



Report

Aquatic Plant Management Plan

Annabelle Lake

Presque Isle Town Lakes Committee

September 30, 2011

Project Number 004010-09002-0

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AQUATIC PLANT MANAGEMENT PLAN

ANNABELLE LAKE

September 30, 2011

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A handwritten signature in blue ink, appearing to read "James T. Scharl", written over a horizontal line.

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1.0 Executive Summary

The Presque Isle Town Lakes Committee (PITLC) was formed in 2005 to address resource management concerns in lakes within the Town of Presque Isle. The Committee has been active in a number of lake management activities on Annabelle Lake including: aquatic plant management, water quality sampling, invasive species sampling, and community education activities. The Committee contracted Northern Environmental (now Bonestroo, Inc.) to help develop an aquatic plant management (APM) plan for Annabelle Lake. The Annabelle Lake APM Plan includes a review of available lake information, an aquatic plant survey, and an evaluation of feasible physical, mechanical, biological, and chemical management alternatives if deemed appropriate. The APM plan also recommends specific prevention activities for aquatic invasive species (AIS) in the lake system; which are discussed below.

Northern Environmental completed an aquatic plant survey on Annabelle Lake in 2008, which identified eighteen aquatic plant species. The most abundant aquatic plants identified during the survey were quillwort (*Isoetes sp.*), large-purple bladderwort (*Utricularia purpurea*), and dwarf watermilfoil (*Myriophyllum tenellum*). The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Annabelle Lake exhibited an FQI of 34.4, higher than the state northern ecoregion average (24.3).

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

No aquatic invasive plants were found during the aquatic plant survey in 2008. If an invasive plant were found the Wisconsin Department of Natural Resources (WDNR) recommends that Annabelle Lake's residents work with WDNR and aquatic plant professionals to determine extent of AIS after discovery and to then determine appropriate management. The fact that the native plant community has an above average FQI score illustrates that there is a unique and diverse plant community in Annabelle Lake. Such a plant community is worthy of protection from human disturbance and from the impact aquatic invasive species would have if introduced to this system. Because of that, the following Recommended Action Plan focuses on conservation and plant protection.

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

Active Goal: To initiate the WDNR Clean Boats, Clean Waters program on Annabelle Lake.

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

Active Goal: To expand an aquatic invasive species monitoring program that will survey for invasive species, and if found, monitor their locations and extent of population spread. The "Adopt a Shoreline" would be a good model.

Active Goal: To continue the Annabelle Lake comprehensive water quality monitoring program through the WDNR Citizen Lake Monitoring Network.

- Active Goal:** To work in concert with the WDNR staff and representatives of fishing related businesses to evaluate Annabelle Lake fish management practices and develop goals in order to maintain and enhance a quality family sport fishery. Areas to explore may be possible encouragement of aquatic vegetation, and programs to add woody debris in the water, etc.
- Active Goal:** To enforce the Town of Presque Isle's 200 foot no-wake areas (from shoreline and islands) ordinances in order to minimize recreational impacts on the plant community, shoreline habitats, and to promote safe boating.
- Active Goal:** To support preservation of critical species, habitat lands, and wetlands within the watershed. (These are areas with rare vegetation such as Annabelle Lake's hemlock groves, important habitat for wildlife, or important spawning and nursery areas for fish. Preservation of these lands has a direct impact on the water quality of the lake).
- Active Goal:** To provide education and information to shoreline property owners regarding how native aquatic plant protection and shoreline management can slow the spread of aquatic invasive plants (if they become introduced), improve the lake fishery, improve wildlife habitat and affect the quality of the water in the lake (including development of a *shoreline restoration packet* that could be given to landowners who's property has development categorized as Moderate or Major).
- Active Goal:** To encourage the incorporation of water quality protection measures in the design, construction and maintenance of all lake access sites on Annabelle Lake (e.g. storm water control, site drainage control, appropriate plant matter disposal, and watercraft wash down facilities if found to be needed).
- Active Goal:** To meet on a regular basis with local government agencies and representatives of lakes located within the Town of Presque Isle, to identify essential and new lake management issues and determine collaborative solutions.

2.0 Introduction

Annabelle Lake is a 213 acre drainage lake located in northern Vilas County. The lake has a 1,100 acre (1.72 square miles) watershed. Annabelle Lake exhibits good water clarity and, according to the Wisconsin Trophic State Index, is a mesotrophic lake.

Lake residents have become concerned about the possibility of the introduction of Eurasian watermilfoil (*Myriophyllum spicatum* - EWM), curly-leaf pondweed (*Potamogeton crispus* - CLP) and other AIS into the aquatic plant community of Annabelle Lake. Although no AIS were recorded during the aquatic plant survey in 2008, this APM Plan includes strategies for detection, monitoring, and management/removal of EWM and CLP from Annabelle Lake if ever established and provide relief for areas of Annabelle Lake experiencing impaired navigation and/or nuisance conditions due to dense, native aquatic plant growth.

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

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2008 baseline aquatic plant survey
- Feasible aquatic plant management alternatives
- Selected suite of aquatic plant management options

3.0 Baseline Information

3.1 LAKE HISTORY AND MORPHOLOGY

Annabelle Lake is located in the Town of Presque Isle in the northern Vilas County, Wisconsin. The lake is part of the headwaters area of the Presque Isle-Black River Watershed, which drains north to Lake Superior. Figure 1 depicts the lake location. The following summarizes the lake’s physical attributes:

Lake Name	Annabelle
Lake Type	Drainage
Surface Area (acres)	213
Maximum depth (feet)	30
Mean depth (feet)	12
Shore length (mi)	4.24*
Public Landing	Yes

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

* - Includes shoreline length of islands

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

3.2 WATERSHED OVERVIEW

The Annabelle Lake watershed encompasses approximately 1,100 acres in northern Vilas County and is primarily forested and undeveloped. Annabelle Lake is connected by waterways and drains into Oxbow Creek before eventually draining into the Presque Isle River. Annabelle Lake is listed as a Priority Navigable Water (PNW) on the Wisconsin list of Designated Waters. Priority Navigable Waters include waters with self-sustaining walleye populations in ceded territories and waters with self sustaining musky populations. Annabelle Lake contains both a self-sustaining walleye population and a self-sustaining muskellunge population within the Ceded Territories.

The Annabelle Lake area consists mainly of Gogebic and Pence soil types. Gogebic and Pence soils are well drained sandy loamy soils formed in glacial till and moraines. A fragipan layer sometimes occurs within Gogebic soils. Fragipans are loamy, brittle subsurface horizons consisting of clay, silt and sand that appear cemented and can restrict plant root growth (USDA, 1988).

3.3 WATER QUALITY

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

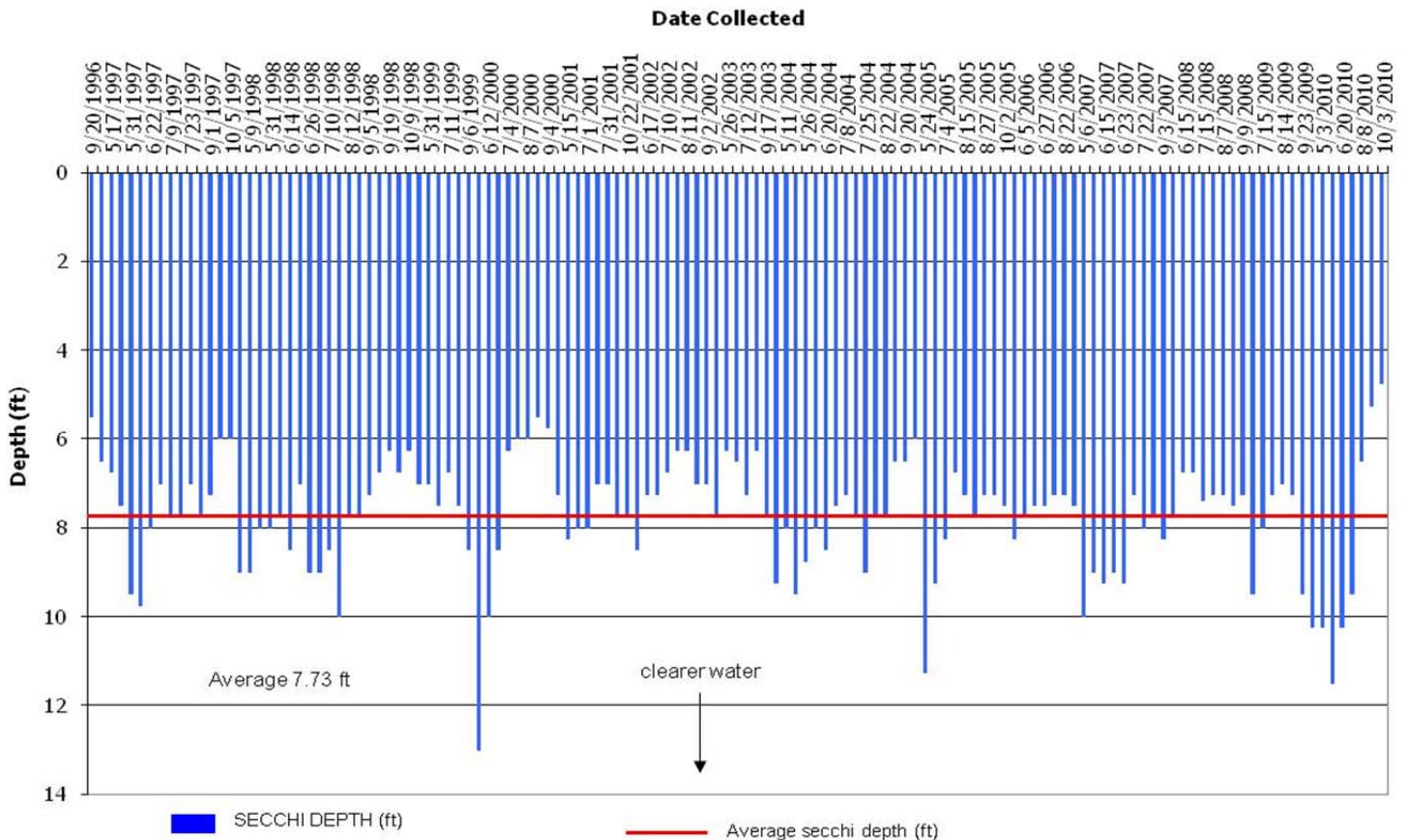
- Water clarity (Secchi depth): 1996 - present (Citizen Lake Monitoring)
- Total phosphorus: 1996 - present (Citizen Lake Monitoring)
- Chlorophyll-a: 1996 - present (Citizen Lake Monitoring)
- Dissolved oxygen and temperature: 1996 – present (Citizen Lake Monitoring)

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

3.3.1 WATER CLARITY

The historical water clarity average based on Secchi Disk readings is 7.73 feet and ranges from 4.75 to 13 feet. The Wisconsin average Secchi Disk reading in 2005 was 10 feet (Larry Bresina, The Secchi Disk and Our Eyes - Working Together To Measure Clarity of Our Lakes; internet document). The following graph illustrates the historical water clarity measurements on Annabelle Lake; data collected up to 2010 is included.

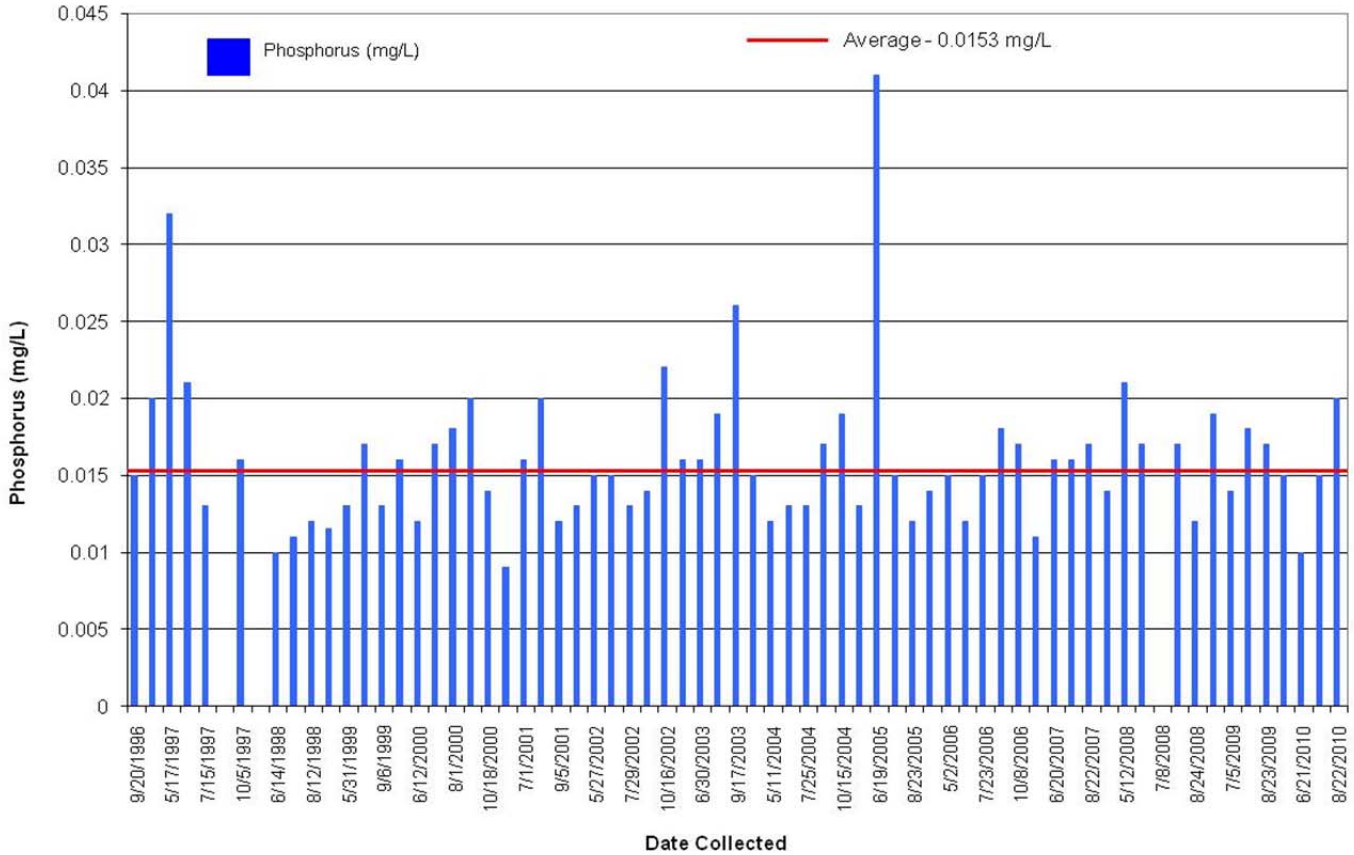
Annabelle Lake Secchi Readings



3.3.2 TOTAL PHOSPHORUS AND CHLOROPHYLL-A

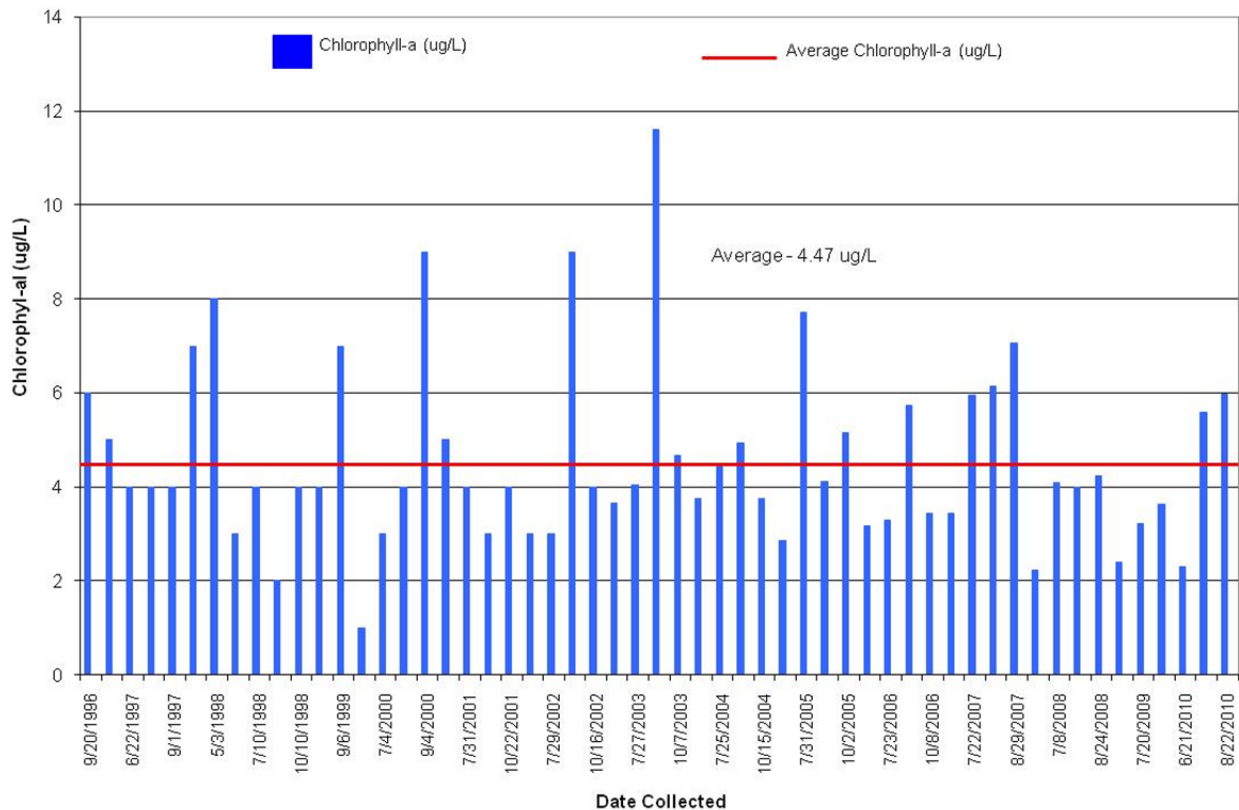
Historically Annabelle Lake has an average phosphorus reading of 0.0153 milligrams per liter (parts per million – ppm). Total phosphorus has varied from 1996 through 2010 from 0.00 ppm to 0.041 ppm. The following graph illustrates the historical phosphorus measurements on Annabelle Lake.

Annabelle Lake Phosphorus Readings



Chlorophyll measurements started in 1996 and continued through 2010, showing an average of 4.47 micrograms per liter (parts per billion – ppb). Data ranged from 1.00 ppb to 11.6 ppb. The following graph illustrates the historical chlorophyll measurements on Annabelle Lake.

Annabelle Lake Chlorophyll a Readings



3.3.3 DISSOLVED OXYGEN AND TEMPERATURE

In conjunction with Citizen Lake Monitoring, volunteers on Annabelle Lake have been recording dissolved oxygen and temperature profiles. Both data were recorded at three foot intervals over the deepest portion of the lake down to 27 feet below the surface. Profiles collected indicate the formation of a thermocline during summer stratification around 18 – 19 feet below the surface. However, due to the shallow nature of Annabelle Lake, a majority of the lake does not experience stratification because it is generally shallower than 18 feet. Results of the temperature and dissolved oxygen profile collection can be found in Appendix I.

3.3.4 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 (ug/L)	Chlorophyll-a (ug/L)	Water Clarity (feet)
Oligotrophic	1-40	Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes.	< 12	<2.6	>13

Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	12 to 24	2.6 to 7.3	13 to 6.5
Eutrophic	51-70	Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive.	> 24	>7	<6.5
Annabelle Lake	45.47	Mesotrophic	15.3	4.47	7.73

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

The historical water clarity, total phosphorus, and chlorophyll-a data indicate that Annabelle Lake is a mesotrophic lake. Data collected during by Citizen Lake Monitors up to 2010 is included in the above averages.

3.4 SUMMARY OF LAKE FISHERY

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

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

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

Records fish stocked in Annabelle Lake go back to 1933. From 1933 – 1946, all fish were stocked as fry, except for perch yearlings in 1933 & fingerlings in 1939 and muskellunge fingerlings in 1941 (only 100 out of the total) and 1946. From 1947 – present, all fish were stocked as fingerlings.

Year	Walleye	Muskellunge	Largemouth Bass	Smallmouth Bass	Perch	Black Crappie
1933	76000	---	---	---	---	---
1936	---	---	---	---	85	---
1937	757850	114375	---	---	---	---
1938	1750000	---	---	---	---	---
1939	341080	50000	---	---	25000	---
1940	---	50000	---	---	---	---
1941	600000	30100*	---	---	---	---
1942	---	8000	---	---	---	---
1946	---	---	4200	---	---	---
1958	11440	---	---	---	---	---
1964	---	500	---	---	---	---
1969	---	600	---	---	---	---
1970	---	200	---	---	---	---
1973	---	400	---	---	---	---
1974	5000	---	---	---	---	---
1977	1785	437	---	---	---	---
1978	9000	---	---	---	---	---
1980	---	300	---	---	---	---
1995	---	---	---	---	---	500
1996	100	---	---	---	---	400
1997	200	---	---	200	---	400
1998	---	---	---	150	---	300
1999	200	---	---	---	---	400

1995 – 1999: private stocking.

30100*: 30,000 fish as fry and 100 as fingerlings.

All fisheries in Annabelle Lake are currently sustained through natural reproduction. Annabelle Lake is located in the Ceded Territories of Wisconsin. The Ceded Territories was ceded to the United States by the Lake Superior Chippewa Tribes in 1837 and 1842. The WDNR describes Native American fishing in the Ceded Territories this way: “The six Chippewa tribes of Wisconsin are legally able to harvest walleyes using a variety of high efficiency methods, but spring spearing is the most frequently used method. In spring each tribe declares how many walleyes and muskellunge they intend to harvest from each lake. Harvest begins shortly after ice-out, with nightly fishing permits issued to individual tribal spearkers. Each permit allows a specific number of fish to be harvested, including one walleye between 20 and 24 inches and one additional walleye of any size. All fish that are taken are documented each night with a tribal clerk or warden present at each boat landing used in a given lake. Once the declared harvest is reached in a given lake, no more permits are issued for that lake and spearfishing ceases (<http://dnr.wi.gov/fish/ceded/tribalharvest.html>).”

All fishing regulations and bag limits for Annabelle Lake are concurrent with standard WDNR regulations in the Ceded Territories. In the Ceded Territories the WDNR works to establish “safe harvest limits” set so there is less than a 1-in-40 chance that more than 35% of the adult walleye population will be harvested in any given lake by either tribal or recreational fishermen, or both combined.

Annabelle Lake was chosen by Great Lakes Indian Fish and Wildlife Commission (GLIFWC) as a long-term walleye trend lake. This means that GLIFWC will survey the walleye population every two to three years for population assessment.

3.5 LAKE MANAGEMENT HISTORY

The Annabelle Lake Property Owners Association was formed in 1996 to ensure health of the lake for future generations. Past management activities on Annabelle Lake are fish stocking by the WDNR and Annabelle Lake Property owners Association and a Comprehensive Lake Management Plan in 2001. The historical stocking data is presented in the previous section. The lake management plan was funded by Large Scale Lake Planning Grant LPL-535 and laid the ground work for lake management. Recommendations related to aquatic plant growth from this plan consisted of maintaining the current aquatic plant ecosystem with no direct vegetation management required.

The Town of Presque Isle has adopted several ordinances that help protect lakes and shorelines. Town of Presque Isle ordinances 500, 902, 908, and 909 all protect lakes in one way or another. Ordinance 501.03(2) mandates no wake on lakes less than 50 acres. 501.03(3), (a) requires no wake within 200 feet of any shoreline. 501.03(4) limits waterskiing and other like activities to the hours between 10 AM and 5 PM. The above mentioned ordinances in the 900 category, zoning, all limit minimum lot frontage to 200 feet, and 300 feet minimum on lots created after March 25th, 2001. Other watershed related ordinances are included in the zoning ordinances.

3.6 GOALS AND OBJECTIVES

PITLC identified the following goals for aquatic plant management on Annabelle Lake.

- Maintain and improve recreational opportunities
- Protect and improve fish and wildlife habitat
- Preserve native aquatic plants
- Prevent the introductions of AIS
- Identify and Protect sensitive areas
- Identify sources of financial assistance for aquatic plant management activities
- Coordinate sound aquatic plant management practices where needed within Annabelle Lake
- Educate the Annabelle Lake community on proper AIS identification and prevention efforts
- Gather citizen input
- Increase citizen participation in lake management

4.0 Project Methods

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

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

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

4.1 EXISTING DATA REVIEW

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

- Local and regional geologic, limnologic, hydrologic, and hydrogeologic research
 - Discussions with lake members
 - Available topographic maps and aerial photographs
 - Data from WDNR files
-
- Review of Annabelle Lake Comprehensive Management Plan Report in 2001

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 July 9, 2008 by Northern Environmental. 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 42 meter grid with 448 pre-determined intercept points (Appendix A / Figure 3). Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix A). Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by tossing a specialized rake on a rope and dragging the rake along the bottom sediments. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus or species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets.

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

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

4.3 SHORELINE CHARACTERIZATION

The point intercept method described above may not accurately identify emergent and floating leaved aquatic plants in near shore areas. Therefore, a boat tour was completed traveling the entire perimeter of the lake's shoreline. During the boat tour, visual observations of the emergent and floating leaved plant communities were located and recorded. The boat tour also included a shoreline characterization, which provides an evaluation of shoreline development on the Lake. The following scale was used to rate the level of shoreline development (Figure 5).

1: Undeveloped (i.e. Forested or wetland)

2: Minor development (i.e. Properties may have mostly natural shoreline, sparse structures set further away from the lake, one pier, and little or no clearing of natural vegetation).

3: Moderate development (i.e. Properties may exhibit clearing and/or manipulation to the shore and lawn areas but not to waters edge. More elaborate piers or boathouses may be present).

4: Major development (i.e. Properties may include large lawn areas extending to the shoreline, which contains little or no natural shoreline vegetation. Increased building density, possibly close to the shore, multiple docks or boathouses, and significant shoreline alteration such as seawalls or rip rap may be present).

4.4 PUBLIC INVOLVEMENT AND PLAN REVIEW

Public involvement and education efforts included a presentation by Northern Environmental with the PITLC members on June 26, 2007 to discuss and kick off the APM Plan project. Draft copies of the APM Plan for Annabelle Lake, and other Presque Isle Town lakes, were submitted to the WDNR and the PITLC for distribution to, and comments from, lake residents. Comments from PITLC and the Vilas County Land and Water Conservation Department will be applied to the documents and completed based on the comments received.

5.0 Discussion of Project Results

5.1 AQUATIC PLANT ECOLOGY

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

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

5.2 AQUATIC INVASIVE SPECIES

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

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

Appendix C provides additional information on these AIS.

5.3 2008 AQUATIC PLANT SURVEY

The survey was carried out July 9, 2008, and included sampling at 448 intercept points. The aquatic macrophyte community of the Lake included 18 floating leaved, emergent, and submerged aquatic vascular plant species during 2008. Table 1 lists the taxa identified during the 2008 aquatic plant survey. Figures 4A through Figure 4E illustrate the locations of each species identified.

Vegetation was identified to a maximum depth of 14 feet (photic zone). Aquatic vegetation was detected at 20.85 percent (%) of photic zone intercept points. A diverse plant community inhabited the lake during 2008; Simpson Diversity Index value of the community was 0.91, taxonomic richness was 18 species, and there was an average of 0.33 species identified at points

that were within the photic zone. There was an average of 1.59 species present at points with vegetation present. Table 2 summarizes these overall aquatic plant community statistics.

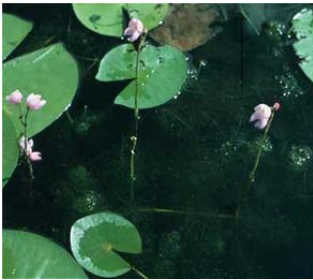
The most abundant aquatic plant identified during the aquatic plant survey was quillwort (*Isoetes sp.*). It exhibited a 5.9% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected). It was present at 28.4% of the sites with vegetation, and had a 17.8% relative frequency of occurrence. Table 3 includes the abundance statistics for each species.

Quillwort is a genera of small plant species that grows on soft or sandy bottoms in water up to several feet deep and prefers soft-water lakes. This plant provides habitat in low nutrient lakes that may have limited plant growth and is sometimes consumed by waterfowl or game birds (Borman, et al. 1997).



Quillwort
Source: UW Herbarium Website

Large purple bladderwort (*Utricularia purpurea*) was the second most abundant species occurring at 4.8% of the photic zone. It was present at 22.9% of sites with vegetation and had a 14.4% relative frequency of occurrence.



Large purple bladderwort
Source: UW Herbarium Website

Large purple bladderwort is found to be more common in small bog lakes in northern Wisconsin. Vegetative material can be identified by whorled, leaf-like branches and the bladders that are borne at the tips of the branches. (Borman, et al., 1997) The flowers are purple and bloom from July and into September. It can be found in soft quiet water, usually shallow but has been found as deep as 10 feet.

Dwarf watermilfoil (*Myriophyllum tenellum*) was the third most abundant vascular plant species occurring at 3.9% of the photic zone. It was present at 18.9% of sites with vegetation and had a 11.7% relative frequency of occurrence.

Dwarf watermilfoil is very different in appearance from all other milfoils. It has short, unbranched stems on which the leaves are small scales or bumps along the stem. Dwarf water milfoil is found primarily on sandy substrate and in depths up to 12 feet. The plant provides good spawning habitat for panfish and the roots and rhizomes help to stabilize sediments (Borman, et al., 1997).



Dwarf watermilfoil
Source: UW Herbarium Website

5.3.1 FLOATING-LEAF PLANTS

The following floating-leaf aquatic plant species was identified during the 2008 aquatic plant survey.

- *Nuphar variegata* (spatterdock)

5.3.2 SUBMERGENT PLANTS

The following 10 submergent aquatic plant species were identified during the 2008 aquatic plant survey.

- *Elatine minima* (waterwort)
- *Eleocharis acicularis* (needle spikerush)
- *Eriocaulon aquaticum* (pipewort)
- *Isoetes sp.* (quillwort)
- *Juncus pelocarpus* (brown-fruited rush)
- *Lobelia dortmanna* (water lobelia)
- *Myriophyllum tenellum* (dwarf watermilfoil)
- *Potamogeton richardsonii* (clasping-leaf pondweed)
- *Utricularia minor* (small bladderwort)
- *Utricularia purpurea* (large purple bladderwort)

5.3.3 EMERGENT PLANTS

The following seven emergent aquatic plant species were identified during the 2008 aquatic plant survey.

- *Dulichium arundinaceum* (three-way sedge)
- *Equisetum fluviatile* (water horsetail)
- *Pontederia chordata* (pickerelweed)
- *Sagittaria rigida* (stiff arrowhead)
- *Schoenoplectus acutus* (hardstem bulrush)
- *Sparganium angustifolium* (narrow-leaved bur-reed)
- *Sparganium fluctans* (floating-leaf bur-reed)

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. 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 2008 aquatic plant survey data was 34.41. This FQI value is higher than Wisconsin's northern region mean of 24.3 and suggests that Annabelle Lake exhibits very good water quality when using aquatic plants as an indicator. Table 4 summarizes the coefficient of conservatism.

5.5 SHORELINE CHARACTERIZATION

Emergent and floating leaved plants identified along the shoreline outside of formal grid sample points included: *Schoenoplectus acutus* (hardstem bulrush), *Equisetum fluviatile* (water horsetail), *Dulichium arundinaceum* (three-way sedge), *Carex lacustris* (lake sedge), *Pontederia cordata* (pickerelweed), *Myrica gale* (sweet gale), *Sagittaria latifolia* (common arrowhead), *Carex*

sp. (sedges species) and *Sparganium sp.* (bur-reed). Refer to Appendix D for descriptions of these plants. Figure 5 illustrates the floating leaved and emergent plant locations identified during the boat survey. Plants identified during the shoreline survey but not during the point-intercept method were not included in the community statistics or calculation of the FQI.

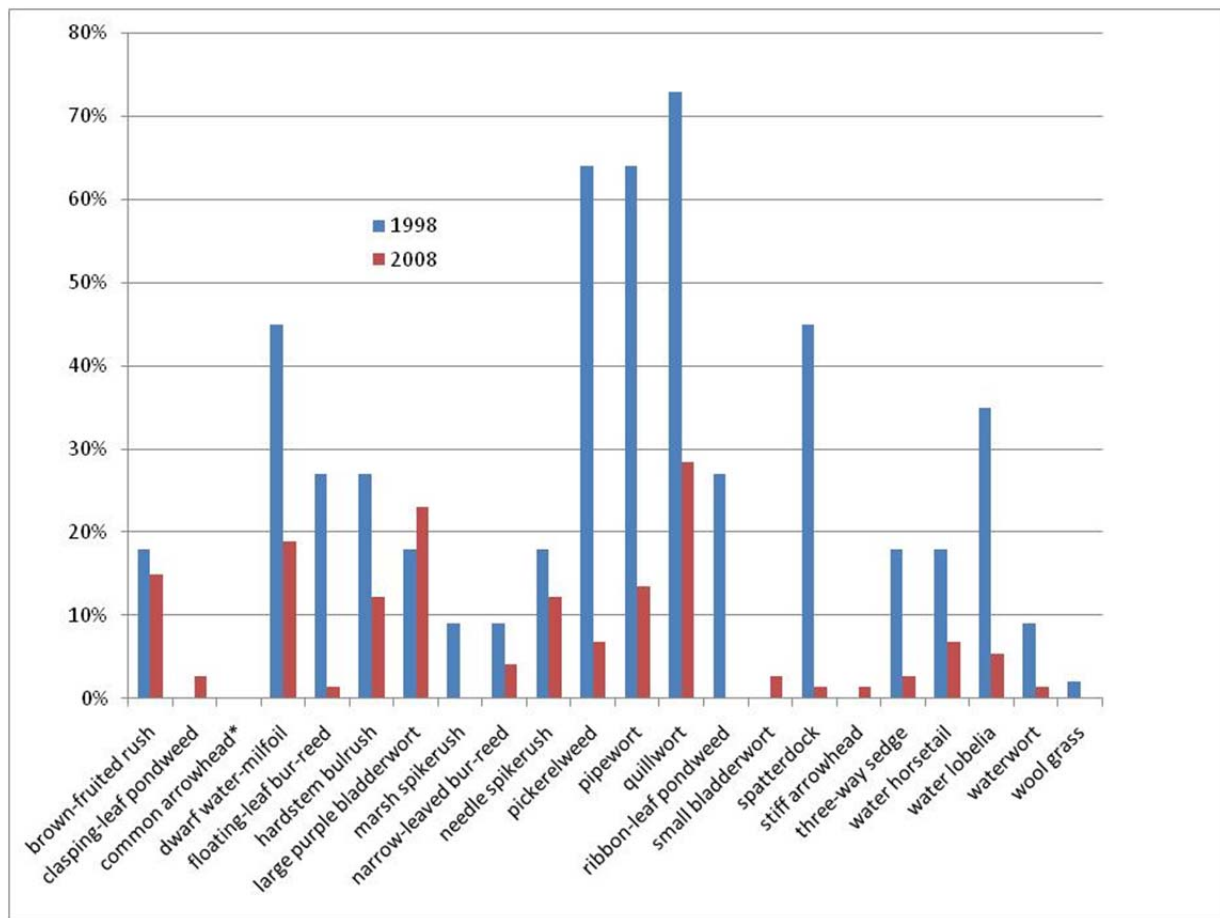
The majority of the shoreline featured minor or no development. Some scattered blocks of moderate development were present on the lakeshore. Figure 5 illustrates the level of shoreline development.

5.6 1998 & 2008 COMPARISON

To complete a comprehensive lake management plan in 2001, a line-transect aquatic plant survey was completed in 1998. During this survey, 19 species were identified on 11 transects and 3 depth-ranges per transect, if possible, for a total of 33 sample stations. At this time, the most common plants identified were, in order; quillwort, pipewort, and pickerelweed. During the 2008 aquatic plant point-intercept survey, 18 species were sampled with quillwort, large purple bladderwort, and dwarf watermilfoil being the most abundant. The table below compares the two surveys.

Specie	1998		2008	
	present	% Frequency of occurrence within vegetated areas	present	% Frequency of occurrence within vegetated areas
brown-fruited rush	yes	18%	yes	14.90%
clasping-leaf pondweed	no	---	yes	2.70%
common arrowhead*	yes	0%	no	---
dwarf water-milfoil	yes	45%	yes	18.90%
floating-leaf bur-reed	yes	27%	yes	1.40%
hardstem bulrush	yes	27%	yes	12.20%
large purple bladderwort	yes	18%	yes	23.00%
marsh spikerush	yes	9%	no	---
narrow-leaved bur-reed	yes	9%	yes	4.10%
needle spikerush	yes	18%	yes	12.20%
pickerelweed	yes	64%	yes	6.80%
pipewort	yes	64%	yes	13.50%
quillwort	yes	73%	yes	28.40%
ribbon-leaf pondweed	yes	27%	no	---
small bladderwort	no	---	yes	2.70%
spatterdock	yes	45%	yes	1.40%
stiff arrowhead	no	---	yes	1.40%
three-way sedge	yes	18%	yes	2.70%
water horsetail	yes	18%	yes	6.80%
water lobelia	yes	35%	yes	5.40%
waterwort	yes	9%	yes	1.40%
wool grass	yes	2%	no	---

* - sepcies was not directly sampled but was noted on the lake



1998 vs. 2008 Frequency of Occurrence by plant species sampled.

In total, four species sampled in 1998 were not directly sampled in 2008; common arrowhead, marsh spike rush, ribbon-leaf pondweed, and wool grass. However, of these species, common arrowhead was identified during the shoreline-survey. Conversely, the following three species were sampled in 2008 but not 1998; claspingleaf pondweed, small bladderwort, and stiff arrowhead. Presence and/or absence of the species between the surveys do not indicate that the species is new or has been extirpated.

These surveys are hard to compare because of their different styles. The 1998 survey was a line-transect survey that featured less total sample points and was done in near-shore areas only. Since all sample points were located in vegetated, near-shore areas, results from this survey will be biased towards higher frequency of occurrence data, especially of near-shore emergent plant species. However, during the 2008 survey, a point-intercept survey was completed with points across the entire lake. This kind of survey will more accurately portray the aquatic plant community across the lake. Because of differences in survey techniques, frequency of occurrence will be lower from the 1998 survey to the 2008 survey.

The aquatic plant community between the years is very similar, with plants present at a majority of the locations and the same basic makeup of dominant plant species present. Additionally, the plant community is mainly comprised of species small in stature (quillwort, pipewort, waterwort, dwarf watermilfoil, and others) which are typical of northern sand-bottom lakes. In both surveys, the plant community is of very high quality and indicates natural conditions. FQI between surveys is very comparable, with 33.03 in 1998 and 34.41 in 2008.

6.0 Management Alternatives and Recommendations

Based on the goals of the stakeholders as mentioned in section 3.6, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives is included in Appendix E. Currently, the Northern Region of the WDNR is working under an aquatic plant management strategy that is officially titled Aquatic Plant Management Strategy, Northern Region WDNR, Summer, 2007 (working draft), or commonly referred to the NOR Region APM Strategy (Appendix H). This strategy lays out an approach for acceptable aquatic plant management in Northern Region lakes. The strategy protects native aquatic plant communities in northern Wisconsin and does not allow permits to control native plants unless documented circumstances of nuisance levels exist. The following management alternatives are based on the approaches described in the NOR Region APM Strategy, and incorporate recommendations of Bonestroo.

6.1 AQUATIC PLANT MAINTENANCE ALTERNATIVES

The maintenance 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 because no significant plant problems exist or no active manipulation is required. This alternative can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community.

6.1.1 AQUATIC INVASIVE SPECIES MONITORING

No AIS were identified during the 2008 survey in Annabelle Lake. In order to monitor for AIS in the future it is highly recommended Annabelle Lake continue efforts with a strong Citizen Lake Monitoring program, that surveys for AIS.. In some lake systems, native aquatic plants “hold their own” and AIS never grow to nuisance levels, in others however, vigilant and active management is required. This can be based on several things including water quality. Data provided on the WDNR Citizen Lake Monitoring website indicates monitoring of water clarity is currently ongoing. Annabelle Lake residents interested in helping out should consider becoming active Citizen Lake Monitors for water quality (Secchi depth, total phosphorus and chlorophyll-a).

Assuming an AIS were to become established in the next several years, the most likely species would be EWM or CLP. If these or other AIS are found a sample should be collected and taken to the DNR for proper confirmation. The University of Wisconsin-Extension Lake’s Program provides training and coordinates the Citizen Lake Monitoring Program. More information about the program is available by contacting Laura Herman, Citizen Lake Monitoring Network Education Specialist, (715) 346-3989, email: lherman@uwsp.edu, website: <http://www.uwsp.edu/cnr/uwexlakes/clmn/>.

Bonestroo also recommends completing lake-wide aquatic plant surveys every 5 years (essentially repeating the 2008 point intercept aquatic plant survey) to monitor changes in the overall aquatic plant community and the effects of the APM activities. Aquatic plant communities

may change with varying water levels, water clarity, nutrient levels, and aquatic plant management actions.

6.1.2 CLEAN BOATS/CLEAN WATERS CAMPAIGN

Measures for the prevention of the introduction of AIS to the lake should be a priority. To prevent the spread of AIS into Annabelle Lake, a monitoring program such as Clean Boats/Clean Waters is an excellent choice. There is one public landing on Annabelle Lake and lake residents are encouraged to form a Clean Boats/Clean Waters (CB/CW) program. This program is carried out by trained volunteers who inspect the incoming boats at public launches. Signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of the public, along with private property and resort owners, about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations. Contact with lake users at this time is a great way to distribute other educational materials. Continuation of this program is recommended and should be promoted by the current CB/CW coordinator on the lake.

6.1.3 AQUATIC PLANT PROTECTION AND SHORELINE MANAGEMENT

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

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. Properties classified in the shoreland survey as having a level 3: Moderate Development or level 4: Major Development, would be good candidates for shoreland restorations. 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 buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake.

The Vilas County Land and Water Conservation Department offers a cost-share program for county landowners. The primary emphasis of the program continues to be to restore native vegetation to shoreland property. For shoreline restoration projects and other conservation practices involving revegetation activities, landowners are reimbursed up to 70% of the costs of planting and purchasing native trees, shrubs, and wildflowers. Interested landowners can contact the Vilas County Land & Water Conservation Department at (715) 479-3648 to request an application form for the program. Another avenue to fund shoreland restoration is the WDNR Lake Protection Grant program. This program offers 75% of the project cost covered by the state up to \$200,000. For more information on the Lake Protection Grant program contact the Lake Management Coordinator at the WDNR Rhinelander Service Center by calling (715) 365-8937.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. Phosphorus free fertilizers should be used when possible. The fertilizers commonly used for lawns and gardens have three major plant macronutrients: Nitrogen, Phosphorus, and Potassium. These are summarized on the fertilizer package by three numbers.

The middle number represents the amount of phosphorus. Since most Wisconsin lakes are "Phosphorus limited", meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Landowners should be encouraged to use phosphorus free fertilizers on lakeshore lawns. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs. Of course, properties with an intact natural buffer require very little maintenance, and no fertilizers.

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

6.1.4 PUBLIC EDUCATION AND INVOLVEMENT

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

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

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

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

6.2 AQUATIC PLANT MANIPULATION ALTERNATIVES

The management alternative may be used when aquatic plants present some sort of problem that must be dealt with or manipulated by human action. The WDNR NOR Region APM Strategy states "Newly-discovered infestations, if found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan." The following alternatives are based on the assumption that the PITLC will meet in consultation with the WDNR before pursuing manipulation of AIS populations.

6.2.1 MANUAL REMOVAL

Though no AIS were found during the 2008 survey, some native plants may be found at nuisance levels at individual properties, manual aquatic plant removal is recommended by individual property owners to alleviate their problems. Manual removal efforts, including hand raking or hand pulling unwanted plants, are allowed under Wisconsin law to a maximum width of 30 feet (recreational zone) per individual property owner. The intent is to provide pier, boatlift or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed this 30-foot recreation zone (manual removal of any native aquatic vegetation beyond the 30-foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code, see Appendix D

Should there exist impaired navigation or nuisance situation, individual riparian owners or a group, can work to define and solve the problem, as defined on Page 6 in Appendix H. If EWM or

CLP ever becomes established within Annabelle Lake, manual (hand) removal of these plants in small, isolated populations, particularly in shallow water would be appropriate. No permit is required to remove non-native invasive aquatic vegetation, as long as the removal is conducted completely by hand with no mechanical assistance of any kind. All aquatic plant material must be removed from the water to minimize dispersion and re-germination of unwanted aquatic plants. Portions of the roots may remain in the sediments, so removal may need to be repeated periodically throughout the growing season. Before significant plant removal is undertaken, a sample of the species assumed to be EWM or CLP should be brought to and confirmed by the WDNR.

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

Landowners removing plants manually should learn to identify the aquatic plant species. If an individual has questions about a particular aquatic plant or what level of manual removal is allowed, they should talk to the Vilas County Land & Water Conservation Department at (715) 479-3648, or Kevin Gauthier, Lakes Management Coordinator, Wisconsin Department of Natural Resources, 107 Sutliff Ave, Rhinelander, (715) 365-8937. Appendix F includes additional resources for plant identification.

6.2.2 AQUATIC INVASIVE PLANT SPECIES CHEMICAL HERBICIDE TREATMENT

If Annabelle Lake becomes infested with EWM or CLP of areas of approximately ¼ acre or greater, a chemical herbicide treatment may be an appropriate way to conduct restoration of native plants. Before any specific course of action is undertaken the WDNR must be consulted. As of the time this report is written the consultation would begin with Kevin Gauthier, Lakes Management Coordinator in Rhinelander, (715) 365-8937. All herbicide treatments must be undertaken with a WDNR issued permit (NR 107 Wisconsin Administrative Code). A WDNR, AIS Early Detection and Rapid Response Grant is usually the best place for a lake group to receive financial assistance for chemical treatment of a newly discovered AIS population.

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

The science regarding what chemicals are most effective and how they can be used is constantly being updated. Currently EWM is the most common aquatic invasive plant species targeted for

chemical treatment in the Northwoods. At present, granular 2,4-D is the most common herbicide used on EWM in the Northwood's area. In order to decrease damage to native plants and be as selective as possible for EWM, treatments are completed in the spring when native plant growth is minimal.

Chemical treatment is usually a long term commitment and requires a specific plan with a goal set for "tolerable" levels of the relevant AIS. One such landmark might be 10% or less of the littoral area being occupied by aquatic invasive plants. WDNR recommends conducting a whole-lake point-intercept survey on a five year bases (for Annabelle Lake the next would be 2012). Such a survey may reveal a new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

Advantages of herbicides include broader control than hand pulling, and represents a true restoration effort, which harvesters do not (this is why harvesters are not discussed in this document). Disadvantages include negative public perception of chemicals in natural lakes, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year) and water use restrictions after application may be necessary.

7.0 Conclusion and Recommended Action Plan

No aquatic invasive plants were found during the aquatic plant survey in 2008. The fact that the native plant community had an above average plant FQI illustrates that there is a unique and diverse plant community in Annabelle Lake. Such a plant community is worthy of protection for human disturbance and the potential impact aquatic invasive species would have if introduced to this system. Because of that, the following recommended action plan focuses on maintenance of the current plant community and conservation of native plants.

7.1 RECOMMENDED ACTIVE GOALS

The recommended action plan includes actions for Annabelle Lake based on the Maintenance Alternative listed above in Section 6. The PITLC president has approved the following active goals. It will be up to residents of Annabelle Lake and the PITLC to determine the actions, find the funding, and gather the individuals needed to implement the active goals.

Active Goal: To initiate the WDNR Clean Boats, Clean Waters program on Annabelle Lake.

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

Active Goal: To expand an aquatic invasive species monitoring program that will survey for invasive species, and if any are found, monitor their locations and extent of populations spread. The "Adopt a Shoreline" would be a good model.

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

Active Goal: To work in concert with the WDNR staff and representatives of fishing related businesses to evaluate Annabelle Lake fish management practices and develop goals in order to maintain and enhance a quality family sport fishery. Areas to explore may be possible encouragement of aquatic vegetation, and programs to add woody debris in the water, etc.

Active Goal: To enforce the Town of Presque Isle's 200 foot no-wake areas (from shoreline and islands) ordinances in order to minimize recreational impacts on the plant community, shoreline habitats, and to promote safe boating.

Active Goal: To support preservation of critical species, habitat lands, and wetlands within the watershed. (These are areas with rare vegetation such as Annabelle Lake's hemlock groves, important habitat for wildlife, or important spawning and

nursery areas for fish. Preservation of these lands has a direct impact on the water quality of the lake).

Active Goal: To provide education and information to shoreline property owners regarding how native aquatic plant protection and shoreline management can slow the spread of aquatic invasive plants (if they become introduced), improve the lake fishery, improve wildlife habitat and affect the quality of the water in the lake (including development of a *shoreline restoration packet* that could be given to landowners who's property has development categorized as Moderate or Major).

Active Goal: To encourage the incorporation of water quality protection measures in the design, construction and maintenance of all lake access sites on Annabelle Lake (e.g. storm water control, site drainage control, appropriate plant matter disposal, and watercraft wash down facilities if found to be needed).

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

7.2 CLOSING

This APM Plan was prepared in cooperation with the Presque Isle Town Lakes Committee. 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 management activities for the lake. This section outlines important monitoring and management activities. The greater APM Plan document and appendices provides a central source of information for the lake's aquatic plant community information, the overall lake ecology, and sources of additional information. If there are any questions about how to use this APM Plan or its contents, please contact Bonestroo.

This APM Plan should be updated periodically to reflect current aquatic plant problems, and the most recent acceptable APM methods. Information regarding aquatic plant management and protection is available from the WDNR website:

<http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm> or from Bonestroo upon request.

8.0 References

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

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Figures

Tables

Appendices

Appendix A - Point Intercept Sample Coordinates

Appendix B – Importance of Aquatic Plants to Lake Ecosystem

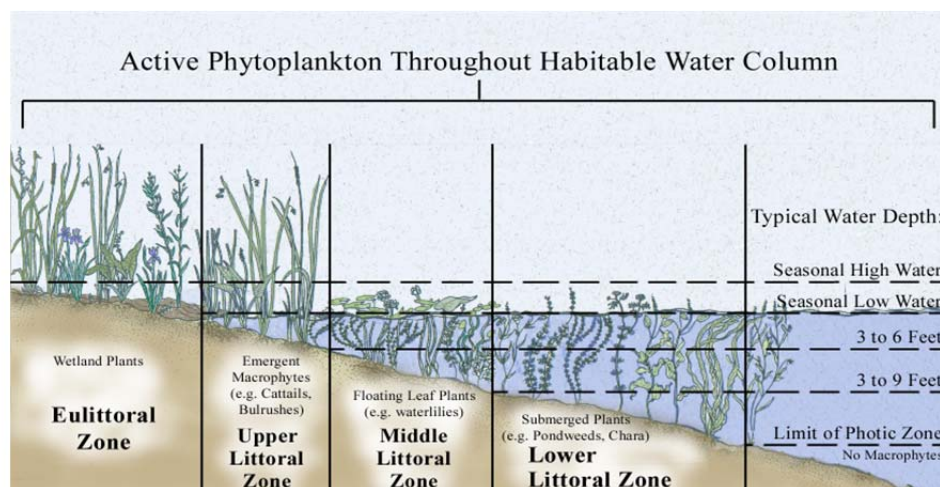
AQUATIC PLANT TYPES AND HABITAT

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:** Occupies water depths of 3 to 9 feet, extending deeper from the upper littoral zone. The middle littoral zone is often dominated by floating-leaf plants.
- Lower Littoral Zone:** Extends to a depth equivalent to the limit of the photic zone, which is the maximum depth that sufficient light can support photosynthesis. This area is dominated by submergent aquatic plant types.

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



Aquatic Plant Communities Schematic



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

AQUATIC PLANTS AND WATER QUALITY

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

In general, 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 occupied by aquatic plants is controlled, water clarity will generally not be affected. However, lake water clarity will likely be reduced if 50 percent or more of the macrophytes are controlled (NALMS, 1997).

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

Appendix C – Aquatic Invasive Species

INVASIVE AQUATIC PLANTS

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

Eurasian Watermilfoil (*Myriophyllum spicatum*)

EWM is the most common AIS found in Wisconsin lakes. EWM was first discovered in southeast Wisconsin in the 1960s. During the 1980s, 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 Vilas County.

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

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



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

Curly leaf pondweed (*Potamogeton crispus*)

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

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



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



Purple Loosestrife (*Lythrum salicaria*)

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

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



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

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

OTHER AQUATIC INVASIVE SPECIES

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

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

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

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

Appendix D – Descriptions of Aquatic Plants

Appendix E – Summary of Aquatic Plant Management Alternatives

Appendix F – NR 107 and NR 109 Wisconsin Administrative Code

Appendix G – Resource for Additional Information

Appendix H – Aquatic Plant Management Strategy, Northern Region WDNR, Summer, 2007 (working draft)

Appendix I – Dissolved Oxygen and Temperature Readings

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
No treatment	N	Do not treat plants	<p>Protects native species that can prevent spread of invasive or exotic species, enhance water quality, and provide habitat for aquatic fauna</p> <p>No financial cost</p> <p>No system disturbance</p> <p>No harmful effects of chemicals</p> <p>Permit not required</p>	May allow small population of invasive plants to become larger, more difficult to control later
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	<p>SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake</p> <p>Works best in soft sediments</p>	<p>Little to no damage done to lake or to native plant species</p> <p>Can be highly selective</p> <p>Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing EWM or CLP</p> <p>Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species</p>	<p>Very labor intensive</p> <p>Needs to be carefully monitored</p> <p>Roots, runners, and even fragments of some species (including EWM) will start new plants, so all of plant must be removed</p> <p>Small-scale control only</p>

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

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 displeasing
				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	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly	May kill desirable plant species, e.g. native water-milfoil or native pondweeds
			Can be used for restoration activities	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	Moderately to highly effective, especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected.	Cannot be used in combination with copper herbicides (used for algae)
			Can be used in synergy with endothall for early season CLP and EWM treatments	Toxic to fish
			Widely used aquatic herbicide	
b. Endothall (Aquathol)	Y	Broad-spectrum ³ , contact ⁴ herbicide that inhibits protein synthesis	Especially effective on CLP and also effective on EWM	Kills many native pondweeds
		Applied as liquid or granules	May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring	Not as effective in dense plant beds
			Can be selective depending on concentration and seasonal timing	Not to be used in water supplies
			Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds	Toxic to aquatic fauna (to varying degrees)
			Limited off-site drift	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 loosestrife 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 availability of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP	Relatively new technique, so effective dosage levels and exposure requirements are not yet known
				Prevents release of sediment phosphorus, which reduces algal growth	Short-term increase in turbidity due to suspended lime particles
				Increases growth of native plants beneficial as fish habitat	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	Most often used against algal problems	Must not eat fish for 30 days from treatment area
			Dosage must consider pH, hardness and water volume	Improves water clarity	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

¹Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.

²Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.

³Broad-spectrum herbicide - Affects both monocots and dicots.

⁴Contact 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 Involves species already present in Madison lakes	Illegal to transport or stock carp in Wisconsin 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 Works in water up to 25 ft	Root system remains for regrowth 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 Works in deep water (17 ft)	Decreases stem density, can affect entire plant Small-scale control May provide long-term control	Creates turbidity Not selective in species removed 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	Creates open water areas rapidly	Fragments of vegetation can re-root
		Works in deep water (14 ft)		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	Eliminates all plants, including native plants important for a healthy lake ecosystem
			Useful for small areas	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
- ▲ Hydorraking/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 (ft²) to over \$0.35/ ft². The costs for installation range from \$0.25 to \$0.50/ ft². 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 dependent 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 ecosystem. 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 release 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 it 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
- ▲ Glyphosate 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. Fluoridone 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: Fluoridone is a very slow-acting herbicide sometimes taking up to several months for visible effects. It requires a long contact time. Fluoridone 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.

Glyphosate Based Herbicide: Glyphosate 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: Glyphoshate 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. Glyphosate 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: Glyphoshate 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 its 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.

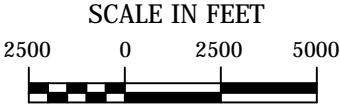
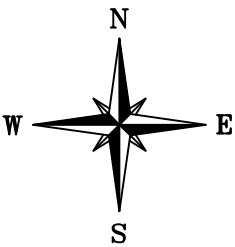
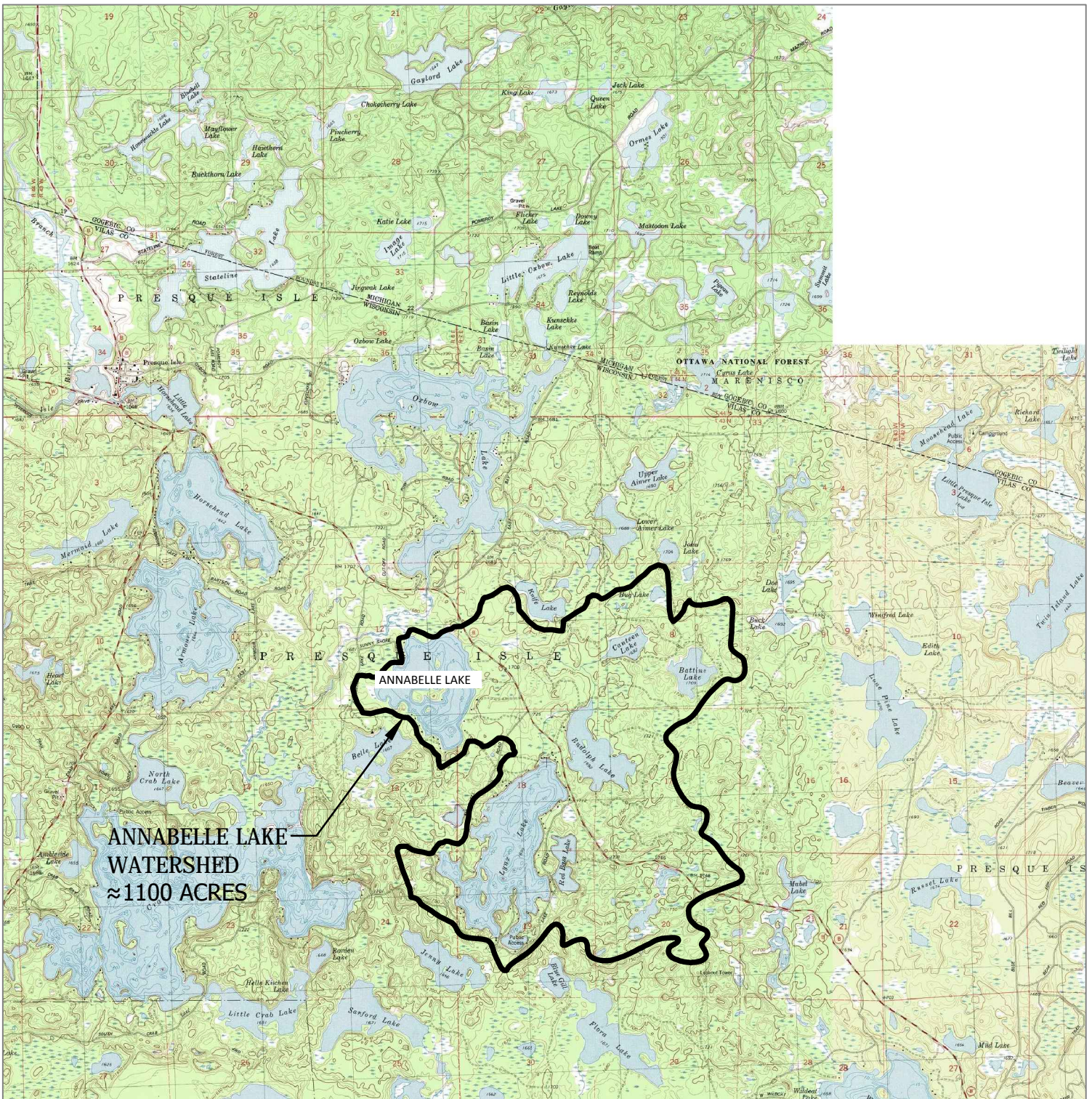
Costs: Costs can be highly variable depending on the selected native species, numbers of plants ordered, and the nearest dealer location.

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



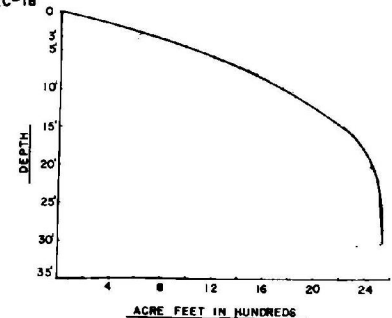
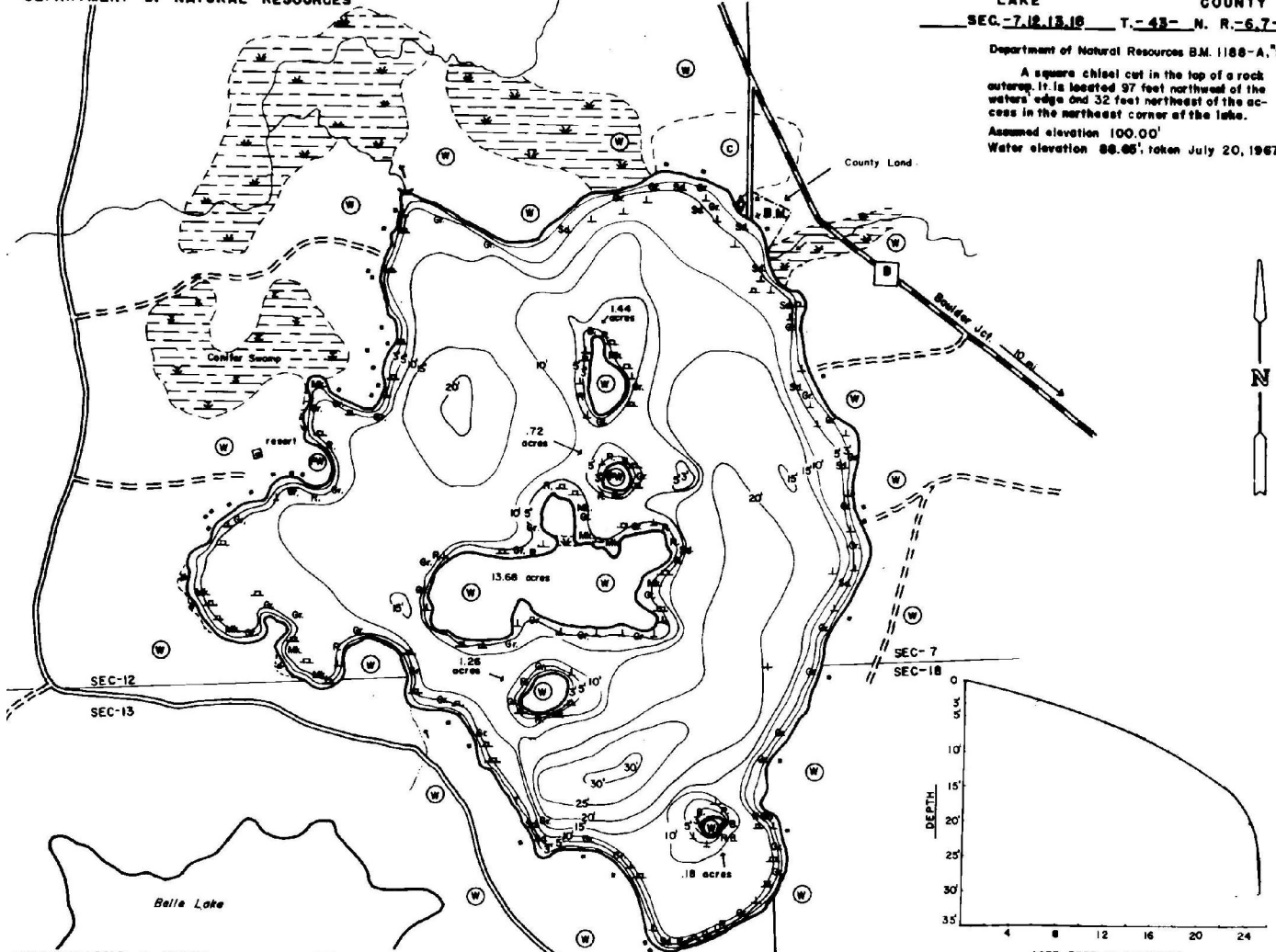
ANNABELLE LAKE REGIONAL WATERSHED

LAKE WATERSHEDS - PRESQUE ISLE
 VILAS COUNTY, WISCONSIN

FIGURE 1

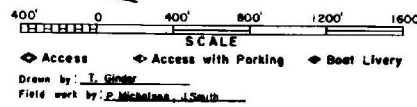


Department of Natural Resources B.M. 1186-A, "X"
A square chisel cut in the top of a rock outcrop. It is located 97 feet northwest of the water's edge and 32 feet northeast of the access in the northeast corner of the lake.
Assumed elevation 100.00'
Water elevation 88.85', taken July 20, 1967.



EQUIPMENT POLE & SONAR MAPPED JUNE 1967
MONTH YEAR

- | TOPOGRAPHIC SYMBOLS | | LAKE BOTTOM SYMBOLS | |
|---------------------|---------------------------|---------------------|-----------------------------|
| ① Brush | Steep slope | P. Peat | B Boulders |
| ② Partially wooded | ~ Indefinite shoreline | Mk. Muck | ⊕ Stumps & Seags |
| ③ Wooded | ⊖ Marsh | C. Clay | ⊗ Rock danger to navigation |
| ④ Cleared | ⊕ Spring | M. Marl | ⊘ Submergent vegetation |
| ⑤ Pastured | — Intermittent stream | Sd. Sand | ⊙ Emergent vegetation |
| ⑥ Agricultural | — Permanent inlet | St. Silt | ⊚ Floating vegetation |
| B.M. Bench Mark | — Permanent outlet | G. Gravel | ⊛ Brush shelters |
| ⊙ Dwelling | ⊖ Dam | R. Rubble | |
| ⊙ Resort | ⊖ D.N.R. State owned land | Bc. Bedrock | |
| ⊙ Camp | | | |



SPECIES OF FISH	ABUNDANT	COMMON	PRESENT
Walleye			
S. Pike			
Walleye			
L. N. Bass			
S. N. Bass			
Perch			
Trout			

WATER AREA 212.5 ACRES
UNDER 3 FT. 5.2 %
OVER 20 FT. 11.0 %
MAX. DEPTH 30 FEET
TOTAL ALK. 10 P.P.M.
VOLUME 2648 ACRE FT.
SHORELINE 2.86 MILES
WITH ISLANDS & 2.4 MILES

2008 AQUATIC PLANT SURVEY
ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

FIGURE 2

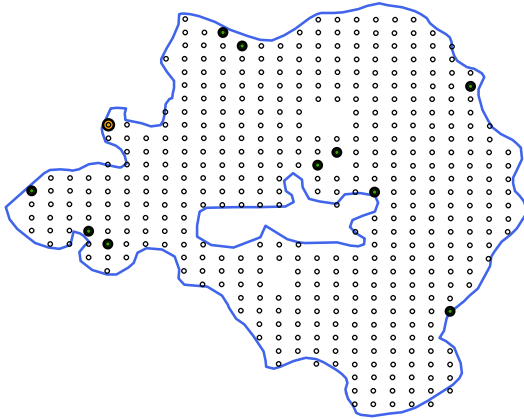




2008 AQUATIC PLANT SURVEY
ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITL
VILAS COUNTY, WISCONSIN

FIGURE 3

F

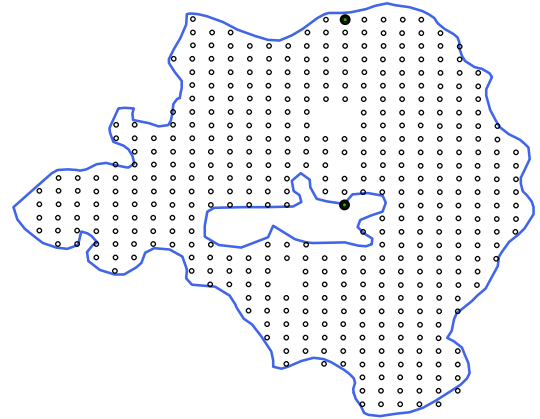


brown-fruited rush

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

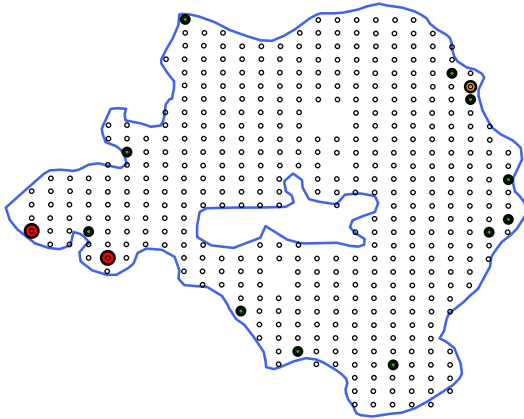


Claspingleaf pondweed

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

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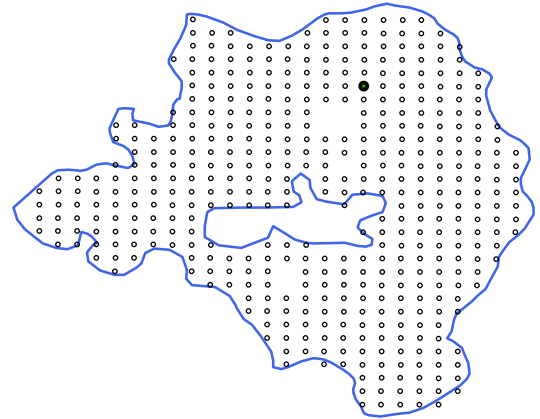


Dwarf water-milfoil

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

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Floating leaf bur-reed

Legend

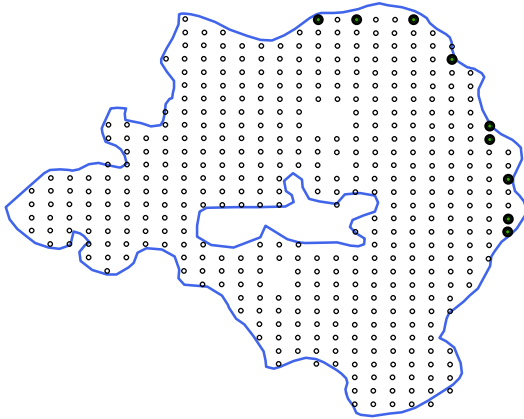
- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

AQUATIC PLANT DISTRIBUTION MAP

ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

FIGURE 4A

F

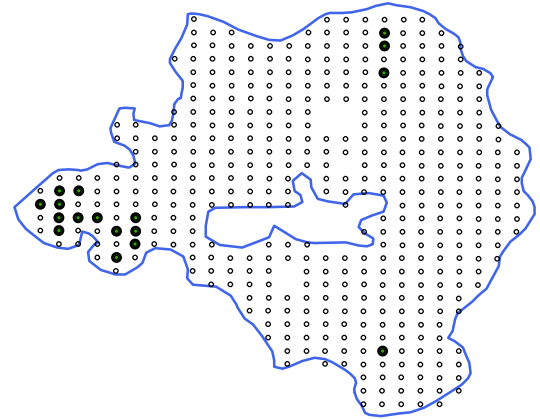


Hard-stem Bulrush

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

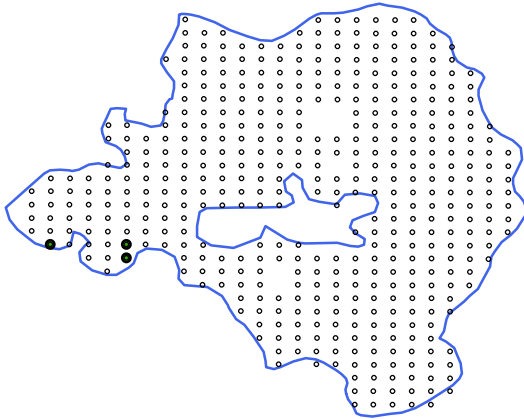


Large purple Bladderwort

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

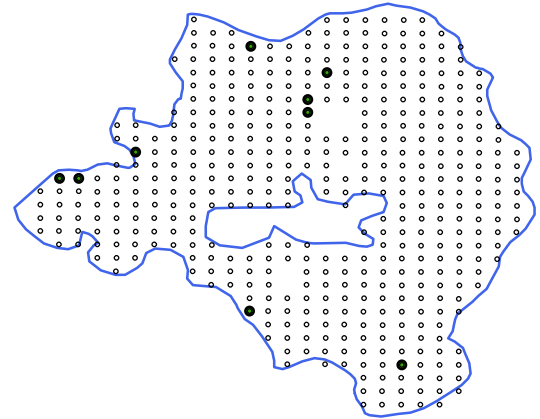


Narrow Leaf Bur-reed

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F



Needle Spikerush

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

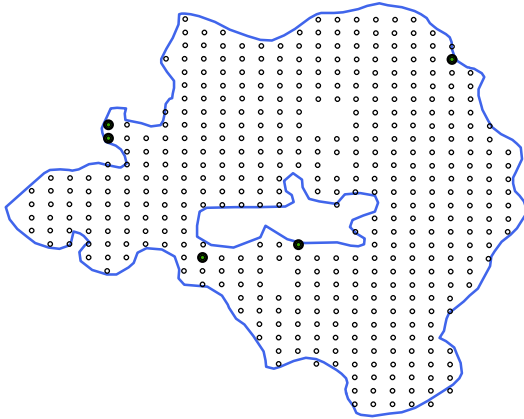
AQUATIC PLANT DISTRIBUTION MAP

**ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN**

FIGURE 4B



F

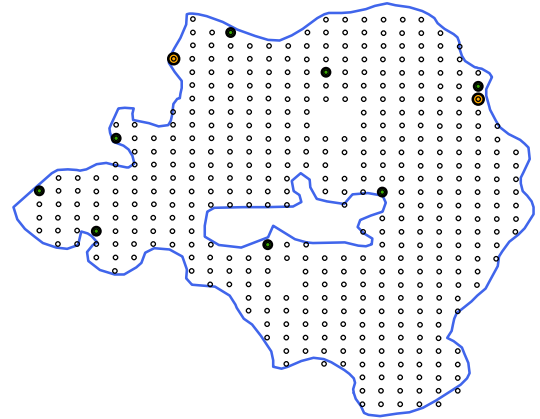


Pickerelweed

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

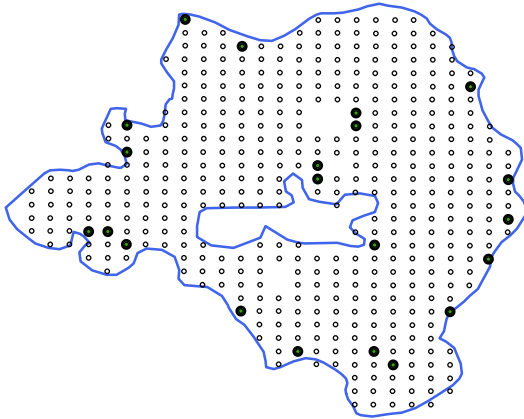


Pipewort

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

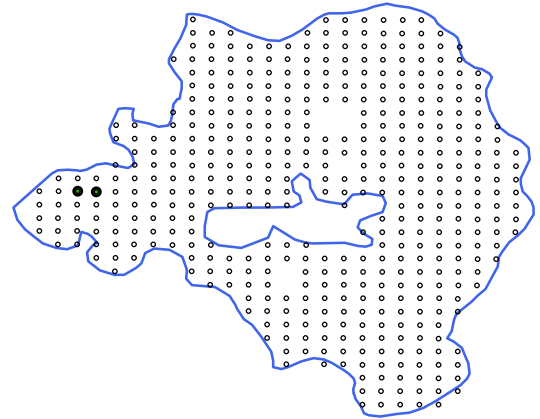


Quillwort

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F



Small-purple Bladderwort

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

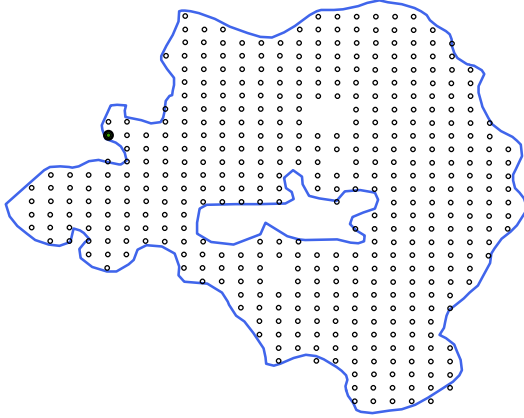
AQUATIC PLANT DISTRIBUTION MAP

ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

FIGURE 4C



F

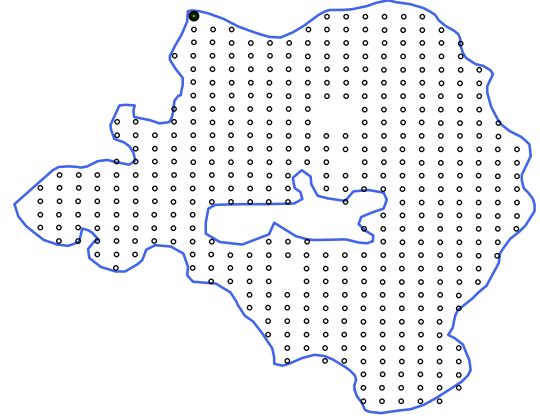


Spatterdock

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

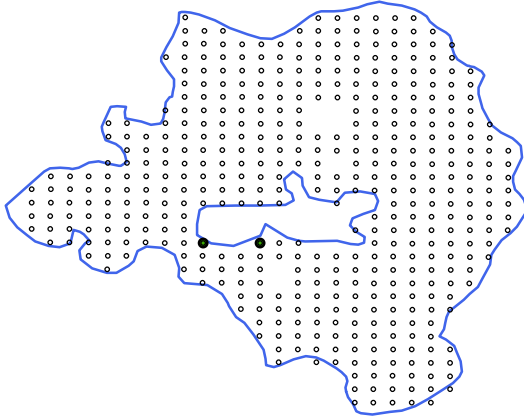


Stiff arrowhead

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F

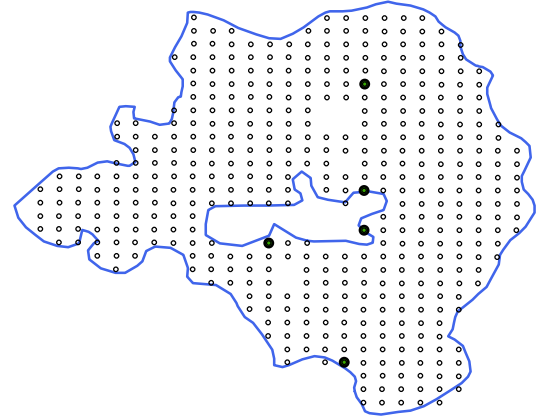


Three-way Sedge

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F



Water Horsetail

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

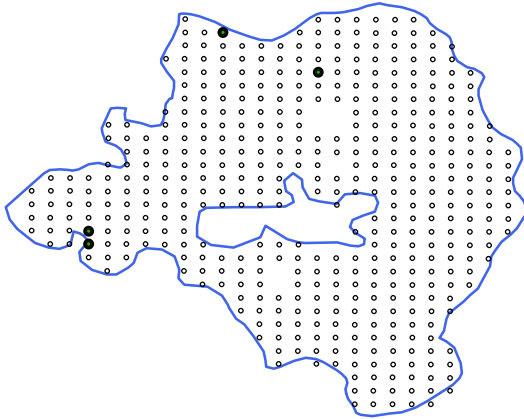
AQUATIC PLANT DISTRIBUTION MAP

**ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN**

FIGURE 4D



F

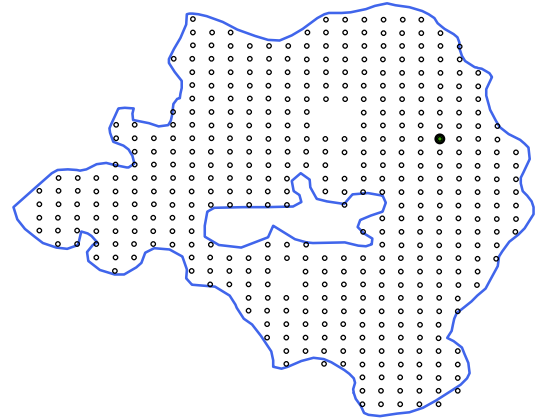


Water Lobelia

Legend

- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

F



waterwort

Legend

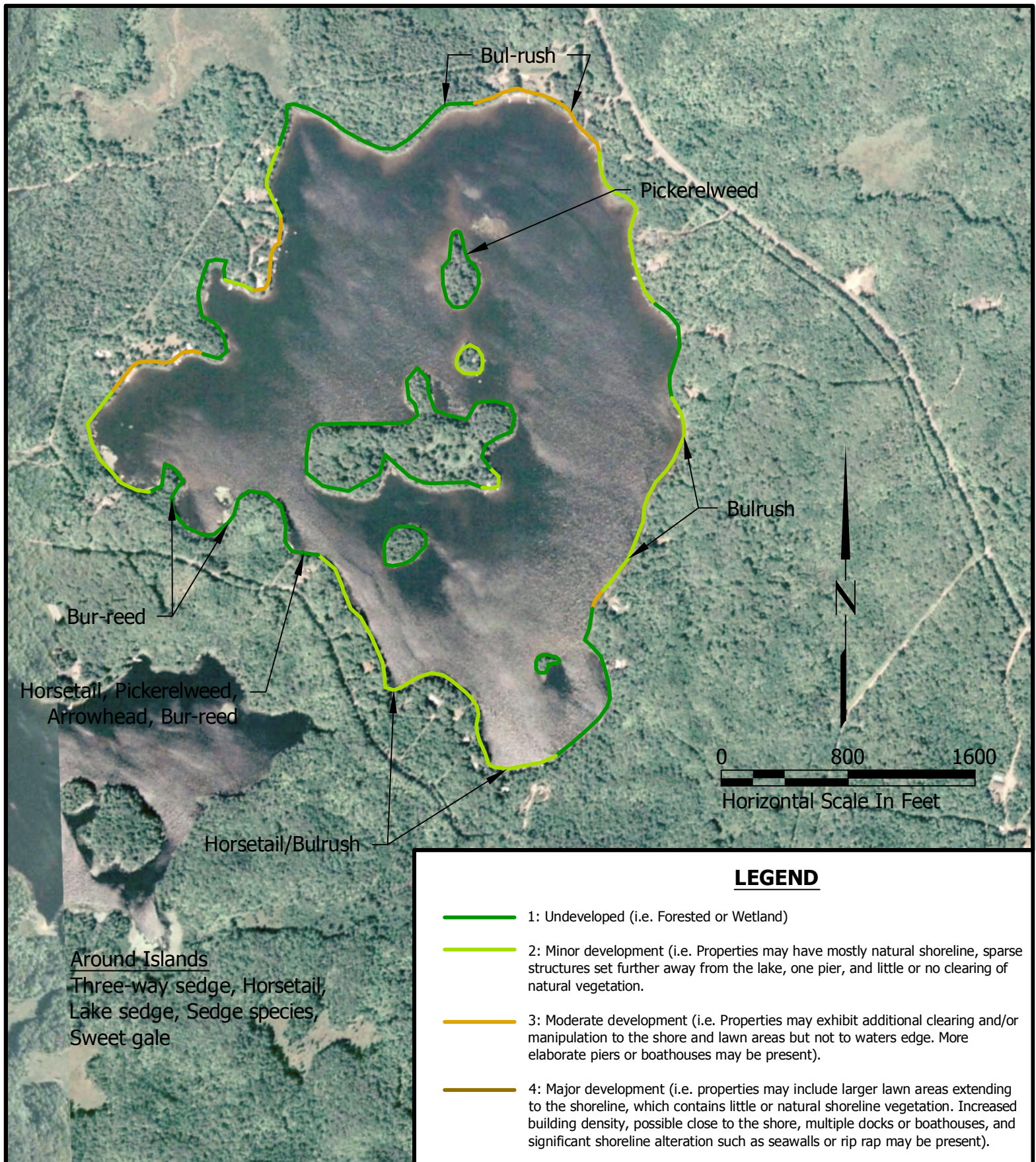
- Sample Points
- A few plants on rake
- Rake head is about 1/2 full
- Overflowing can not see rake head

AQUATIC PLANT DISTRIBUTION MAP

**ANNABELLE LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN**

FIGURE 4E





SHORELINE CHARACTERIZATION

TOWN OF PRESQUE ISLE
 ANNABELLE LAKE, VILAS COUNTY, WISCONSIN

FIGURE: 5



Table 1: Taxa Detected During 2008 Aquatic Plant Survey, Annabelle Lake, Vilas County, WI

Genus	Species	ID	Common Name	Category
<i>Dulichium</i>	<i>arundinaceum</i>	1	Three-way sedge	Emergent
<i>Elatine</i>	<i>minima</i>	2	Waterwort	Submersed
<i>Eleocharis</i>	<i>acicularis</i>	3	Needle spikerush	Submersed
<i>Equisetum</i>	<i>fluviatile</i>	4	Water horsetail	Emergent
<i>Eriocaulon</i>	<i>aquaticum</i>	5	Pipewort	Submersed
<i>Isoetes</i>	<i>sp.</i>	6	Quillwort	Submersed
<i>Juncus</i>	<i>pelocarpus</i>	7	Brown-fruited rush	Submersed
<i>Lobelia</i>	<i>dortmanna</i>	8	Water lobelia	Submersed
<i>Myriophyllum</i>	<i>tenellum</i>	9	Dwarf water milfoil	Submersed
<i>Nuphar</i>	<i>variegata</i>	10	Spatterdock	Floating-leaf
<i>Pontederia</i>	<i>cordata</i>	11	Pickerelweed	Emergent
<i>Potamogeton</i>	<i>richardsonii</i>	12	Clasping-leaf pondweed	Submersed
<i>Sagittaria</i>	<i>rigida</i>	13	Stiff arrowhead	Emergent
<i>Schoenoplectus</i>	<i>acutus</i>	14	Hardstem bulrush	Emergent
<i>Sparganium</i>	<i>angustifolium</i>	15	Narrow-leaved bur-reed	Emergent
<i>Sparganium</i>	<i>fluctans</i>	16	Floating-leaf bur-reed	Emergent
<i>Utricularia</i>	<i>minor</i>	17	Small bladderwort	Submersed
<i>Utricularia</i>	<i>purpurea</i>	18	Large-purple bladderwort	Submersed

Table 2: 2008 Aquatic Plant Community Statistics, Annabelle Lake, Vilas County, WI

Aquatic Plant Community Statistics	2008
Frequency of occurrence at sites shallower than maximum depth of plants	20.85%
Simpson Diversity Index	0.90
Maximum Depth of Plants (Feet)	14
Taxonomic Richness (Number Taxa)	18
Average Number of Species per Site (sites less than max depth of plant growth)	0.33
Average Number of Species per Site (sites with vegetation)	1.59
Average Number of NATIVE Species per Site (sites less than max depth of plant growth)	0.33
Average Number of NATIVE Species per Site (sites with vegetation)	1.59

Table 3: 2008 Aquatic Plant Taxa-Specific Statistics, Annabelle Lake, Vilas County, WI

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	Average Density
<i>Dulichium</i>	<i>arundinaceum</i>	Three-way sedge	2.70	0.56	1.69	2	1
<i>Elatine</i>	<i>minima</i>	Waterwort	1.35	0.28	0.85	1	1
<i>Eleocharis</i>	<i>acicularis</i>	Needle spikerush	12.16	2.54	7.63	9	1
<i>Equisetum</i>	<i>fluviatile</i>	Water horsetail	6.76	1.41	4.24	5	1
<i>Eriocaulon</i>	<i>aquaticum</i>	Pipewort	13.51	2.82	8.47	10	1
<i>Isoetes</i>	<i>sp.</i>	Quillwort	28.38	5.92	17.80	21	1
<i>Juncus</i>	<i>pelocarpus</i>	Brown-fruited rush	14.86	3.10	9.32	11	1
<i>Lobelia</i>	<i>dortmanna</i>	Water lobelia	5.41	1.13	3.39	4	1
<i>Myriophyllum</i>	<i>tenellum</i>	Dwarf water milfoil	18.92	3.94	11.86	14	1
<i>Nuphar</i>	<i>variegata</i>	Spatterdock	1.35	0.28	0.85	1	1
<i>Pontederia</i>	<i>cordata</i>	Pickerelweed	6.76	1.41	4.24	5	1
<i>Potamogeton</i>	<i>richardsonii</i>	Clasping-leaf pondweed	2.70	0.56	1.69	2	1
<i>Sagittaria</i>	<i>rigida</i>	Stiff arrowhead	1.35	0.28	0.85	1	1
<i>Schoenoplectus</i>	<i>acutus</i>	Hardstem bulrush	12.16	2.54	7.63	9	1
<i>Sparganium</i>	<i>angustifolium</i>	Narrow-leaved bur-reed	4.05	0.85	2.54	3	1
<i>Sparganium</i>	<i>fluctans</i>	Floating-leaf bur-reed	1.35	0.28	0.85	1	1
<i>Utricularia</i>	<i>minor</i>	Small bladderwort	2.70	0.56	1.69	2	1
<i>Utricularia</i>	<i>purpurea</i>	Large-purple bladderwort	22.97	4.79	14.41	17	1

Table 4: 2008 Floristic Quality Index, Annabelle Lake, Vilas County, WI

Genus	Species	Common Name	Coefficient of Conservatism C
<i>Dulichium</i>	<i>arundinaceum</i>	Three-way sedge	9
<i>Elatine</i>	<i>minima</i>	Waterwort	9
<i>Eleocharis</i>	<i>acicularis</i>	Needle spikerush	5
<i>Equisetum</i>	<i>fluviatile</i>	Water horsetail	7
<i>Eriocaulon</i>	<i>aquaticum</i>	Pipewort	9
<i>Isoetes</i>	<i>sp.</i>	Quillwort	8
<i>Juncus</i>	<i>pelocarpus</i>	Brown-fruited rush	8
<i>Lobelia</i>	<i>dortmanna</i>	Water lobelia	10
<i>Myriophyllum</i>	<i>tenellum</i>	Dwarf water milfoil	10
<i>Nuphar</i>	<i>variegata</i>	Spatterdock	6
<i>Pontederia</i>	<i>cordata</i>	Pickerelweed	8
<i>Potamogeton</i>	<i>richardsonii</i>	Clasping-leaf pondweed	5
<i>Sagittaria</i>	<i>rigida</i>	Stiff arrowhead	8
<i>Schoenoplectus</i>	<i>acutus</i>	Hardstem bulrush	6
<i>Sparganium</i>	<i>angustifolium</i>	Narrow-leaved bur-reed	9
<i>Sparganium</i>	<i>fluctans</i>	Floating-leaf bur-reed	10
<i>Utricularia</i>	<i>minor</i>	Small bladderwort	10
<i>Utricularia</i>	<i>purpurea</i>	Large-purple bladderwort	9

N 18

Mean C 8.111111111

Floristic Quality Index (FQI) 34.41253002

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 ecological conditions, with low tolerance of disturbance.

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7	46.21559461	-89.69063642	58	46.2174757	-89.68735858
8	46.21521662	-89.69063855	59	46.21709771	-89.68736072
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20	46.21521367	-89.68954951	71	46.21936418	-89.6868033
21	46.21483567	-89.68955164	72	46.21898619	-89.68680544
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30	46.21521219	-89.689005	81	46.21558424	-89.68682479
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47	46.21709919	-89.68790526	98	46.21633873	-89.68627596
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111	46.21822721	-89.68572065	162	46.21973468	-89.68407834
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113	46.21747122	-89.68572496	164	46.21897869	-89.68408268
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149	46.21671223	-89.68464022	200	46.2117953	-89.68357938
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151	46.21595624	-89.68464454	202	46.22086565	-89.68298269
152	46.21557825	-89.68464671	203	46.22048766	-89.68298487
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Point ID	Latitude	Longitude	Point ID	Latitude	Longitude
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208	46.21859769	-89.68299575	259	46.21405873	-89.68193284
209	46.2174637	-89.68300227	260	46.21368074	-89.68193502
210	46.21708571	-89.68300445	261	46.21330274	-89.6819372
211	46.21670771	-89.68300662	262	46.21292475	-89.68193938
212	46.21632972	-89.6830088	263	46.21254675	-89.68194157
213	46.21595173	-89.68301097	264	46.21216876	-89.68194375
214	46.21406175	-89.68302185	265	46.21179076	-89.68194593
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218	46.21254978	-89.68303055	269	46.21027878	-89.68195466
219	46.21217178	-89.68303272	270	46.20990079	-89.68195684
220	46.21179379	-89.6830349	271	46.22086111	-89.68134898
221	46.21141579	-89.68303707	272	46.22048311	-89.68135117
222	46.2110378	-89.68303924	273	46.22010512	-89.68135335
223	46.22086414	-89.68243812	274	46.21972713	-89.68135554
224	46.22048615	-89.6824403	275	46.21934913	-89.68135773
225	46.22010815	-89.68244248	276	46.21897114	-89.68135991
226	46.21973016	-89.68244466	277	46.21859314	-89.6813621
227	46.21935216	-89.68244684	278	46.21821515	-89.68136429
228	46.21897417	-89.68244902	279	46.21783716	-89.68136647
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241	46.21179228	-89.68249041	292	46.21254524	-89.68139708
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245	46.22048463	-89.68189573	296	46.21103326	-89.68140582
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323	46.21216572	-89.68085478	374	46.21518663	-89.67974823
324	46.21178773	-89.68085697	375	46.21480864	-89.67975043
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Point ID	Latitude	Longitude
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Free-Floating Plants

There were no free-floating plants collected during the 2008 aquatic plant survey.

Floating-Leaf Plants

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).



Spatterdock
Source: UW Herbarium Website

Submergent Plants



Waterwort
Source: UW Herbarium Website

Elatine minima (waterwort) only grows a few centimeters tall in the water. On exposed mudflats, it forms a low spreading mat. It can be found on exposed mudflats to water several meters deep. It is usually found on sandy, low disturbed sites. It is grazed by numerous waterfowl and provides habitat for zooplankton and young fish. (Borman, et al., 1997).

Eleocharis acicularis (Needle spikerush) has slender and short stems that emerge in tufts from fine rhizomes. Stems are topped with an oval spikelet that is wider than the stem. (Borman, et al, 1997). It prefers hard substrates and is found more frequently in northern Wisconsin (Nichols, 1999). This species provides food for a variety of waterfowl and muskrats.



Needle spikerush
Source: UW Herbarium Website



Seven-angle pipewort
Source: UW Herbarium Website

Eriocaulon aquaticum (seven-angle pipewort) has translucent green leaves that taper from the base to the tip and have a checkerboard appearance created by many short cross-veins. Pipeworts are usually found on sandy shores and in shallow water of soft-water lakes (Borman, et al. 1997).



Quillwort

Source: UW Herbarium Website

Isoetes sp. (Quillwort) is a genera of small plant species that grows on soft or sandy bottoms in water up to several feet deep and prefers soft-water lakes. This plant provides habitat in low nutrient lakes that may have limited plant growth and is sometimes consumed by waterfowl or game birds (Borman, et al. 1997).

Juncus pelocarpus (Brown-fruited Rush) has tufts of tapered green leaves. The outer ones cup around the inner leaves at the base. Numerous pale brown flowers are borne singly along one side of the spreading branches. A distinctive feature of this plant is the awl-shaped bulblets that replace some flowers. It grows in boggy or sandy soil of shallow water and shorelines. The seed is eaten by a variety of birds. It forms valuable beds that are used by spawning fish and invertebrates (Borman, et al. 1997).



Brown-fruited rush

Source: UW Herbarium Website



Water Lobelia

Source: UW Herbarium Website

Lobelia dortmanna (Water lobelia) is found in water less than 5 feet deep with the leaves situated around a basal rosette anchored by dense roots. Each leaf is made of two hollow tubes fused together. Water lobelia produces a sole flower stalk from the middle of the leaves that produces pale-blue to white flowers. When in dense beds, water lobelia can stabilize sandy shorelines while offering habitat for invertebrates and young fish (Borman, et al., 1997).

Myriophyllum tenellum (Dwarf watermilfoil) is very different in appearance from all other milfoils. It has short, unbranched stems on which the leaves are small scales or bumps along the stem. Dwarf water milfoil is found primarily on sandy substrate and in depths up to 12 feet. The plant provides good spawning habitat for panfish and the roots and rhizomes help to stabilize sediments (Borman, et al., 1997).



Dwarf watermilfoil

Source: UW Herbarium Website



Clasping Leaf Pondweed

Source: UW Herbarium Website

Potamogeton richardsonii (Clasping Leaf Pondweed) is a submergent aquatic plant with lance-shaped leaves that clasp the stem. Clasping leaf pondweed can be found growing in a variety of sediment types in water up to 12 feet deep and can tolerate disturbed conditions. It is often found growing with Coontail and Small Pondweed (Borman, et al., 1997).

Utricularia minor (Small bladderwort) has leaves that are flattened with a midrib. The bladders are on scattered on the leaf-divisions. It can be found in water a few inches deep up to a few meters deep. The plant is more common in still water. It provides both food and cover for fish.



Small bladderwort
Source: UW-Herbarium Website



Large purple bladderwort
Source: UW Herbarium Website

Utricularia purpurea (large purple bladderwort) is found to be more common in small bog lakes in northern Wisconsin. Vegetative material can be identified by whorled, leaf-like branches and the bladders that are borne at the tips of the branches. (Borman, et al., 1997) The flowers are purple and bloom from July and into September. It can be found in soft quiet water, usually shallow but has been found as deep as 10 feet.

Emergent Plants

Plants identified during the shoreline survey are included.



Sedge
Source: UW Herbarium Website

Carex sp. (Sedge species) are grass-like at first glance but the leaves come off the stems at three angles as opposed to two angles like grasses. The definitive characteristic is the sac-like structure call a perigynium that surrounds the ovary and nutlet. This structure is unique and distinguishes it from grasses but it also separates it from other genera in the sedge family. (Borman, et al., 1997).

Dulichium arundinaceum (3 way sedge) is a semi aquatic plant that grows 1-3 feet tall. It grows in wet areas not more than 3 feet deep. It is a turbidity tolerant species and prefers soft substrates and low conductivity and alkalinity waters. Flowering occurs in mid summer.



3 way sedge
Source: UW Herbarium Website



Water horsetail
Source: UW Herbarium Website

Equisetum fluviatile L. (Water horsetail) has jointed stems that emerge from a buried rhizome. The hollow stems are ridged and stiff. Water horsetail can be found in marshes and shallow water of lakes and ponds in water less than 3 feet. It provides a food source for waterfowl, ruffed grouse and moose where they occur. It is a prominent food source for trumpeter swans. (Borman, et al., 1997).



Sweet Gale

Myrica gale (Sweet gale) is a small shrub commonly found in wetlands and bogs. Sweet gale has leaves that are spirally arranged and is able to grow in nitrogen poor conditions. The plant gives off a sweet smell and can be used as an insect repellent or in perfumes.

Pontederia cordata (Pickerelweed) can commonly be mistaken for Arrowhead (*Sagittaria spp.*) when not in bloom. The leaves are glossy and heart-shaped and originate from a large rhizome and have many fine veins. However, when in bloom, its blue-flowered spike is distinctive. Pickerelweed is located in shallower water in a variety of sediments and often forms large colonies in protected bays which helps stabilize shorelines. The seeds are consumed by waterfowl (Borman, et al., 1997).



Pickerelweed
Source: James Scharl



Crested arrow-head
Source: UW Herbarium Website

Sagittaria rigida (stiff arrow-head) has slender leaves that emerge from a short dense rhizome. It is similar in appearance to grass-leaved arrowhead, but the leaves are bent at a slight angle where they emerge from the stalk. It is found in habitats from shallow shorelines to water depths up to 2 meters. It will grow in a variety of sediments and often forms extensive beds. Stiff arrowhead has high wildlife value. It is consumed in some manner by waterfowl, shorebirds, muskrats, beavers and porcupines. (Borman, et al., 1997).

Sparganium spp. (Bur-reed) is a variable species ranging from erect, emergent leaves to wide, flat, floating leaves only. However, all species have a distinguishable "bur", or fruit, that takes on a prickly appearance created by the beaks of the fruits within the cluster. They grow in moist shoreline soils to water up to three feet deep in softer sediments. Bur-reed provides nesting sites for waterfowl and shorebirds with the fruit being eaten by waterfowl and the plant itself being grazed upon by deer and muskrat (Borman, et al., 1997).



Bur-reed
Source: UW Herbarium Website



Hardstem Bulrush

Source: UW Herbarium Website

Schoenoplectus acutus (Hardstem bulrush) has tall cylindrical olive-green sturdy stems. The firm stems are hard when pressed between one's 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 invertebrates, northern pike, and marsh birds (Borman et al., 1997).

Sparganium angustifolium (Narrow-leaved bur-reed) has narrow floating leaves that are rounded on the back. It is found growing along shorelines in most soil types. The fruit is grazed upon by waterfowl, while the plant provides nesting cover for birds and waterfowl (Borman, et al., 1997).



Narrow-leaved Bur-reed

Source: UW Herbarium Website



Floating-leaf bur-reed

Source: UW Herbarium Website

Sparganium fluctuans (Floating-leaf bur-reed) has flat, wide floating leaves. The flower stalk is branched with 2-4 fruiting heads. The leaves of bur-reed can be recognized by holding one up to the light to see the very fine checkerboard of veins. Colonies of bur-reed help anchor sediment and provide nesting sites for waterfowl and shorebirds.

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Chapter NR 107

AQUATIC PLANT MANAGEMENT

NR 107.01	Purpose.
NR 107.02	Applicability.
NR 107.03	Definitions.
NR 107.04	Application for permit.
NR 107.05	Issuance of permit.
NR 107.06	Chemical fact sheets.

NR 107.07	Supervision.
NR 107.08	Conditions of the permit.
NR 107.09	Special limitation.
NR 107.10	Field evaluation use permits.
NR 107.11	Exemptions.

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 labeled 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

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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 spe-

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cific 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;

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(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.**

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Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

NR 109.01	Purpose.
NR 109.02	Applicability.
NR 109.03	Definitions.
NR 109.04	Application requirements and fees.
NR 109.05	Permit issuance.
NR 109.06	Waivers.

NR 109.07	Invasive and nonnative aquatic plants.
NR 109.08	Prohibitions.
NR 109.09	Plan specifications and approval.
NR 109.10	Other permits.
NR 109.11	Enforcement.

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.

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(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

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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.ercd.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 Identification

<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

AQUATIC PLANT MANAGEMENT STRATEGY

**Northern Region WDNR
Summer, 2007
(working draft)**

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote “whole lake” management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the “up-north” appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these “invaders” benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a "whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). “

State Statute 23.24(3)(b) states:

“The department may require that an application for an aquatic plant management permit contain a plan for the department’s approval as to how the aquatic plants will be introduced, removed, or controlled.”

Wisconsin Administrative Code NR 109.04(3)(a) states:

“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.”

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents “impairment of navigation” and/or “nuisance conditions”. Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of “impairment of navigation” and/or “nuisance conditions”. No new individual permits will be issued during the interim.
2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.
3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
 - a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR’s Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDNR review and approval.
 - b. Individuals holding past permits for control of *invasive* aquatic plants and/or “mixed stands” of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if “impairment of navigation” and/or “nuisance conditions” is adequately documented, unless there is an approved lake management plan for the lake in question.
4. Control of invasive species or “mixed stands” of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).
5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.
- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

- a. Specific locations of navigation routes (preferably with GPS coordinates)
- b. Specific dimensions in length, width, and depth
- c. Specific times when plants cause the problem and how long the problem persists
- d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
- e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the *nuisance* must include:

- a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
- b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
- c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (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).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

Date	Depth	DO (mg/l)	Temperature (F)
9/20/1996	3	---	59
9/20/1996	6	---	59
9/20/1996	9	---	59
9/20/1996	12	---	59
9/20/1996	15	---	58
9/20/1996	18	---	58
9/20/1996	21	---	53
9/20/1996	24	---	50
9/20/1996	27	---	47
10/11/1996	3	---	50
10/11/1996	6	---	49
10/11/1996	9	---	49
10/11/1996	12	---	48
10/11/1996	15	---	48
10/11/1996	18	---	48
10/11/1996	21	---	48
10/11/1996	24	---	48
10/11/1996	27	---	48
5/17/1997	3	13	50
5/17/1997	6	13	50
5/17/1997	9	12	48
5/17/1997	12	12	48
5/17/1997	15	14	47
5/17/1997	18	12	47
5/17/1997	21	12	47
5/17/1997	24	12	46
5/17/1997	27	13	46
6/22/1997	3	8	74
6/22/1997	6	8	69
6/22/1997	9	8	66
6/22/1997	12	6	64
6/22/1997	15	5	58
6/22/1997	18	4	54
6/22/1997	21	3	53
6/22/1997	24	2	51
6/22/1997	27	2	50
7/15/1997	3	8	76
7/15/1997	6	8	76
7/15/1997	9	8	68
7/15/1997	12	3	62
7/15/1997	15	1	56
7/15/1997	18	1	54
7/15/1997	21	0	52
7/15/1997	24	0	51
7/15/1997	27	0	51
9/1/1997	3	8	68
9/1/1997	6	7	68
9/1/1997	9	7	66
9/1/1997	12	6	65
9/1/1997	15	2	62
9/1/1997	18	0	56
9/1/1997	21	0	53
9/1/1997	24	0	51
9/1/1997	27	0	49

Date	Depth	DO (mg/l)	Temperature (F)
10/5/1997	3	8	59
10/5/1997	6	8	59
10/5/1997	9	8	59
10/5/1997	12	8	58
10/5/1997	15	8	57
10/5/1997	18	8	56
10/5/1997	21	7	56
10/5/1997	24	7	56
10/5/1997	27	0	54
5/3/1998	3	9	61
5/3/1998	6	9	61
5/3/1998	9	8	60
5/3/1998	12	8	53
5/3/1998	15	7	50
5/3/1998	18	6	48
5/3/1998	21	6	48
5/3/1998	24	6	48
5/3/1998	27	4	46
6/14/1998	3	8	64
6/14/1998	6	8	64
6/14/1998	9	8	62
6/14/1998	12	7	61
6/14/1998	15	5	60
6/14/1998	18	3	56
6/14/1998	21	2	53
6/14/1998	24	0	50
6/14/1998	27	0	47
7/10/1998	3	8	74
7/10/1998	6	7	74
7/10/1998	12	4	68
7/10/1998	15	1	62
7/10/1998	18	0	55
7/10/1998	21	0	55
7/10/1998	24	0	53
7/10/1998	27	0	49
8/12/1998	3	9	53
8/12/1998	6	7	74
8/12/1998	9	6	73
8/12/1998	12	4	71
8/12/1998	15	2	68
8/12/1998	18	0	57
8/12/1998	21	0	54
8/12/1998	24	0	54
8/12/1998	27	0	50
10/10/1998	3	9	53
10/10/1998	6	9	54
10/10/1998	9	9	53
10/10/1998	12	9	53
10/10/1998	15	9	53
10/10/1998	18	9	53
10/10/1998	21	9	52
10/10/1998	24	8	52
10/10/1998	27	8	52

Date	Depth	DO (mg/l)	Temperature (F)
5/31/1999	3	9	68
5/31/1999	6	8	64
5/31/1999	9	8	60
5/31/1999	12	8	59
5/31/1999	15	8	56
5/31/1999	18	7	55
5/31/1999	21	5	53
5/31/1999	24	4	46
5/31/1999	27	4	45
7/11/1999	3	8	72
7/11/1999	6	8	71
7/11/1999	9	7	70
7/11/1999	12	6	69
7/11/1999	15	3	65
7/11/1999	18	3	61
7/11/1999	21	0	54
7/11/1999	24	0	53
7/11/1999	27	0	50
9/6/1999	3	8	72
9/6/1999	6	8	72
9/6/1999	9	7	70
9/6/1999	12	5	69
9/6/1999	15	3	67
9/6/1999	18	1	62
9/6/1999	21	0	56
9/6/1999	24	0	54
9/6/1999	27	0	53
11/7/1999	3	11	41
11/7/1999	6	11	40
11/7/1999	9	11	40
11/7/1999	12	11	40
11/7/1999	15	11	40
11/7/1999	18	11	40
11/7/1999	21	11	40
11/7/1999	24	11	40
11/7/1999	27	11	40
6/12/2000	3	8	69
6/12/2000	6	8	67
6/12/2000	9	8	65
6/12/2000	12	7	63
6/12/2000	15	6	59
6/12/2000	18	4	54
6/12/2000	21	3	50
6/12/2000	24	3	49
6/12/2000	27	3	49
7/4/2000	3	8	72
7/4/2000	6	8	70
7/4/2000	9	7	68
7/4/2000	12	6	65
7/4/2000	15	4	65
7/4/2000	18	2	56
7/4/2000	21	2	53
7/4/2000	24	1	51
7/4/2000	27	0	49

Date	Depth	DO (mg/l)	Temperature (F)
8/1/2000	3	7	76
8/1/2000	6	7	72
8/1/2000	9	6	72
8/1/2000	12	5	71
8/1/2000	15	2	66
8/1/2000	18	2	65
8/1/2000	21	2	62
8/1/2000	24	0	56
8/1/2000	27	0	52
9/4/2000	3	7	66
9/4/2000	6	7	66
9/4/2000	9	7	66
9/4/2000	12	7	66
9/4/2000	15	7	66
9/4/2000	18	7	66
9/4/2000	21	0	55
9/4/2000	24	0	53
9/4/2000	27	0	51
10/18/2000	3	10	51
10/18/2000	6	9	50
10/18/2000	9	9	50
10/18/2000	12	9	50
10/18/2000	15	9	50
10/18/2000	18	9	50
10/18/2000	21	9	49
10/18/2000	24	9	49
10/18/2000	27	8	49
5/23/2001	3	8	58
5/23/2001	6	8	58
5/23/2001	9	8	58
5/23/2001	12	8	58
5/23/2001	15	8	56
5/23/2001	18	6	54
5/23/2001	21	5	53
5/23/2001	24	3	47
5/23/2001	27	3	47
7/1/2001	3	8	72
7/1/2001	6	8	72
7/1/2001	9	8	72
7/1/2001	12	7	70
7/1/2001	15	4	60
7/1/2001	18	2	55
7/1/2001	21	1	52
7/1/2001	24	0	50
7/1/2001	27	0	48
7/31/2001	3	7	72
7/31/2001	6	7	69
7/31/2001	9	6	69
7/31/2001	12	6	69
7/31/2001	15	1	64
7/31/2001	18	0	55
7/31/2001	21	0	55
7/31/2001	24	0	53
7/31/2001	27	0	50

Date	Depth	DO (mg/l)	Temperature (F)
9/5/2001	3	8	70
9/5/2001	6	8	70
9/5/2001	9	8	69
9/5/2001	12	7	68
9/5/2001	15	7	66
9/5/2001	18	5	66
9/5/2001	21	0	56
9/5/2001	24	0	54
9/5/2001	27	0	52
10/22/2001	3	9	48
10/22/2001	6	8	48
10/22/2001	9	10	48
10/22/2001	12	10	48
10/22/2001	15	9	48
10/22/2001	18	10	48
10/22/2001	21	9	48
10/22/2001	24	9	48
10/22/2001	27	9	47
5/27/2002	3	9	59
5/27/2002	6	9	58
5/27/2002	9	9	58
5/27/2002	12	9	53
5/27/2002	15	8	52
5/27/2002	18	8	52
5/27/2002	21	8	50
5/27/2002	24	8	50
5/27/2002	27	6	49
6/24/2002	3	7	72
6/24/2002	6	7	69
6/24/2002	9	6	67
6/24/2002	12	5	64
6/24/2002	15	4	57
6/24/2002	18	3	54
6/24/2002	21	2	52
6/24/2002	24	1	52
6/24/2002	27	1	52
7/29/2002	3	7	80
7/29/2002	6	6	80
7/29/2002	9	6	76
7/29/2002	12	1	68
7/29/2002	15	0	62
7/29/2002	18	0	54
7/29/2002	21	0	52
7/29/2002	24	0	52
7/29/2002	27	0	52
9/2/2002	3	7	70
9/2/2002	6	7	70
9/2/2002	9	7	70
9/2/2002	12	6	68
9/2/2002	15	3	64
9/2/2002	18	1	61
9/2/2002	21	0	55
9/2/2002	24	0	54
9/2/2002	27	0	54

Date	Depth	DO (mg/l)	Temperature (F)
10/16/2002	3	9	45
10/16/2002	6	9	45
10/16/2002	9	9	45
10/16/2002	12	9	45
10/16/2002	15	9	45
10/16/2002	18	9	45
10/16/2002	21	9	45
10/16/2002	24	9	45
10/16/2002	27	9	45
5/26/2003	3	8.2	64
5/26/2003	6	8.2	62
5/26/2003	9	8	60
5/26/2003	12	8	60
5/26/2003	15	7.5	59
5/26/2003	18	6.7	56
5/26/2003	21	5.5	54
5/26/2003	24	5	50
5/26/2003	27	4.5	47
6/30/2003	3	7.6	71
6/30/2003	6	7.4	69
6/30/2003	9	7.4	66
6/30/2003	12	5.5	65
6/30/2003	15	4.7	64
6/30/2003	18	1	55
6/30/2003	21	0.6	54
6/30/2003	24	0.5	54
6/30/2003	27	0.3	51
7/27/2003	3	7.6	74
7/27/2003	6	7.5	72
7/27/2003	9	7.2	71
7/27/2003	12	5.8	68
7/27/2003	15	0.3	59
7/27/2003	18	0.3	55
7/27/2003	21	0	53
7/27/2003	24	0	53
7/27/2003	27	0	51
9/17/2003	3	7.6	65
9/17/2003	6	7.5	65
9/17/2003	9	7.5	65
9/17/2003	12	7.5	64
9/17/2003	15	6.5	63
9/17/2003	18	1.2	60
9/17/2003	21	1	59
9/17/2003	24	0	54
9/17/2003	27	0	51
10/7/2003	3	9.6	49
10/7/2003	6	9.6	48
10/7/2003	9	9.6	47
10/7/2003	12	9.3	47
10/7/2003	15	9.1	47
10/7/2003	18	9.1	46
10/7/2003	21	9.1	46
10/7/2003	24	9	46
10/7/2003	27	8.7	46

Date	Depth	DO (mg/l)	Temperature (F)
5/11/2004	3	8.9	56
5/11/2004	6	8.9	56
5/11/2004	9	8.8	54
5/11/2004	12	8.8	53
5/11/2004	15	8.6	51
5/11/2004	18	8.5	51
5/11/2004	21	8.6	50
5/11/2004	24	7.3	49
5/11/2004	27	6.2	49
6/20/2004	3	7.7	67
6/20/2004	6	7.5	66
6/20/2004	9	7.1	65
6/20/2004	12	5.8	62
6/20/2004	15	4.2	57
6/20/2004	18	7.6	56
6/20/2004	21	2.6	56
6/20/2004	24	2	56
6/20/2004	27	1.9	56
7/25/2004	3	7.2	71
7/25/2004	6	7	70
7/25/2004	9	6.8	70
7/25/2004	12	5.1	67
7/25/2004	15	2.7	61
7/25/2004	18	1.7	58
7/25/2004	21	0.1	57
7/25/2004	24	0	55
7/25/2004	27	0	55
8/15/2004	3	7.6	66
8/15/2004	6	7.2	65
8/15/2004	9	6.8	64
8/15/2004	12	6.8	64
8/15/2004	15	6.7	64
8/15/2004	18	0.8	60
8/15/2004	21	0	57
8/15/2004	24	0	55
8/15/2004	27	0	54
10/15/2004	3	9.1	53
10/15/2004	6	8.9	53
10/15/2004	9	8.9	52
10/15/2004	12	8.8	52
10/15/2004	15	8.7	52
10/15/2004	18	8.6	52
10/15/2004	21	8.5	52
10/15/2004	24	8.5	52
10/15/2004	27	8	52
5/24/2005	3	10.1	62.4
5/24/2005	6	9.4	58.2
5/24/2005	9	9.4	57
5/24/2005	12	9.4	55.4
5/24/2005	15	9.2	51.2
5/24/2005	18	8.6	49.8
5/24/2005	21	8	49.2
5/24/2005	24	8	48.5
5/24/2005	27	8	47.6

Date	Depth	DO (mg/l)	Temperature (F)
6/19/2005	3	8	72.3
6/19/2005	6	7.9	69.8
6/19/2005	9	7.8	68.7
6/19/2005	12	7.5	67.1
6/19/2005	15	6	55.2
6/19/2005	18	3.3	51.2
6/19/2005	21	1.9	49.8
6/19/2005	24	0.9	49.1
6/19/2005	27	0.9	48.5
7/31/2005	3	9	72.8
7/31/2005	6	8.8	71.9
7/31/2005	9	6.9	71.4
7/31/2005	12	6.7	70.7
7/31/2005	15	3	68
7/31/2005	18	0.5	55.5
7/31/2005	21	0.1	52.7
7/31/2005	24	0.1	50.7
7/31/2005	27	0	49.2
8/23/2005	3	7.9	70.8
8/23/2005	6	7.5	69.4
8/23/2005	9	7.5	68.3
8/23/2005	12	7.2	67.8
8/23/2005	15	5.6	67.2
8/23/2005	18	1.1	59
8/23/2005	21	1	53.4
8/23/2005	24	0.6	50.7
8/23/2005	27	0	49.8
10/2/2005	3	8.4	61.7
10/2/2005	6	8.2	60.8
10/2/2005	9	8.2	60.4
10/2/2005	12	8.2	60
10/2/2005	15	8.2	59
10/2/2005	18	8.2	58.2
10/2/2005	21	7.7	57.9
10/2/2005	24	6.1	56.1
10/2/2005	27	0.8	51
5/2/2006	3	9.9	51
5/2/2006	6	9.3	50
5/2/2006	9	9.3	50
5/2/2006	12	9.1	50
5/2/2006	15	8.9	50
5/2/2006	18	8.9	50
5/2/2006	21	8.7	50
5/2/2006	24	5.7	46
5/2/2006	27	5.6	45
6/27/2006	3	7.8	72
6/27/2006	6	7.8	71
6/27/2006	9	6.7	67
6/27/2006	12	5.6	65
6/27/2006	15	3.7	57
6/27/2006	18	2.7	55
6/27/2006	21	0.1	52
6/27/2006	24	0.1	52
6/27/2006	27	0.1	52

Date	Depth	DO (mg/l)	Temperature (F)
7/23/2006	3	7	73
7/23/2006	6	7	73
7/23/2006	9	6.8	73
7/23/2006	12	6.6	71
7/23/2006	15	2.2	63
7/23/2006	18	0.5	57
7/23/2006	21	0.2	54
7/23/2006	24	0.1	52
7/23/2006	27	0	52
8/22/2006	3	7.2	73
8/22/2006	6	7.2	71
8/22/2006	9	7.2	71
8/22/2006	12	7.2	70
8/22/2006	15	5.9	68
8/22/2006	18	1.6	62
8/22/2006	21	0.6	58
8/22/2006	24	0.1	55
8/22/2006	27	0	54
10/8/2006	3	9	54
10/8/2006	6	9	54
10/8/2006	9	9	54
10/8/2006	12	9	53
10/8/2006	15	9	53
10/8/2006	18	9	52
10/8/2006	21	9	52
10/8/2006	24	9	52
10/8/2006	27	9	50
5/6/2007	3	8.9	55.4
5/6/2007	6	8.9	55.4
5/6/2007	9	8.9	55.2
5/6/2007	12	8.9	55
5/6/2007	15	8.9	54.5
5/6/2007	18	8.5	53.7
5/6/2007	21	7.5	49
5/6/2007	24	7.2	45.8
5/6/2007	27	5.5	45.3
6/20/2007	3	7.7	70.3
6/20/2007	6	7.7	69.9
6/20/2007	9	7.1	68.3
6/20/2007	12	7.7	67.8
6/20/2007	15	5.7	64.5
6/20/2007	18	2.6	60
6/20/2007	21	1.6	55.2
6/20/2007	24	1	51
6/20/2007	27	0.4	49.4
7/22/2007	3	7.6	71.6
7/22/2007	6	7.4	70.5
7/22/2007	9	7.2	70.1
7/22/2007	12	6.9	69.8
7/22/2007	15	6.5	68.7
7/22/2007	18	1.5	62.9
7/22/2007	21	0.6	46.1
7/22/2007	24	0.1	51.8
7/22/2007	27	0.1	50.3

Date	Depth	DO (mg/l)	Temperature (F)
8/26/2007	3	7.6	68.3
8/26/2007	6	7.5	67.8
8/26/2007	9	6.8	67.2
8/26/2007	12	6.5	67.2
8/26/2007	15	6.1	66.5
8/26/2007	18	0.8	65.1
8/26/2007	21	0.6	59.3
8/26/2007	24	0.5	53
8/26/2007	27	0	51.2
5/12/2008	3	9.2	51.2
5/12/2008	6	9.2	51
5/12/2008	9	9.2	50.9
5/12/2008	12	9.1	50.1
5/12/2008	15	9.1	50.7
5/12/2008	18	9.1	50.7
5/12/2008	21	8.8	49.8
5/12/2008	24	8.8	47.6
5/12/2008	27	7.6	44.9
7/6/2008	3	7.3	70.5
7/6/2008	6	7.2	70.1
7/6/2008	9	7.1	69.5
7/6/2008	12	6.6	68.8
7/6/2008	15	4.1	66
7/6/2008	18	1.4	61.7
7/6/2008	21	0.1	57
7/6/2008	24	0.1	53.1
7/6/2008	27	0	53.4
7/15/2008	1	8.38	70.1
7/15/2008	2	8.29	70.1
7/15/2008	3	8.11	70
7/15/2008	4	7.99	69.6
7/15/2008	5	7.71	69.2
7/15/2008	6	7.65	69.2
7/15/2008	7	7.58	69.1
7/15/2008	8	7.54	69.7
7/15/2008	9	7.37	68.8
7/15/2008	10	7.31	68.7
7/15/2008	11	7.21	67.1
7/15/2008	12	7.09	66.5
7/15/2008	13	6.71	64.8
7/15/2008	14	6.01	63.1
7/15/2008	15	5.77	62.2
7/15/2008	16	4.03	61.6
7/15/2008	17	3.12	60.9
7/15/2008	18	3.01	60.3
7/15/2008	19	2.71	59.7
7/15/2008	20	2.67	58.9
7/15/2008	21	2.11	57.8
7/15/2008	22	1.58	56.4
7/15/2008	23	1.07	55.6
7/15/2008	24	0.91	54.7
7/15/2008	25	0.88	54.3
7/15/2008	26	0.61	54.3

Date	Depth	DO (mg/l)	Temperature (F)
7/27/2008	3	7.4	73.2
7/27/2008	6	7.4	72.7
7/27/2008	9	7.4	71.6
7/27/2008	12	5.2	70.5
7/27/2008	15	7.8	66.9
7/27/2008	18	0.7	62.7
7/27/2008	21	0.2	58.2
7/27/2008	24	0.2	54.8
7/27/2008	27	0	52.8
8/24/2008	3	7	71.2
8/24/2008	6	7	71
8/24/2008	9	7	70.8
8/24/2008	12	7	70.8
8/24/2008	15	6.7	70.7
8/24/2008	18	1.6	62.6
8/24/2008	21	0.6	58.2
8/24/2008	24	0.1	54.5
8/24/2008	27	0.1	52.7
5/12/2009	3	55.9	9.2
5/12/2009	6	55.4	9
5/12/2009	9	53.9	9
5/12/2009	12	52.1	9
5/12/2009	15	49.4	8.5
5/12/2009	18	48.3	8
5/12/2009	21	46.7	6.2
5/12/2009	24	46.4	6.2
5/12/2009	27	45.6	5.2
7/15/2009	3	69	8.2
7/15/2009	6	68.7	8
7/15/2009	9	68.3	8
7/15/2009	12	65.1	7.8
7/15/2009	15	63.4	7.2
7/15/2009	18	57.1	3.6
7/15/2009	21	54.5	0.7
7/15/2009	24	51.8	0.3
7/15/2009	27	48.9	0.1
7/20/2009	3	66.2	7.7
7/20/2009	6	65.1	7.8
7/20/2009	9	64.7	7.8
7/20/2009	12	64.4	7.8
7/20/2009	15	63.8	7.8
7/20/2009	18	61.8	3.9
7/20/2009	21	54.8	2.5
7/20/2009	24	51.6	0
7/20/2009	27	50	0
8/23/2009	3	67.8	7.7
8/23/2009	6	66	7.7
8/23/2009	9	65.4	7.4
8/23/2009	12	65.1	7.4
8/23/2009	15	64.7	7.1
8/23/2009	18	63.8	6.2
8/23/2009	21	57.5	0.6
8/23/2009	24	53.4	0.6
8/23/2009	27	51.2	0

Date	Depth	DO (mg/l)	Temperature (F)
4/17/2010	3	51.2	10
4/17/2010	6	51	10
4/17/2010	9	50.7	10
4/17/2010	12	50.7	10
4/17/2010	15	50.5	10
4/17/2010	18	50.1	10
4/17/2010	21	50	10
4/17/2010	24	50	10
4/17/2010	27	49.8	10
6/20/2010	3	69.6	8
6/20/2010	6	69.2	8
6/20/2010	9	67.6	8
6/20/2010	12	65.3	7.6
6/20/2010	15	60.2	6.6
6/20/2010	18	55.7	5
6/20/2010	21	53.6	2
6/20/2010	24	52.5	0.6
6/20/2010	27	52.1	0.1
8/8/2010	3	74.1	---
8/8/2010	6	73.9	---
8/8/2010	9	73.4	---
8/8/2010	12	72.8	---
8/8/2010	15	68.5	---
8/8/2010	18	61.8	---
8/8/2010	21	56.4	---
8/8/2010	24	54.1	---
8/8/2010	27	53	---
8/22/2010	3	70.9	6.9
8/22/2010	6	69.6	6.9
8/22/2010	9	69	6.8
8/22/2010	12	68.7	6
8/22/2010	15	67.4	4.6
8/22/2010	18	65.1	3.6
8/22/2010	21	57.3	3
8/22/2010	24	55	0.1
8/22/2010	27	53.4	0.1