An Aquatic Vegetation Survey of Marshall Lake

Vilas County, Wisconsin

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Wisconsin Department of Natural Resources
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1.0 INTRODUCTION

Marshall Lake is an 87-acre drainage lake with a maximum depth of 17 feet. It is located within the Wisconsin River drainage basin northwest of the town of Conover in Vilas County. As determined from Secchi disk transparency data collected over the past 14 years, the lake has relatively high water clarity and can be classified as a mesotrophic system. However, in recent years, riparian property owners have expressed concerns regarding apparent increases in aquatic plant growth around the lake which is interfering with navigation and recreational activities.

In response to these concerns, in July 2010, Onterra ecologists conducted an aquatic plant point-intercept survey as described by the Wisconsin Department of Natural Resources Bureau of Science Services (PUB-SS-1068 2010) to not only characterize spatial distribution and abundance of the submersed aquatic plant species within Marshall Lake, but to determine if non-native, invasive aquatic plant species were causing the fore mentioned recreational interference. Detailed descriptions of the 2010 survey methods, data analysis and results are discussed in the following sections.

Aquatic Plants

Aquatic Plant Sampling Methodology and Data Analysis

Aquatic plants are an important element in every healthy aquatic ecosystem, and changes in these ecosystems are often first seen in the plant community. Whether these changes are positive, like variable water levels or negative, like increased shoreland development or the introduction of an exotic species, the plant community will respond. Plant communities respond in a variety of ways; there may be a loss of one or more species, certain life forms, such as emergents or floating-leaf communities may disappear from certain areas of the waterbody, or there may be a shift in plant dominance between species. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide very useful information for management decisions.

The aquatic plant survey that was completed on Marshall Lake assessed both native and potential non-native species in the system. A comprehensive survey of aquatic macrophytes was conducted to characterize the existing communities within the lake and include inventories of emergent, submergent, and floating-leaved aquatic plants within them. Specifically, the study was conducted in response to concerns brought about by the Marshall Lake stakeholders regarding over-abundant aquatic plant growth within Marshall Lake in recent years. The point-intercept method as described Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010 was used to complete this study in late July 2010. Based upon guidance from the WDNR, a point spacing of 36 meters was used resulting in 278 points (Map 1).

At each point-intercept location within the littoral zone, information regarding the depth, substrate type (muck, sand, or rock), and the plant species sampled along with their relative abundance on the sampling rake was recorded. A pole-mounted rake was used to collect the plant samples, depth, and sediment information at point locations of 14 feet or less. A rake head tied to a rope (rope rake) was used at sites greater than 14 feet. At locations sampled with a rope rake, depth information was collected with the onboard sonar unit and information regarding substrate type was not collected due to the inability of the sampler to *feel* the bottom.

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the species that were found within the lake, both exotic and native. The list also contains the life-form of each plant found, its scientific name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in life-forms that are present, can be an early indicator of changes in the health of the ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of this project, plant samples were collected from plots laid out on a grid that covered the entire system (Map 1). Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. In this section, two types of data are displayed: littoral frequency of occurrence and relative frequency of occurrence. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are less than the maximum depth of plant growth (littoral zone). Littoral frequency is displayed as a percentage.

Relative frequency of occurrence uses the littoral frequency for occurrence for each species compared to the sum of the littoral frequency of occurrence from all species. These values are presented in percentages and if all of the values were added up, they would equal 100%. For example, if water lily had a relative frequency of 0.1 and we described that value as a percentage, it would mean that water lily made up 10% of the population.

In the end, this analysis indicates the species that dominate the plant community within the lake. Shifts in dominant plants over time may indicate disturbances in the ecosystem. For instance, low water levels over several years may increase the occurrence of emergent species while decreasing the occurrence of floating-leaf species. Introductions of invasive exotic species may result in major shifts as they crowd out native plants within the system.

Species Diversity

Species diversity is probably the most misused value in ecology because it is often confused with species richness. Species richness is simply the number of species found within a system or community. Although these values are related, they are far from the same because diversity also takes into account how evenly the species are distributed within the system. A lake with 25 species may not be more diverse than a lake with 10 if the first lake is highly dominated by one or two species and the second lake has a more even distribution.

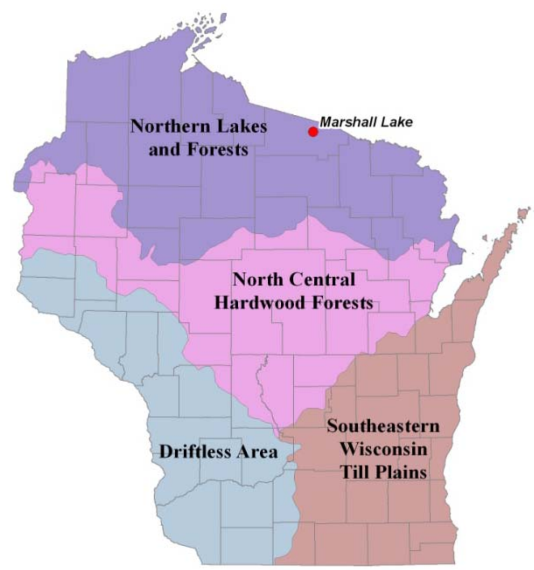


Figure 1. Location of Marshall Lake within the ecoregions of Wisconsin. After Nichols 1999.

A lake with high species diversity is much more stable than a system with a low diversity. This is analogous to a diverse financial portfolio in that a diverse aquatic plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. For example, a lake with a diverse plant community is much better suited to compete against exotic infestation than a lake with a lower diversity.

Floristic Quality Assessment

Floristic Quality Assessment (FQA) is used to evaluate the closeness of a lake's aquatic plant community to that of an undisturbed or pristine system. The higher the floristic quality, the closer the lake is to an undisturbed system. FQA is an excellent tool for comparing individual waterbodies and the same waterbody over time. In this section, the floristic quality of Marshall Lake will be compared to similar waterbodies within the same Wisconsin ecoregion in the state (Figure 1).

Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states.

As mentioned above, species richness is simply the number of species that occur in the waterbody; for this analysis, only native species are utilized. Average species conservatism utilizes the coefficient of conservatism values for each of those species in its calculation. A species coefficient of conservatism value indicates that the likelihood of a given species being found in an undisturbed (pristine) system. The values range from one to ten. Species that are normally found in disturbed systems have lower coefficients, while species frequently found in pristine systems have higher values. For example, cattail, an invasive native species, has a value of 1, while common hard and softstem bulrush have values of 5, and Oakes pondweed, a sensitive and rare species, has a value of 10. On their own, the species richness and average conservatism values are useful in assessing an aquatic ecosystem's plant community; however, the best assessment of the plant community's health is determined when the two values are used to calculate the floristic quality.

Exotic Plants

Because of their tendency to upset the natural balance of an aquatic ecosystem, exotic species are paid particular attention to during the aquatic plant surveys. Two exotics, curly-leaf pondweed and Eurasian water milfoil are the primary targets of this extra attention.

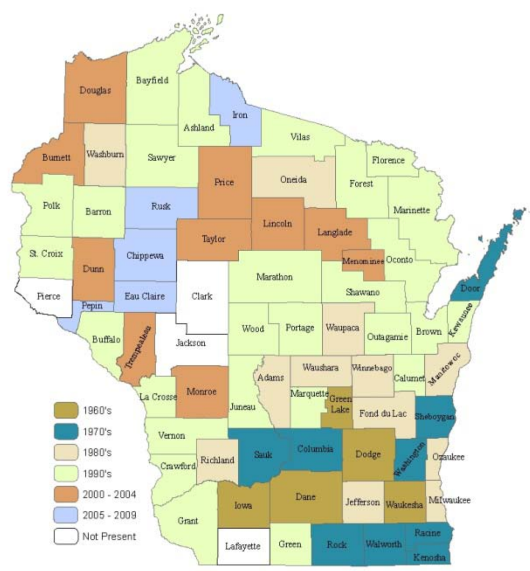


Figure 2. Spread of Eurasian water milfoil within WI counties. WDNR Data 2009 mapped by Onterra.

Eurasian water-milfoil is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties (Figure 2). Eurasian water-milfoil is unique in that its primary mode of propagation is not by seed. It actually spreads by shoot fragmentation, which has supported its transport between lakes and rivers via boats and other equipment. In addition to its propagation method, Eurasian water-milfoil has two other competitive advantages over native aquatic plants, 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian water-milfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly – leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced in early May, giving the plant a significant jump on native vegetation. Like Eurasian water-milfoil, curly-leaf pondweed can become so abundant that it hampers recreational activities within the waterbody. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.

Aquatic Plant Point-intercept Survey Results

The aquatic plant point-intercept survey began on July 14, 2010, and due to inclement weather, was completed on July 21, 2010 by Onterra. During the survey, 31 aquatic plant species were located; all of which are considered to be native species (Table 1). It is believed that exotic plant species do not occur in Marshall Lake at this time or exist at an undetectable level. Aquatic vegetation was found growing to the lake's maximum depth of 17 feet and is relatively evenly distributed across all depths (Figure 3). This indicates that the entire area of the lake supports aquatic plant growth. The relatively high water clarity in Marshall Lake allows light levels required for photosynthesis to penetrate to deeper depths and sustain aquatic vegetation.

Marshall Lake is highly vegetated, with approximately 83% of the 269 point-intercept sampling points visited containing aquatic vegetation. Along with high water clarity, the lake's substrate is also very conducive to supporting abundant plant growth. The vast majority (88%) of Marshall Lake's substrate is composed of fine organic matter, or muck (Map 2). Similar to terrestrial plants, most aquatic plant species favor this soft, nutrient-rich sediment, as courser substrates such as sand and gravel do not provide adequate nutrients. However, sandy substrates are often colonized by a collective group of small, rooted plants known as *isoetids*, which are slow-growing and rather inconspicuous. Four species of isoetids (lake quillwort, spiny-spored quillwort, water lobelia, and dwarf water milfoil) can be found growing in the shallow, sandy margins of Marshall Lake.

Figure 4 shows that of the 31 species located in Marshall Lake, the three most frequently encountered species were common waterweed, Griffith's pondweed, and northern water milfoil. Common waterweed, as its name suggests, is widespread in waterbodies throughout North America, and can often grow to densities that hamper navigation and recreational activities. Because it has the ability to attain essential nutrients directly from the water, common waterweed does not produce extensive root systems making it susceptible to uprooting by wave action and water movement. When this occurs, uprooted plants float and aggregate at the water's surface where they continue to grow and form dense mats. If they completely detach from the bottom, wind and water currents can carry these mats to shore.

Table 1. Aquatic plant species located on Marshall Lake during July point-intercept survey.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
Emergent	*Carex pseudocyperus*	Cypress-like sedge	8
	Dulichium arundinaceum	Three-way sedge	9
	Eleocharis palustris	Creeping spikerush	6
	Glyceria canadensis	Rattlesnake grass	7
	Iris versicolor	Northern blue flag	5
	Juncus alpinus	Northern green rush	6
	Sagittaria latifolia	Common arrowhead	3
FL	*Nuphar variegata*	Spatterdock	6
	Nymphaea odorata	White water lily	6
FL/E	*Sparganium emersum*	Short-stemmed bur-reed	8
Submergent	*Chara sp.*	Muskgrasses	7
	Ceratophyllum demersum	Coontail	3
	Elodea canadensis	Common waterweed	3
	Isoetes lacustris	Lake quillwort	8
	Isoetes echinospora	Spiny-spored quilwort	8
	Lobelia dortmanna	Water lobelia	10
	Myriophyllum tenellum	Dwarf water milfoil	10
	Myriophyllum sibiricum	Northern water milfoil	7
	Najas flexilis	Slender naiad	6
	Potamogeton pusillus	Small pondweed	7
	Potamogeton strictifolius	Stiff pondweed	8
	Potamogeton gramineus	Variable pondweed	7
	Potamogeton foliosus	Leafy pondweed	6
	Potamogeton natans	Floating-leaf pondweed	5
	Potamogeton robbinsii	Fern pondweed	8
	Potamogeton x griffithii	Griffith's pondweed	N/A
	Sagittaria sp. (rosette)	Arrowhead rosette	N/A
	Vallisneria americana	Wild celery	6
S/E	*Eleocharis acicularis*	Needle spikerush	5
	Juncus pelocarpus	Brown-fruited rush	8
	Sagittaria cuneata	Arum-leaved arrowhead	7

FL = Floating Leaf
FL/E = Floating Leaf and Emergent
S/E = Submergent and Emergent

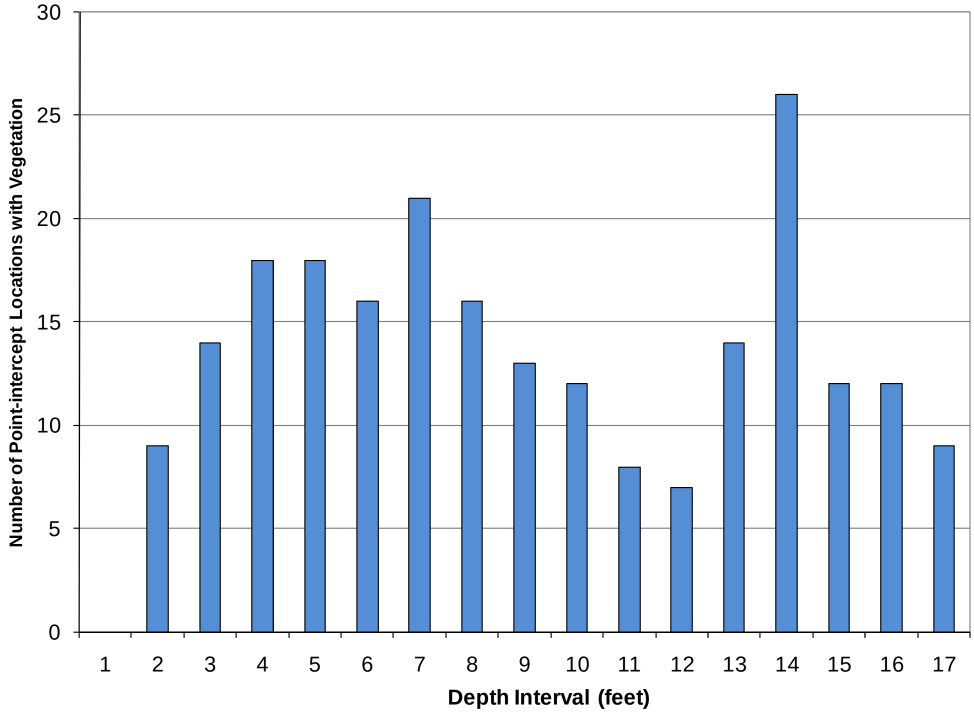


Figure 3. Marshall Lake aquatic plant distribution across littoral depths. Created using data from July 2010 survey.

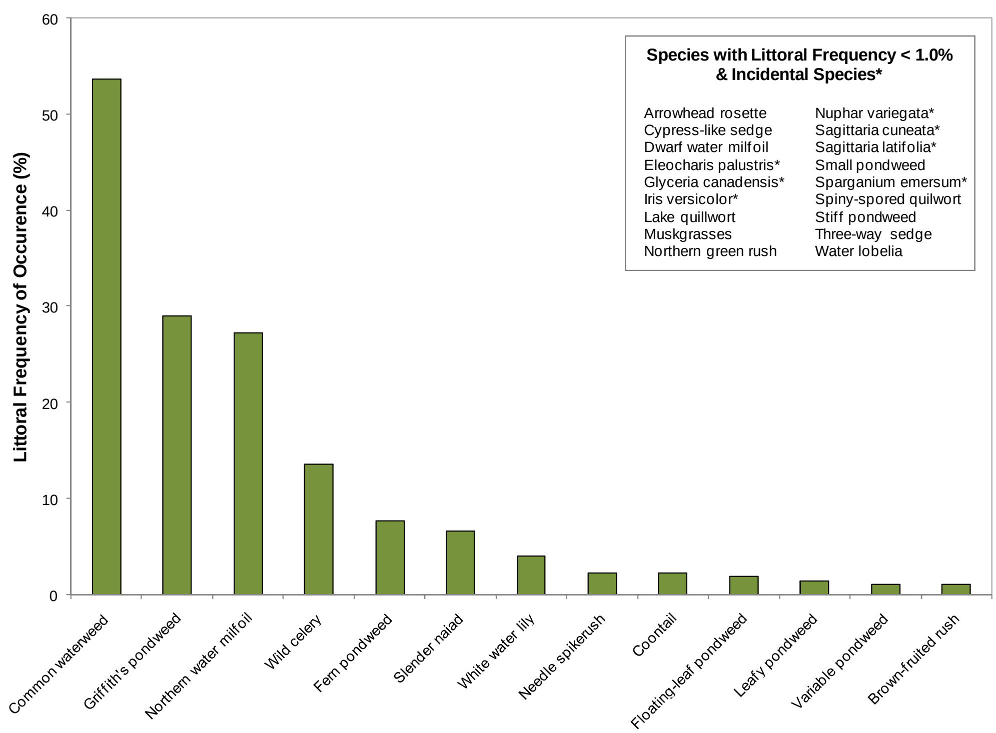


Figure 4. Marshall Lake aquatic plant littoral occurrence analysis. Created using data from July 2010 survey.

Photo 1. Griffith's pondweed (*Potamogeton* x *griffithii*) colony on Marshall Lake. Taken during July 2010 survey.

During the survey on Marshall Lake, a couple surface mats of common waterweed were observed in deeper water. Despite moderate winds, these mats did not change their locations within the lake and appeared to be held in place via a network of plants extending to the bottom. Figure 5a displays the point-intercept locations containing common waterweed, illustrating that the majority is located in the deeper areas of the lake between 12 and 16 feet. Aside from the observed surface mats, most of the common waterweed was growing on the bottom well below the surface.

The second-most common plant in Marshall Lake is Griffith's pondweed. Griffith's pondweed is a hybrid between two high-quality native species: alpine pondweed (*Potamogeton alpinus*) and white-stem pondweed (*Potamogeton praelongus*). Hybridization within the pondweed genus is believed to be relatively common, and the hybrid pondweed in Marshall Lake possesses morphological attributes of both parental species (Photo 1). No individuals of either of the parental species were located within the lake, meaning this plant entered Marshall Lake as a hybrid or is a relic from a time when both parental species existed in the lake. Large, dense colonies of this plant were observed growing at or near the water surface. The data show that this plant was most abundant in shallower waters around the lake, primarily between 4 and 8 feet (Figure 5b), almost forming a ring around the lake.

Northern water milfoil, arguably Wisconsin's most common native milfoil species, was fairly widespread in Marshall Lake (Figure 5c). This species does well in lakes with soft sediments and high water clarity. Northern water milfoil is often falsely identified as Eurasian water milfoil with its feather-like leaves and 'reddish' appearance observed in late summer as it reacts to sun exposure. Only one other milfoil species, dwarf water milfoil, was located in Marshall Lake. Dwarf water milfoil often inhabits areas of sand and is morphologically much different from northern water milfoil, resembling a miniature sprig of asparagus having leaves reduced to small scales that hug the stem.

Marshall Lake contains a high number of aquatic plant species (31). The high species richness found in the lake is well above the Northern Lakes and Forests Ecoregion and Wisconsin state medians (Figure 6). Because of this, one may assume that the lake also has high species diversity. However, as discussed earlier, species diversity is also influenced by how evenly the plant species are distributed within the community. The Simpson's diversity index for Marshall Lake's plant community (0.81) shows that the lake's plant community is moderately diverse. In other words, if two individual plants were randomly sampled from Marshall Lake's plant community, there would be an 81% probability that the two individuals would be of different species. Looking at the relative frequencies of aquatic plant species (Figure 7), approximately 78% if the lake's plant community is made up of only four species. The domination of the plant community by these four species contributes to the lake's moderate diversity value.

Figure 5. Marshall Lake point-intercept locations with (a) Common waterweed, (b) Griffith's pondweed, and (c) Northern water milfoil.

Data collected from the aquatic plant survey indicates that the average conservatism value is equal to the Northern Lakes and Forests ecoregion median and slightly higher than the state median (Figure 6). This signifies that Marshall Lake's plant community is of comparable quality to those of other lakes within the ecoregion, and of higher quality than most other lakes in the state. The plant community of Marshall Lake is composed of species that are considered to be tolerant of environmental disturbance, as well as species shown to be especially sensitive to disturbances such as water quality degradation.

Combining the lake's species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in an exceptionally high value of 37.1 (equation shown below); well above the median values of the state and ecoregion and further illustrating the quality of Marshall Lake's plant community.

$$\text{FQI} = \text{Average Coefficient of Conservatism (6.7)} * \sqrt{\text{Number of Native Species (31)}}$$
$$\text{FQI} = 37.1$$

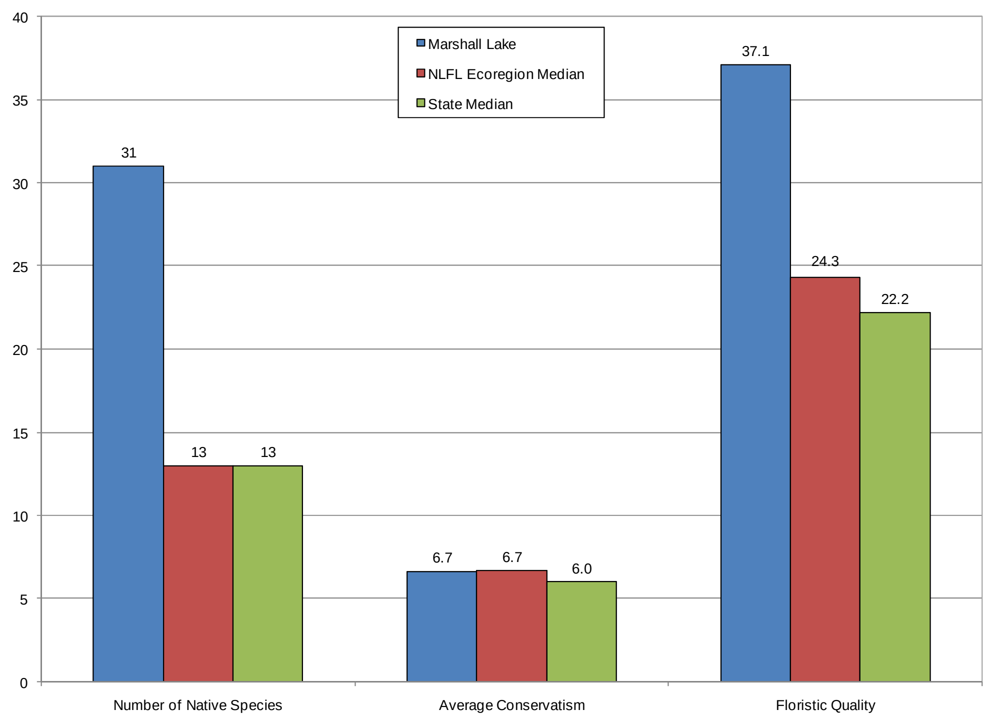


Figure 6. Marshall Lake floristic quality assessment. Created using data from July 2010 surveys. Analysis following Nichols (1999).

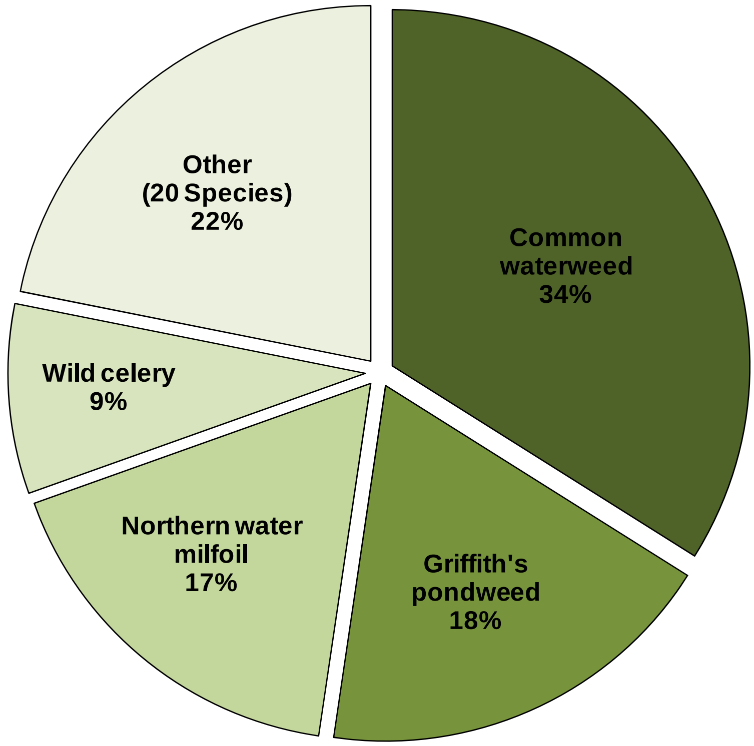


Figure 7. Marshall Lake aquatic plant relative occurrence analysis. Created using data from July 2010 survey.

SUMMARY AND CONCLUSIONS

The 2010 aquatic plant survey was conducted on Marshall Lake to ascertain if concerns regarding apparent increases in aquatic plant growth within the lake were being caused by non-native, invasive species. Fortunately, none were located within the lake during the survey and the lake supports a vibrant, high quality native plant community. However, this plant community is hindering navigation and recreational activities in certain areas. Although common waterweed is the most abundant plant within the lake, the vast majority was growing in deeper water below the surface. Aside from a couple areas of uprooted surface mats, this species does not appear to be the primary cause of recreational interference on Marshall Lake. The field crew conducting the survey did not run into any navigational issues while in the deeper areas of the lake.

However, navigation was more difficult in shallower areas near-shore and in the southern portion of the lake. These areas, mainly between 4 and 8 feet, were dominated by dense colonies of Griffith's pondweed. It appears that this pondweed is the primary cause of the conditions that are concerning lake stakeholders. The large colonies of this plant have not been observed by Onterra ecologists before, and little (if any) information is known on the ecology of hybridized pondweeds in terms of how they interact with the rest of the plant community.

Recent studies have indicated that hybrids from other aquatic plant genera, such as the naiads and water milfoils, can possess competitive advantages over other native species, often aggressively out-competing them (Les et al. 2010). Dr. Robert Freckmann, curator of the University of Wisconsin Stevens Point herbarium and one of the authorities on the flora of Wisconsin, has noted that reports of aggressive hybrid pondweeds have been increasing in recent years as intensity of field work and collection of specimens increases (Dr. Robert Freckmann personal comm.). Since this is the first vegetation survey conducted on Marshall Lake and no historical data exists for which to compare, it is not possible to conclude at this time whether or not this particular pondweed population is acting aggressively and/or increasing in occurrence. A repeat survey in the near future may reveal if this indeed is the case.

Aquatic vegetation can become more abundant with increasing concentrations of select nutrients that often originate from sources such as agricultural runoff or leaking septic systems. Increased nutrient inputs also spur greater algae growth within the water column, reducing water clarity. Roger Kerstner has been sampling water clarity via Secchi disk on Marshall Lake during the growing season almost continuously for the past 14 years. When these data are compiled, it shows that Marshall Lake's water clarity has remained relatively constant over this time period, with no apparent positive or negative trends (Figure 8). We can conclude from this data that increasing nutrient inputs to Marshall Lake are likely not occurring, and thus not the reason for the anecdotal increases in aquatic vegetation.

Marshall Lake, with its high water clarity and soft organic substrates, is prime habitat for supporting abundant aquatic plant growth. Fluctuations in aquatic vegetation abundance occur naturally over time with varying climatic conditions and water level variations. However, according to Marshall Lake stakeholders, water levels have remained stable over recent years. Climatic conditions governing ice-off, water temperature, light availability, precipitation, etc., all affect annual aquatic plant growth. For example, years with early ice-off provides aquatic plants with a prolonged growing season, and higher water temperatures favor more vigorous and rapid aquatic plant growth. Climatic conditions also can favor individual species of aquatic plants, and these species may increase in their occurrence over a given period of time while others may decrease.

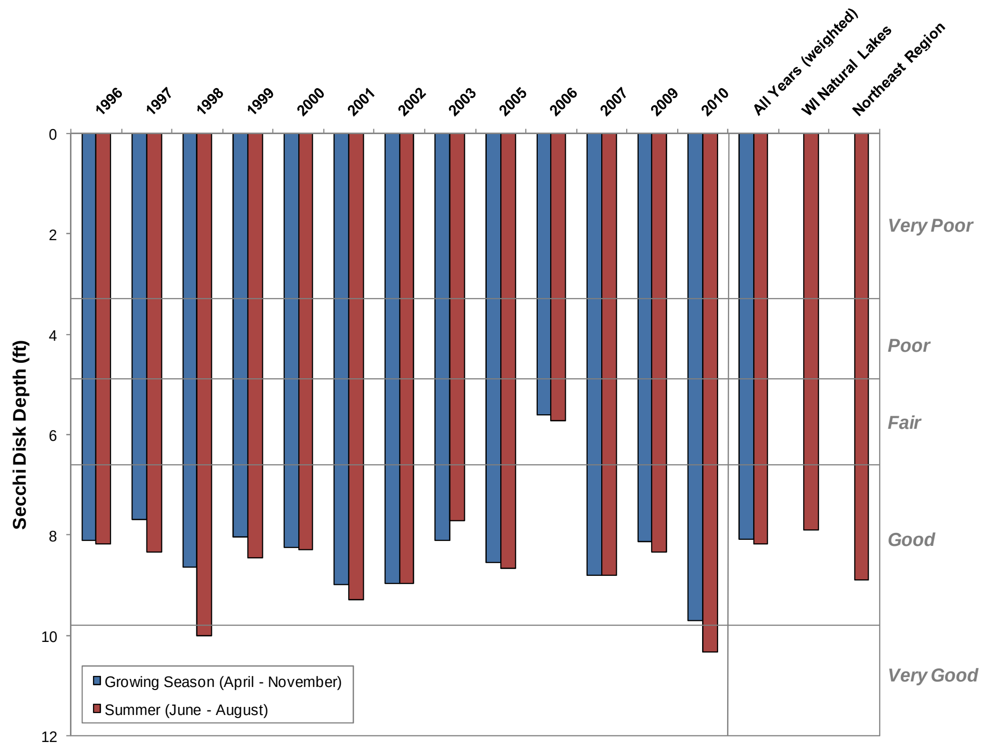


Figure 8. Marshall Lake, regional, and state Secchi disk clarity values. Marshall Lake data collected by Roger Kerstner (Marshall Lake stakeholder). Mean values calculated with summer month sample data. Water Quality Index values adapted from Lillie and Mason (1983).

Marshall Lake is a productive system with a moderately diverse plant community. This plant community, with a mosaic of species with differing morphological attributes, provides zooplankton, macroinvertebrates, fish, and other wildlife with diverse structural habitat and various sources of food. Lakes with a diverse plant community also have a higher resilience to environmental disturbances and greater resistance to invasion by non-native plants. Invasive species, if introduced to Marshall Lake, will have a more difficult time becoming established due to the abundance and competition from native flora.

However, if establishment of an invasive such as Eurasian water milfoil does occur, it will likely do very well in Marshall Lake. The navigational/recreational interferences experienced presently on Marshall Lake due to native species are minor when compared to a lake infested with Eurasian water milfoil. On lakes lacking public access, the responsibility of preventing invasive species introductions falls heavily on the property owners with private access points. It is their responsibility to make sure that boats/trailers and other equipment are free of plants, water, and sediment material before launching into Marshall Lake.

If the goal of Marshall Lake stakeholders is to facilitate access to open water areas of the lake, two possibilities exist: 1) manually remove the plants, and 2) contract to have the plants cut and removed through mechanical harvesting. The use of herbicides to control aquatic plant growth on Marshall Lake would likely not be permitted as the plants, including the hybrid pondweed, are native species and valuable components to the lake ecosystem. Herbicide application to control native plants is usually only permissible under very special circumstances when native aquatic plants severely restrict navigation. One of the main goals of the Aquatic Plant Management Strategy Northern Region WDNR (Appendix B) is to preserve native species and prevent openings for invasive species establishment.

Manual removal techniques are allowable to all riparians and do not require a permit if the area of plant removal is no more than 30 feet wide and any piers, boatlifts, swim rafts, and other recreational and water use devices are located within that 30 feet. While not applicable to Marshall Lake, please note that a permit is needed in all instances if wild rice is to be removed.

Mechanical harvesting is frequently used in some parts of Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. A typical mechanical harvesting plan would consist of creating navigation lanes (20-30 feet wide) that would allow riparians to have access to deeper parts of the system. Contracting a harvesting firm to conduct these actions carry significant costs and may not be feasible for lakes with limited access such as Marshall Lake. And while new technology has emerged, the equipment required for such activities is still quite large, bulky, and tends to be quite difficult to use on smaller lakes.

If manual removal techniques are able to alleviate the nuisance conditions, they should be utilized first and foremost. However, if this method provides incapable of reducing the nuisance conditions on the lake, a defined, WDNR-approved plan of management would need to be developed that outlines the goals and locations that mechanical harvesting methods would be implemented.

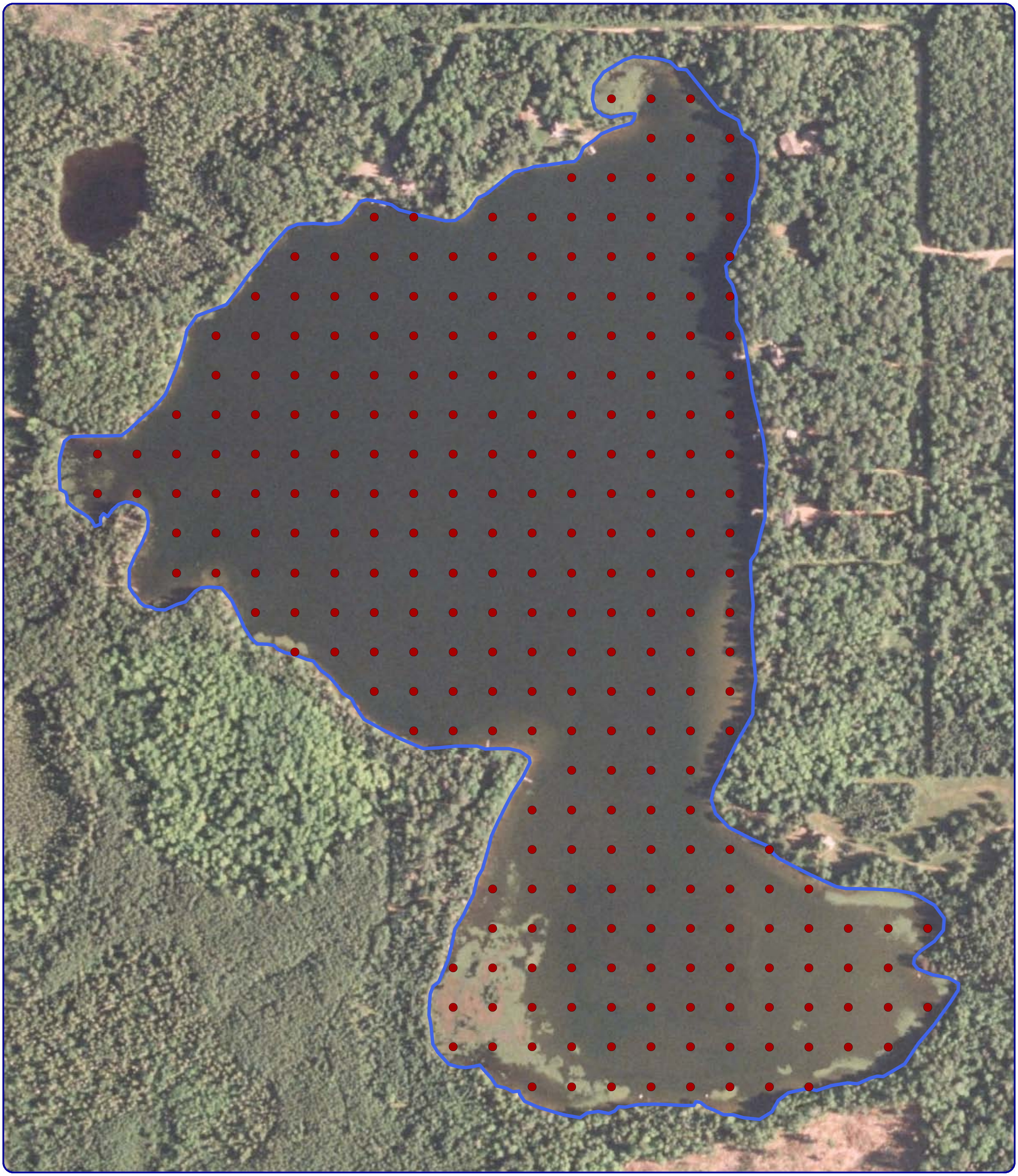
The last option not explored above is to not do anything. While this may seem unfavorable to many riparians, the conditions that are favoring the observed increased aquatic plant growth over the recent years may change and the associated conditions may subside on their own.

LITERATURE CITED

Hauxwell, J., Knight, S., Wagner, Mikulyuk, A., Nault, M., Porzky, M. and S. Chase. 2010. Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications. Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS-1068 2010. Madison, Wisconsin, USA.

Les, D.H., Sheldon, S.P., and Tippery, N.P. 2010. Hybridization in Hydrophiles: Natural Interspecific Hybrids in *Najas* (Hydrocharitaceae). Systematic Botany 35(4): 736-744.

Nichols, S.A. 1999. Floristic quality assessment of Wisconsin lake plant communities with example applications. Journal of Lake and Reservoir Management 15(2): 133-141



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Feet

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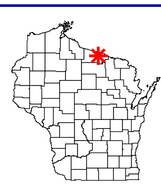
Sources:
Hydro: WDNR
Orthophotography: NAIP 2005
Aquatic Plant Survey: Onterra, 2010
Map Date: January 12, 2011
File Name: Marshall_2010_PointIntercept_Locations



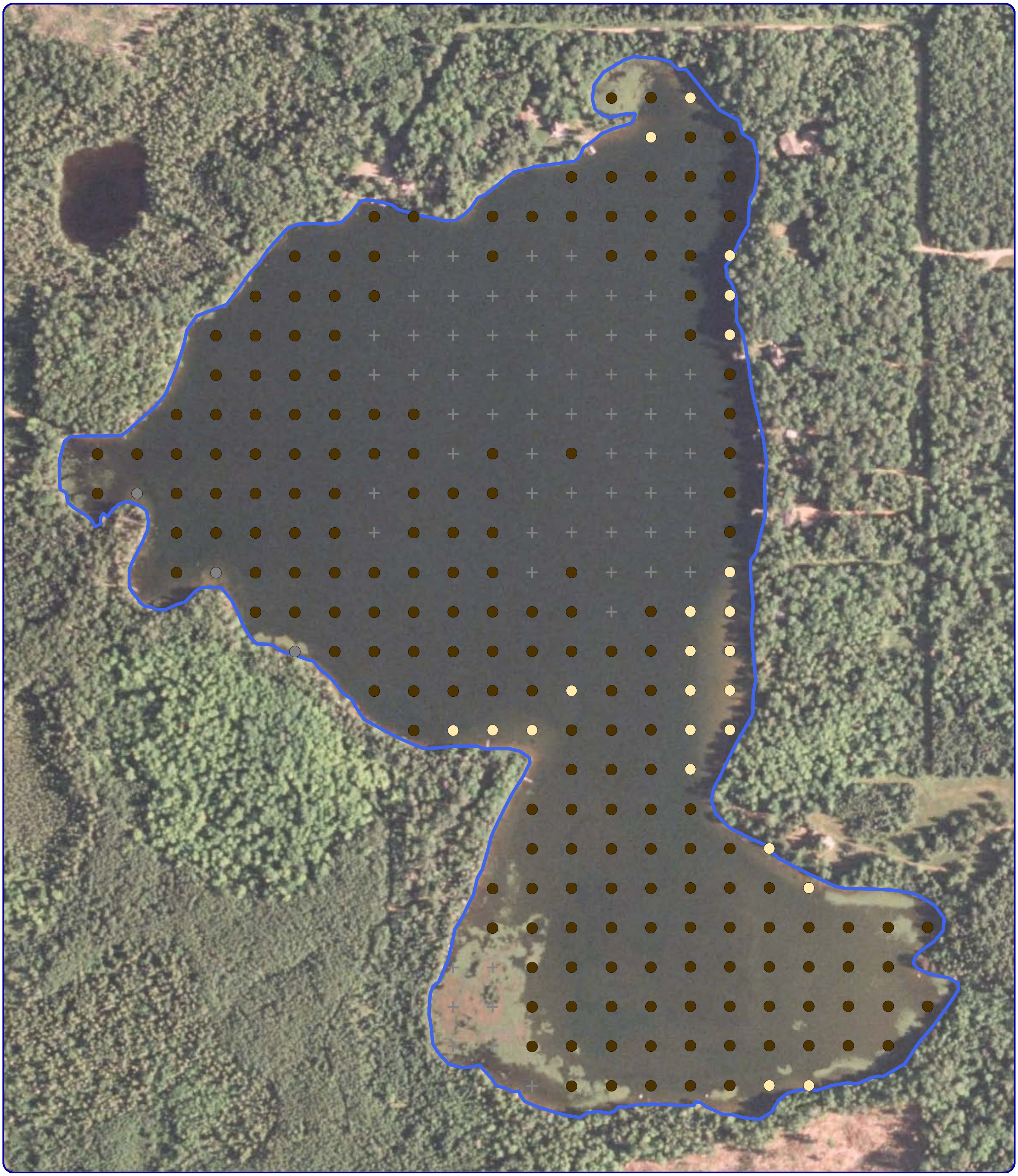
Project Location in Wisconsin

Legend

Marshall Lake ~ 87 acres
WDNR Definition

Point-intercept Survey Location
36-meter spacing, 278 total points

Map 1
Marshall Lake
Vilas County, Wisconsin
2010 Survey
Sampling Locations



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Sources:
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Orthophotography: NAIP 2005
Aquatic Plant Survey: Onterra, 2010
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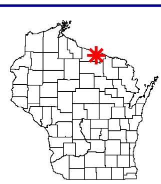

Project Location in Wisconsin

Legend

Sediment Types

- No Data (too deep or unreachable)
- Sand
- Muck
- Rock

Map 2
Marshall Lake
Vilas County, Wisconsin
2010 Survey
Sediment Types

A

APPENDIX A

Marshall Lake 2010 Aquatic Plant Survey Data

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Notes	Carex pseudocyperus	Ceratophyllum demersum	Chara sp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Isoetes echinospora	Isoetes lacustris	Juncus alpinus	Juncus pelocarpus	Lobelia dortmanna	Myriophyllum sibiricum	Myriophyllum tenellum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton strictifolius	Potamogeton x griffithii	Sagittaria sp. (rosette)	Vallisneria americana
1	46.094448	-89.356016	4	M	P							1												1						
2	46.094124	-89.356019	3	M	P							1									1									2
3	46.094445	-89.355550	6	M	P													1												
4	46.094121	-89.355554	2	R	P	No Vegetation																								
5	46.094767	-89.355080	10	M	P							1																		
6	46.094443	-89.355084	10	M	P							2																		
7	46.094119	-89.355088	8	M	P			1										1										1		
8	46.093795	-89.355092	6	M	P							1						1						1				1		
9	46.093471	-89.355096	6	M	P							1								1				1				1		
10	46.095412	-89.354607	7	M	P																							3		1
11	46.095088	-89.354611	8	M	P													1										1		
12	46.094764	-89.354615	9	M	P							2																		
13	46.094440	-89.354619	10	M	P							1						1										2		
14	46.094116	-89.354622	8	M	P																							3		
15	46.093792	-89.354626	8	M	P							1						1												
16	46.093468	-89.354630	2	R	P																									
17	46.095733	-89.354138	7	M	P							1														1		3		
18	46.095409	-89.354142	9	M	P																					1		2		
19	46.095085	-89.354145	13	M	P													1										1		
20	46.094761	-89.354149	10	M	P			3																						
21	46.094437	-89.354153	14	M	P							1																		
22	46.094113	-89.354157	12	M	P							1						1										1		1
23	46.093789	-89.354160	13	M	P													1												
24	46.093465	-89.354164	8	M	P													1												
25	46.093141	-89.354168	7	M	P							1						1										1		
26	46.096055	-89.353668	8	M	P							1						1										1		1
27	46.095731	-89.353672	14	M	P							1						1										1		1
28	46.095407	-89.353676	14	M	P							2																		
29	46.095083	-89.353680	14	M	P							3																		
30	46.094759	-89.353683	14	M	P							2																		
31	46.094435	-89.353687	13	M	P							2																		
32	46.094111	-89.353691	13	M	P							2																		
33	46.093787	-89.353695	11	M	P							1						1												
34	46.093463	-89.353699	7	M	P													1										3		
35	46.093139	-89.353702	7	M	P															1										1
36	46.092815	-89.353706	4	R	P						1			1			1		1	1	1	1								
37	46.096052	-89.353203	14	M	P							1						1												
38	46.095728	-89.353206	14	M	P	No Vegetation																								
39	46.095404	-89.353210	15	M	P							2																		

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Notes	Carex pseudocyperus	Ceratophyllum demersum	Chara sp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Isoetes echinospora	Isoetes lacustris	Juncus alpinus	Juncus pelocarpus	Lobelia dortmanna	Myriophyllum sibiricum	Myriophyllum tenellum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton strictifolius	Potamogeton x griffithii	Sagittaria sp. (rosette)	Vallisneria americana
40	46.095080	-89.353214	16	M	P							2																		
41	46.094756	-89.353218	15	M	P							3																		
42	46.094432	-89.353222	14	M	P	No Vegetation																								
43	46.094108	-89.353225	14	M	P							2																		
44	46.093784	-89.353229	14	M	P							2						1												
45	46.093460	-89.353233	8	M	P							1						1										1		2
46	46.093136	-89.353237	9	M	P							1						2												
47	46.092812	-89.353240	7	M	P													1										1		2
48	46.096373	-89.352733	6	M	P													2								2		1		1
49	46.096049	-89.352737	10	M	P							1																		
50	46.095725	-89.352741	14	M	P	No Vegetation																								
51	46.095401	-89.352744	15	M	R							2														1				
52	46.095077	-89.352748	14	M	R							2																		
53	46.094753	-89.352752	14	M	P	No Vegetation																								
54	46.094429	-89.352756	14	M	P							3																		
55	46.094105	-89.352760	14	M	R							3																		
56	46.093781	-89.352763	15	M	R							3						1												
57	46.093457	-89.352767	9	M	P							1						1												
58	46.093133	-89.352771	9	M	P							1						1										1		
59	46.092810	-89.352775	8	M	P																							2		
60	46.092486	-89.352779	7	M	P							1						1										2		
61	46.096371	-89.352267	8	M	P							3																		1
62	46.096047	-89.352271	14	M	R							3																		
63	46.095723	-89.352275	15	M	R							1																		
64	46.095399	-89.352279	16	M	R	No Vegetation																								
65	46.095075	-89.352283	16	M	R							1																		
66	46.094751	-89.352286	16	M	P							3																		
67	46.094427	-89.352290	15	M	P							1																		
68	46.094103	-89.352294	15	M	P	No Vegetation																								
69	46.093779	-89.352298	13	M	P							2																		
70	46.093455	-89.352302	15	M	P							2																		
71	46.093131	-89.352305	14	M	P							1																		
72	46.092807	-89.352309	10	M	P													1								1				
73	46.092483	-89.352313	8	M	P																							2		
74	46.092159	-89.352317	5	M	P															1								1		1
75	46.096044	-89.351805	16	M	R							2																		
76	46.095720	-89.351809	17	M	R							1																		
77	46.095396	-89.351813	16	M	R	No Vegetation																								
78	46.095072	-89.351817	15	M	R	No Vegetation																								

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79	46.094748	-89.351821	15	M	R	No Vegetation																								
80	46.094424	-89.351824	15	M	R							3																		
81	46.094100	-89.351828	12	M	P							1																		
82	46.093776	-89.351832	12	M	P							1						1												
83	46.093452	-89.351836	12	M	P							2						1												
84	46.093128	-89.351840	12	M	P							1																		
85	46.092804	-89.351843	9	M	P																							2		1
86	46.092480	-89.351847	7	M	P																					1		1		1
87	46.092156	-89.351851	5	S	P															1			1					1		1
88	46.090212	-89.351874				Unreachable																								
89	46.089888	-89.351878				Unreachable																								
90	46.089564	-89.351881				Unreachable																								
91	46.096365	-89.351336	8	M	P							1						1												1
92	46.096041	-89.351340	14	M	P							3																		1
93	46.095717	-89.351344	17	M	R													1												
94	46.095393	-89.351347	16	M	R	No Vegetation																								
95	46.095069	-89.351351	16	M	R							1																		
96	46.094746	-89.351355	14	M	R													2												
97	46.094422	-89.351359	13	M	P							3																		
98	46.094098	-89.351363	13	M	P							1						2												
99	46.093774	-89.351366	13	M	P							3																		
100	46.093450	-89.351370	13	M	P							3						1												
101	46.093126	-89.351374	12	M	P	No Vegetation																								
102	46.092802	-89.351378	9	M	P							2																		1
103	46.092478	-89.351382	8	M	P																							2		
104	46.092154	-89.351385	4	S	P						1	1						1												
105	46.090858	-89.351401	3	M	P																									1
106	46.090534	-89.351404	2	M	P															1				1						
107	46.090210	-89.351408				Unreachable																								
108	46.089886	-89.351412				Unreachable																								
109	46.089562	-89.351416				Unreachable																								
110	46.096363	-89.350870	10	M	P							1						1												2
111	46.096039	-89.350874	14	M	R							3																		
112	46.095715	-89.350878	17	M	R							1																		
113	46.095391	-89.350882	17	M	R							1																		
114	46.095067	-89.350886	16	M	R							1																		
115	46.094743	-89.350889	15	M	R	No Vegetation																								
116	46.094419	-89.350893	15	M	R	No Vegetation																								
117	46.094095	-89.350897	14	M	R			1				1						1												

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118	46.093771	-89.350901	14	M	R							3														1				
119	46.093447	-89.350904	13	M	R							1						1												
120	46.093123	-89.350908	12	M	P							2						1												
121	46.092799	-89.350912	10	M	P																							1		2
122	46.092475	-89.350916	7	M	P																							1		
123	46.092151	-89.350920	4	S	P							1						1										1		
124	46.091503	-89.350927	5	M	P	No Vegetation																								
125	46.091179	-89.350931	5	M	P															1										
126	46.090855	-89.350935	4	M	P															1										
127	46.090531	-89.350939	4	M	P													1		1										
128	46.090207	-89.350943	3	M	P																1									
129	46.089883	-89.350946	3	M	P	No Vegetation																								
130	46.089559	-89.350950	2	M	P																1									
131	46.089235	-89.350954	2	M	P															1					1			1		
132	46.096684	-89.350401	9	M	P							1													1			1		
133	46.096360	-89.350405	11	M	P							2						1												
134	46.096036	-89.350408	14	M	R							3																		
135	46.095712	-89.350412	17	M	R							2																		
136	46.095388	-89.350416	17	M	R							1																		
137	46.095064	-89.350420	17	M	R							1																		
138	46.094740	-89.350424	16	M	R							2																		
139	46.094416	-89.350427	16	M	R			1				1																1		
140	46.094092	-89.350431	15	M	R							1																		
141	46.093768	-89.350435	14	M	R			1				2																		
142	46.093444	-89.350439	13	M	P	No Vegetation																								
143	46.093120	-89.350443	9	M	P							1																		
144	46.092796	-89.350446	9	M	P							2						1										2		
145	46.092472	-89.350450	8	S	P																							1		1
146	46.092148	-89.350454	7	M	P																							1		
147	46.091824	-89.350458	7	M	P	No Vegetation																								
148	46.091500	-89.350462	7	M	P																							1		
149	46.091176	-89.350465	7	M	P																							2		
150	46.090852	-89.350469	7	M	P							2						1												
151	46.090528	-89.350473	5	M	P							1						1												
152	46.090204	-89.350477	5	M	P																							1		
153	46.089880	-89.350481	3	M	P	No Vegetation																								
154	46.089556	-89.350484	3	M	P													1			1									
155	46.089232	-89.350488	2	M	P													1			1		1							
156	46.097329	-89.349927	3	M	P																1					1				1

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157	46.096681	-89.349935	10	M	P							1						1												
158	46.096358	-89.349939	11	M	P													1												
159	46.096034	-89.349943	11	M	P	No Vegetation																								
160	46.095710	-89.349947	13	M	R							1																		
161	46.095386	-89.349950	16	M	R							2																		
162	46.095062	-89.349954	17	M	R							1																		
163	46.094738	-89.349958	17	M	R							1																		
164	46.094414	-89.349962	16	M	R	No Vegetation																								
165	46.094090	-89.349966	16	M	R	No Vegetation																								
166	46.093766	-89.349969	16	M	R							2																		
167	46.093442	-89.349973	15	M	R							3						1												
168	46.093118	-89.349977	13	M	R							1						2												
169	46.092794	-89.349981	10	M	P	No Vegetation																								
170	46.092470	-89.349985	9	M	P							1						1										2		
171	46.092146	-89.349988	8	M	P													2												1
172	46.091822	-89.349992	6	M	P							2						1										1		
173	46.091498	-89.349996	6	M	P							2																3		
174	46.091174	-89.350000	5	M	P							1																2		
175	46.090850	-89.350004	5	M	P							1																3		
176	46.090526	-89.350007	5	M	P							1																1		
177	46.090202	-89.350011	5	M	P							2						1										2		
178	46.089878	-89.350015	5	M	P																							1		
179	46.089554	-89.350019	4	M	P																	1								
180	46.089230	-89.350023	4	M	P																1									
181	46.097327	-89.349462	4	M	P							1						1						1		1				
182	46.097003	-89.349466	6	S	P	No Vegetation																								
183	46.096679	-89.349469	8	M	P													1												1
184	46.096355	-89.349473	9	M	P																					1		2		
185	46.096031	-89.349477	11	M	P																					3				
186	46.095707	-89.349481	14	M	R							3																		
187	46.095383	-89.349485	14	M	R							2																		
188	46.095059	-89.349488	15	M	R							2																		
189	46.094735	-89.349492	16	M	R			1				1																		
190	46.094411	-89.349496	16	M	R	No Vegetation																								
191	46.094087	-89.349500	16	M	R							2																		
192	46.093763	-89.349504	16	M	R	No Vegetation																								
193	46.093439	-89.349507	14	M	R							1																		
194	46.093115	-89.349511	13	M	P	No Vegetation																								
195	46.092791	-89.349515	10	M	P							1																		1

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196	46.092467	-89.349519	8	M	P													1										2		
197	46.092143	-89.349523	7	M	P													1								1				
198	46.091819	-89.349527	7	M	P													1								2		1		
199	46.091495	-89.349530	7	M	P							2																1		
200	46.091171	-89.349534	6	M	P							1						1										1		
201	46.090847	-89.349538	6	M	P							3																		
202	46.090523	-89.349542	6	M	P							1						1										3		
203	46.090199	-89.349546	6	M	P							1																3		
204	46.089875	-89.349549	5	M	P							1																		
205	46.089551	-89.349553	4	M	P	No Vegetation																								
206	46.089227	-89.349557	4	M	P	No Vegetation																								
207	46.097324	-89.348996	3	S	P						1																			1
208	46.097000	-89.349000	4	M	P							1														3			1	
209	46.096676	-89.349004	4	M	P																					1		2		
210	46.096352	-89.349007	4	M	P							2						1												
211	46.096028	-89.349011	9	M	P							2						1												
212	46.095704	-89.349015	11	M	P							2						1												
213	46.095380	-89.349019	12	M	P							2																		1
214	46.095056	-89.349023	13	M	R																	2								
215	46.094732	-89.349027	14	M	R							3																		
216	46.094408	-89.349030	14	M	R							3																		
217	46.094084	-89.349034	15	M	R							2																		
218	46.093760	-89.349038	14	M	R													1												
219	46.093436	-89.349042	13	M	R							1						1										1		1
220	46.093112	-89.349046	12	S	P	No Vegetation																								
221	46.092788	-89.349049	5	S	P															1								1		1
222	46.092464	-89.349053	5	S	P	No Vegetation																								
223	46.092140	-89.349057	5	S	P	No Vegetation																								
224	46.091816	-89.349061	7	S	P	No Vegetation																								
225	46.091492	-89.349065	7	M	P							1						1									1			1
226	46.091168	-89.349068	7	M	P							1														3				
227	46.090844	-89.349072	7	M	P							1						1								1		2		
228	46.090520	-89.349076	7	M	P							3																1		
229	46.090196	-89.349080	6	M	P							1																2		
230	46.089872	-89.349084	6	M	P							1																2		
231	46.089548	-89.349088	4	M	P							1								1										
232	46.089225	-89.349091	3	M	P							1								1										
233	46.096998	-89.348534	5	M	P																							1		1
234	46.096674	-89.348538	7	M	P																							3		

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Notes	Carex pseudocyperus	Ceratophyllum demersum	Chara sp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Isoetes echinospora	Isoetes lacustris	Juncus alpinus	Juncus pelocarpus	Lobelia dortmanna	Myriophyllum sibiricum	Myriophyllum tenellum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton strictifolius	Potamogeton x griffithii	Sagittaria sp. (rosette)	Vallisneria americana
235	46.096350	-89.348542	6	M	P																							3		
236	46.096026	-89.348546	4	S	P							1						1								1		1		1
237	46.095702	-89.348549	6	S	P						1	1								1								1		2
238	46.095378	-89.348553	6	S	P							1						1		1			1				1			
239	46.095054	-89.348557	10	M	P													1										2		1
240	46.094730	-89.348561	10	M	P							3																		1
241	46.094406	-89.348565	11	M	P							3																		1
242	46.094082	-89.348568	11	M	P							3																		
243	46.093758	-89.348572	11	M	P							2																		
244	46.093434	-89.348576	4	S	P				1			1																		
245	46.093110	-89.348580	2	S	P	No Vegetation																								
246	46.092786	-89.348584	2	S	P	No Vegetation																								
247	46.092462	-89.348588	2	S	P														1											
248	46.092138	-89.348591	2	S	P						1		1		1	1														
249	46.091166	-89.348603	4	M	P							2																		
250	46.090842	-89.348607	4	M	P																							3		
251	46.090518	-89.348610	6	M	P																					1		1		
252	46.090194	-89.348614	5	M	P																					1		1		
253	46.089870	-89.348618	5	M	P							1						1										3		
254	46.089546	-89.348622	4	M	P							1										1								
255	46.089222	-89.348626	3	M	P							1								1								1		
256	46.091163	-89.348137	2	S	P		1			1	1				1	1	1													
257	46.090839	-89.348141	5	M	P							1																1		
258	46.090515	-89.348145	5	M	P																					1		2		
259	46.090191	-89.348149	5	M	P																1							1		
260	46.089867	-89.348152	5	M	P	No Vegetation																								
261	46.089543	-89.348156	3	M	P																							2		
262	46.089219	-89.348160	3	S	P	No Vegetation																								
263	46.090836	-89.347675	3	S	P								1			2		1												
264	46.090512	-89.347679	4	M	P	No Vegetation																								
265	46.090188	-89.347683	3	M	P															1								2		
266	46.089865	-89.347687	3	M	P													1										1		
267	46.089541	-89.347691	3	M	P															1										
268	46.089217	-89.347694	2	S	P	No Vegetation																								
269	46.090510	-89.347213	3	M	P	No Vegetation																								
270	46.090186	-89.347217	3	M	P																1									
271	46.089862	-89.347221	4	M	P	No Vegetation																								
272	46.089538	-89.347225	3	M	P	No Vegetation																								
273	46.090507	-89.346748	2	M	P																1									

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Notes	Carex pseudocyperus	Ceratophyllum demersum	Chara sp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Isoetes echinospora	Isoetes lacustris	Juncus alpinus	Juncus pelocarpus	Lobelia dortmanna	Myriophyllum sibiricum	Myriophyllum tenellum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton strictifolius	Potamogeton x griffithii	Sagittaria sp. (rosette)	Vallisneria americana
274	46.090183	-89.346752	2	M	P	No Vegetation																								
275	46.089859	-89.346755	3	M	P	No Vegetation																								
276	46.089535	-89.346759	3	M	P	No Vegetation																								
277	46.090505	-89.346282	2	M	P	No Vegetation																								
278	46.089857	-89.346290	2	M	P																							1		1

B

APPENDIX B

Aquatic Plant Management Strategy – Northern Region WDNR 2007

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

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).

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* *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.