Report

Aquatic Plant Management Plan

Van Vliet Lake

Presque Isle Town Lakes Committee

September 30, 2011

Project Number 004010-09002-0

Bonestroo

1203 Storbeck Drive
Waupun, WI 53963

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

www.bonestroo.com

Bonestroo

AQUATIC PLANT MANAGEMENT PLAN

VAN VLIET LAKE

September 30, 2011

Prepared For:

Presque Isle Town Lakes Committee
7595 Annabelle Lake Road
Presque Isle, Wisconsin 54557

Prepared By:

Bonestroo
1203 Storbeck Drive
Waupun, Wisconsin 53963

Project Number: 004010-09002-0

James T. Scharl
Graduate Scientist

Table of Contents

1.0 Executive Summary 1
2.0 Introduction 3
3.0 Baseline Information 4
3.1 Lake History and Morphology 4
3.2 Watershed Overview 4
3.3 Water Quality 4
3.3.1 Water Clarity 5
3.3.2 Total Phosphorus and Chlorophyll-a 5
3.3.3 Dissolved Oxygen and Temperature 7
3.3.4 Trophic State Index 7
3.4 Summary of Lake Fishery 8
3.5 Lake Management History 9
3.6 Goal and Objectives 9
4.0 Project Methods 10
4.1 Existing Data Review 10
4.2 Aquatic Plant Survey and Analysis 10
4.3 Shoreline Characterization 11
4.4 Public Involvement and Plan Review 12
5.0 Discussion of Project Results 13
5.1 Aquatic Plant Ecology 13
5.2 Aquatic Invasive Species 13
5.3 2008 Aquatic Plant Survey 13
5.3.1 Floating-Leaf Plants 15
5.3.2 Submergent Plants 15
5.3.3 Emergent Plants 15
5.4 Floristic Quality Index 15
5.5 Shoreline Characterization 16
5.6 2004 & 2008 Comparison 16
6.0 Management Alternatives and Recommendations 18
6.1 Aquatic Plant Maintenance Alternatives 18
6.1.1 Aquatic Invasive Species 18
6.1.2 Clean Boats/Clean Waters Campaign 19
6.1.3 Aquatic Plant Protection and Shoreline Management 19
6.1.4 Public Education and Involvement 20
6.2 Aquatic Plant Manipulation Alternatives 20
6.2.1 Manual Removal 20
6.2.2 Aquatic Invasive Plant Species Chemical Herbicide Treatment 21
7.0 Conclusion and Recommended Action Plan 23

7.1 Recommended Active Goals 23
7.2 Closing 24
8.0 References 25

FIGURES

Lake Location and Watershed 1
Bathymetric Map 2
Point Intercept Sampling Locations 3
July 2008 Aquatic Plant Distribution ..... 4A – 4E
Shoreline Characterization 5

TABLES

Taxa Detected During 2008 Aquatic Plant Surveys 1
2008 Aquatic Plant Community Statistics 2
2008 Aquatic Plant Taxa-Specific Statistics 3
Floristic Quality Index 1 4

APPENDIX

Point Intercept Sample Coordinates ..... A
Importance of Aquatic Plants to Lake Ecosystem ..... B
Aquatic Invasive Species C
Descriptions of Aquatic Plants ..... D
Summary of Aquatic Plant Management Alternatives ..... E
NR 107 and NR109 Wisconsin Administrative Code ..... F
Resource for Additional Information ..... G
Aquatic Plant Management Strategy, Northern Region WDNR ..... H
Dissolved Oxygen and Temperature Readings I
Additional Information / Lake Resident Comments ..... J

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 Van Vliet 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 Van Vliet Lake. The Van Vliet 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 Van Vliet Lake in 2008, which identified twenty three aquatic plant species. The most abundant aquatic plants identified during the survey were fern pondweed (*Potamogeton robbinsii*), coontail (*Ceratophyllum demersum*), and common waterweed (*Elodea canadensis*). The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Van Vliet Lake exhibited an FQI of 30.23, 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 Van Vliet Lakes 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 Van Vliet 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 Van Vliet Lake Aquatic Plant Management Plan:

Active Goal: To continue and expand the WDNR Clean Boats, Clean Waters program on Van Vliet 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 Van Vliet Lake water quality.

Active Goal: To implement and maintain an aquatic invasive species monitoring program that will survey for invasive species, and if found, monitor their locations and extent of population spread.

Active Goal: To continue and expand the Van Vliet 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 Van Vliet Lake fish management practices and develop goals in order to maintain and enhance a quality family sport fishery.

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 Van Vliet 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 Van Vliet 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.

Active Goal: To manage areas of impaired navigation and/or nuisance conditions as outlined in Northern Region WDNR APM Strategy Document, Appendix H, page 6.

2.0 Introduction

Van Vliet Lake is a 220 acre drainage lake located in northern Vilas County. The lake has a 1,400 acre (2.19 square miles) watershed. Van Vliet Lake exhibits good water clarity and, according to the Wisconsin Trophic State Index, is a mesotrophic lake.

Lake residents have become concerned about increasing aquatic vegetation and require management strategies for areas with impaired navigation and/or nuisance conditions and 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 Van Vliet 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 Van Vliet Lake if ever established and provide relief for areas of Van Vliet Lake experiencing impaired navigation and/or nuisance conditions due to dense, native aquatic plant growth.

This document is the APM Plan for Van Vliet 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

Van Vliet 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	Van Vliet
Lake Type	Drainage
Surface Area (acres)	220
Maximum depth (feet)	20
Mean depth (feet)	9
Public Landing	Yes

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

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

3.2 WATERSHED OVERVIEW

The Van Vliet Lake watershed encompasses approximately 1,400 acres in northern Vilas County and is primarily forested and undeveloped. Van Vliet Lake is connected by navigable waterways to Averill and Presque Isle Lakes before draining into the Presque Isle River. Van Vliet 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. Van Vliet Lake contains both a self-sustaining walleye population and a self-sustaining muskellunge population within the Ceded Territories.

The Van Vliet 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

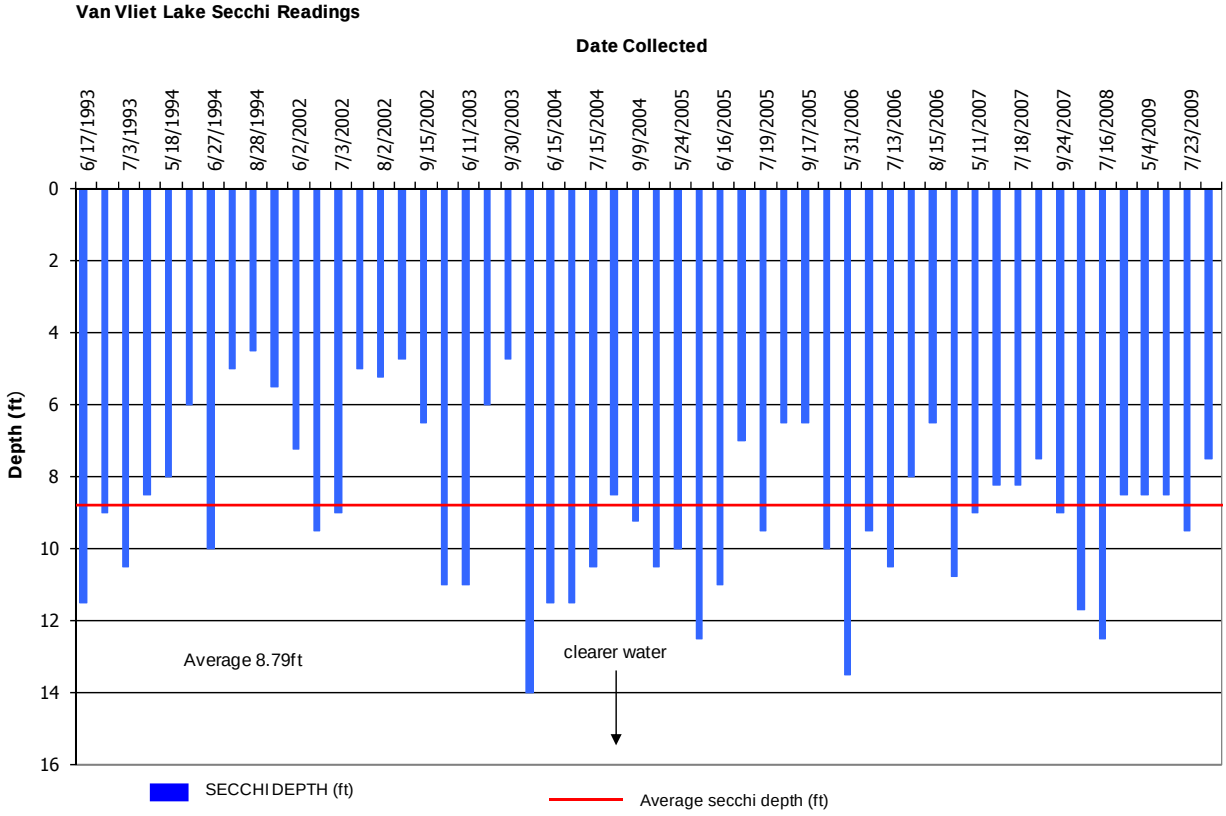
- Water clarity (Secchi depth): 1993-1994, 2002 - 2009 (Citizen Lake Monitoring)
- Total phosphorus: 1993, 2003 - present (Citizen Lake Monitoring)
- Chlorophyll-a: 1993, 2003 - present (Citizen Lake Monitoring)

The above referenced data was used in creating the Van Vliet 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

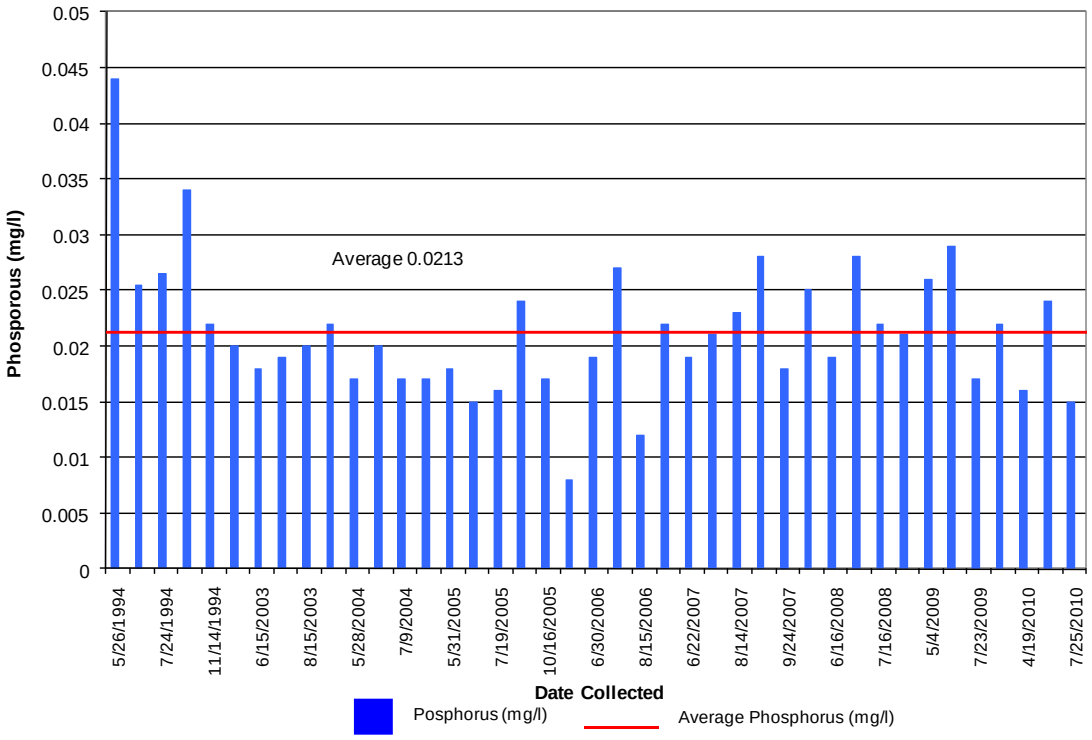
The historical water clarity average based on Secchi Disk readings is 8.79 feet (2.68 meters) and ranges from 4.5 to 14 feet. The Wisconsin average Secchi Disk reading in 2005 was 10 feet (Larry Bresina, The Secchi Disk and Our Eyes - Working Together To Measure Clarity of Our Lakes; internet document). The following graph illustrates the historical water clarity measurements on Van Vliet Lake; data collected up to 2009 is included.



3.3.2 TOTAL PHOSPHORUS AND CHLOROPHYLL-A

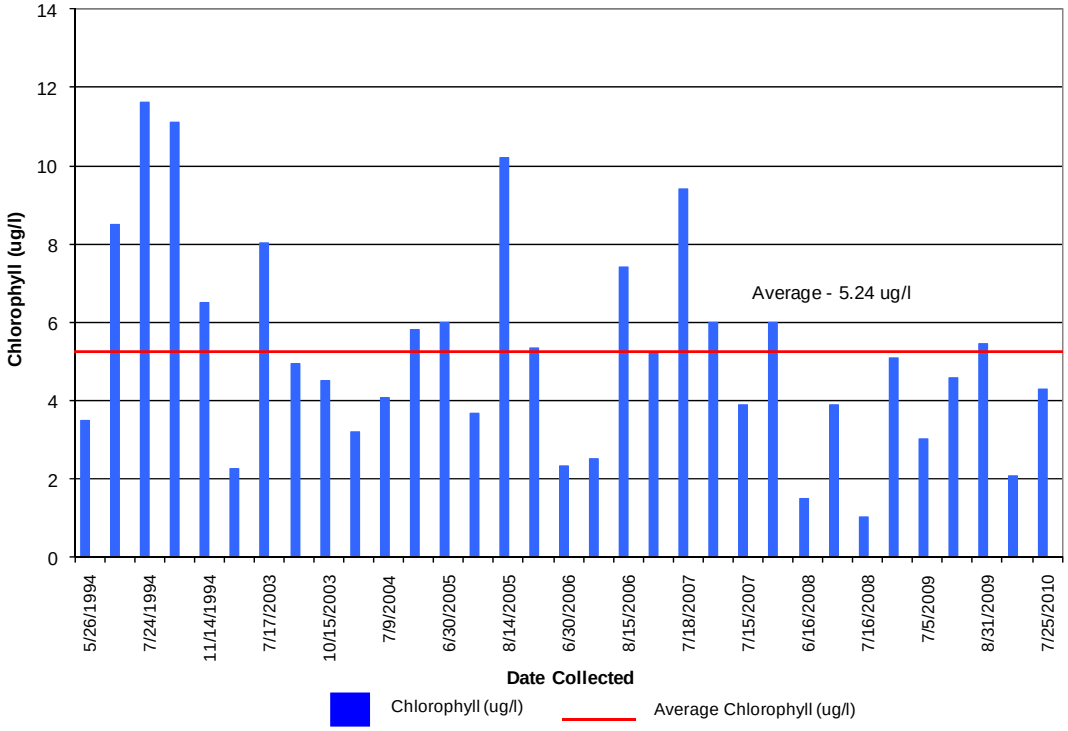
Historically Van Vliet Lake has and average phosphorus reading of 0.0213 milligrams per liter (parts per million – ppm). Total phosphorus has varied from 1994 through 2010 from 0.008 ppm to 0.044 ppm. The following graph illustrates the historical phosphorus measurements on Van Vliet Lake.

Van Vliet Lake Phosphorus Readings



Chlorophyll measurements started in 1994 and continued through 2010, showing an average of 5.24 micrograms per liter (parts per billion – ppb). Data ranged from 1.03 ppb to 11.6 ppb. The following graph illustrates the historical chlorophyll measurements on Van Vliet Lake.

Van Vliet Lake Chlorophyll *a* Readings



3.3.3 Dissolved Oxygen and Temperature

In conjunction with Citizen Lake Monitoring, volunteers on Van Vliet 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 21 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 Van Vliet 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
Van Vliet Lake	**46.97**	**Mesotrophic**	**21.3**	**5.24**	**8.79**

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 Van Vliet 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 Van Vliet Lake.

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

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

The WDNR website presents records of fish stocked in Van Vliet Lake (WDNR Fish stocking website, 2010). All muskellunge stocked in Van Vliet Lake were large fingerling in size and used to supplement natural reproduction.

Year	Muskellunge
2003	145
2005	110
2007	72
2009	109

All fisheries in Van Vliet Lake are currently sustained through natural reproduction. Van Vliet 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 spearers. 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 Van Vliet Lake are concurrent with standard WDNR regulations in the Ceded Territories except for walleye and bass. For non-Chippewa anglers there is no minimum size limit for walleye with a two (2) fish daily bag limit, but only one may be over 15 inches. For both largemouth and smallmouth bass, the daily bag limit is 1 with a minimum size of 18". 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.

3.5 LAKE MANAGEMENT HISTORY

Past management activities on Van Vliet Lake are fish stocking by the WDNR and a Comprehensive Lake Management Plan in 2004-2005. The historical WDNR stocking data is presented in the previous section. The lake management plan was funded by Small Scale Lake Planning Grant SPL-091-05 and laid the ground work for lake management. In association with this grant, the Van Vliet Lake Association was able to enact citizen lake monitoring and purchase the necessary equipment, including a dissolved oxygen and temperature meter. Recommendations related to aquatic plant growth from this plan consisted of maintaining the current aquatic plant ecosystem, though heavy plant growth was noted in several areas.

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 Van Vliet 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 Van Vliet Lake
- Educate the Van Vliet 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

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 16, 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 46 meter grid with 432 pre-determined intercept points (Figure 3). Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix A). Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by tossing a specialized 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. Members of the Van Vliet Lake Association were also along during the 2008 aquatic plant survey, helping with the collection of data. Draft copies of the APM Plan for Van Vliet 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

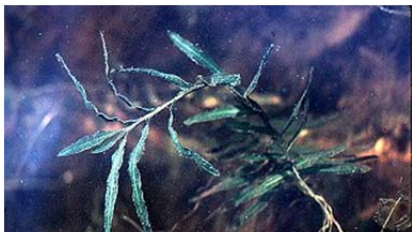
The survey was carried out July 16, 2008, and included sampling at 432 intercept points. The aquatic macrophyte community of the Lake included 23 floating leaved, emergent, and submerged aquatic vascular plant species during 2008. Table 1 lists the taxa identified during the 2008 aquatic plant survey. Figures 4A through Figure 4E illustrate the locations of each species identified.

Vegetation was identified to a maximum depth of 18 feet (photic zone). Aquatic vegetation was detected at 88.64 percent (%) of photic zone intercept points. A diverse plant community

inhabited the lake during 2008; Simpson Diversity Index value of the community was 0.85, taxonomic richness was 23 species, and there was an average of 2.61 species identified at points that were within the photic zone. There was an average of 3.05 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 fern pondweed *(Potamogeton robbinsii*). It exhibited a 61.5% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected). It was present at 69.4% of the sites with vegetation, and had a 22.7% relative frequency of occurrence. Table 3 includes the abundance statistics for each species.

Fern Pondweed is a submergent pondweed with robust stems and strongly two-ranked leaves, creating a feather or fern-like appearance while in the water. Fern pondweed sprouts in the spring and thrives in deeper water. Fern pondweed provides habitat for invertebrates that are grazed by waterfowl and also offers good cover for fish, particularly northern pike (Borman, et al., 1997).



Fern Pondweed
Source: UW Herbarium Website

Coontail (*Ceratophyllum demersum*) was the second most abundant species occurring at 54.6% of the photic zone. It was present at 61.6% of sites with vegetation and had a 20.2% relative frequency of occurrence.

Coontail
Source: UW Herbarium Website

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

Common waterweed (*Elodea canadensis*) was the third most abundant vascular plant species occurring at 46.2% of the photic zone. It was present at 52.1% of sites with vegetation and had a 17.1% relative frequency of occurrence.

Elodea is an abundant native plant species that is distributed statewide. It prefers soft substrate and water depths to 15 feet (Nichols, 1999). Elodea reproduces by seed and sprigs (USDA, 2002). The stems of elodea offer shelter and grazing to fish, but very dense elodea can interfere with fish movement. Elodea can be considered invasive at times and out-competes other more desirable plants. Note: Elodea nuttalli was also noted in the lake.

Elodea
Source: UW Herbarium Website

5.3.1 FLOATING-LEAF PLANTS

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

- Brasenia schreberi (watershield)
- *Nymphaea odorata* (white water lily)

5.3.2 SUBMERGENT PLANTS

The following 19 submergent aquatic plant species were identified during the 2008 aquatic plant survey.

- *Bidens beckii* (water marigold)
- Ceratophyllum demersum (coontail)
- *Chara sp.* (chara or muskgrass) [algal]
- *Elodea canadensis* (elodea or common waterweed)
- *Elodea nuttalli* (slender waterweed)
- *Heteranthera dubia* (water star-grass)
- *Myriophyllum heterophyllum* (various-leaved watermilfoil)
- *Myriophyllum sibiricum* (northern watermilfoil)
- *Najas flexilis* (bushy pondweed or slender naiad)
- Potamogeton amplifolius (large-leaf pondweed)
- Potamogeton illinoensis (Illinois pondweed)
- *Potamogeton praelongus* (white-stem pondweed)
- Potamogeton pusillus (small pondweed)
- Potamogeton richardsonii (clasping-leaf pondweed)
- Potamogeton robinnsii (fern pondweed)
- Potamogeton zosteriformis (flat-stem pondweed)
- Schoenoplectus subterminalis (water bulrush)
- Stuckenia pectinata (sago pondweed)
- *Vallisneria americana* (wild celery)

5.3.3 EMERGENT PLANTS

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

- *Eleocharis palustris* (creeping spikerush)
- *Sagittaria cristata* (crested arrowhead)

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 30.23. This FQI value is higher than Wisconsin's northern region mean of 24.3 and

suggests that Van Vliet Lake exhibits very good water quality when using aquatic plants as an indicator. Table 4 summarizes the coefficient of conservatisms.

5.5 SHORELINE CHARACTERIZATION

Emergent and floating leaved plants identified along the shoreline outside of formal grid sample points included: *Sagittaria sp.* (arrowhead), *Nuphar variegata* (spatterdock), *Nymphaea odorata* (white water lily) *Eleocharis palustris* (creeping spikerush), *Pontederia cordata* (pickerelweed), *Typha sp*. (cattail), *Carex sp.* (sedges species) and *Sparaganium 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.

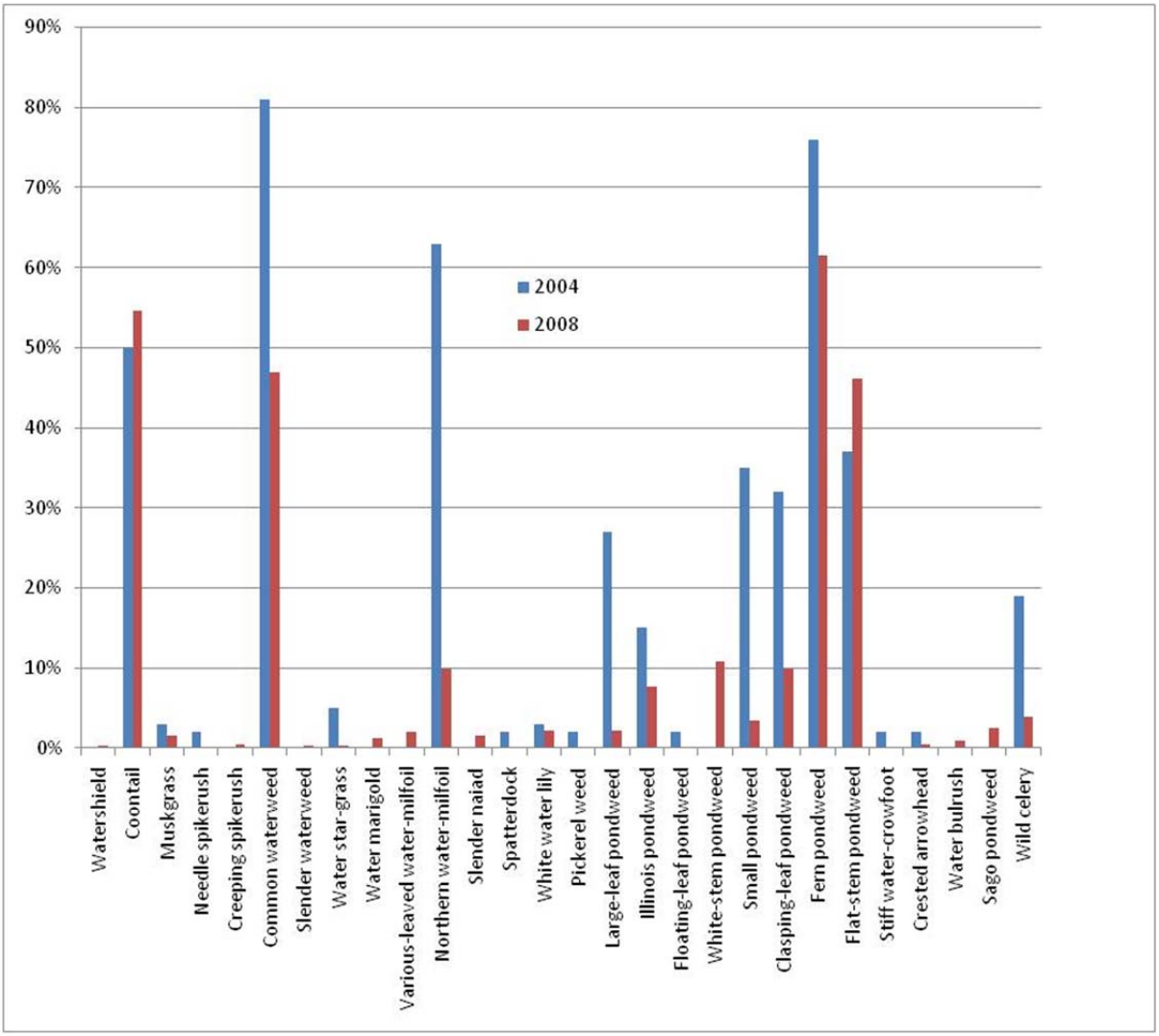
The majority of the shoreline was moderately developed with residences. Some scattered blocks of undeveloped woodlands were present on the lakeshore. Figure 5 illustrates the level of shoreline development.

5.6 2004 & 2008 COMPARISON

To complete a comprehensive lake management plan in 2004-2005, a line-transect aquatic plant survey was completed in 2004. During this survey, 19 species were identified on 26 transects and 3 depth-ranges per transect, when possible, for a total of 62 sample stations. At this time, the most common plants identified were, in order; Coontail, fern pondweed, and common waterweed. During the 2008 aquatic plant point-intercept survey, 23 species were sampled with the same three species being the most abundant. The table below compares the two surveys.

	2004		2008	
Specie	present	% Frequency of occurrence within photic zone	present	% Frequency of occurrence within photic zone
Watershield	no	---	yes	0.25%
Coontail	yes	50%	yes	54.57%
Muskgrass	yes	3%	yes	1.48%
Needle spikerush	yes	2%	no	---
Creeping spikerush	no	---	yes	0.49%
Common waterweed	yes	81%	yes	46.91%
Slender waterweed*	no	---	yes	0.25%
Water star-grass	yes	5%	yes	0.25%
Water marigold	no	---	yes	1.23%
Various-leaved water-milfoil	no	---	yes	1.98%
Northern water-milfoil	yes	63%	yes	9.88%
Slender naiad	no	---	yes	1.48%
Spatterdock	yes	2%	no	---
White water lily	yes	3%	yes	2.22%
Pickerel weed	yes	2%	no	---
Large-leaf pondweed	yes	27%	yes	2.22%
Illinois pondweed	yes	15%	yes	7.65%
Floating-leaf pondweed	yes	2%	no	---
White-stem pondweed	no	---	yes	10.86%
Small pondweed	yes*	35%	yes	3.46%
Clasping-leaf pondweed	yes	32%	yes	9.88%
Fern pondweed	yes	76%	yes	61.48%
Flat-stem pondweed	yes	37%	yes	46.17%
Stiff water-crowfoot	yes	2%	no	---
Crested arrowhead	yes*	2%	yes	0.49%
Water bulrush	no	---	yes	0.99%
Sago pondweed	no	---	yes	2.41%
Wild celery	yes	19%	yes	3.95%

* - These plants were not identified down to species level during the 2004 transect survey.



2004 vs. 2008 Frequency of Occurrence by plant species sampled.

In total, five species sampled in 2004 were not directly sampled in 2008; pickerel weed, spatterdock, needle spike rush, floating-leaf pondweed, and stiff-water crowfoot. However, of these species, pickerel weed and spatterdock were identified during the shoreline-survey. Conversely, the following nine species were sampled in 2008 but not 2004; watershield, creeping spikerush, slender waterweed, water marigold, various-leaved watermilfoil, bushy pondweed, white-stem pondweed, water bulrush, and sago pondweed. Though this may seem like a high number of potentially new species between the surveys, the increased diversity may be due to a much larger number of sample locations. Aquatic plant growth between the years seems very similar, with plants present at a majority of the locations and the same basic makeup of dominant plant species present. However, several lake residents have expressed observations in changes to the aquatic plant community including plants growing at new, deeper locations specifically an increase in deep-water coontail. Low water levels allowing penetration of light to new lake bottom areas may have caused these changes. The Van Vliet Lake Association board does not view this as an area of concern at the moment, but that it should continue to be monitored (*See Appendix J - Additional Information / Lake Resident Comments).* Differences between these surveys and presence or absence of species is does not indicate a cause for alarm, at this time.

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 Van Vliet Lake. In order to monitor for AIS in the future a strong Citizen Lake Monitoring program that surveys for AIS is highly recommended. 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. Van Vliet 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 Van Vliet Lake, a monitoring program such as Clean Boats/Clean Waters is an excellent choice. There is one public landing on Van Vliet Lake and lake residents are currently participating in Clean Boats/Clean Waters (CB/CW) program. This program is carried out by trained volunteers who inspect the incoming boats at public launches. Signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of the public, along with private property and resort owners, about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations. Contact with lake users at this time is a great way to distribute other educational materials. 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, dense aquatic plant growth was found in some portions in the lake, similar to the 2004 survey done for the Comprehensive Lake Management Plan. Densest growth was located in the south-western bay of Van Vliet Lake with fern-pondweed and common waterweed being the predominant plants. The overall shallowness of the bay, soft muck bottom, and water clarity of Van Vliet Lake produce ideal conditions for aquatic plant growth in this area which can easily grow to the surface and reach nuisance levels.

Since 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 F.

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 Van Vliet 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 D includes additional resources for plant identification.

6.2.2 Aquatic Invasive Plant Species Chemical Herbicide Treatment

If Van Vliet 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 Van Vliet 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 Van Vliet 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 Van Vliet 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 Van Vliet Lake and the PITLC to determine the actions, find the funding, and gather the individuals needed to implement the active goals.

Active Goal: To continue and expand the WDNR Clean Boats, Clean Waters program on Van Vliet 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 Van Vliet Lake water quality.

Active Goal: To implement and maintain 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.

Active Goal: To continue and expand the Van Vliet 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 Van Vliet Lake fish management practices and develop goals in order to maintain and enhance a quality family sport fishery.

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 Van Vliet 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 Van Vliet 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.

Active Goal: To manage areas of impaired navigation and/or nuisance conditions as outlined in Northern Region WDNR APM Strategy Document, page 6.

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.

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

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

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

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

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

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

McComas, Steve, *Lake Management Plan for Van Vliet Lake, Vilas County, Wisconsin,* Blue Water Science, 2005

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

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

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

United States Department of Agriculture, *Soil Survey of Vilas County, Wisconsin*. 1988

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

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

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

Wetzel, Robert G., *Limnology*, 1983

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

Wisconsin Department of Natural Resources, *Aquatic Invasive Species Website (*http://dnr.wi.gov/invasives/aquatic/), Accessed April 2007

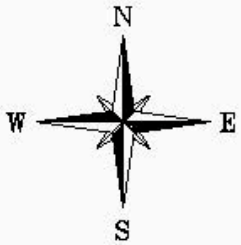
Wisconsin Department of Natural Resources, *Listing of Wisconsin Waters with Eurasian Water-Milfoil (current as of 01/02/2007)*, 2007

Wisconsin Department of Natural Resources, *Fish Stocking Website*

(http://infotrek.er.usgs.gov/doc/wdnr_biology/Public_Stocking/StateMapHotspotsAllYears.htm), Accessed April, 2007

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

Figures



VAN VLIET REGIONAL WATERSHED

LAKE WATERSHEDS - PRESQUE ISLE

VILAS COUNTY, WISCONSIN

FIGURE 1

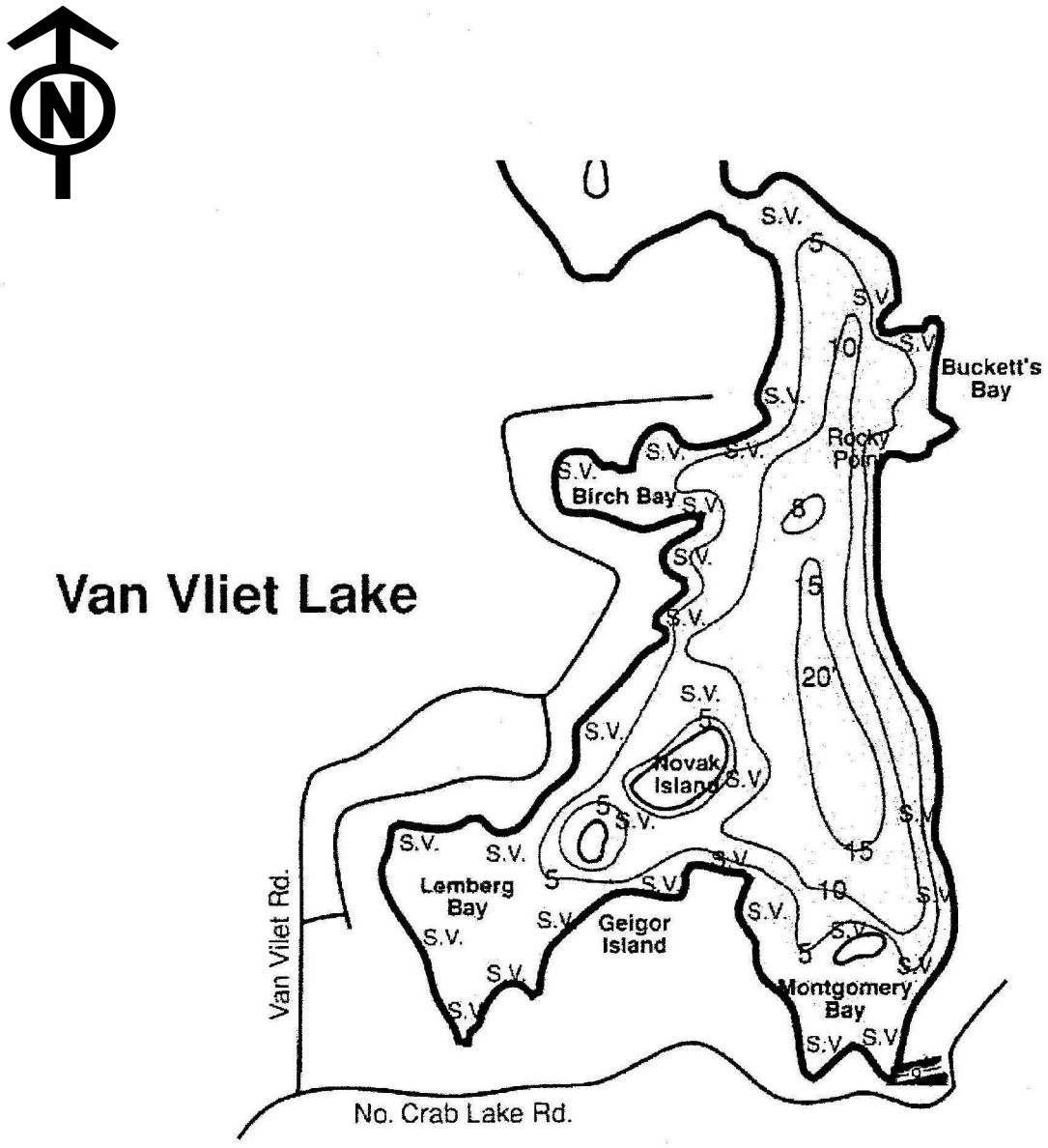
Bonestroo

DATE: 9-8-10

COMM: 004010-09002-0

Lake Map and Lake Statistics

Van Vliet Lake is approximately 220 acres in size, with a watershed of 1,370 acres. The average depth of Van Vliet Lake is 3 meters (9 feet) with a maximum depth of 6 meters (20 feet)



Van Vliet Lake, Vilas County, Wisconsin.

FIGURE 2

2010 AQUATIC PLANT SURVEY

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo

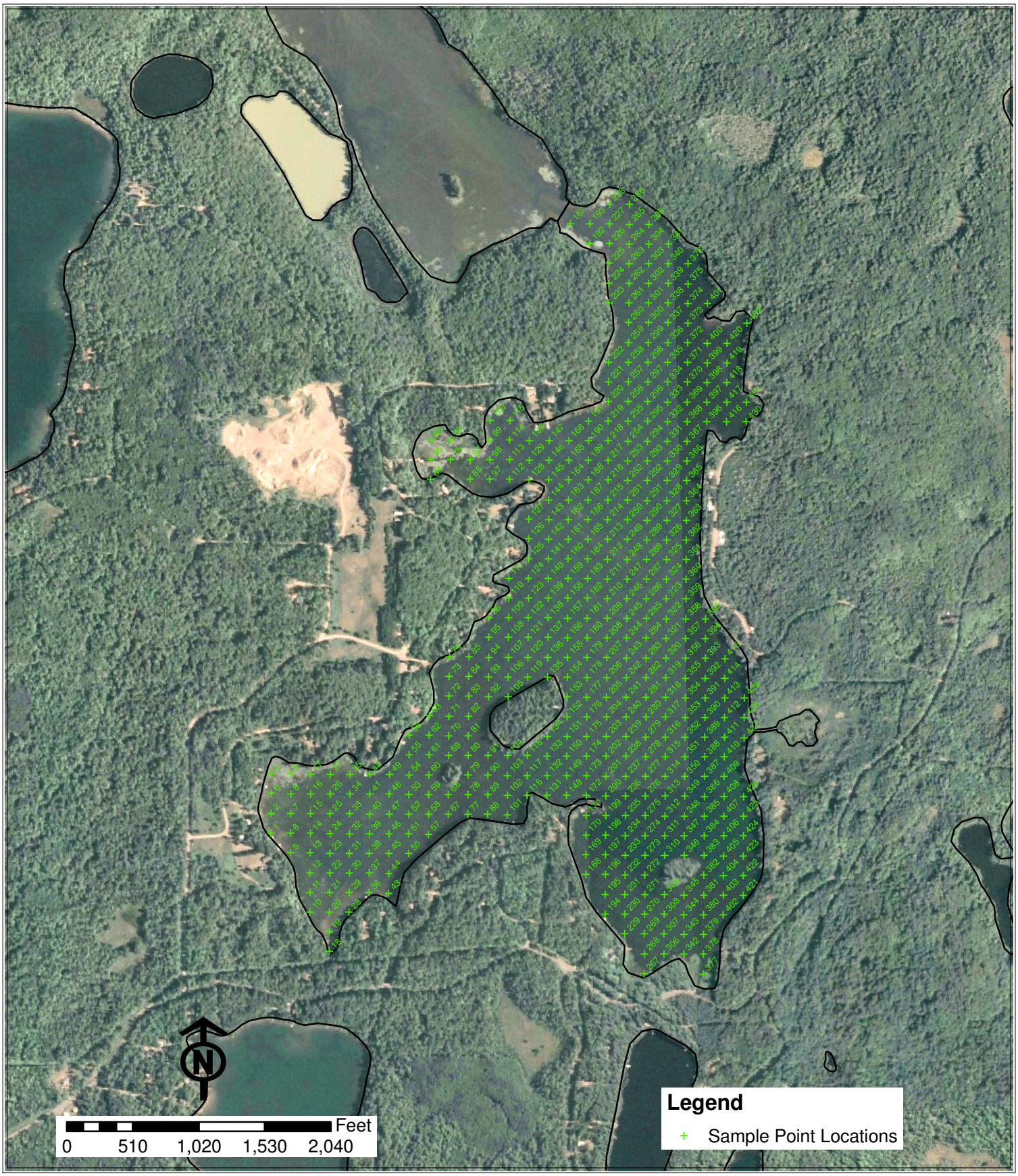
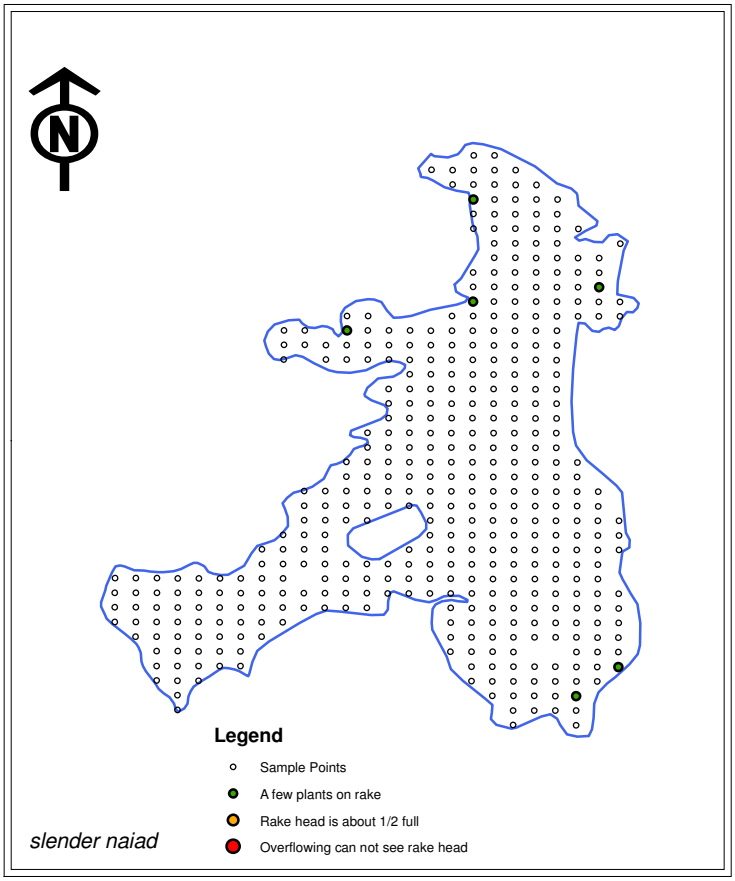


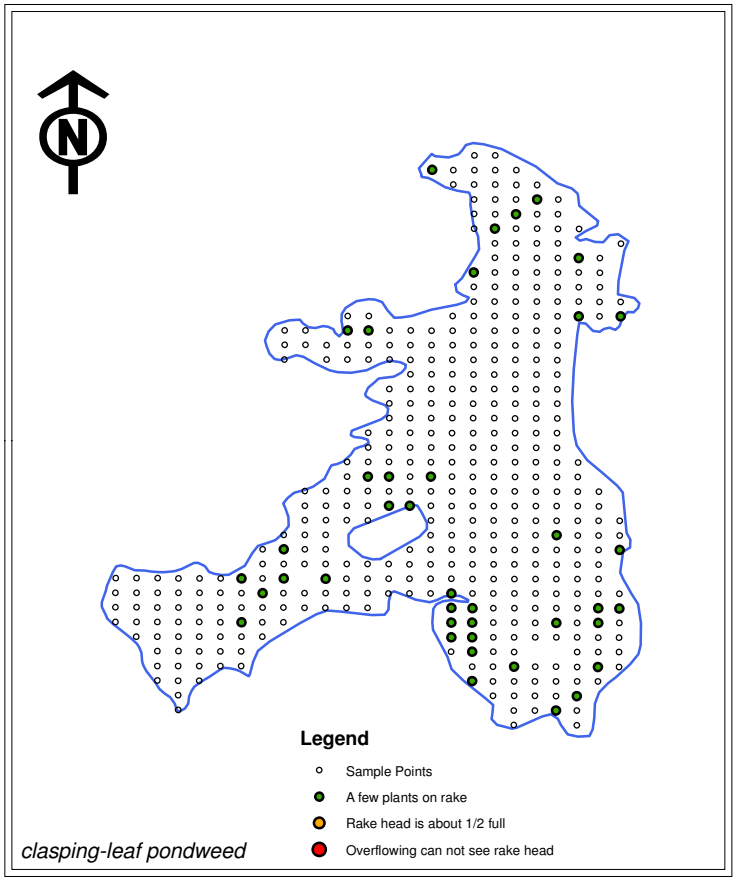
FIGURE 3

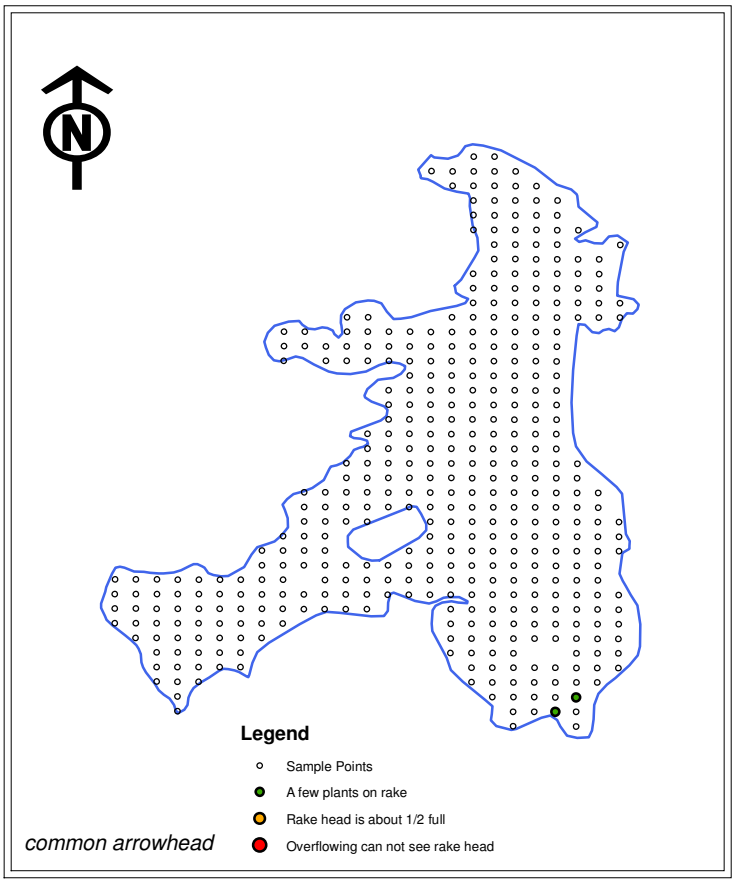
2008 AQUATIC PLANT SURVEY

VAN VLIET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo







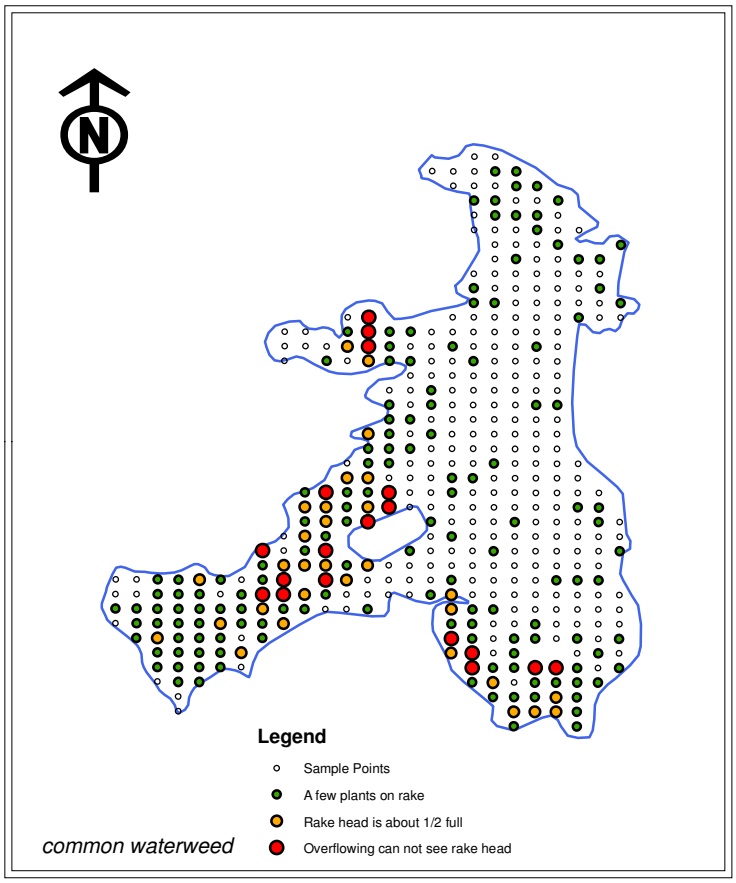
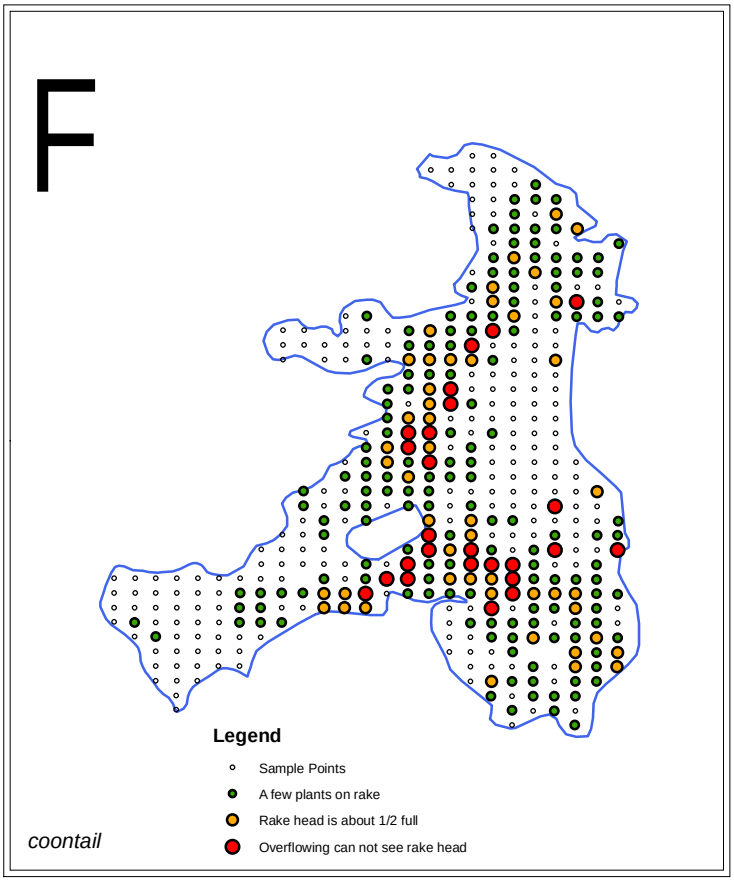


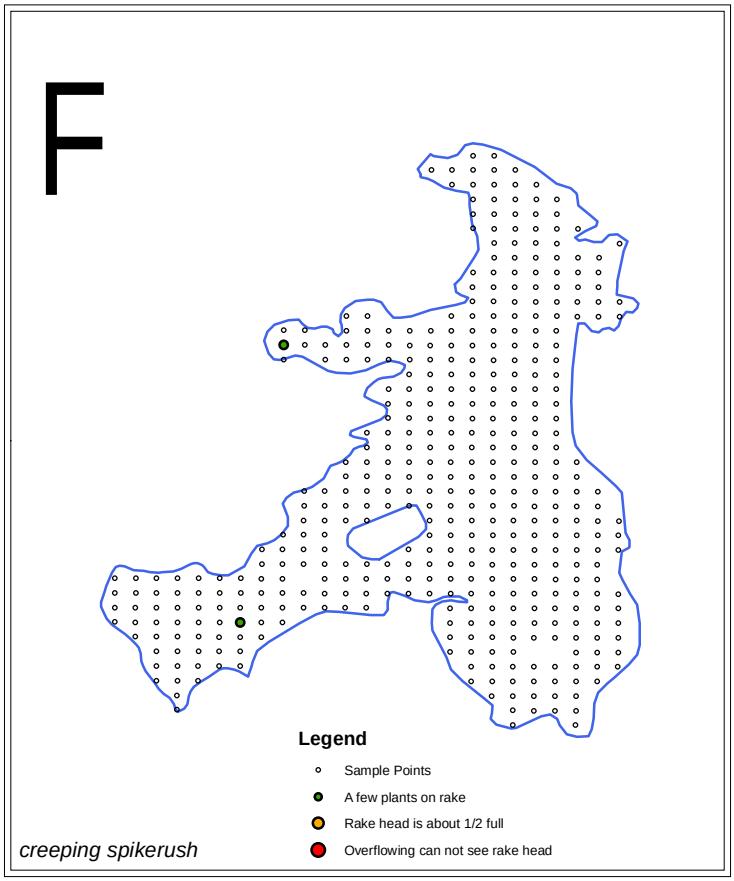
FIGURE 4A

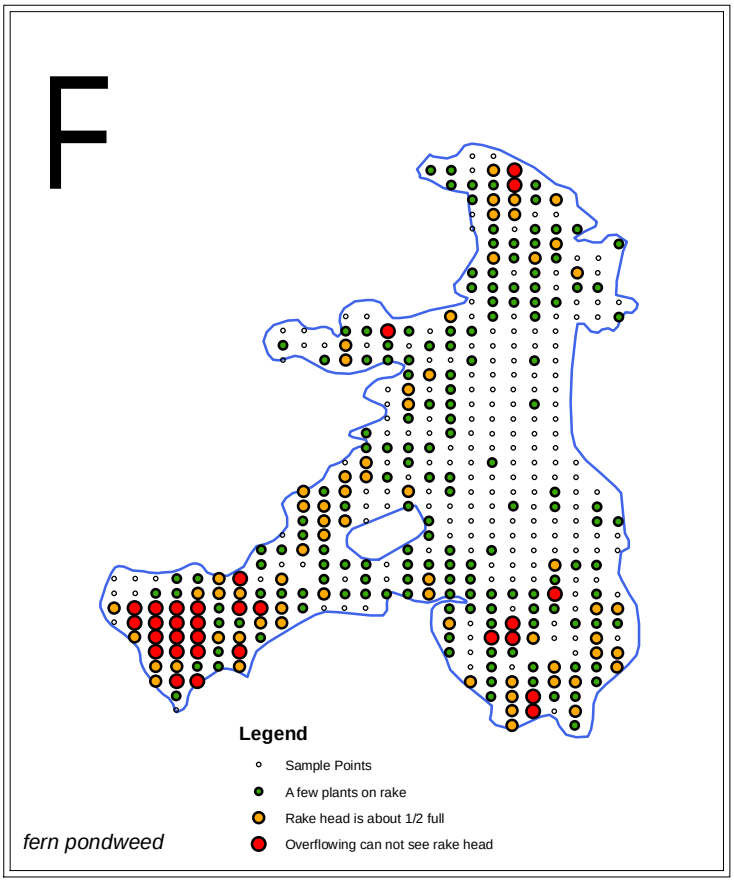
AQUATIC PLANT DISTRIBUTION MAP

VAN VLIET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo







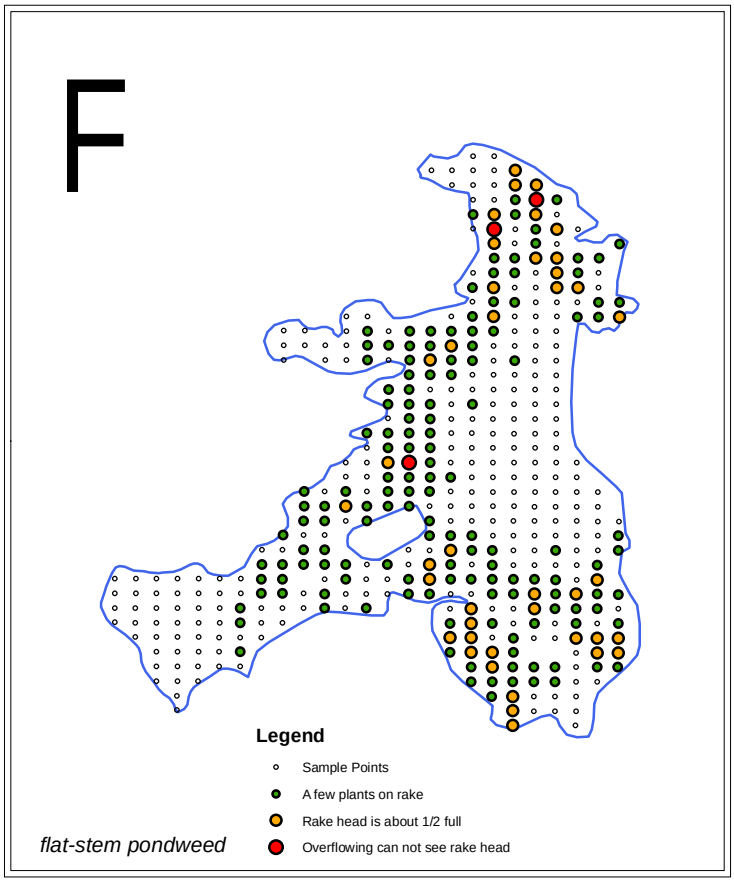
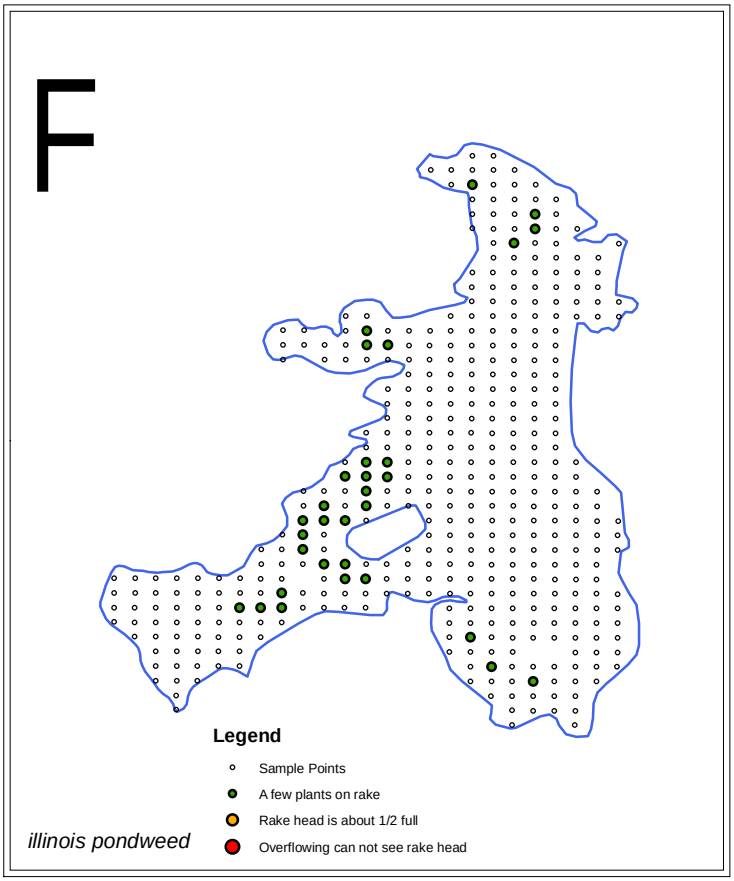


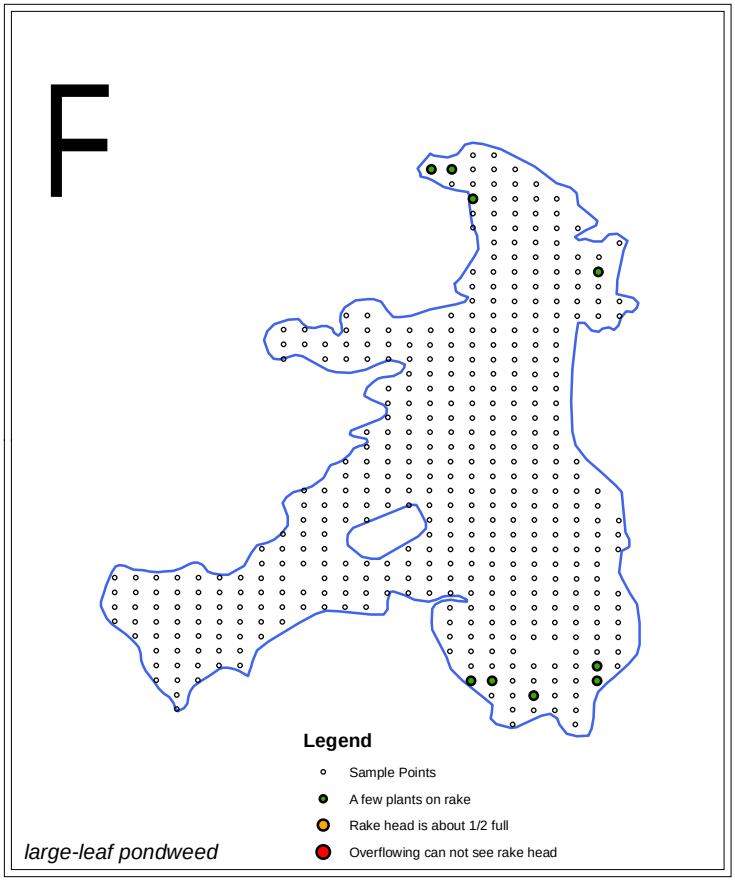
FIGURE 4B

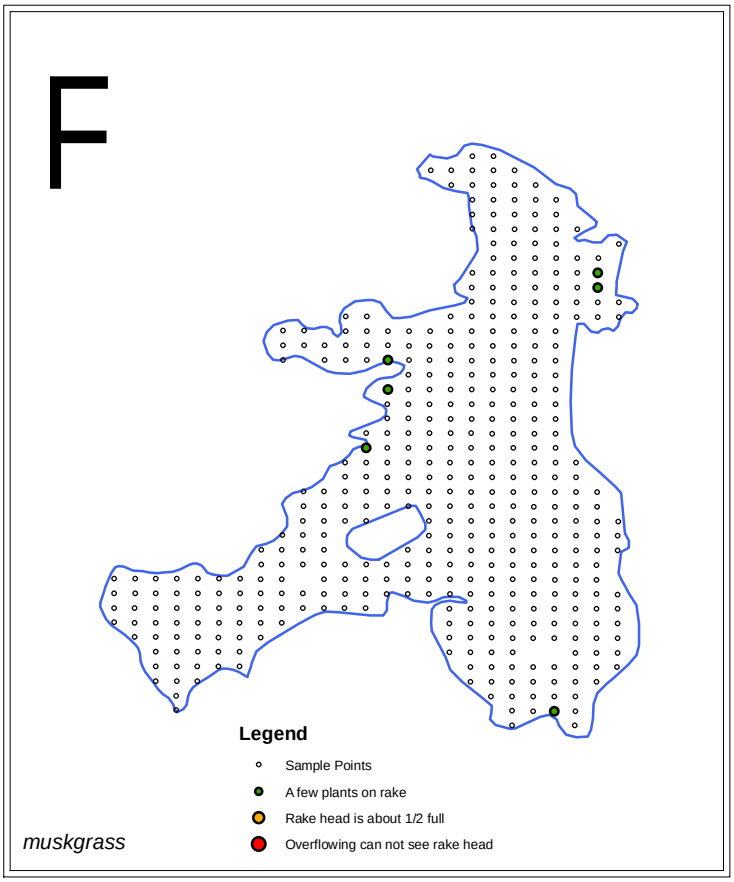
AQUATIC PLANT DISTRIBUTION MAP

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo







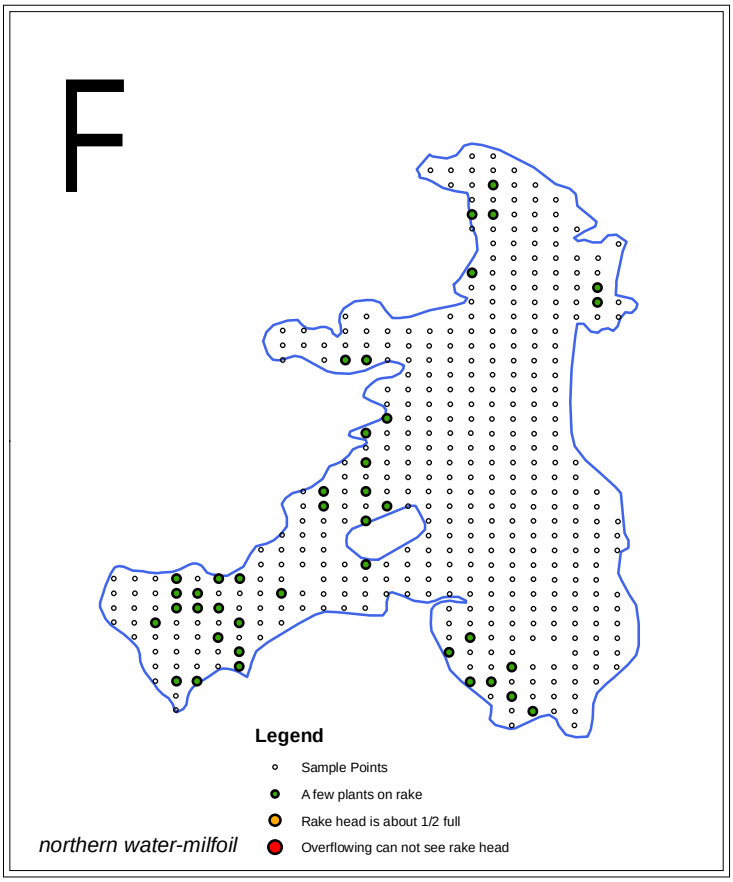
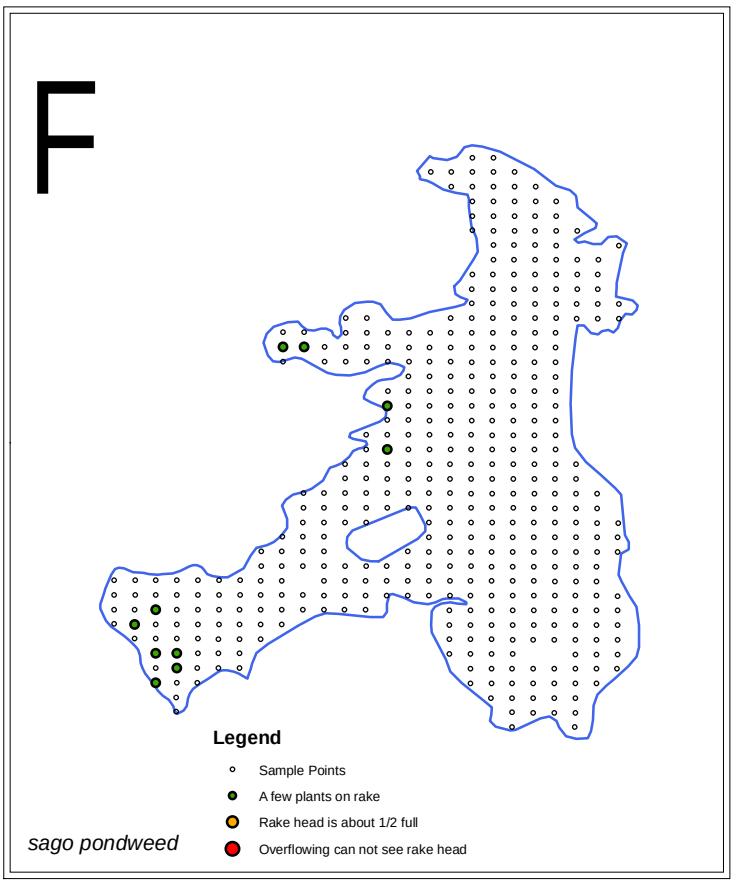


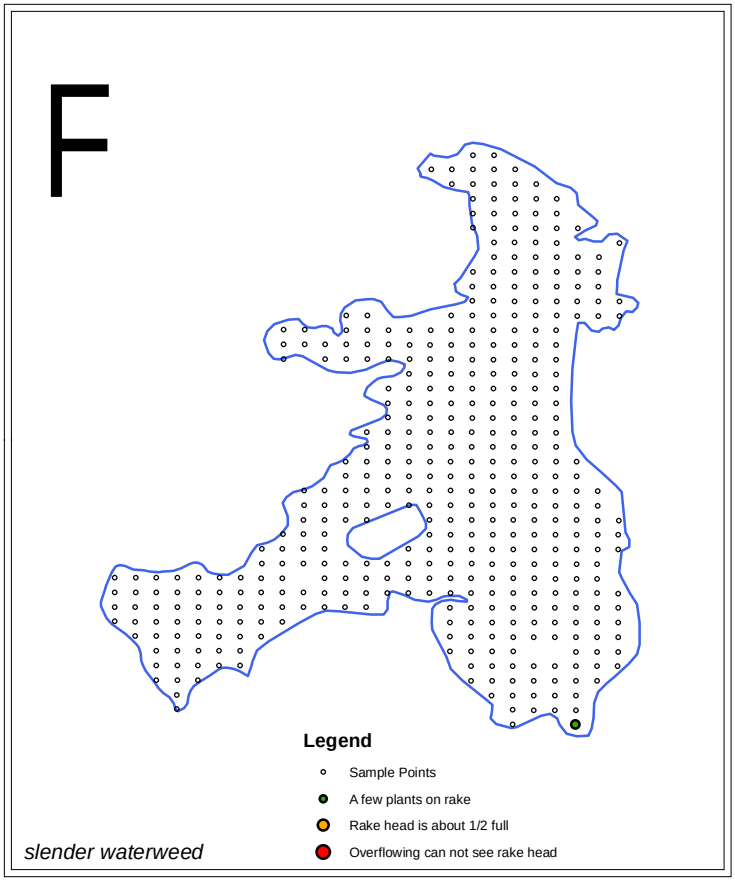
FIGURE 4C

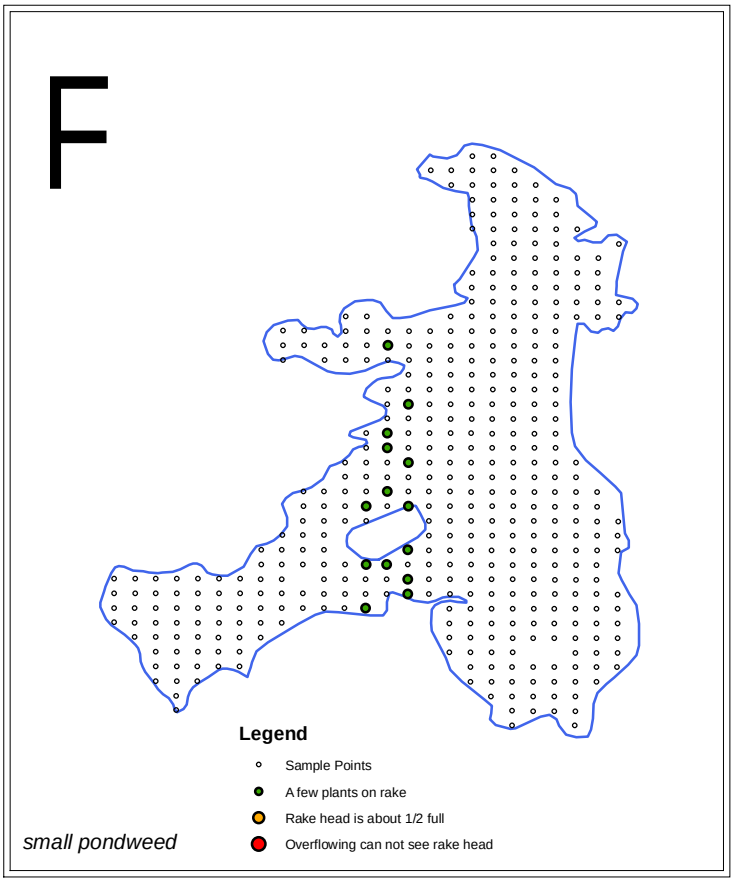
AQUATIC PLANT DISTRIBUTION MAP

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo







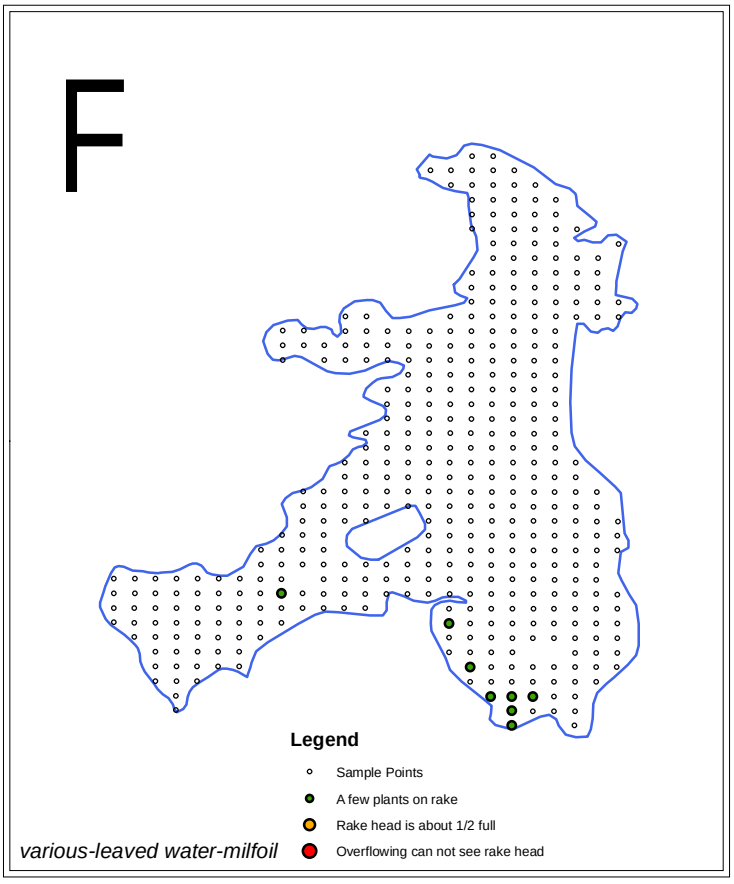
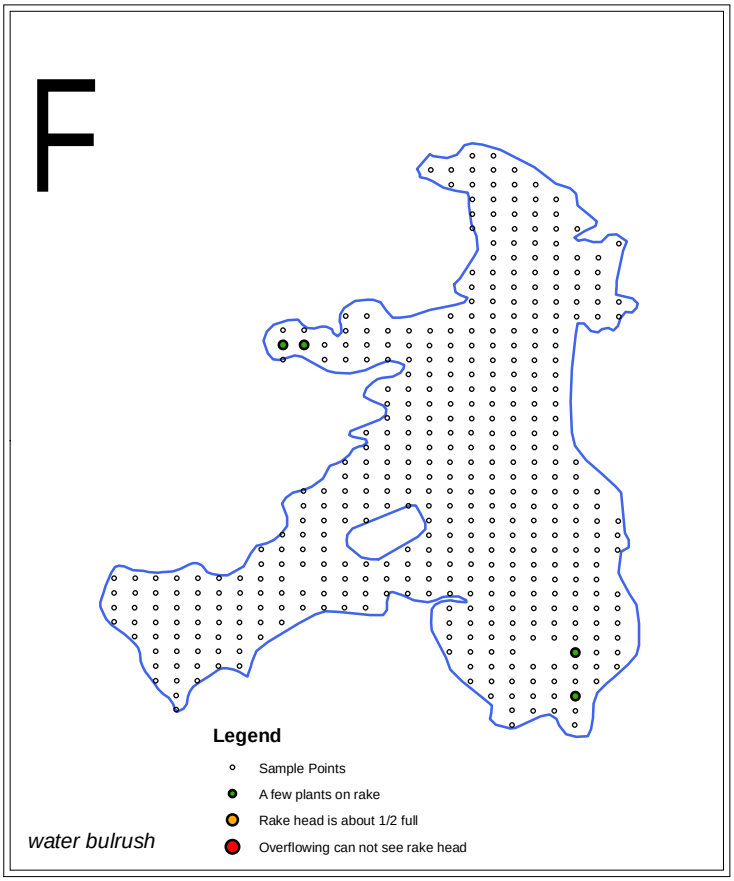


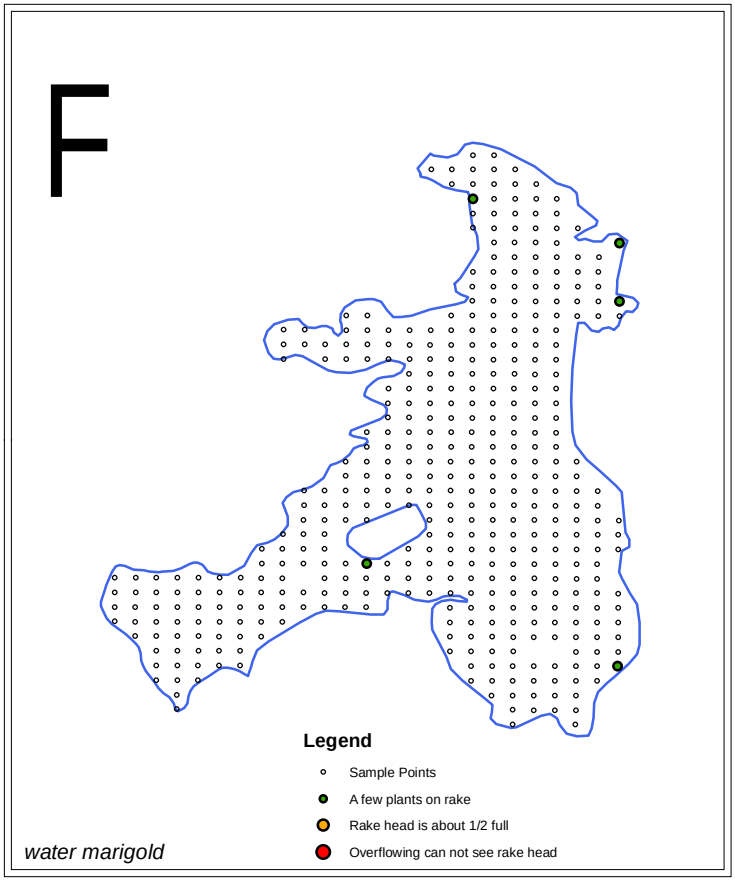
FIGURE 4D

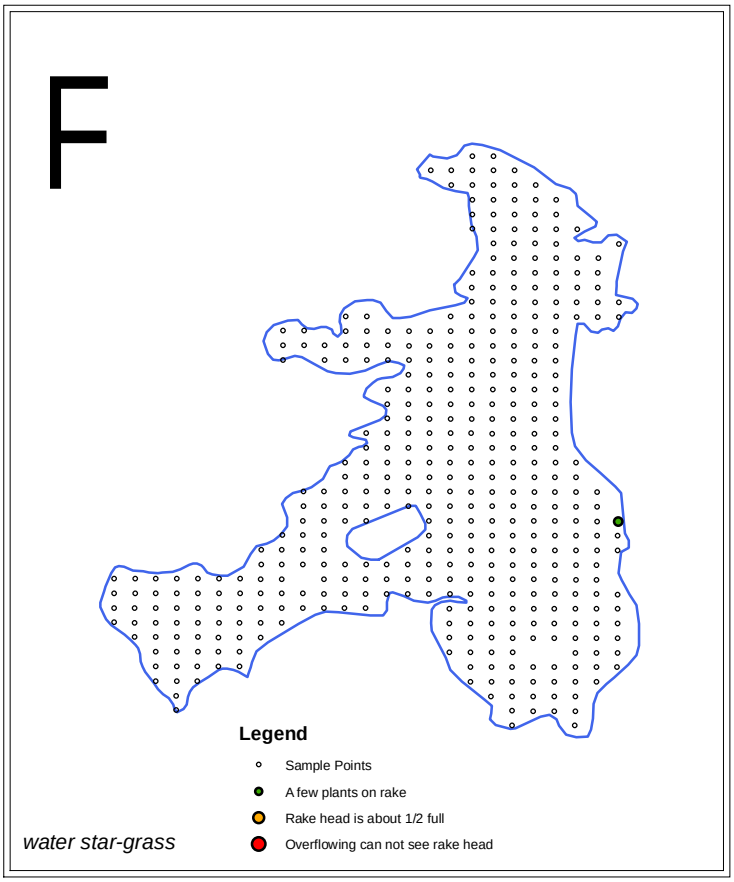
AQUATIC PLANT DISTRIBUTION MAP

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo







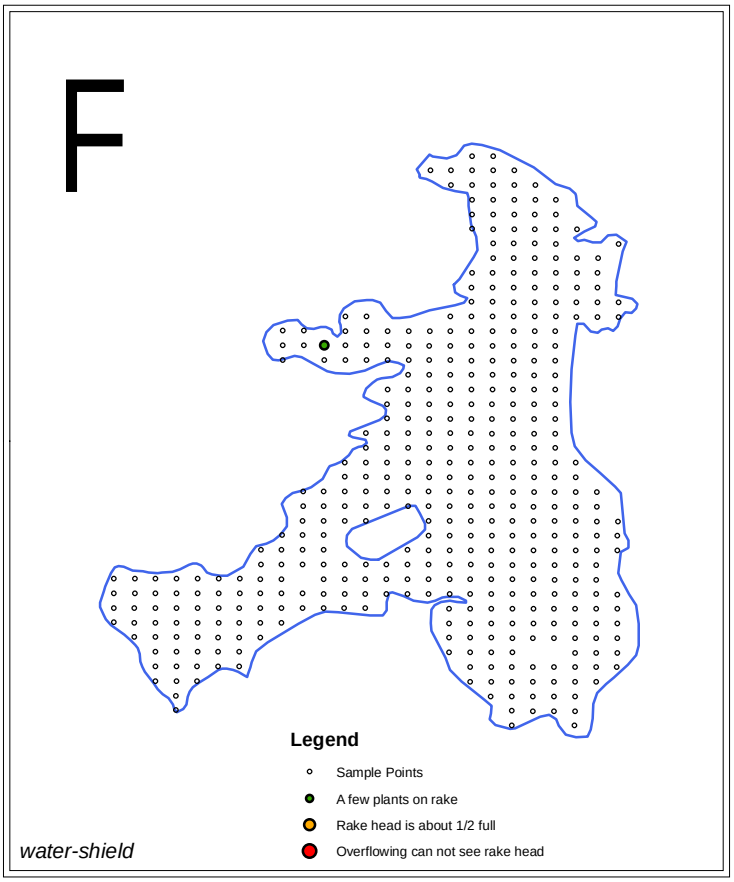
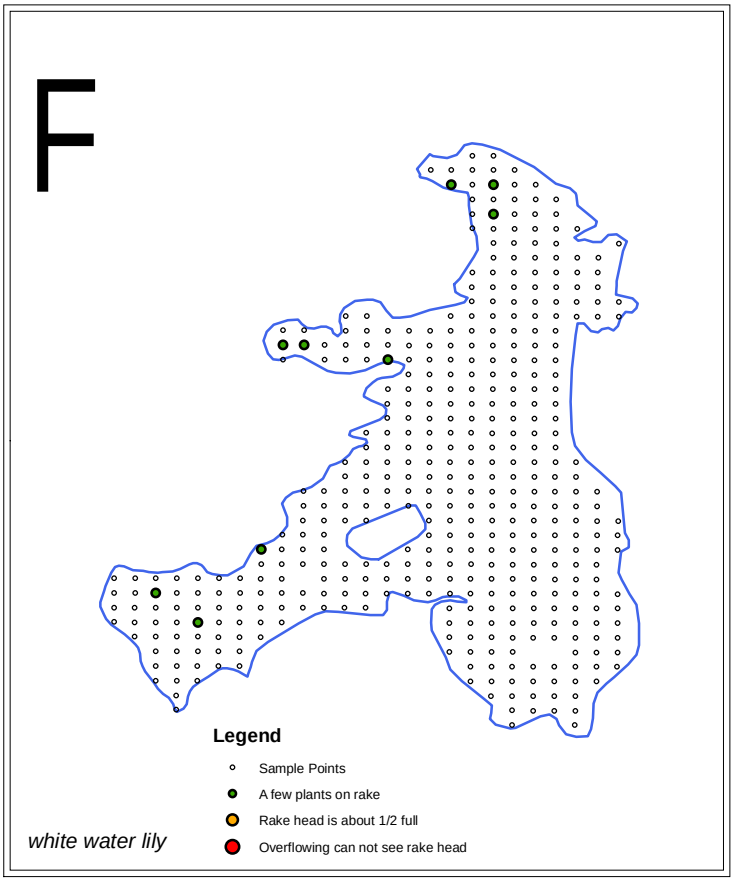


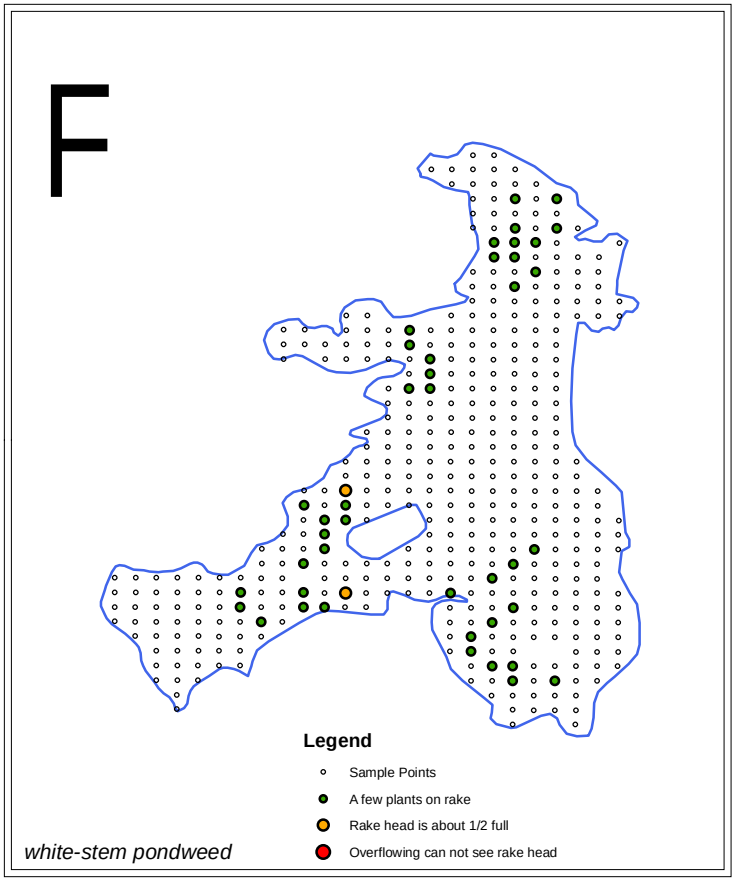
FIGURE 4E

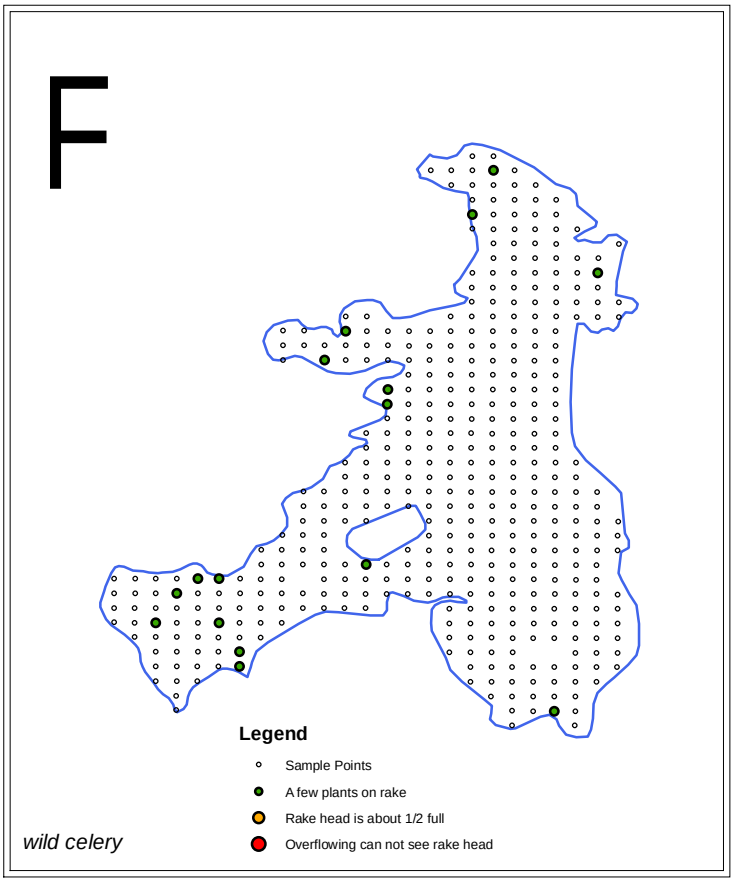
AQUATIC PLANT DISTRIBUTION MAP

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

Bonestroo





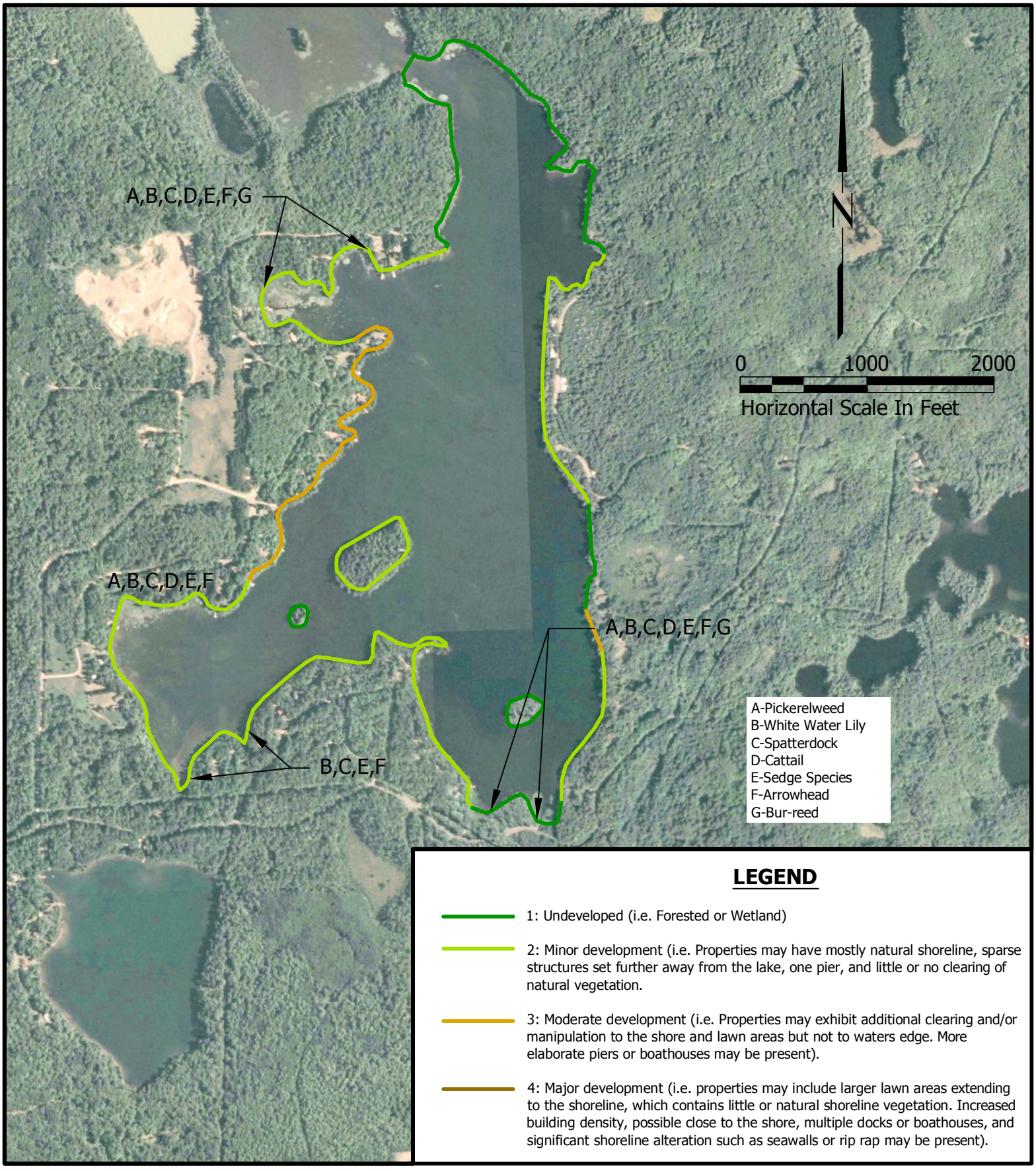


AQUATIC PLANT DISTRIBUTION MAP

VAN VILET LAKE
TOWN OF PRESQUE ISLE - PITLC
VILAS COUNTY, WISCONSIN

FIGURE 4F

Bonestroo



SHORELINE CHARACTERIZATION

TOWN OF PRESQUE ISLE

FIGURE: 5

VAN VLIET LAKE, VILAS COUNTY, WISCONSIN

Bonestroo

P:\4010\4010090020\CAD\DWG\VAN VLIET FIGURE 5.DWG

4010-090020

Tables

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

Genus	Species	ID	Common Name	Category
Bidens	*beckii*	1	Water marigold	Submersed
Brasenia	*schreberi*	2	Watershield	Floating-leaf
Ceratophyllum	*demersum*	3	Coontail	Submersed
Chara	*sp.*	4	Muskgrass	Submersed
Eleocharis	*palustris*	5	Creeping spikerush	Emergent
Elodea	*canadensis*	6	Common waterweed*	Submersed
Elodea	*nuttalli*	7	Slender waterweed*	Submersed
Heternathera	*dubia*	8	Water star-grass	Submersed
Myriophyllum	*heterophyllum*	9	Various-leaved water-milfoil	Submersed
Myriophyllum	*sibiricum*	10	Northern water-milfoil	Submersed
Najas	*flexilis*	11	Slender naiad	Submersed
Nymphaea	*odorata*	12	White water lily	Floating-leaf
Potamogeton	*amplifolius*	13	Large-leaf pondweed	Submersed
Potamogeton	*illinoensis*	14	Illinois pondweed	Submersed
Potamogeton	*praelongus*	15	White-stem pondweed	Submersed
Potamogeton	*pusillus*	16	Small pondweed	Submersed
Potamogeton	*richardsonii*	17	Clasping-leaf pondweed	Submersed
Potamogeton	*robbinsii*	18	Fern pondweed	Submersed
Potamogeton	*zosteriformis*	19	Flat-stem pondweed	Submersed
Sagittaria	*cristata*	20	Crested arrowhead	Emergent
Schoenoplectus	*subterminalis*	21	Water bulrush	Submersed
Stuckenia	*pectinata*	22	Sago pondweed	Submersed
Vallisneria	*americana*	23	Wild celery	Submersed

** - Though both E. nuttali & E. canadensis are likely present, E. nuttali was collected & vouchered*

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

Aquatic Plant Community Statistics	2008
Frequency of occurrence at sites shallower than maximum depth of plants	88.64%
Simpson Diversity Index	0.85
Maximum Depth of Plants (Feet)	18
Taxonomic Richness (Number Taxa)	23
Average Number of Species per Site (sites less than max depth of plant growth)	2.61
Average Number of Species per Site (sites with vegetation)	3.05
Average Number of NATIVE Species per Site (sites less than max depth of plant growth)	2.61
Average Number of NATIVE Species per Site (sites with vegetation)	3.05

Table 3: 2008 Aquatic Plant Taxa-Specific Statistics, Van Vliet 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
Bidens	*beckii*	Water marigold	1.39	1.23	0.46	5	1
Brasenia	*schreberi*	Watershield	0.28	0.25	0.09	1	1
Ceratophyllum	*demersum*	Coontail	61.56	54.57	20.18	221	1
Chara	*sp.*	Muskgrass	1.67	1.48	0.55	6	1
Eleocharis	*palustris*	Creeping spikerush	0.56	0.49	0.20	2	1
Elodea	*canadensis*	Common waterweed*	53.07	46.91	17.30	190	1
Elodea	*nuttalli*	Slender waterweed*	0.28	0.25	0.09	1	1
Heternathera	*dubia*	Water star-grass	0.28	0.25	0.09	1	1
Myriophyllum	*heterophyllum*	Various-leaved water-milfoil	2.23	1.98	0.73	8	1
Myriophyllum	*sibiricum*	Northern water-milfoil	11.14	9.88	3.65	40	1
Najas	*flexilis*	Slender naiad	1.67	1.48	0.55	6	1
Nymphaea	*odorata*	White water lily	2.51	2.22	0.82	9	1
Potamogeton	*amplifolius*	Large-leaf pondweed	2.51	2.22	0.82	9	1
Potamogeton	*illinoensis*	Illinois pondweed	8.64	7.65	2.83	31	1
Potamogeton	*praelongus*	White-stem pondweed	12.26	10.86	4.02	44	1
Potamogeton	*pusillus*	Small pondweed	3.90	3.46	1.28	14	1
Potamogeton	*richardsonii*	Clasping-leaf pondweed	11.14	9.88	3.65	40	1
Potamogeton	*robbinsii*	Fern pondweed	69.36	61.48	22.74	249	1
Potamogeton	*zosteriformis*	Flat-stem pondweed	52.09	46.17	17.08	187	1
Sagittaria	*cristata*	Crested arrowhead	0.56	0.49	0.18	2	1
Schoenoplectus	*subterminalis*	Water bulrush	1.11	0.99	0.37	4	1
Stuckenia	*pectinata*	Sago pondweed	2.79	2.47	0.91	10	1
Vallisneria	*americana*	Wild celery	4.46	3.95	1.46	16	1

* - Though both E. nuttali & E. canadensis are likely present, E. nuttali was collected & vouchered

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

Genus	Species	Common Name	Coefficient of Conservatism C
Bidens	*beckii*	Water marigold	8
Brasenia	*schreberi*	Watershield	6
Ceratophyllum	*demersum*	Coontail	3
Chara	*sp.*	Muskgrass	7
Eleocharis	*palustris*	Creeping spikerush	6
Elodea	*canadensis*	Common waterweed*	3
Elodea	*nuttalli*	Slender waterweed*	7
Heternathera	*dubia*	Water star-grass	6
Myriophyllum	*heterophyllum*	Various-leaved water-milfoil	7
Myriophyllum	*sibiricum*	Northern water-milfoil	6
Najas	*flexilis*	Slender naiad	6
Nymphaea	*odorata*	White water lily	6
Potamogeton	*amplifolius*	Large-leaf pondweed	7
Potamogeton	*illinoensis*	Illinois pondweed	6
Potamogeton	*praelongus*	White-stem pondweed	8
Potamogeton	*pusillus*	Small pondweed	7
Potamogeton	*richardsonii*	Clasping-leaf pondweed	5
Potamogeton	*robbinsii*	Fern pondweed	8
Potamogeton	*zosteriformis*	Flat-stem pondweed	6
Sagittaria	*cristata*	Crested arrowhead	9
Schoenoplectus	*subterminalis*	Water bulrush	9
Stuckenia	*pectinata*	Sago pondweed	3
Vallisneria	*americana*	Wild celery	6

** - Though both E. nuttali & E. canadensis are likely present, E. nuttali was collected & vouchered*

N 23
Mean C 6.304347826
Floristic Quality Index (FQI) 30.23459004

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.

Appendices

Appendix A - Point Intercept Sample Coordinates

Point ID	Latitude	Longitude
1	46.18911	-89.7669
2	46.18952	-89.7669
3	46.18994	-89.7669
4	46.19036	-89.7669
5	46.18869	-89.7663
6	46.18911	-89.7663
7	46.18952	-89.7663
8	46.18994	-89.7663
9	46.19035	-89.7663
10	46.18744	-89.7657
11	46.18786	-89.7657
12	46.18827	-89.7657
13	46.18869	-89.7657
14	46.1891	-89.7657
15	46.18952	-89.7657
16	46.18994	-89.7657
17	46.19035	-89.7657
18	46.1866	-89.7651
19	46.18702	-89.7651
20	46.18744	-89.7651
21	46.18785	-89.7651
22	46.18827	-89.7651
23	46.18869	-89.7651
24	46.1891	-89.7651
25	46.18952	-89.7651
26	46.18994	-89.7651
27	46.19035	-89.7651
28	46.18744	-89.7645
29	46.18785	-89.7645
30	46.18827	-89.7645
31	46.18869	-89.7645
32	46.1891	-89.7645
33	46.18952	-89.7645
34	46.18993	-89.7645
35	46.19035	-89.7645
36	46.18785	-89.7639
37	46.18827	-89.7639
38	46.18868	-89.7639
39	46.1891	-89.7639
40	46.18952	-89.7639
41	46.18993	-89.7639
42	46.19035	-89.7639
43	46.18785	-89.7633
44	46.18827	-89.7633
45	46.18868	-89.7633
46	46.1891	-89.7633
47	46.18952	-89.7633
48	46.18993	-89.7633
49	46.19035	-89.7633
50	46.18868	-89.7627
51	46.1891	-89.7627
52	46.18951	-89.7627
53	46.18993	-89.7627
54	46.19035	-89.7627
55	46.19076	-89.7627
56	46.19118	-89.7627
57	46.1891	-89.7621
58	46.18951	-89.7621
59	46.18993	-89.7621
60	46.19035	-89.7621
61	46.19076	-89.7621
62	46.19118	-89.7621
63	46.19159	-89.7621
64	46.19659	-89.7621
65	46.19701	-89.7621
66	46.19742	-89.7621
67	46.18951	-89.7615
68	46.18993	-89.7615
69	46.19076	-89.7615
70	46.19118	-89.7615
71	46.19159	-89.7615
72	46.19201	-89.7615
73	46.19243	-89.7615
74	46.19284	-89.7615
75	46.19701	-89.7615
76	46.19742	-89.7615
77	46.18951	-89.7609
78	46.18993	-89.7609
79	46.19034	-89.7609
80	46.19076	-89.7609
81	46.19118	-89.7609
82	46.19159	-89.7609
83	46.19201	-89.7609
84	46.19242	-89.7609
85	46.19284	-89.7609
86	46.19659	-89.7609
87	46.197	-89.7609
88	46.18951	-89.7603
89	46.18993	-89.7603
90	46.19034	-89.7603
91	46.19076	-89.7603
92	46.19201	-89.7603
93	46.19242	-89.7603
94	46.19284	-89.7603
95	46.19326	-89.7603
96	46.19367	-89.7603
97	46.19659	-89.7603
98	46.197	-89.7603
99	46.19742	-89.7603
100	46.19784	-89.7603
101	46.18951	-89.7597
102	46.18992	-89.7597

Point ID	Latitude	Longitude
103	46.19034	-89.7597
104	46.19076	-89.7597
105	46.19201	-89.7597
106	46.19242	-89.7597
107	46.19284	-89.7597
108	46.19325	-89.7597
109	46.19367	-89.7597
110	46.19409	-89.7597
111	46.1945	-89.7597
112	46.19659	-89.7597
113	46.197	-89.7597
114	46.19742	-89.7597
115	46.19783	-89.7597
116	46.18992	-89.7591
117	46.19034	-89.7591
118	46.19076	-89.7591
119	46.19242	-89.7591
120	46.19284	-89.7591
121	46.19325	-89.7591
122	46.19367	-89.7591
123	46.19409	-89.7591
124	46.1945	-89.7591
125	46.19492	-89.7591
126	46.19534	-89.7591
127	46.19575	-89.7591
128	46.19658	-89.7591
129	46.197	-89.7591
130	46.19742	-89.7591
131	46.18992	-89.7585
132	46.19034	-89.7585
133	46.19075	-89.7585
134	46.19117	-89.7585
135	46.19242	-89.7585
136	46.19284	-89.7585
137	46.19325	-89.7585
138	46.19367	-89.7585
139	46.19408	-89.7585
140	46.1945	-89.7585
141	46.19492	-89.7585
142	46.19533	-89.7585
143	46.19575	-89.7585
144	46.19617	-89.7585
145	46.19658	-89.7585
146	46.197	-89.7585
147	46.19742	-89.7585
148	46.18992	-89.7579
149	46.19034	-89.7579
150	46.19075	-89.7579
151	46.19117	-89.7579
152	46.19159	-89.7579
153	46.192	-89.7579
154	46.19242	-89.7579
155	46.19283	-89.7579
156	46.19325	-89.7579
157	46.19367	-89.7579
158	46.19408	-89.7579
159	46.1945	-89.7579
160	46.19492	-89.7579
161	46.19533	-89.7579
162	46.19575	-89.7579
163	46.19617	-89.7579
164	46.19658	-89.7579
165	46.197	-89.7579
166	46.19741	-89.7579
167	46.20199	-89.7578
168	46.18825	-89.7573
169	46.18867	-89.7573
170	46.18909	-89.7573
171	46.1895	-89.7573
172	46.18992	-89.7573
173	46.19034	-89.7573
174	46.19075	-89.7573
175	46.19117	-89.7573
176	46.19158	-89.7573
177	46.192	-89.7573
178	46.19242	-89.7573
179	46.19283	-89.7573
180	46.19325	-89.7573
181	46.19367	-89.7573
182	46.19408	-89.7573
183	46.1945	-89.7573
184	46.19492	-89.7573
185	46.19533	-89.7573
186	46.19575	-89.7573
187	46.19616	-89.7573
188	46.19658	-89.7573
189	46.197	-89.7573
190	46.19741	-89.7573
191	46.19783	-89.7573
192	46.20158	-89.7572
193	46.20199	-89.7572
194	46.18742	-89.7567
195	46.18784	-89.7567
196	46.18825	-89.7567
197	46.18867	-89.7567
198	46.18909	-89.7567
199	46.1895	-89.7567
200	46.18992	-89.7567
201	46.19033	-89.7567
202	46.19075	-89.7567
203	46.19117	-89.7567
204	46.19158	-89.7567
205	46.192	-89.7567
206	46.19242	-89.7567

Point ID	Latitude	Longitude
207	46.19283	-89.7567
208	46.19325	-89.7567
209	46.19366	-89.7567
210	46.19408	-89.7567
211	46.1945	-89.7567
212	46.19491	-89.7567
213	46.19533	-89.7567
214	46.19575	-89.7567
215	46.19616	-89.7567
216	46.19658	-89.7567
217	46.197	-89.7567
218	46.19741	-89.7567
219	46.19783	-89.7567
220	46.19824	-89.7567
221	46.19866	-89.7567
222	46.19908	-89.7567
223	46.20033	-89.7567
224	46.20074	-89.7567
225	46.20116	-89.7567
226	46.20157	-89.7566
227	46.20199	-89.7566
228	46.20241	-89.7566
229	46.187	-89.7561
230	46.18742	-89.7561
231	46.18783	-89.7561
232	46.18825	-89.7561
233	46.18867	-89.7561
234	46.18908	-89.7561
235	46.1895	-89.7561
236	46.18992	-89.7561
237	46.19033	-89.7561
238	46.19075	-89.7561
239	46.19117	-89.7561
240	46.19158	-89.7561
241	46.192	-89.7561
242	46.19241	-89.7561
243	46.19283	-89.7561
244	46.19325	-89.7561
245	46.19366	-89.7561
246	46.19408	-89.7561
247	46.1945	-89.7561
248	46.19491	-89.7561
249	46.19533	-89.7561
250	46.19575	-89.7561
251	46.19616	-89.7561
252	46.19658	-89.7561
253	46.19699	-89.7561
254	46.19741	-89.7561
255	46.19783	-89.7561
256	46.19824	-89.7561
257	46.19866	-89.7561
258	46.19908	-89.7561
259	46.19949	-89.7561
260	46.19991	-89.7561
261	46.20032	-89.7561
262	46.20074	-89.7561
263	46.20116	-89.7561
264	46.20157	-89.756
265	46.20199	-89.756
266	46.20241	-89.756
267	46.18617	-89.7555
268	46.18658	-89.7555
269	46.187	-89.7555
270	46.18742	-89.7555
271	46.18783	-89.7555
272	46.18825	-89.7555
273	46.18867	-89.7555
274	46.18908	-89.7555
275	46.1895	-89.7555
276	46.18992	-89.7555
277	46.19033	-89.7555
278	46.19075	-89.7555
279	46.19116	-89.7555
280	46.19158	-89.7555
281	46.192	-89.7555
282	46.19241	-89.7555
283	46.19283	-89.7555
284	46.19325	-89.7555
285	46.19366	-89.7555
286	46.19408	-89.7555
287	46.19449	-89.7555
288	46.19491	-89.7555
289	46.19533	-89.7555
290	46.19574	-89.7555
291	46.19616	-89.7555
292	46.19658	-89.7555
293	46.19699	-89.7555
294	46.19741	-89.7555
295	46.19783	-89.7555
296	46.19824	-89.7555
297	46.19866	-89.7555
298	46.19907	-89.7555
299	46.19949	-89.7555
300	46.19991	-89.7555
301	46.20032	-89.7555
302	46.20074	-89.7555
303	46.20116	-89.7555
304	46.20157	-89.7554
305	46.20199	-89.7554
306	46.18658	-89.7549
307	46.187	-89.7549
308	46.18742	-89.7549
309	46.18783	-89.7549
310	46.18867	-89.7549

Point ID	Latitude	Longitude
311	46.18908	-89.7549
312	46.1895	-89.7549
313	46.18991	-89.7549
314	46.19033	-89.7549
315	46.19075	-89.7549
316	46.19116	-89.7549
317	46.19158	-89.7549
318	46.192	-89.7549
319	46.19241	-89.7549
320	46.19283	-89.7549
321	46.19324	-89.7549
322	46.19366	-89.7549
323	46.19408	-89.7549
324	46.19449	-89.7549
325	46.19491	-89.7549
326	46.19533	-89.7549
327	46.19574	-89.7549
328	46.19616	-89.7549
329	46.19658	-89.7549
330	46.19699	-89.7549
331	46.19741	-89.7549
332	46.19782	-89.7549
333	46.19824	-89.7549
334	46.19866	-89.7549
335	46.19907	-89.7549
336	46.19949	-89.7549
337	46.19991	-89.7549
338	46.20032	-89.7549
339	46.20074	-89.7549
340	46.20115	-89.7549
341	46.20157	-89.7548
342	46.18658	-89.7543
343	46.187	-89.7543
344	46.18741	-89.7543
345	46.18783	-89.7543
346	46.18866	-89.7543
347	46.18908	-89.7543
348	46.1895	-89.7543
349	46.18991	-89.7543
350	46.19033	-89.7543
351	46.19075	-89.7543
352	46.19116	-89.7543
353	46.19158	-89.7543
354	46.19199	-89.7543
355	46.19241	-89.7543
356	46.19283	-89.7543
357	46.19324	-89.7543
358	46.19366	-89.7543
359	46.19408	-89.7543
360	46.19449	-89.7543
361	46.19491	-89.7543
362	46.19532	-89.7543
363	46.19574	-89.7543
364	46.19616	-89.7543
365	46.19657	-89.7543
366	46.19699	-89.7543
367	46.19741	-89.7543
368	46.19782	-89.7543
369	46.19824	-89.7543
370	46.19866	-89.7543
371	46.19907	-89.7543
372	46.19949	-89.7543
373	46.1999	-89.7543
374	46.20032	-89.7543
375	46.20074	-89.7543
376	46.20115	-89.7543
377	46.18616	-89.7537
378	46.18658	-89.7537
379	46.187	-89.7537
380	46.18741	-89.7537
381	46.18783	-89.7537
382	46.18825	-89.7537
383	46.18866	-89.7537
384	46.18908	-89.7537
385	46.1895	-89.7537
386	46.18991	-89.7537
387	46.19033	-89.7537
388	46.19074	-89.7537
389	46.19116	-89.7537
390	46.19158	-89.7537
391	46.19199	-89.7537
392	46.19241	-89.7537
393	46.19283	-89.7537
394	46.19324	-89.7537
395	46.19366	-89.7537
396	46.19782	-89.7537
397	46.19824	-89.7537
398	46.19865	-89.7537
399	46.19907	-89.7537
400	46.19949	-89.7537
401	46.20032	-89.7537
402	46.18741	-89.7531
403	46.18783	-89.7531
404	46.18824	-89.7531
405	46.18866	-89.7531
406	46.18908	-89.7531
407	46.18949	-89.7531
408	46.18991	-89.7531
409	46.19033	-89.7531
410	46.19074	-89.7531
411	46.19116	-89.7531
412	46.19158	-89.7531
413	46.19199	-89.7531
414	46.19241	-89.7531

Point ID	Latitude	Longitude
415	46.19282	-89.7531
416	46.19782	-89.7531
417	46.19824	-89.7531
418	46.19865	-89.7531
419	46.19907	-89.7531
420	46.19949	-89.7531
421	46.18783	-89.7525
422	46.18824	-89.7525
423	46.18866	-89.7525
424	46.18908	-89.7525
425	46.18949	-89.7525
426	46.18991	-89.7525
427	46.19116	-89.7525
428	46.19157	-89.7525
429	46.19199	-89.7525
430	46.19782	-89.7525
431	46.19824	-89.7525
432	46.1999	-89.7525

Point ID	Latitude	Longitude

Appendix B – Importance of Aquatic Plants to Lake Ecosystem

Bonestroo

AQUATIC PLANT TYPES AND HABITAT

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

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

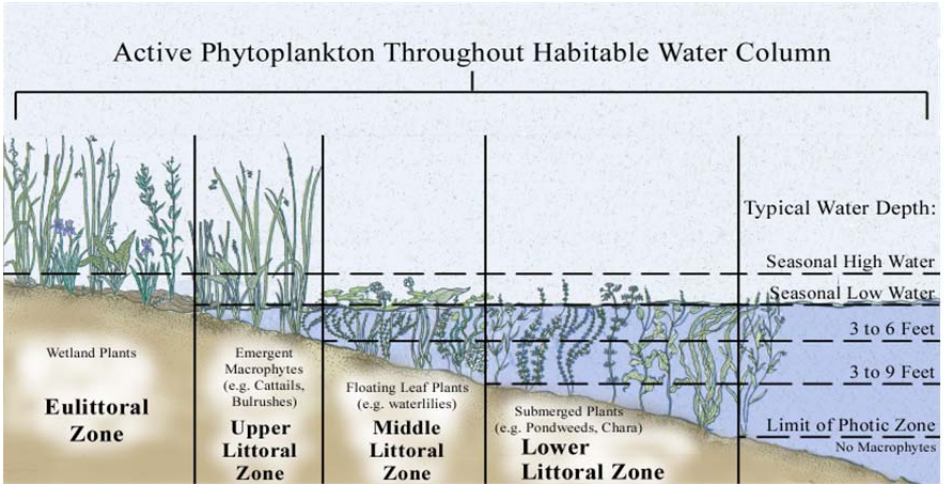
Eulittoral Zone: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

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

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

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

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



Aquatic Plant Communities Schematic

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

AQUATIC PLANTS AND WATER QUALITY

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

In general, 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

Bonestroo

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

Free-Floating Plants

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

Floating-Leaf Plants

Brasenia schreberi (Watershield) has floating leaves with elastic stems with the leaf stalk attaching to the middle of the leaves. All submersed portions of the plant are usually covered with a gelatinous coating. Watershield is commonly identified by the lack of a leaf notch and the central location of the petiole. Watershield is most commonly found growing in soft sediments that contain partially decomposed organic matter. The seeds, leaves, stem and buds are a source of food by waterfowl. The floating leaves also offer shelter and shade for fish and invertebrates (Borman, et al., 1997). Watershield is a sensitive aquatic plant this is not tolerant of pollutants and adverse human impacts to the lake ecosystem (Nichols, 1999).

Watershield
Source: University of Florida Website

White Water Lily
Source: UW Herbarium Website

Nymphaea odorata (White Water Lily) has a flexible stalk with a round floating leaf. White Water Lily can be found growing in a variety of sediment types in less than 6 feet of water. Fragrant white flowers occur throughout the summer. The floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

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

Coontail
Source: UW Herbarium Website

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

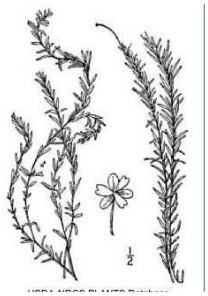
Chara, sp. (Muskgrass / Chara) looks like a vascular plant; it actually is a multi-celled alga (macroalgae). Muskgrass is usually found in hard waters and prefers muddy or sandy substrate and can often be found in deeper water than other submergent plants. Muskgrass beds provide valuable habitat for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

Chara sp.
Source: UW Herbarium Website

Elodea
Source: UW Herbarium Website

Elodea canadensis (Elodea or common waterweed) is an abundant native plant species that is distributed statewide. It prefers soft substrate and water depths to 15 feet (Nichols, 1999). Elodea reproduces by seed and sprigs (USDA, 2002). The stems of elodea offer shelter and grazing to fish, but very dense elodea can interfere with fish movement. Elodea can be considered invasive at times and out-competes other more desirable plants.

Elodea nuttalli (slender waterweed) is usually small leaved and delicate compared to E. canadensis. E. nuttalli is branching with bright green stems usually 40 inches in length. It is found in quiet waters in fine sediment soils (Nichols, 1999).



Slender waterweed
Source: UW Herbarium Website

Heterantha dubia (Water stargrass) is a submergent aquatic plant with freely-branched flattened stems and long narrow leaves. The plant is found growing to 3 meters, has no substrate preference, and is turbidity tolerant (Nichols, 1999). Water stargrass is often mistaken for Flat-Stem Pondweed (*Potamogeton zosteriformis*), however can be e distinguished by its prominent mid-vein and many fine, parallel veins.

Bidens beckii (Watermarigold) has submersed leaves that are finely divided into thread-like divisions. This plant also produces aerial leaves that are lance-shaped and toothed. When blooming, the yellow flower is similar in appearance to a daisy. Water marigold is found mainly in shallower water, but can be found up to 10 feet deep in soft-sediment areas. The submerged leaves provide shade and shelter for fish (Borman, et al., 1997).

Water marigold
Source: UW Herbarium Website

Myriophyllum heterophyllum (Various-leaved watermilfoil) has stems that emerge from a hardy rootstalk. The leaves are divided like a feather, with a short stalk and about 7-10 pairs of thread-like leaflets. Most of the leaves are arranged in whorls. The whorls are closely spaced, usually less than 10 mm apart. Similar species are dwarf watermilfoil (*Myriophyllum tenellum*). They can be differentiated by the size of the plant and has greatly reduced leaves. Various-leaved watermilfoil can also be confused with four other species of watermilfoils with whorled leaves, Northern watermilfoil (*Myriophyllum sibiricum*), Eurasian watermilfoil (*Myriophyllum spicatum*), alternate flowered watermilfoil (*Myriophyllum alterniflorum*) and whorled watermilfoil (*Myriophyllum verticillatum*).

Various-leaved watermilfoil
Source: University of Florida Website

Northern watermilfoil
Source: UW Herbarium Website

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

Najas flexilis (slender naiad) has fine branched stems that emerge from a slight rootstalk. Slender Naiad can grow in both shallow and deep water. Waterfowl, marsh birds, and muskrats consume the stems, leaves, and seeds of naiad. The foliage produces forage and shelter opportunities for fish and invertebrates (Borman, et al., 1997).

Slender Naiad
Source: UW Herbarium Website

Large-leaf Pondweed
Source: UW Herbarium Website

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

Potamogeton illinoensis (Illinois Pondweed) has stout stems that emerge from thick rhizomes. Most of the submersed leaves are lance-shaped to oval and either attach directly to the stem or have a short stalk. The leaves often have a sharp, needle like tip. Floating leaves which have a thick stalk and ellipse shaped blade are sometimes produced. Illinois pondweed is usually found in water with moderate to high pH and fairly good water clarity. The fruit produced by Illinois pondweed can be locally important to ducks and geese. The plant may also be grazed by muskrat, deer and beaver. This pondweed also offers excellent shade and cover for fish and good surface area for invertebrates.

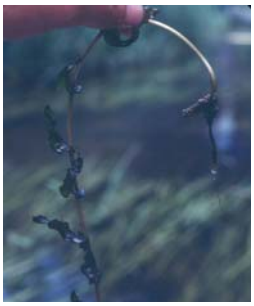
Illinois Pondweed
Source: University of Florida Website

White-stem Pondweed
Source: UW Herbarium Website

Potamogeton praelongis (White-stem Pondweed) has zigzag stems. Submersed leaves are lance to oval shaped and clasp the stem. The leaves have strong veins and the tip of the leaf is boat-shaped and splits when pressed, creating a notch at the end of the leaf. White stem pondweed is usually found in soft sediment in water ranging from 3-15 feet deep and found in lakes with good water clarity. Fruit of white pondweed provides a valuable razing opportunity for ducks and geese. White stem pondweed is considered a good food producer and valuable habitat for muskellunge.

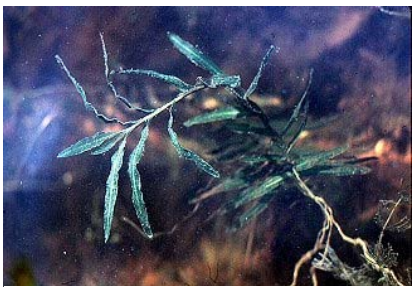
Potamogeton pusillus (Small Pondweed) has small slender stems, and branches repeatedly near its ends. There is some limited reproduction by seed. Small pondweed can be locally important as a food source for a variety of wildlife. Waterfowl feed on small pondweed as well as deer, muskrat, and some small fish (Borman, et al., 1997).

Small Pondweed
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).

Potamogeton robbinsii (Fern Pondweed) is a submergent pondweed with robust stems and strongly two-ranked leaves, creating a feather or fern-like appearance while in the water. Fern pondweed sprouts in the spring and thrive in deeper water. Fern pondweed provides habitat for invertebrates that are grazed by waterfowl and also offers good cover for fish, particularly northern pike (Borman, et al., 1997).

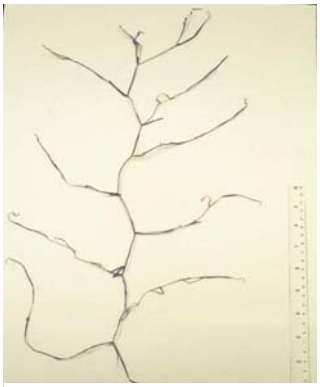

Fern Pondweed
Source: UW Herbarium Website

Flat- Stem Pondweed
Source: UW Herbarium Website

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

Water Bulrush
Source: UW Herbarium Website

Schoenoplectus subterminalis (Water bulrush) is the most truly aquatic bulrush in our region with only the tips of fertile stems poking out of the water. Stems develop from a fine rhizome. Slender, limp stem float in the water along with hair-like leaves that arise near the base. Submersed leaves of water bulrush could be confused with the fine, submersed stems of Robbins spikerush (*Eleocharis robbinsii*). However, the leaf-like stems of Robbins spikerush are all separate, while the leaves of water bulrush sheath each other at the base. Grass-like meadows of water bulrush provide invertebrate habitat and shelter for fish (Borman, et al., 1997).



Sago Pondweed
Source: UW Herbarium Website

Stuckenia pectinata (Sago Pondweed) resembles two other pondweeds with needle-like leaves, but sago pondweed tends to be much more common. The fruit and tubers of sago pondweed are very important food sources for waterfowl, while leaves and stems provide shelter for small fish and invertebrates (Borman, et al., 1997).

Vallisneria americana (Wild Celery) also known as eel-grass or tape-grass, and has ribbon-like leaves that tend to grow until they emerge in clusters along the waters surface. Wild celery is a premiere source of food for waterfowl. All portions of the plant are consumed. Beds of wild celery are also considered good fish habitat providing shade, shelter and feeding opportunities (Borman, et al., 1997).

Wild Celery
Source: UW Herbarium Website

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).

Eleocharis palustris (Creeping spikerush) has stems that rise either singly or in small clusters. Stems are topped with a spikelet that tapers to a point. Its shape resembles a burning match (Borman, et al., 1997). The spikelet is covered with scales. It prefers hard substrates (Nichols, 1999). The beds of this species provide food for a variety of waterfowl and helps anchor near shore sediments.

Creeping spikerush
Source: UW Herbarium Website

Pickerelweed
Source: James Scharl

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).

Sagittaria cristata (crested arrow-head) has slender leaves that emerge from a short dense rhizome. It is found in habitats from shallow shorelines to water depths up to 6 feet. It will grow in a variety of sediments and often forms extensive beds. Crested arrowhead has high wildlife value. It is consumed in some manner by waterfowl, shorebirds, muskrats, beavers and porcupines. (Borman, et al., 1997).

Crested arrow-head
Source: UW Herbarium Website

Bur-reed
Source: UW Herbarium Website

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 sediements. 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).

Typha sp. (Cattail) has pale green, sword-like leaves that are sheathed around one another at the base. Cattails can grow to nuisance levels, but do provide nesting habitat for many marsh birds and cover for small fish (Borman, et al., 1997).

Cattail
Source: UW Herbarium Website

Appendix E – Summary of Aquatic Plant Management Alternatives

Management Options for Aquatic Plants

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

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

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

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

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

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

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

h.	Lime slurry	Y	Applications of lime temporarily raise water pH, which limits the availablity of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP	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**
[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
[3]Broad-spectrum herbicide - Affects both monocots and dicots.
[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

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

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

Aquatic Plant Management

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

Physical Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Costs: Costs for a harvesting operation are highly variable 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 ecosytem. This method has the potential for significant reductions in aquatic plant growth. These methods can be completed in "off season" months avoiding interference with summer recreation activities.

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

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

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

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

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

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

Chemical Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Biological Controls

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

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

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

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

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

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

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

Appendix F – NR 107 and NR 109 Wisconsin Administrative Code

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

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 labelers with the Wisconsin department of agriculture, trade and consumer protection. Chemical management shall be allowed in a manner consistent with sound ecosystem management and shall minimize the loss of ecological values in the water body.

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

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

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

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

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

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

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

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

Note: The DNR district headquarters are located at:

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

(2) The application shall be accompanied by:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

a. The applicant will conduct a public informational meeting in a location near the water body when a combination of 5 or more individuals, organizations, special units of government, or local units of government request the meeting in writing to the applicant

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

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-

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;

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

(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.**

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

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.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the

shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30–foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

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

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

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

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

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

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

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

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

Note: Scientific collectors permit requirements are still applicable.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

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

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

(g) An education and information strategy.

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

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

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

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

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

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

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

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

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

Appendix G – Resource for Additional Information

Online References for More Information

General Information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Aquatic Invasive Species

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

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

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

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

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

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

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

Grants

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

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

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

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

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

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

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

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

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 WNDR 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.

Appendix I – Dissolved Oxygen and Temperature Readings

Date	Depth	Water Temp (F)	D/O (mg/l)
5/26/1994	1	66	---
5/26/1994	3	64	---
5/26/1994	6	63	---
5/26/1994	9	60	---
5/26/1994	15	58	---
5/26/1994	22	57	---
5/26/1994	25	55	---
6/27/1994	1	74	---
6/27/1994	3	72	---
6/27/1994	6	70	---
6/27/1994	9	69	---
6/27/1994	15	65	---
6/27/1994	20	63	---
7/24/1994	1	75	---
7/24/1994	3	74	---
7/24/1994	6	71	---
7/24/1994	9	66	---
7/24/1994	15	65	---
7/24/1994	20	64	---
8/28/1994	1	68	---
8/28/1994	3	68	---
8/28/1994	6	67	---
8/28/1994	9	66	---
8/28/1994	15	65	---
8/28/1994	20	64	---
11/14/1994	1	44	---
11/14/1994	3	43	---
11/14/1994	6	43	---
11/14/1994	9	42	---
11/14/1994	15	42	---
11/14/1994	20	41	---
5/25/2003	3	60	---
5/25/2003	6	60	---
5/25/2003	9	59.7	---
5/25/2003	12	59.3	---
5/25/2003	15	59.3	---
5/25/2003	18	58.8	---
5/25/2003	21	55.7	---
6/11/2003	0	75	---
6/11/2003	3	70.8	---
6/11/2003	6	69.2	---
6/11/2003	9	68	---
6/11/2003	12	65.8	---
6/11/2003	15	63.1	---
6/11/2003	18	62	---
6/11/2003	21	61.5	---
7/12/2003	3	71.6	---
7/12/2003	6	71.4	---
7/12/2003	9	71.2	---
7/12/2003	12	70.1	---
7/12/2003	15	67.4	---
7/12/2003	18	65.1	---
7/12/2003	21	60.2	---

Date	Depth	Water Temp (F)	D/O (mg/l)
6/15/2004	3	69.2	---
6/15/2004	6	67.8	---
6/15/2004	9	67.4	---
6/15/2004	12	66	---
6/15/2004	15	65.3	---
6/15/2004	18	64.4	---
6/15/2004	21	63.6	---
6/29/2004	0	66.7	---
6/29/2004	3	65.4	---
6/29/2004	6	65.3	---
6/29/2004	9	65.1	---
6/29/2004	12	63.8	---
6/29/2004	15	63.3	---
6/29/2004	18	63.1	---
6/29/2004	21	62.9	---
7/15/2004	3	71.9	5.75
7/15/2004	6	71.6	6.59
7/15/2004	9	71	7.30
7/15/2004	12	66.2	10.32
7/15/2004	15	64.7	6.23
7/15/2004	18	64.2	12.17
7/15/2004	21	63.5	9.47
8/29/2004	3	68.9	6.79
8/29/2004	6	68.7	6.80
8/29/2004	9	66.3	7.86
8/29/2004	12	65.6	7.66
8/29/2004	15	65.4	7.24
8/29/2004	18	64.4	9.82
8/29/2004	21	64	5.38
9/28/2004	3	65.6	7.29
9/28/2004	6	65.4	7.31
9/28/2004	9	65.3	6.96
9/28/2004	12	65.1	12.66
9/28/2004	15	64.5	7.36
9/28/2004	18	65.4	6.81
9/28/2004	21	63.3	7.20
5/24/2005	3	62.6	8.96
5/24/2005	6	62.4	9.11
5/24/2005	9	62.2	9.28
5/24/2005	12	62	8.77
5/24/2005	15	61.8	8.75
5/24/2005	18	61.7	9.15
5/24/2005	21	61.5	8.21
5/31/2005	3	58.4	8.33
5/31/2005	6	57.7	8.27
5/31/2005	9	57.3	8.20
5/31/2005	12	56.4	7.43
5/31/2005	15	55.7	6.18
5/31/2005	18	55.2	5.95
5/31/2005	21	53.6	2.58
6/16/2005	15	63.2	5.87
6/16/2005	18	62.8	0.20
6/16/2005	21	62.6	0.10

Date	Depth	Water Temp (F)	D/O (mg/l)
7/7/2005	3	61	6.11
7/7/2005	6	60.3	6.66
7/7/2005	9	58.2	5.66
7/7/2005	12	55.4	5.25
7/7/2005	15	70	5.16
7/7/2005	18	63	4.42
7/7/2005	21	59	0.18
7/19/2005	3	74	5.72
7/19/2005	6	73	5.71
7/19/2005	9	70.7	5.72
7/19/2005	12	70.6	5.26
7/19/2005	15	70.4	2.68
7/19/2005	18	70.2	0.40
7/19/2005	21	68.2	0.60
8/14/2005	3	79.1	5.38
8/14/2005	6	78.9	4.88
8/14/2005	9	77.8	5.02
8/14/2005	12	74	5.31
8/14/2005	15	71.8	5.24
8/14/2005	18	69.7	0.07
8/14/2005	21	67.5	0.09
10/16/2005	3	74	9.30
10/16/2005	6	74	9.29
10/16/2005	9	73.8	9.37
10/16/2005	12	73.8	9.34
10/16/2005	15	73.6	9.17
10/16/2005	18	72	9.47
10/16/2005	21	68.6	9.28
5/31/2006	3	54.1	8.21
5/31/2006	6	53.9	8.06
5/31/2006	9	53.8	9.41
5/31/2006	12	53.7	10.58
5/31/2006	15	53.4	9.47
5/31/2006	18	53.4	8.38
5/31/2006	21	53.3	5.55
6/30/2006	3	72	7.80
6/30/2006	6	71.8	7.91
6/30/2006	9	69.8	7.81
6/30/2006	12	62.5	7.78
6/30/2006	15	59.3	5.02
6/30/2006	18	57.9	1.76
6/30/2006	21	57.1	0.94
7/13/2006	3	72.9	7.68
7/13/2006	6	72.6	7.28
7/13/2006	9	71.8	7.46
7/13/2006	12	71.2	6.71
7/13/2006	15	70.2	4.91
7/13/2006	18	65.9	1.33
7/13/2006	21	60.4	1.01
8/15/2006	3	78.3	6.99
8/15/2006	6	76.5	6.85
8/15/2006	9	74.2	7.02
8/15/2006	12	73.4	7.04
8/15/2006	15	72.3	6.57
8/15/2006	18	70.7	6.33
8/15/2006	21	62.1	0.98

Date	Depth	Water Temp (F)	D/O (mg/l)
10/10/2006	3	72.9	9.37
10/10/2006	6	72.6	9.37
10/10/2006	9	72.5	9.38
10/10/2006	12	72.2	9.19
10/10/2006	15	72	9.00
10/10/2006	18	71.8	9.32
10/10/2006	21	64.9	9.12
5/11/2007	3	53.4	10.30
5/11/2007	6	53.4	10.28
5/11/2007	9	53.3	10.37
5/11/2007	12	53.2	10.28
5/11/2007	15	53.1	10.01
5/11/2007	18	53	10.12
5/11/2007	21	52.9	10.02
6/22/2007	3	72.9	12.27
6/22/2007	6	72.2	10.07
6/22/2007	9	72	10.59
6/22/2007	12	71.6	9.81
6/22/2007	15	68	9.69
6/22/2007	18	65.4	5.47
6/22/2007	21	63.6	5.41
7/18/2007	3	73.3	7.93
7/18/2007	6	70.8	7.73
7/18/2007	9	69.9	7.30
7/18/2007	12	69.1	5.76
7/18/2007	15	68.8	5.18
7/18/2007	18	68	1.89
7/18/2007	21	67.6	1.38
8/14/2007	3	75.3	7.05
8/14/2007	6	75.3	7.05
8/14/2007	9	75.2	6.98
8/14/2007	12	75.3	7.13
8/14/2007	15	75	6.76
8/14/2007	18	74.4	6.56
8/14/2007	21	70.3	1.92
9/24/2007	3	61.7	8.93
9/24/2007	6	61.7	8.93
9/24/2007	9	61.6	8.76
9/24/2007	12	61.6	8.76
9/24/2007	15	61.5	9.05
9/24/2007	18	61.5	9.05
9/24/2007	21	61.6	6.36
5/8/2008	3	51.3	11.93
5/8/2008	6	50.2	11.99
5/8/2008	9	50.1	12.01
5/8/2008	12	49.8	11.63
5/8/2008	15	48.9	11.23
5/8/2008	18	48.6	11.05
5/8/2008	21	48.4	10.76
6/19/2008	3	67	8.67
6/19/2008	6	66.9	8.68
6/19/2008	9	66.6	8.71
6/19/2008	12	66.1	8.58
6/19/2008	15	65.9	8.07
6/19/2008	18	65.6	7.40
6/19/2008	21	65	2.66

Date	Depth	Water Temp (F)	D/O (mg/l)
7/15/2008	1	71.5	8.05
7/15/2008	2	71.3	7.88
7/15/2008	3	71	7.86
7/15/2008	4	70.9	7.82
7/15/2008	5	70.7	7.67
7/15/2008	6	70.7	7.78
7/15/2008	7	70.7	7.57
7/15/2008	8	70.7	7.28
7/15/2008	9	70.2	7.41
7/15/2008	10	70.1	7.53
7/15/2008	11	69.7	7.43
7/15/2008	12	69.5	7.05
7/15/2008	13	69.1	6.83
7/15/2008	14	68.9	7.14
7/15/2008	15	68.9	5.78
7/15/2008	16	68.8	5.94
7/15/2008	17	68.6	5.79
7/15/2008	18	68.5	5.56
7/15/2008	19	67.9	1.5
7/15/2008	20	67.6	1.32
7/15/2008	21	67.6	1.28
7/16/2008	3	74.5	8.07
7/16/2008	6	73.2	8.26
7/16/2008	9	70.7	7.32
7/16/2008	12	70.2	5.77
7/16/2008	15	69.8	4.96
7/16/2008	18	69.5	3.20
7/16/2008	21	69.8	1.34
8/18/2008	3	74	9.00
8/18/2008	6	73.6	8.90
8/18/2008	9	73.1	8.80
8/18/2008	12	71.5	6.40
8/18/2008	15	71.2	4.97
8/18/2008	18	70.8	3.46
8/18/2008	21	67.3	0.13
5/4/2009	3	52.8	12.10
5/4/2009	6	52.7	12.00
5/4/2009	9	51.5	11.90
5/4/2009	12	49.7	12.70
5/4/2009	15	49.6	12.40
5/4/2009	18	49.1	12.10
5/4/2009	21	48.9	10.80
7/5/2009	3	69.9	9.67
7/5/2009	6	69.9	9.58
7/5/2009	9	69.5	9.81
7/5/2009	12	67.9	9.15
7/5/2009	15	65.2	6.90
7/5/2009	18	64.2	3.41
7/5/2009	21	63.9	2.43
7/23/2009	3	70	10.30
7/23/2009	6	69.4	9.86
7/23/2009	9	68.5	9.73
7/23/2009	12	67.1	8.24
7/23/2009	15	65.9	5.41
7/23/2009	18	65.6	3.05
7/23/2009	21	65.4	2.41

Date	Depth	Water Temp (F)	D/O (mg/l)
8/31/2009	3	64.4	8.49
8/31/2009	6	64.3	8.40
8/31/2009	9	64.2	9.05
8/31/2009	12	64.1	8.90
8/31/2009	15	64	8.60
8/31/2009	18	64	9.40
8/31/2009	21	63.9	7.70

Appendix J –Additional Information / Lake Resident Comments

ADDITIONAL INFORMATION / LAKE RESIDENT COMMENTS

Anecdotally, several long-time lake residents and have expressed observations-concerns on increased weed population change - growth.

1. "Weed growth within my bay has made fishing in many areas impossible. Certain areas are almost impassable. People continue to grind through these areas with motors at high rpm, scattering weed fragments in all directions." (Refers to the west side).

2. Growth of lilly pads in the bay has exploded in the last 3-4 years. Much of this has probably come about as a result of one individual cutting channels to their pier due to low water. Lilly pad fragments were scattered all over the bay and lake and probably reseeded (Refers to the west side).

These changes may or may not be due to several years of low water levels. The residents and the Board of the Van Vliet Lake Association do feel this is an area of concern and should be closely monitored and addressed in the future.