates and effectiveness will depend on many factors including climate, water temperature, type and extent of aquatic plants, and other site-specific issues. Sterile (triploid) fish have been developed resulting in no reproduction of the grass carp and population control. This technology has demonstrated mixed results and is most appropriately used for lake-wide, low intensity control of submersed plants. Some states do not allow stocking of herbivorous fish. In Wisconsin, stocking of grass carp is prohibited.

Advantages: This technology can provide multiple years of aquatic plant control from a single stocking. Compared to other long-term aquatic plant control techniques such as bottom tillage or bottom barriers, costs may be relatively low.

Disadvantages: Sterile grass carp exhibit distinct food preferences, limiting their applicability. Grass carp may feed selectively on the preferred plants, while less preferred plants, including milfoil, may increase. The effects of using grass carp may not be immediate. Overstocking may result in an impact on non-target plants or eradication of beneficial plants, altering lake habitat. Using grass carp may result in algae blooms and increased turbidity. If precautions are not taken (i.e. inlet and outlet control structures to prevent fish migration) the fish may migrate and have adverse effects on non-target vegetation.

Costs: Costs can range from $50/acre to over $2,000/acre, at stocking rates of 5 fish/acre to 200 fish/acre.

Herbivorous Insects: Non-native and native insect species have been used to control rooted plants. Using herbivorous insects is intended to selectively control target species. These aquatic larvae of moths, beetles, and thrips use specific host aquatic plants. Several non-native species have been imported under USDA approval and used in integrated pest management programs, a combination of biological, chemical, and mechanical controls.

These non-native insects are being used in southern states to control nuisance plant species and appear climate-limited, their northern range being Georgia and North Carolina. While successes have been demonstrated, non-native species have not established themselves for solving biological problems, sometimes creating as many problems as they solve. Therefore, government agencies prefer alternative controls.

Native insects such as the larvae of midgeflies, caddisflies, beetles, and moths may be successful APM controls in northern states. Recently however, the native aquatic weevil *Euhrychiopsis lecontei* has received the most attention. This weevil has been associated with native northern water milfoil. The weevil can switch plant hosts and feed on Eurasian watermilfoil, destroying it's growth points. While the milfoil weevil is gaining popularity, it is still experimental.

Advantages: Herbivorous insects are expected to have no negative effects on non-target species. The insects have shown promise for long term control when used as part of integrated aquatic plant management programs. The milfoil weevils do not use non-milfoil plants as hosts.

Disadvantages: Natural predator prey cycles indicate that incomplete control is likely. An oscillating cycle of control and re-growth is more likely. Fish predation may complicate controls. Large numbers of milfoil weevils may be required for a dense stand and can be expensive. The weevil leaves the water during the winter, may not return to the water in the spring, and are subject to bird predation in their terrestrial habitat. Application is manual and extremely time consuming. Introducing any species, especially non-native ones, into an aquatic ecosystem may have undesirable effects. Therefore, it is extremely important to understand the life cycles of the insects and the host plants.

Costs: Reported costs of herbivorous insects rang from $300/acre to $3,000/acre.

Specifically, the native milfoil weevils cost approximately $1.00 per weevil. It is generally considered appropriate to use 5 to 7 weevils per stem. Dense stands of milfoil may contain 1 to 2 million stems per acre. Therefore, costs of this new technology are currently prohibitive.

Plant Pathogens: Using a plant pathogen to control nuisance aquatic plants has been studied for many years, however, plant pathogens still remain largely experimental. Fungi are the most common pathogens, while bacteria and viruses have also been used. There is potential for highly specific plant applications.

Advantages: Plant pathogens may be highly species specific. They may provide substantial control of a nuisance species.

Disadvantages: Pathogens are experimental. The effectiveness and longevity of control is not well understood. Possible side effects are also unknown.

Costs: These techniques are experimental therefore a supply of specific products and costs are not established.

Native Plants: This method involves removing the nuisance plant species through chemical or physical means and re-introducing seeds, cuttings, or whole plants of desirable species. Success has been variable. When using seeds, they need to be planted early enough to encourage the full growth and subsequent seed production of those plants. Transplanting mature plants may be a better way to establish seed producing populations of desirable aquatics. Recognizing that a healthy, native, desirable plant community may be resistant to infestations of nuisance species, planting native plants should be encouraged as an APM alternative. Non-native plants can not be translocated.

Advantages: This alternative can restore native plant communities. It can be used to supplement other methods and potentially prevent future needs for costly repeat APM treatments.

Disadvantages: While this appears to be a desirable practice, it is experimental at this time and there are not many well documented successes. Nuisance species may eventually again invade the areas of native plantings. Careful planning is required to ensure that the introduced species do not themselves become nuisances. Hand planting aquatic plants is labor intensive.

Costs: Costs can be highly variable depending on the selected native species, numbers of plants ordered, and the nearest dealer location.

Aquatic Plant Prevention

The phrase "an ounce of prevention is worth a pound of cure" certainly holds true for APM. Prevention is the best way to avoid nuisance aquatic plant growth. Prevention of the spread of invasive aquatic plants must also be achieved. Inspecting boats, trailers, and live wells for live aquatic plant material is the best way to prevent nuisance aquatic plants from entering a new aquatic ecosystem. Protecting the desirable native plant communities is also important in maintaining a healthy aquatic ecosystem and preventing the spread of nuisance aquatics once they are present.

Prolific growth of nuisance aquatic plants can be prevented by limiting nutrient (i.e. phosphorus) inputs to the water body. Aeration or phosphorus precipitation can achieve controls of in-lake cycling of phosphorus, however, if there are additional outside sources of nutrients, these methods will be largely ineffective in controlling algae blooms or intense aquatic macrophyte infestations. Watershed management activities to control nutrient laden storm water runoff are critical to controlling excessive nutrient loading to the water bodies. Nutrient loading can be prevented/minimized by the following:

- Shoreline buffers
- Using non-phosphorus fertilizers on lawns
- Settling basins for storm water effluents

Chapter NR 107

AQUATIC PLANT MANAGEMENT

Note: Chapter NR 107 as it existed on February 28, 1989 was repealed and a new Chapter NR 107 was created effective March 1, 1989.

NR 107.01 Purpose. The purpose of this chapter is to establish procedures for the management of aquatic plants and control of other aquatic organisms pursuant to s. 227.11 (2) (a), Stats., and interpreting s. 281.17 (2), Stats. A balanced aquatic plant community is recognized to be a vital and necessary component of a healthy aquatic ecosystem. The department may allow the management of nuisance–causing aquatic plants with chemicals registered and labeled by the U.S. environmental protection agency and labeled and registered by firms licensed as pesticide manufacturers and labelers with the Wisconsin department of agriculture, trade and consumer protection. Chemical management shall be allowed in a manner consistent with sound ecosystem management and shall minimize the loss of ecological values in the water body.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.02 Applicability. Any person sponsoring or conducting chemical treatment for the management of aquatic plants or control of other aquatic organisms in waters of the state shall obtain a permit from the department. Waters of the state include those portions of Lake Michigan and Lake Superior, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other ground or surface water, natural or artificial, public or private, within the state or its jurisdiction as specified in s. 281.01 (18), Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.03 Definitions. (1) "Applicator" means the person physically applying the chemicals to the treatment site.

(2) "Chemical fact sheet" means a summary of information on a specific chemical written by the department including general aquatic community and human safety considerations applicable to Wisconsin sites.

(3) "Department" means the department of natural resources.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.04 Application for permit. (1) Permit applications shall be made on forms provided by the department and shall be submitted to the district director for the district in which the project is located. Any amendment or revision to an application shall be treated by the department as a new application, except as provided in s. NR 107.04 (3) (g).

Note: The DNR district headquarters are located at:

1. Southern — 3911 Fish Hatchery Road, Fitchburg 53711
2. Southeast — 2300 N. Dr. Martin Luther King Jr. Dr., Box 12436, Milwaukee 53212
3. Lake Michigan — 1125 N. Military Ave., Box 10448, Green Bay 54307
4. North Central — 107 Sutliff Ave., Box 818, Rhinelander 54501
5. Western — 1300 W. Clairemont Ave., Call Box 4001, Eau Claire 54702
6. Northwest — Hwy 70 West, Box 309, Spooner 54801

(2) The application shall be accompanied by:

(a) A nonrefundable permit application fee of $20, and, for proposed treatments larger than 0.25 acres, an additional refundable acreage fee of $25.00 per acre, rounded up to the nearest whole acre, applied to a maximum of 50.0 acres.

1. The acreage fee shall be refunded in whole if the entire permit is denied or if no treatment occurs on any part of the permitted treatment area. Refunds will not be prorated for partial treatments.

2. If the permit is issued with the proposed treatment area partially denied, a refund of acreage fees shall be given for the area denied.

(b) A legal description of the body of water proposed for treatment including township, range and section number;

(c) One copy of a detailed map or sketch of the body of water with the proposed treatment area dimensions clearly shown and with pertinent information necessary to locate those properties, by name of owner, riparian to the treatment area, which may include street address, local telephone number, block, lot and fire number where available. If a local address is not available, the home address and phone number of the property owner may be included;

(d) A description of the uses being impaired by plants or aquatic organisms and reason for treatment;

(e) A description of the plant community or other aquatic organisms causing the use impairment;

(f) The product names of chemicals proposed for use and the method of application;

(g) The name of the person or commercial applicator, and applicator certification number, when required by s. NR 107.08 (5), of the person conducting the treatment;

(h) A comparison of alternative control methods and their feasibility for use on the proposed treatment site.

(3) In addition to the information required under sub. (2), when the proposed treatment is a large–scale treatment exceeding 10.0 acres in size or 10% of the area of the water body that is 10 feet or less in depth, the application shall be accompanied by:

(a) A map showing the size and boundaries of the water body and its watershed.

(b) A map and list identifying known or suspected land use practices contributing to plant–related water quality problems in the watershed.

(c) A summary of conditions contributing to undesirable plant growth on the water body.

(d) A general description of the fish and wildlife uses occurring within the proposed treatment site.

(e) A summary of recreational uses of the proposed treatment site.

(f) Evidence that a public notice of the proposed application has been made, and that a public informational meeting, if required, has been conducted.

1. Notice shall be given in 2 inch x 4 inch advertising format in the newspaper which has the largest circulation in the area affected by the application.

2. The notice shall state the size of the proposed treatment, the approximate treatment dates, and that the public may request within 5 days of the notice that the applicant hold a public informational meeting on the proposed application.

a. The applicant will conduct a public informational meeting in a location near the water body when a combination of 5 or more individuals, organizations, special units of government, or local units of government request the meeting in writing to the applicant with a copy to the department within 5 days after the notice is made. The person or entity requesting the meeting shall state a specific agenda of topics including problems and alternatives to be discussed.

b. The meeting shall be given a minimum of one week advance notice, both in writing to the requestors, and advertised in the format of subd. 1.

(g) The provisions of pars. (a) to (e) shall be repeated once every 5 years and shall include new information. Annual modifications of the proposed treatment within the 5–year period which do not expand the treatment area more than 10% and cover a similar location and target organisms may be accepted as an amendment to the original application. The acreage fee submitted under sub. (2) (a) shall be adjusted in accordance with any proposed amendments.

(4) The applicant shall certify to the department that a copy of the application has been provided to any affected property owners' association, inland lake district, and, in the case of chemical applications for rooted aquatic plants, to any riparian property owners adjacent to and within the treatment area.

(5) A notice of the proposed treatment shall be provided by the department to any person or organization indicating annually in writing a desire to receive such notification.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.05 Issuance of permit. (1) The department shall issue or deny issuance of the requested permit between 10 and 15 working days after receipt of an acceptable application, unless:

(a) An environmental impact report or statement is required under s. 1.11, Stats. Notification to the applicant shall be in writing within 10 working days of receipt of the application and no action may be taken until the report or statement has been completed; or

(b) A public hearing has been granted under s. 227.42, Stats.

(2) If a request for a public hearing is received after the permit is issued but prior to the actual treatment allowed by the permit, the department is not required to, but may, suspend the permit because of the request for public hearing.

(3) The department may deny issuance of the requested permit if:

(a) The proposed chemical is not labeled and registered for the intended use by the United States environmental protection agency and both labeled and registered by a firm licensed as a pesticide manufacturer and labeler with the Wisconsin department of agriculture, trade and consumer protection;

(b) The proposed chemical does not have a current department aquatic chemical fact sheet;

(c) The department determines the proposed treatment will not provide nuisance relief, or will place unreasonable restrictions on existing water uses;

(d) The department determines the proposed treatment will result in a hazard to humans, animals or other nontarget organisms;

(e) The department determines the proposed treatment will result in a significant adverse effect on the body of water;

(f) The proposed chemical application is for waters beyond 150 feet from shore except where approval is given by the department to maintain navigation channels, piers or other facilities used by organizations or the public including commercial facilities;

(g) The proposed chemical applications, other than those conducted by the department pursuant to ss. 29.421 and 29.424, Stats., will significantly injure fish, fish eggs, fish larvae, essential fish food organisms or wildlife, either directly or through habitat destruction;

(h) The proposed chemical application is in a location known to have endangered or threatened species as specified pursuant to s. 29.604, Stats., and as determined by the department;

(i) The proposed chemical application is in locations identified by the department as sensitive areas, except when the applicant demonstrates to the satisfaction of the department that treatments can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

1. Sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water.

2. The department shall notify any affected property owners' association, inland lake district, and riparian property owner of locations identified as sensitive areas.

(4) New applications will be reviewed with consideration given to the cumulative effect of applications already approved for the body of water.

(5) The department may approve the application in whole or in part consistent with the provisions of subs. (3) (a) through (i) and (4). Denials shall be in writing stating reasons for the denial.

(6) Permits may be issued for one treatment season only.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (3) (g) and (h) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.06 Chemical fact sheets. (1) The department shall develop a chemical fact sheet for each of the chemicals in present use for aquatic nuisance control in Wisconsin.

(1m) Chemical fact sheets for chemicals not previously used in Wisconsin shall be developed within 180 days after the department has received notice of intended use of the chemical.

(2) The applicant or permit holder shall provide copies of the applicable chemical fact sheets to any affected property owners' association and inland lake district.

(3) The department shall make chemical fact sheets available upon request.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.07 Supervision. (1) The permit holder shall notify the district office 4 working days in advance of each anticipated treatment with the date, time, location, and proposed size of treatment. At the discretion of the department, the advance notification requirement may be waived.

(2) Supervision by a department representative may be required for any aquatic nuisance control project involving chemicals. Supervision may include inspection of the proposed treatment area, chemicals, and application equipment before, during or after treatment. The inspection may result in the determination that treatment is unnecessary or unwarranted in all or part of the proposed area, or that the equipment will not control the proper dosage.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.08 Conditions of the permit. (1) The department may stop or limit the application of chemicals to a body of water if at any time it determines that chemical treatment will be ineffective, or will result in unreasonable restrictions on current water uses, or will produce unnecessary adverse side effects on nontarget organisms. Upon request, the department shall state the reason for such action in writing to the applicant.

(2) Chemical treatments shall be performed in accordance with label directions, existing pesticide use laws, and permit conditions.

(3) Chemical applications on lakes and impoundments are limited to waters along developed shoreline including public parks except where approval is given by the department for projects of public benefit.

(4) Treatment of areas containing high value species of aquatic plants shall be done in a manner which will not result in adverse long–term or permanent changes to a plant community in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including *Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Potamogeton pectinatus, Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania aquatica, Zannichellia palustris* and *Brasenia schreberi.*

(5) Treatment shall be performed by an applicator currently certified by the Wisconsin department of agriculture, trade and consumer protection in the aquatic nuisance control category whenever:

(a) Treatment is to be performed for compensation by an applicator acting as an independent contractor for hire;

(b) The area to be treated is greater than 0.25 acres;

(c) The product to be used is classified as a "restricted use pesticide"; or

(d) Liquid chemicals are to be used.

(6) Power equipment used to apply liquid chemicals shall include the following:

(a) Containers used to mix and hold chemicals shall be constructed of watertight materials and be of sufficient size and strength to safely contain the chemical. Measuring containers and scales for the purpose of measuring solids and liquids shall be provided by the applicator;

(b) Suction hose used to deliver the chemical to the pump venturi assembly shall be fitted with an on–off ball–type valve. The system shall also be designed to prevent clogging from chemicals and aquatic vegetation;

(c) Suction hose used to deliver surface water to the pump shall be fitted with a check valve to prevent back siphoning into the surface water should the pump stop;

(d) Suction hose used to deliver a premixed solution shall be fitted with an on–off ball–type valve to regulate the discharge rate;

(e) Pressure hose used to discharge chemicals to the surface water shall be provided with an on–off ball–type valve. This valve will be fitted at the base of the hose nozzle or as part of the nozzle assembly;

(f) All pressure and suction hoses and mechanical fittings shall be watertight;

(g) Equipment shall be calibrated by the applicator. Evidence of calibration shall be provided at the request of the department supervisor.

(h) Other equipment designs may be acceptable if capable of equivalent performance.

(7) The permit holder shall be responsible for posting those areas of use in accordance with water use restrictions stated on the chemical label, but in all cases for a minimum of one day, and with the following conditions:

(a) Posting signs shall be brilliant yellow and conspicuous to the nonriparian public intending to use the treated water from both the water and shore, and shall state applicable label water use restrictions of the chemical being used, the name of the chemical and date of treatment. For tank mixes, the label requirements of the most restrictive chemical will be posted;

(b) Minimum sign dimensions used for posting shall be 11 inches by 11 inches or consistent with s. ATCP 29.15. The department will provide up to 6 signs to meet posting requirements. Additional signs may be purchased from the department;

(c) Signs shall be posted at the beginning of each treatment by the permit holder or representing agent. Posting prior to treatment may be required as a permit condition when the department determines that such posting is in the best interest of the public;

(d) Posting signs shall be placed along contiguous treated shoreline and at strategic locations to adequately inform the public. Posting of untreated shoreline located adjacent to treated shoreline and noncontiguous shoreline shall be at the discretion of the department;

(e) Posting signs shall be made of durable material to remain up and legible for the time period stated on the pesticide label for water use restrictions, after which the permit holder or representing agent is responsible for sign removal.

(8) After conducting a treatment, the permit holder shall complete and submit within 30 days an aquatic nuisance control report on a form supplied by the department. Required information will include the quantity and type of chemical, and the specific size and location of each treatment area. In the event of any unusual circumstances associated with a treatment, or at the request of the department, the report shall be provided immediately. If treatment did not occur, the form shall be submitted with appropriate comment by October 1.

(9) Failure to comply with the conditions of the permit may result in cancellation of the permit and loss of permit privileges for the subsequent treatment season. A notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder accompanied by a statement of appeal rights.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89**;** correction in (7) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1995, No. 477.

NR 107.09 Special limitation. Due to the significant risk of environmental damage from copper accumulation in sediments, swimmer's itch treatments performed with copper sulfate products at a rate greater than 10 pounds of copper sulfate per acre are prohibited.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.10 Field evaluation use permits. When a chemical product is considered for aquatic nuisance control and does not have a federal label for such use, the applicant shall apply to the administrator of the United States environmental protection agency for an experimental use permit under section 5 of the federal insecticide, fungicide and rodenticide act as amended (7 USC 136 et seq.). Upon receiving a permit, the permit holder shall obtain a field evaluation use permit from the department and be subject to the requirements of this chapter. Department field evaluation use permits shall be issued for the purpose of evaluating product effectiveness and safety under field conditions and will require in addition to the conditions of the permit specified in s. NR 107.08 (1) through (9), the following:

(1) Treatment shall be limited to an area specified by the department.

(2) The permit holder shall submit to the department a summary of treatment results at the end of the treatment season. The summary shall include:

(a) Total chemical used and distribution pattern, including chemical trade name, formulation, percent active ingredient, and dosage rate in the treated water in parts per million of active ingredient;

(b) Description of treatment areas including the character and the extent of the nuisance present;

(c) Effectiveness of the application and when applicable, a summary comparison of the results obtained from past experiments using the same chemical formulation;

(d) Other pertinent information required by the department; and

(e) Conclusions and recommendations for future use.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.11 Exemptions. (1) Under any of the following conditions, the permit application fee in s. NR 107.04 (2) (a) will be limited to the basic application fee:

(a) The treatment is made for the control of bacteria on swimming beaches with chlorine or chlorinated lime;

(b) The treatment is intended to control algae or other aquatic nuisances that interfere with the use of the water for potable purposes;

(c) The treatment is necessary for the protection of public health, such as the control of disease carrying organisms in sanitary sewers, storm sewers, or marshes, and the treatment is sponsored by a governmental agency.

(2) The treatment of purple loosestrife is exempt from ss. NR 107.04 (2) (a) and (3), and 107.08 (5).

(3) The use of chemicals in private ponds is exempt from the provisions of this chapter except for ss. NR 107.04 (1), (2), (4) and (5), 107.05, 107.07, 107.08 (1), (2), (8) and (9), and 107.10.

(a) A private pond is a body of water located entirely on the land of an applicant, with no surface water discharge or a discharge that can be controlled to prevent chemical loss, and without access by the public.

(b) The permit application fee will be limited to the non–refundable $20 application fee.

(4) The use of chemicals in accordance with label instructions is exempt from the provisions of this chapter, when used in:

(a) Water tanks used for potable water supplies;

(b) Swimming pools;

(c) Treatment of public or private wells;

(d) Private fish hatcheries licensed under s. 95.60, Stats.;

(e) Treatment of emergent vegetation in drainage ditches or rights–of–way where the department determines that fish and wildlife resources are insignificant; or

(f) Waste treatment facilities which have received s. 281.41, Stats., plan approval or are utilized to meet effluent limitations set forth in permits issued under s. 283.31, Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (4) (d) and (f) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.715, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter. Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non–native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.02 Applicability. A person sponsoring or conducting manual removal, burning or using mechanical means or aquatic plant inhibitors to control aquatic plants in navigable waters, or introducing non–native aquatic plants to waters of this state shall obtain an aquatic plant management permit from the department under this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.03 Definitions. In this chapter:

(1) "Aquatic community" means lake or river biological resources.

(2) "Beneficial water use activities" mean angling, boating, swimming or other navigational or recreational water use activity.

(3) "Body of water" means any lake, river or wetland that is a water of this state.

(4) "Complete application" means a completed and signed application form, the information specified in s. NR 109.04 and any other information which may reasonably be required from an applicant and which the department needs to make a decision under applicable provisions of law.

(5) "Department" means the Wisconsin department of natural resources.

(6) "Manual removal" means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.

(7) "Navigable waters" means those waters defined as navigable under s. 30.10, Stats.

(8) "Permit" means aquatic plant management permit.

(9) "Plan" means aquatic plant management plan.

(10) "Wetlands" means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.04 Application requirements and fees. (1) Permit applications shall be made on forms provided by the department and shall be submitted to the regional director or designee for the region in which the project is located. Permit applications for licensed aquatic nursery growers may be submitted to the department of agriculture, trade and consumer protection.

Note: Applications may be obtained from the department's regional headquarters or service centers. DATCP has agreed to send application forms and instructions provided by the department to aquatic nursery growers along with license renewal forms. DATCP will forward all applications to the department for processing.

(2) The application shall be accompanied by all of the following unless the application is made by licensed aquatic nursery growers for selective harvesting of aquatic plants for nursery stock. Applications made by licensed aquatic nursery growers for harvest of nursery stock do not have to include the information required by par. (d), (e), (h), (i) or (j).

(a) A nonrefundable application fee. The application fee for an aquatic plant management permit is:

1. $30 for a proposed project to manage aquatic plants on less than one acre.

2. $30 per acre to a maximum of $300 for a proposed project to manage aquatic plants on one acre or larger. Partial acres shall be rounded up to the next full acre for fee determination. An annual renewal of this permit may be requested with an additional application fee of one–half the original application fee, but not less than $30.

(b) A legal description of the body of water including township, range and section number.

(c) One copy of a detailed map of the body of water with the proposed introduction or control area dimensions clearly shown. Private individuals doing plant introduction or control shall provide the name of the owner riparian to the management area, which includes the street address or block, lot and fire number where available and local telephone number or other pertinent information necessary to locate the property.

(d) One copy of any existing aquatic management plan for the body of water, or detailed reference to the plan, citing the plan references to the proposed introduction or control area, and a description of how the proposed introduction or control of aquatic plants is compatible with any existing plan.

(e) A description of the impairments to water use caused by the aquatic plants to be managed.

(f) A description of the aquatic plants to be controlled or removed.

(g) The type of equipment and methods to be used for introduction, control or removal.

(h) A description of other introduction or control methods considered and the justification for the method selected.

(i) A description of any other method being used or intended for use for plant management by the applicant or on the area abutting the proposed management area.

(j) The area used for removal, reuse or disposal of aquatic plants.

(k) The name of any person or commercial provider of control or removal services.

(3) (a) The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long–term sustainability of beneficial water use activities.

(b) Within 30 days of receipt of the plan, the department shall notify the applicant of any additional information or modifications to the plan that are required. If the applicant does not submit the additional information or modify the plan as requested by the department, the department may dismiss the aquatic plant management permit application.

(c) The department shall approve the aquatic plant management plan before an application may be considered complete.

(4) The permit sponsor may request an annual renewal in writing from the department under s. NR 109.05 if there is no change proposed in the conditions of the original permit issued.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.05 Permit issuance. (1) The department shall issue or deny issuance of the requested permit within 15 working days after receipt of a completed application and approved plan as required under s. NR 109.04 (3).

(2) The department may specify any of the following as conditions of the permit:

(a) The quantity of aquatic plants that may be introduced or controlled.

(b) The species of aquatic plants that may be introduced or controlled.

(c) The areas in which aquatic plants may be introduced or controlled.

(d) The methods that may be used to introduce or control aquatic plants.

(e) The times during which aquatic plants may be introduced or controlled.

(f) The allowable methods used for disposing of or using aquatic plants that are removed or controlled.

(g) Annual or other reporting requirements to the department that may include information related to pars. (a) to (f).

(3) The department may deny issuance of the requested permit if the department determines any of the following:

(a) Aquatic plants are not causing significant impairment of beneficial water use activities.

(b) The proposed introduction or control will not remedy the water use impairments caused by aquatic plants as identified as a part of the application in s. NR 109.04 (2) (e).

(c) The proposed introduction or control will result in a hazard to humans.

(d) The proposed introduction or control will cause significant adverse impacts to threatened or endangered resources.

(e) The proposed introduction or control will result in a significant adverse effect on water quality, aquatic habitat or the aquatic community including the native aquatic plant community.

(f) The proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

(g) The proposed management will result in significant adverse long–term or permanent changes to a plant community or a high value species in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Stuckenia pectinata (Potamogeton pectinatus), Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania spp., Zannichellia palustris and Brasenia schreberi.

(h) If wild rice is involved, the stipulations incorporated by *Lac Courte Oreilles v. Wisconsin*, 775 F. Supp. 321 (W.D. Wis. 1991) shall be complied with.

(i) The proposed introduction or control will interfere with the rights of riparian owners.

(j) The proposed management is inconsistent with a department approved aquatic plant management plan for the body of water.

(4) The department may approve the application in whole or in part consistent with the provisions of sub. (3). A denial shall be in writing stating the reasons for the denial.

(5) (a) The department may issue an aquatic plant management permit on less than one acre in a single riparian area for a 3–year term.

(b) The department may issue an aquatic plant management permit for a one–year term for more than one acre or more than one riparian area. The permit may be renewed annually for up to a total of 3 years in succession at the written request of the permit holder, provided no modifications or changes are made from the original permit.

(c) The department may issue an aquatic plant management permit containing a department–approved plan for a 3 to 5 year term.

(d) The department may issue an aquatic plant management permit to a licensed nursery grower for a 3–year term for the harvesting of aquatic plants from a publicly owned lake bed or for a 5–year term for harvesting of aquatic plants from privately owned beds with the permission of the property owner.

(6) The approval of an aquatic plant management permit does not represent an endorsement of the permitted activity, but represents that the applicant has complied with all criteria of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03**; reprinted to restore dropped language from rule order, Register October 2003 No. 574.**

NR 109.06 Waivers. The department waives the permit requirements under this chapter for any of the following:

(1) Manual removal or use of mechanical devices to control or remove aquatic plants from a body of water 10 acres or less that is entirely confined on the property of one person with the permission of that property owner.

Note: A person who introduces native aquatic plants or removes aquatic plants by manual or mechanical means in the course of operating an aquatic nursery as authorized under s. 94.10, Stats., on privately owned non–navigable waters of the state is not required to obtain a permit for the activities.

(2) A riparian owner who manually removes aquatic plants from a body of water or uses mechanical devices designed for cutting or mowing vegetation to control plants on an exposed lake bed that abuts the owner's property provided that the removal meets all of the following:

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30–foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

2. Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 when performed in a manner that does not harm the native aquatic plant community; or

3. Removal of dislodged aquatic plants that drift on–shore and accumulate along the waterfront.

(b) Is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1., or in an area known to contain threatened or endangered resources or floating bogs.

(c) Does not interfere with the rights of other riparian owners.

(d) If wild rice is involved, the procedures of s. NR 19.09 (1) shall be followed.

(4) Control of purple loosestrife by manual removal or use of mechanical devices when performed in a manner that does not harm the native aquatic plant community or result in or encourage re–growth of purple loosestrife or other nonnative vegetation.

(5) Any aquatic plant management activity that is conducted by the department and is consistent with the purposes of this chapter.

(6) Manual removal and collection of native aquatic plants for lake study or scientific research when performed in a manner that does not harm the native aquatic plant community.

Note: Scientific collectors permit requirements are still applicable.

(7) Incidental cutting, removal or destroying of aquatic plants when engaged in beneficial water use activities.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.07 Invasive and nonnative aquatic plants. **(1)** The department may designate any aquatic plant as an invasive aquatic plant for a water body or a group of water bodies if it has the ability to cause significant adverse change to desirable aquatic habitat, to significantly displace desirable aquatic vegetation, or to reduce the yield of products produced by aquaculture.

(2) The following aquatic plants are designated as invasive aquatic plants statewide: Eurasian water milfoil, curly leaf pondweed and purple loosestrife.

(3) Native and nonnative aquatic plants of Wisconsin shall be determined by using scientifically valid publications and findings by the department.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.08 Prohibitions. **(1)** No person may distribute an invasive aquatic plant, under s. NR 109.07.

(2) No person may intentionally introduce Eurasian water milfoil, curly leaf pondweed or purple loosestrife into waters of this state without the permission of the department.

(3) No person may intentionally cut aquatic plants in public/navigable waters without removing cut vegetation from the body of water.

(4) (a) No person may place equipment used in aquatic plant management in a navigable water if the person has reason to believe that the equipment has any aquatic plants or zebra mussels attached.

(b) This subsection does not apply to equipment used in aquatic plant management when re–launched on the same body of water without having visited different waters, provided the re–launching will not introduce or encourage the spread of existing aquatic species within that body of water.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.09 Plan specifications and approval. **(1)** Applicants required to submit an aquatic plant management plan, under s. NR 109.04 (3), shall develop and submit the plan in a format specified by the department.

(2) The plan shall present and discuss each of the following items:

(a) The goals and objectives of the aquatic plant management and protection activities.

(b) A physical, chemical and biological description of the waterbody.

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

(e) An evaluation of chemical, mechanical, biological and physical aquatic plant control methods.

(f) Recommendations for an integrated aquatic plant management strategy utilizing some or all of the methods evaluated in par. (e).

(g) An education and information strategy.

(h) A strategy for evaluating the efficacy and environmental impacts of the aquatic plant management activities.

(i) The involvement of local units of government and any lake organizations in the development of the plan.

(3) The approval of an aquatic plant management plan does not represent an endorsement for plant management, but represents that adequate considerations in planning the actions have been made.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.10 Other permits. Permits issued under s. 30.12, 30.20, 31.02 or 281.36, Stats., or under ch. NR 107 may contain provisions which provide for aquatic plant management. If a permit issued under one of these authorities contains the appropriate conditions as required under this chapter for aquatic plant management, a separate permit is not required under this chapter. The permit shall explicitly state that it is intended to comply with the substantive requirements of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.11 Enforcement. **(1)** Violations of this chapter may be prosecuted by the department under chs. 23, 30 and 31, Stats.

(2) Failure to comply with the conditions of a permit issued under or in accordance with this chapter may result in cancellation of the permit and loss of permit privileges for the subsequent year. Notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

Online References for More Information

General Information

http://www.dnr.state.wi.us/org/water/fhp/lakes/aquaplan.htm
Wisconsin Department of Natural Resources - Aquatic Plant Management

http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp
UW Extension Lakes Program – Aquatic Plant Management in Wisconsin

http://www.wisconsinlakes.org/
Wisconsin Association of Lakes

http://www.uwsp.edu/cnr/uwexlakes/
UW Extension Lakes Program – Homepage

http://datcp.state.wi.us/index.jsp
Wisconsin Department of Agriculture, Trade and Consumer Protection

http://el.erdc.usace.army.mil/aqua/
Army Corps of Engineers – Aquatic Plant Control Research Program

http://www.nalms.org/
North American Lake Management Society

http://www.apms.org/
Aquatic Plant Management Society

http://www.fapms.org/
Florida Aquatic Plant Management Society

http://www.mapms.org/
Midwest Aquatic Plant Management Society

http://www.epa.gov/
Environmental Protection Agency

http://web.fisheries.org/main/
American Fisheries Society

http://www.botany.wisc.edu/herbarium/
Wisconsin State Herbarium – Aquatic Plant Indenfication

http://www.uwsp.edu/cnr/uwexlakes/CBCW/default.asp
UW Extension Lakes Program – Clean Boats Clean Waters

Aquatic Invasive Species

http://www.dnr.state.wi.us/invasives/aquatic/
Wisconsin Department of Natural Resources – Aquatic Invasive Species

http://www.uwex.edu/erc/invasives.html
UW Extension- Environmental Resources Center

http://www.ipaw.org/
Invasive Plants Association of Wisconsin

http://www.seagrant.wisc.edu/ais/
University of Wisconsin Sea Grant Institute– Aquatic Invasive Species

http://www.anstaskforce.gov/default.php
Aquatic Nuisance Species Task Force

http://www.invasivespeciesinfo.gov/aquatics/databases.shtml
United States Department of Agriculture – Invasive Species Information Center

http://aquat1.ifas.ufl.edu/welcome.html
University of Florida - Center for Aquatic and Invasive Plants

Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/Largelake.html
Lake Management Planning – Large Scale Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/smalllake.html
Lake Management Planning – Small Scale Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/invasivespecies.html
Aquatic Invasive Species

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/lakeprotection.html
Lake Protection and Classification Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/recboat.html
Recreation Boating Facilities

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Rivers/riverplanning.html
River Protection Planning

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Rivers/riverprotection.html
River Protection Management