Amery Lakes Aquatic Plant Management Plan
Pike, North Twin and South Twin Lakes

Polk County, Wisconsin

May 2014

Sponsored By
Amery Lakes Protection and Rehabilitation District

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Introduction

This aquatic plant management plan for the Amery Lakes of Pike, North Twin, and South Twin in Polk County, Wisconsin presents a strategy for managing aquatic plants by protecting native plant populations, alleviating nuisance conditions, and controlling and preventing establishment of invasive species. The plan includes data about the plant community, watershed, and water quality of Amery Lakes. Based on this data and public input, goals and strategies for the sound management of aquatic plants are presented. This plan will guide the Amery Lakes Protection and Rehabilitation District (Amery Lakes District) and the Wisconsin Department of Natural Resources (WDNR) in aquatic plant management for Amery Lakes over the next five years (from 2014 through 2018).

Amery Lakes Aquatic Plant Management Goals

The goals of the Amery Lakes Aquatic Plant Management Plan are as follows:

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

GOAL 2. Preserve our diverse native plant community

GOAL 3. Increase understanding regarding aquatic plants and their management

GOAL 4. Allow navigation for fishing and boating

This aquatic plant management plan is guided by public input, scientific data, and requirements from the Wisconsin Department of Natural Resources (WDNR). The plan is required by WDNR regulations for certain aquatic plant management activities and to obtain grants that fund aquatic invasive species management. WDNR guidelines determine the required plan contents and necessary public input.

The WDNR's aquatic plant management planning guidelines and Northern Region Aquatic Plant Management Strategy (Summer 2007) framed the development of the plan. (See Appendix F for a copy of this strategy.) WDNR sampling protocol and plant survey methods were also utilized in plan development. The Amery Lakes Aquatic Plant Advisory Committee worked within these limits and guidelines to develop the management strategy for aquatic plants in Amery Lakes.

More information about managing aquatic plants in Wisconsin is available from www.uwsp.edu/cnr/uwexlakes/ecology/apmguide.asp or http://dnr.wi.gov/lakes/plants/

Public Input for Plan Development

Three advisory committee meetings were held to guide the development of the Amery Lakes Aquatic Plant Management (APM) Plan. The group met to learn about APM planning requirements; the condition of the Amery Lakes watershed, water quality, and aquatic plants; aquatic plant management to date; and management options available.

The APM Committee expressed a variety of concerns that are reflected in the goals and objectives for aquatic plant management in this plan. The committee also guided implementation strategies in the plan. Committee input is summarized in the meeting notes included as Appendix A.

Following advisory committee input, the draft plan update was made available to lake residents and other interested parties. Residents were made aware of the availability of the draft with a notice published in the Amery Free Press. The plan was available for review between May 5 and May 12, 2014 on the City of Amery web site (amerywisconsin.org) and at the Amery Public Library during regular business hours. A public meeting was held to gather comments on the plan Thursday, May 8 beginning at 6:30 p.m. Four members of the advisory committee attended, but no one else was present.

Lake Information

Amery Lakes are located in Polk County, Wisconsin in the city of Amery and the town of Lincoln. Information about the lakes is reported in Table 1 below. A map of the lakes with public boat landings indicated is included as Figure 1.

Table 1. Amery Lakes Information (Wisconsin Department of Natural Resources, 2014)

Lake	Type	Lake Acres	Watershed Acres	Watershed/ Lake Ratio	Max Depth	Mean Depth
Pike (WBIC 262400)	Seepage	148	399	2.7	33 feet	14 feet
North Twin (WBIC 2623900)	Drainage	129	178	1.4	27 feet	11 feet
South Twin (WBIC 2623800)	Drainage	72	124	1.7	9 feet	5 feet

Water Quality

Trophic State

Trophic state describes the productivity of a lake. The least productive or nutrient-rich lakes are oligotrophic lakes. The most productive lakes are referred to as eutrophic. Those in the middle are called mesotrophic. More productive lakes have more nutrients available for algae growth. If a watershed with little runoff and phosphorus sources surrounds a lake, the water will tend to have low phosphorus levels. This will result in limited plant and algae growth, causing it to be classified as an oligotrophic lake. Amery Lakes are classified as mesotrophic lakes. The lakes have low watershed to lake ratios which range from 1.4 to 2.7.

Previous Lake Studies

The Amery Lakes District – Lake Management Feasibility Study was completed from 1980-82. A second study was completed in 1991. Detailed topographic maps were prepared in the 1991 study and in-lake water quality information was updated. Results of the two studies were combined in the 1991 report. Information included watershed delineation, land use identification, calculations of phosphorus loading, and descriptions of plant and algae growth. Recommendations included keeping flow from Apple River to North Twin Lake closed (since May 1989), diverting storm sewers away from Amery Lakes, passing a lawn fertilizer ordinance with phosphorus limits (completed September 1992), and installing an aerator to prevent fish kills in South Twin Lake (completed 1989). (Amery Lakes Protection and Rehabilitation District, 1991-1992)

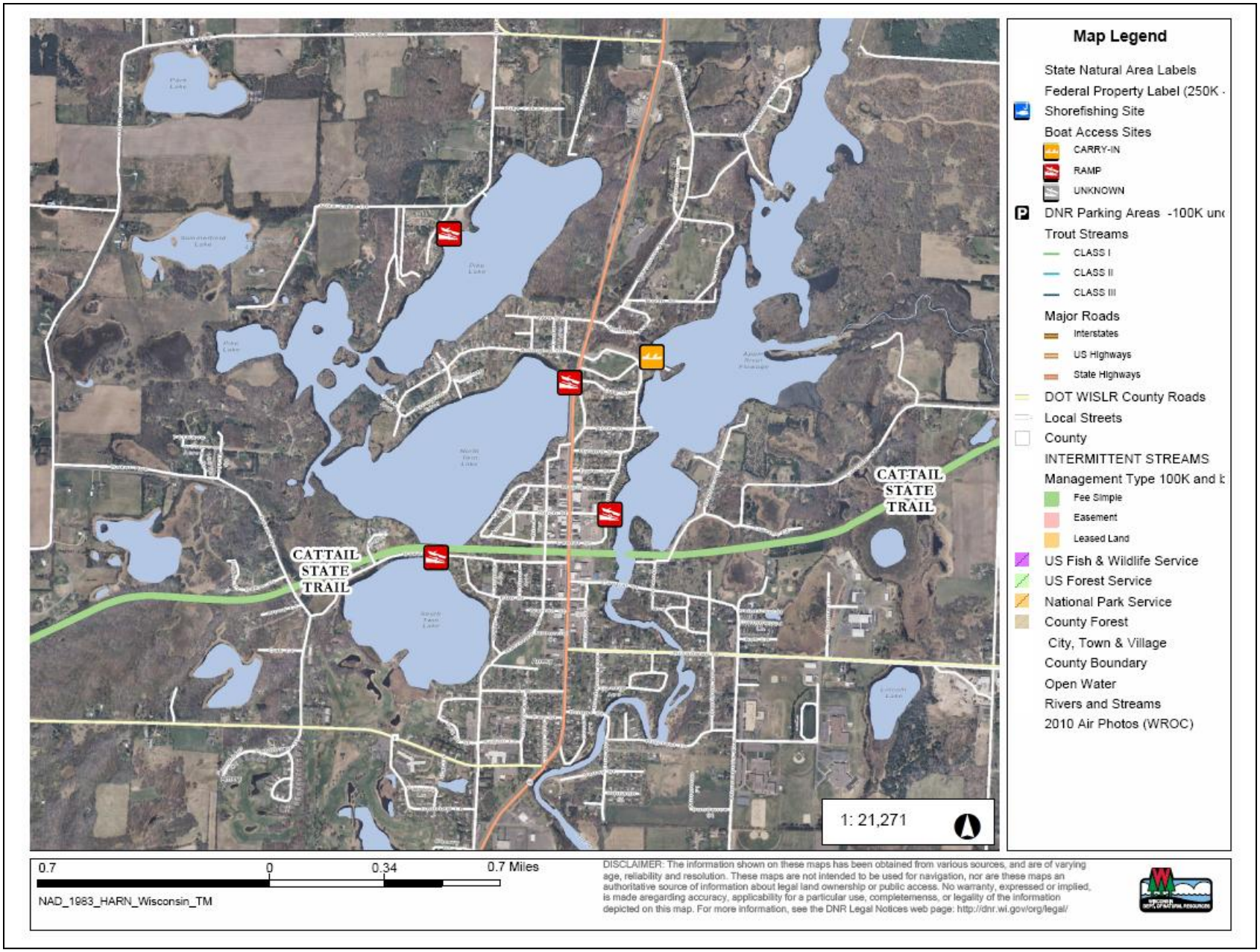


Figure 1. Map of Amery Lakes (from WDNR WebView)

A Lake Management Plan was prepared for the Amery Lakes Protection and Rehabilitation District by Cedar Corporation in 2004. The study and plan included the following:

- Watershed delineation
- Map of watershed land uses
- Stormwater flow monitoring and grab sample collection
- Review of water quantity data
- In-lake water quality monitoring
- In-lake sediment sampling and analysis
- Macrophyte (aquatic plant) survey
- In-lake water quality modeling
- Community survey
- Recommendations and management plan

The study revealed that the lakes are vulnerable to small increases in phosphorus and sediment from watershed runoff from the city's stormwater drainage system. The plan recommended ongoing education and outreach, watershed best management practices, development of a stormwater management plan, ordinance updates, fish stocking and habitat improvements, and ongoing lake water quality monitoring. (Cedar Corporation, 2004)

Citizen Lake Monitoring Results[2]

Secchi depths are the most commonly collected and available self-help lake monitoring data. Secchi depths measure water clarity. The secchi depth reported is the depth at which the black and white secchi disk is no longer visible when it is lowered into the water. Greater secchi depths occur with greater water clarity. Volunteers measured secchi depths for Pike Lake and North Twin Lakes from 1987 to 1993. Students from the Amery High School Freshwater Ecology class collected and analyzed total phosphorus samples and gathered secchi depths in later years. Secchi depths are shown in Figure 2. While not all years are included, a trend toward increasing water clarity in Pike and North Twin Lakes is evident. Total phosphorus results from 2011 through 2013 are included in Figure 3.

[2] Wisconsin Department of Natural Resources Citizen Lake Monitoring results (http://dnr.wi.gov/lakes/CLMN).

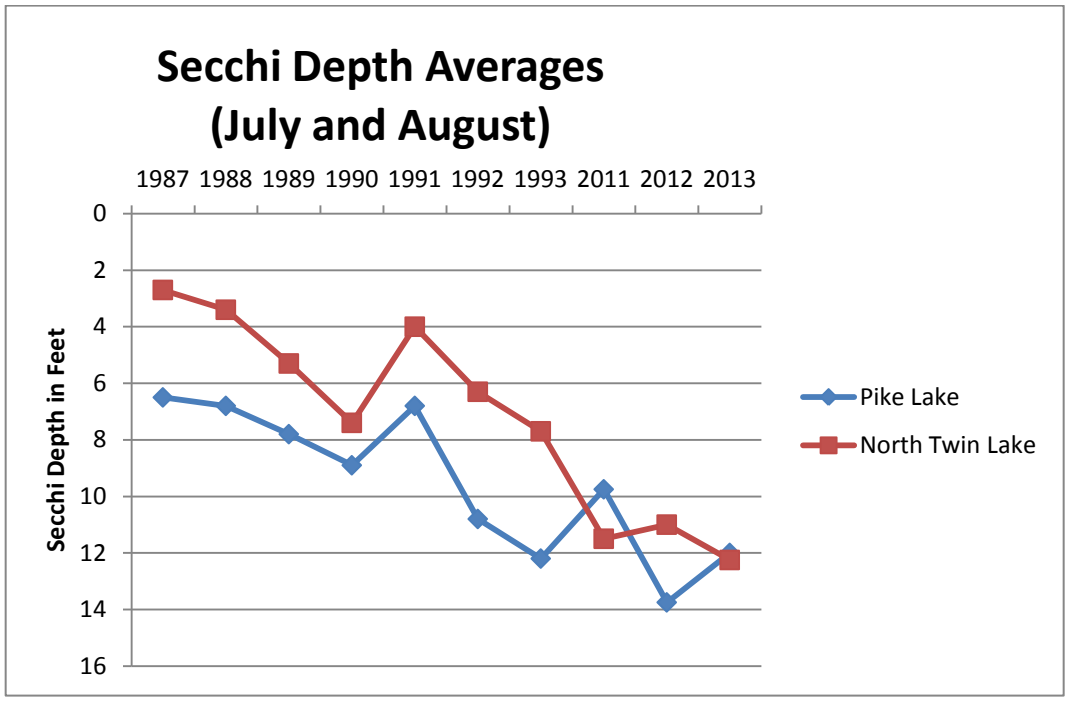


Figure 2. Amery Lakes Secchi Depth (July and August)

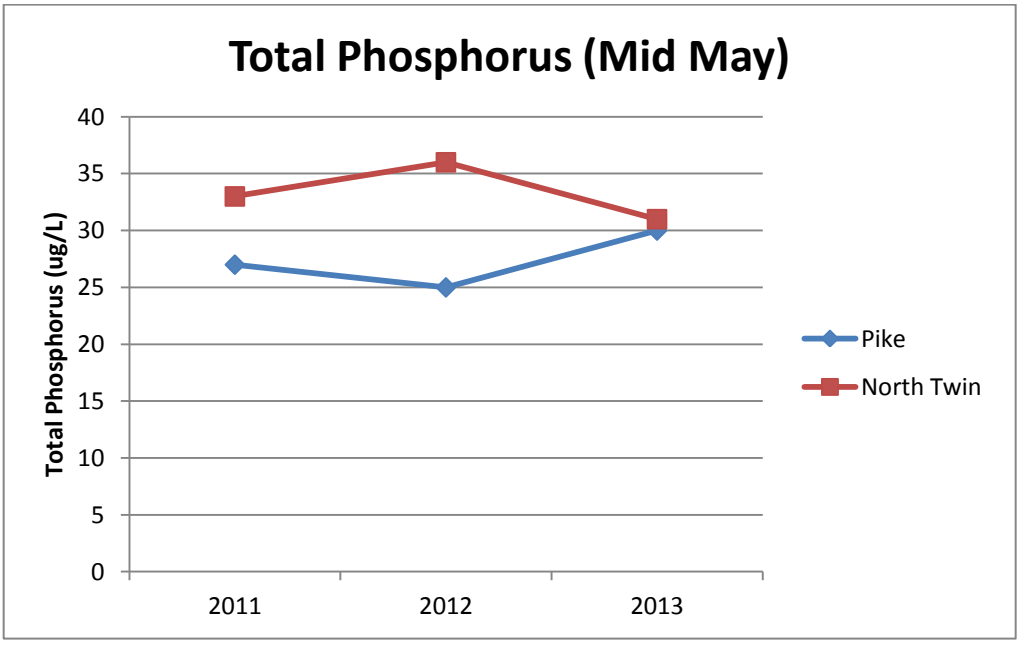


Figure 3. Amery Lakes Total Phosphorus (Mid May)

Water Quality in Shallow Lakes

It is important to note that aquatic plants play a critical role in maintaining water quality in the Amery Lakes – especially in South Twin, because it is very shallow. If aquatic plants are not present in shallow lakes, nutrient-rich sediments can be re-suspended, and water clarity would be expected to decrease dramatically. The figure below illustrates that for shallow-water lakes, an aquatic plant dominated system is highly preferable to a lake without aquatic plants. In fact, restoration efforts for shallow lakes frequently focus on re-establishing aquatic plants in order to improve water clarity.

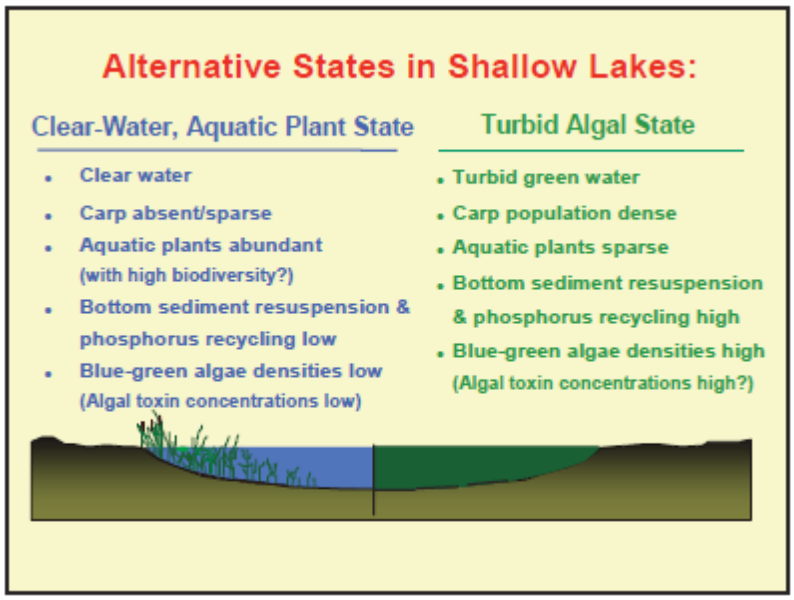


Figure 5. Alternative States in Shallow Lakes
From Lake Wingra presentation adopted from Sheffer 1990

Watershed

The Stormwater Water Management Plan for the City of Amery provides comprehensive data about the Amery Lakes watershed. (SEH, 2009) The watershed of Amery Lakes includes land within the city of Amery and in the town of Lincoln. The watershed area of each of the lakes is as follows: Pike Lake 399 acres, North Twin Lake 178 acres, South Twin Lake 124 acres. The lake drainage basins or subwatersheds are shown in Figure 4. (SEH, 2009)

Land use within the stormwater plan study area is shown in Figure 5, and the acres of land uses for each subwatershed are included in Table 2.

Table 2. Subwatershed Land Use in Acres

Subwatershed	Commercial	Residential	Institutional	Industrial	Open Space
Pike Lake	16	166	>1	4	212
North Twin	5	96	1	0	76
South Twin	5	69	4	0	46

Phosphorus is the pollutant that most influences the clarity of Amery Lakes because it is the limited ingredient for algae growth. Phosphorus is found dissolved in runoff water and carried in soil particles that erode from bare soil. Phosphorus runoff from the watershed is determined by how land is used in the watershed, along with watershed soils and topography.

When a watershed is maintained in natural vegetation, there is less runoff of pollutants that impact the lakes. Agricultural, commercial, and residential lands tend to contribute greater amounts of phosphorus in runoff. Soil erosion is reduced when there is good vegetative cover. Water flow is slowed by tall vegetation, and forest groundcovers and fallen leaves allow runoff water to soak into the ground. In summary, anything that reduces soil erosion and/or the amount of runoff water flowing from a portion of the watershed reduces pollution to the lake.

Phosphorus runoff in pounds per acre per year is shown in Figure 6. Highest levels of phosphorus loading come from runoff from the most densely-developed commercial and residential areas within the city of Amery. Runoff from much of Amery's downtown area and a portion of its surrounding residential area drains by curb and gutter to storm sewers. The storm sewer eventually discharges into North Twin Lake, South Twin Lake, the Apple River, the stream connecting South Twin to the Apple River, or to an internally drained water body or depression. Pike Lake does not have any storm sewer discharge locations.

Water quality practice recommendations

Because of high groundwater levels, soil types, and limited undeveloped areas, appropriate space needed for water quality practices is limited within the city limits. The stormwater management plan recommends that individual home and business owners install practices such as rain gardens, infiltration practices, and native plantings. Street sweeping with a vacuum sweeper is also recommended. The City of Amery already uses a mechanical sweeper about once a month with the most concentrated efforts in the downtown area. Street sweeping is also completed in the fall to collect leaves and other debris.

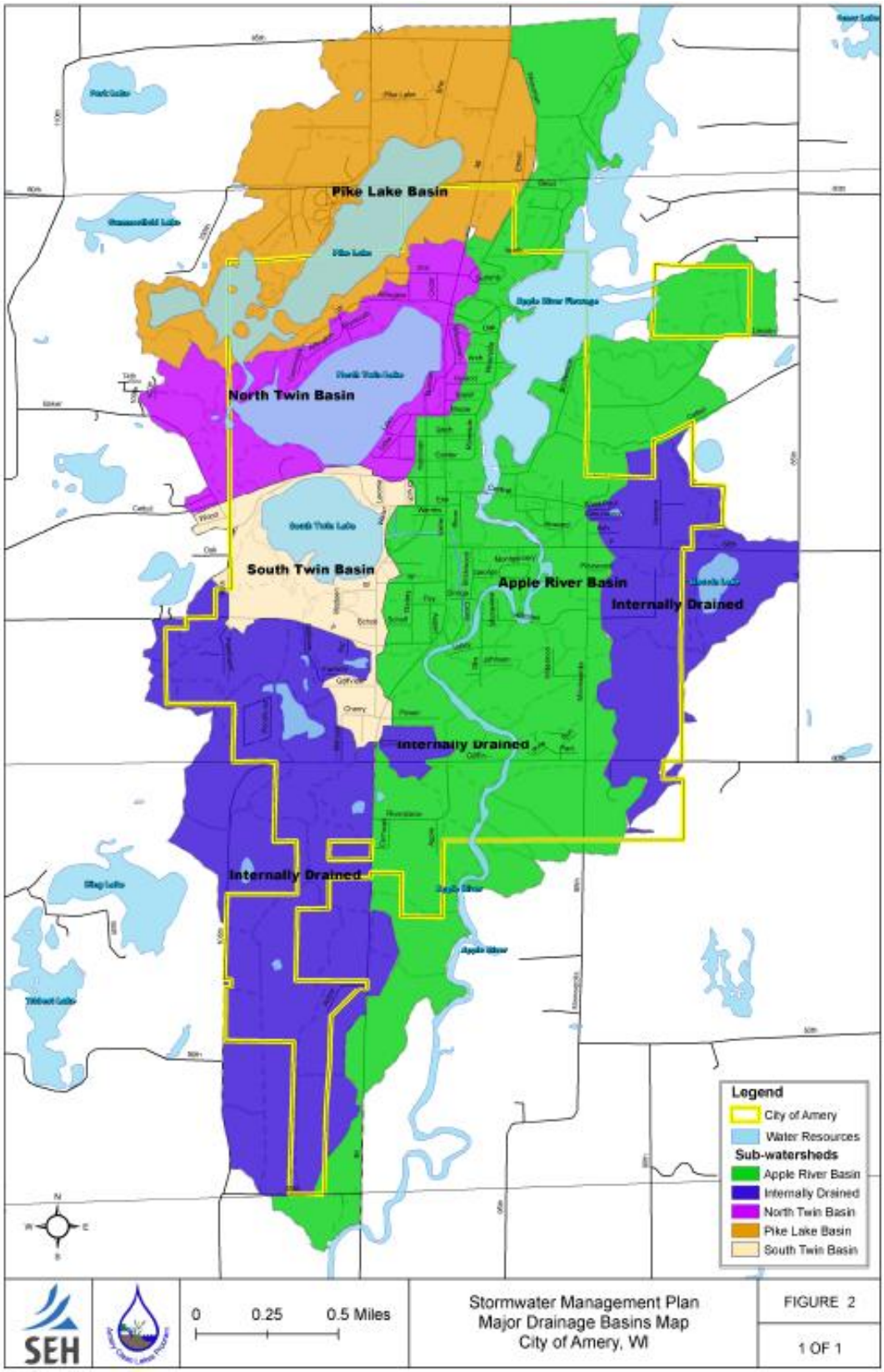


Figure 4. Amery Subwatersheds/Basins (SEH)

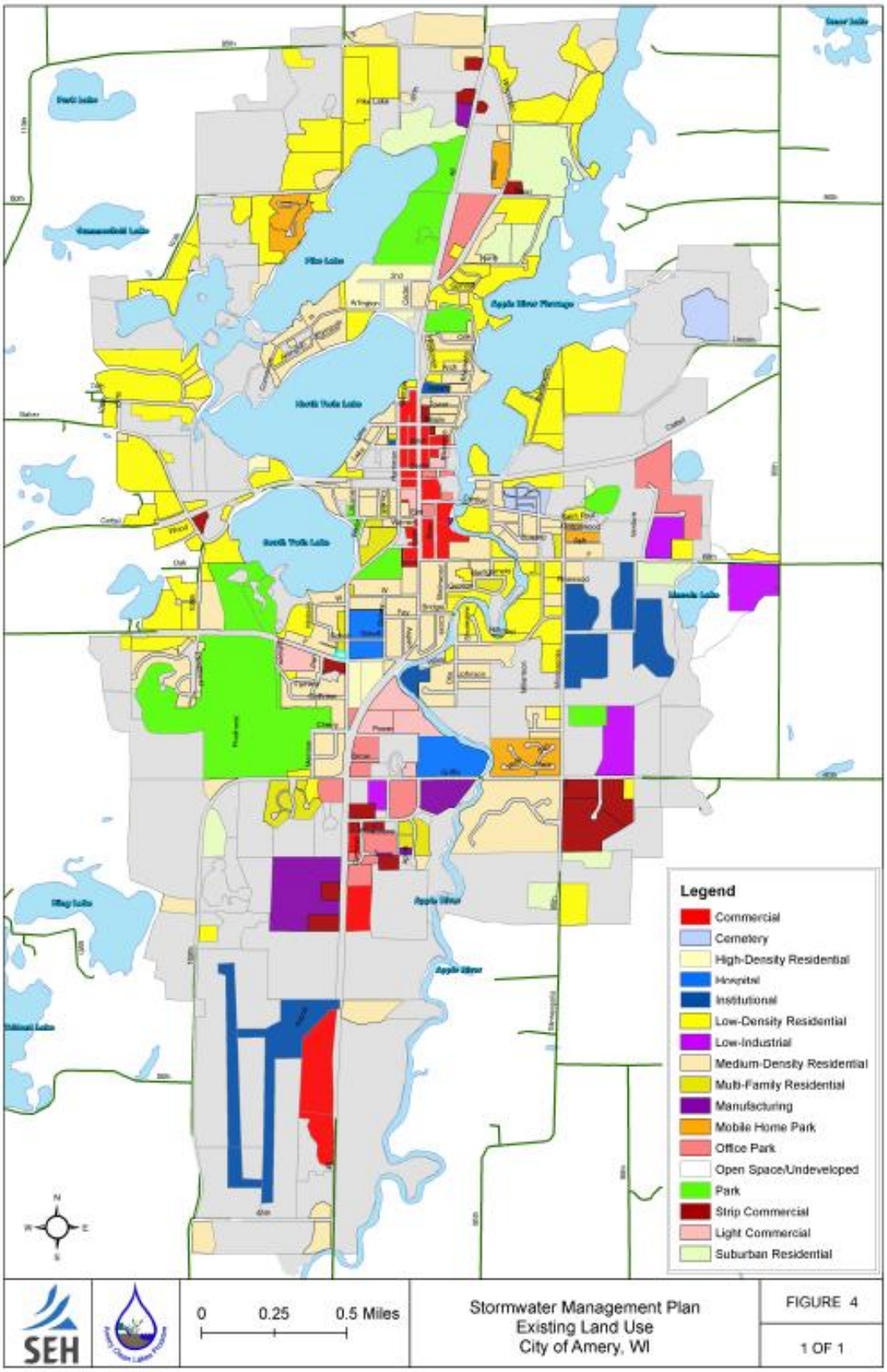


Figure 5. Amery Land Uses (SEH)

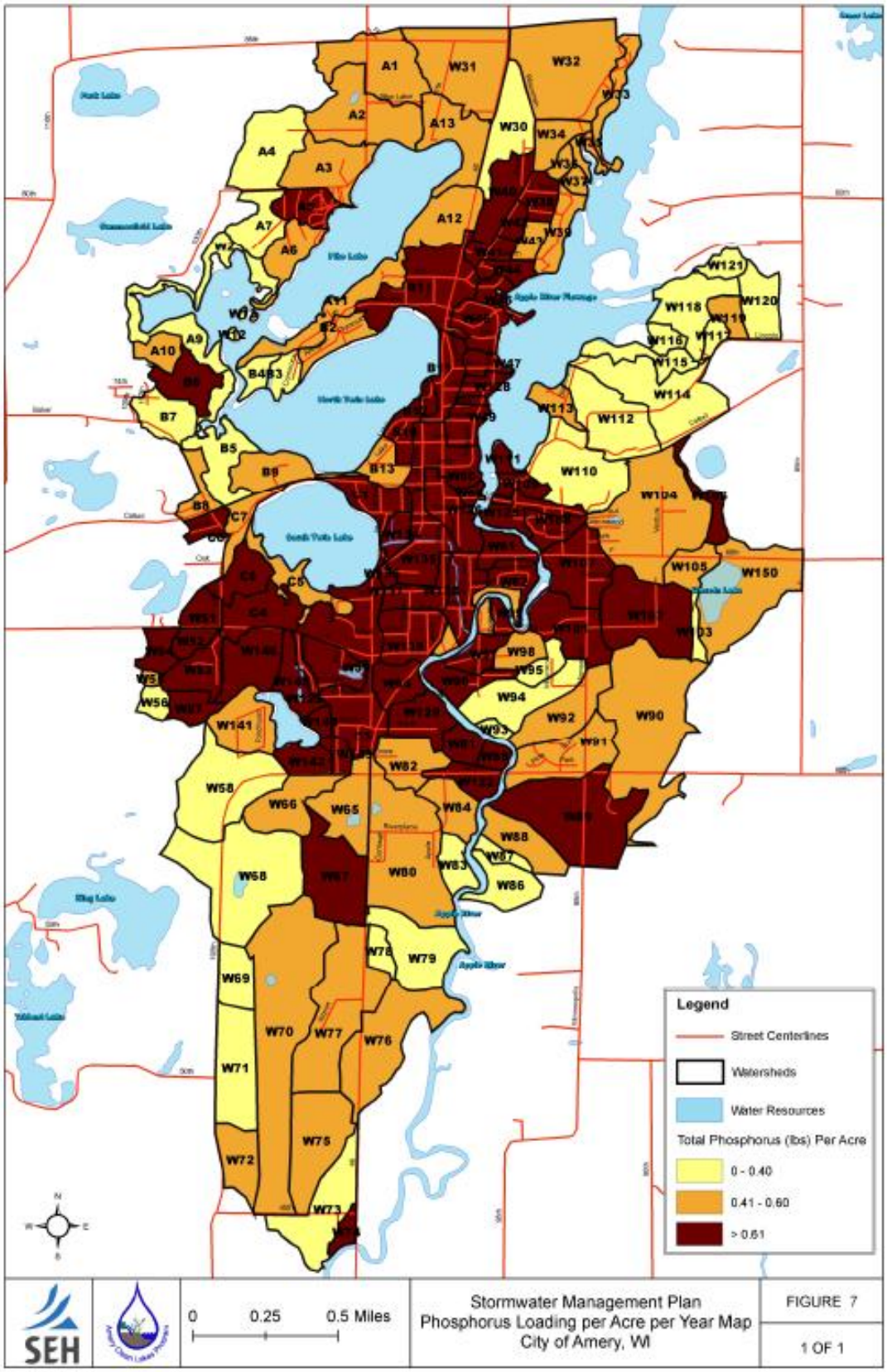


Figure 6. Amery Watersheds Phosphorus Loading (SEH)

Amery Clean Lakes Project

The City of Amery worked in partnership with the Amery Lakes Protection and Rehabilitation District to carry out a WDNR Lake Protection Grant project. The project was guided by the Amery Stormwater Committee that included Amery City Council and Amery Lakes District representatives along with city and county staff and consultants.

Stormwater Planning and Ordinance Update

A WDNR Stormwater Planning Grant supported the development of the previously mentioned Stormwater Management Plan and updates to ordinances.

The following documents resulted:

Stormwater Management Plan. City of Amery, Wisconsin. City of Amery, Amery Lakes Protection and Rehabilitation District, Wisconsin Department of Natural Resources. SEH No. A-AMERY0601.00. February 2009.

Financing Amery's Stormwater Management Plan. City of Amery, Wisconsin. City of Amery, Amery Lakes Protection and Rehabilitation District, Wisconsin Department of Natural Resources. SEH No. AAMERY0601. February 2009.

Stormwater Management and Erosion Control Ordinance. City of Amery. June 2009.

Flagpole Park Stormwater Wetland

The lake protection grant supported design and installation of stormwater wetland ponds at Flagpole Park. This land is within the Wisconsin Department of Transportation right of way and serves as a city park. The project diverted storm sewers to a series of ponds that are planted with native vegetation. The treated water flows to North Twin Lake. This area was identified as a priority in the grant application and the stormwater management plan.

Figure 7. Flagpole Park Stormwater Wetland

A sign at the park helps visitors understand the stormwater wetland functions.

Figure 8. Flagpole Park Sign

Demonstration Projects

Several demonstration projects were installed in the Amery Lakes watershed. City residents also received free rain barrels and technical assistance for reducing runoff to city storm sewers, Amery Lakes, and the Apple River. The city crew assisted with the installation of several projects. Education to back up the project included a brochure, rain garden classes and parties, and the Amery Lakes District newsletter.

Table 3. Amery Clean Lakes Demonstration Projects

Rain Barrels	Porous Concrete	Rain Gardens	Designs (not yet installed)
75	1	8	13

Figure 9. Amery Clean Lakes Demonstration Projects

Aquatic Habitats

Shoreline Inventory and Primary Human Use Areas

In 2008 and 2009, the Amery High School Freshwater Ecology class completed a shoreline inventory as part of a Wisconsin Lakes Protection Grant project. (Amery High School, 2009) This shoreline inventory recorded if shorelines were developed or natural. In addition, the riparian zone (ordinary high water mark to 35 feet) was evaluated for type (natural, hard or impervious, lawn, etc.). Finally, there were critical habitat areas delineated on all the lakes. The results are reported in the table and figures below.

Table 4. Shoreline Development on Amery Lakes

Lake	Natural	Lawn	Rip rap	Hard surface	Structure	Sand	Sea wall
Pike	74.5%	4.0%	3.5%	0.3%	0.2%	0.0%	0.0%
North Twin	34.7%	25.1%	34.3%	0.8%	0.3%	0.4%	2.1%
South Twin	38.6%	10.8%	9.5%	0.2%	0.0%	1.2%	0.0%

Figure 10. Pike Lake Natural (green) and Developed (red) Shoreline

Figure 11. North Twin Lake Natural (green) and Developed (red) Shoreline

Figure 12. South Twin Lake Natural (green) and Developed (red) Shoreline

Table 5. Amery Lakes Riparian Zone Composition

Lake Riparian	Natural (wetland)	Lawn	Road/hard surface	Sand	Structure
North Twin	37.0% (25.1%)	48.6%	13.8%	0.5%	0.14%
Pike Lake	89.4% (7.1%)	9.1%	1.4%	0.0%	0.05%
South Twin	41.4% (26.1%)	34.9%	20.8%	2.8%	0.07

As Table 5 shows, Pike Lake had extensive natural riparian vegetation, with nearly 90% of the riparian zone (from the water to 35 feet inland) still natural. This was mostly due to the large amount of undeveloped shoreline in the backwaters of the lake and to undeveloped York Park, which makes up about 25% of the main lake shoreline.

Both North and South Twin had extensive lawn and hard surface in the riparian zones surrounding the lakes. These areas can contribute extensively to high nutrient loads from runoff.

Critical Habitat

The map below shows the areas that were considered critical habitat areas for Pike Lake, North Twin Lake, and South Twin Lake. The areas were selected because they provide benefits for fish, birds, mammals, and/or protect water quality, and/or are critical to the lake ecosystem health. These areas have not been formally adopted by the Department of Natural Resources.

Figure 13. Proposed Critical Habitat Areas A-F

Figure 14. Proposed Critical Habitat Area G

Figure 15. Proposed Critical Habitat Area H

Table 6. Summary of Proposed Critical Habitat Areas

Critical Habitat Area	Location and description
A	Area A is a backwater of Pike Lake (known as "bass hole" area). Area has large amount of floating vegetation and near shore shrub cover. Submergent vegetation is very diverse providing valuable cover and many fine leaved species important for plankton. Steep bank on south shore could be erosion concern so maintaining shrub and tree cover important. Large amount of large woody debris in the littoral zone. Large numbers of waterfowl, birds, and mammals such as beaver and muskrat use this area.
B	Area B is on north and east shore of Pike Lake backwater area. Many floating and emergent plants in this area. Floating bog on east shore. Many birds use this area including an extensive area for water fowl breeding and rearing.
C and D	Area C is on east side of channel between Pike Lake and North Twin Lake. This area has extensive growth of northern wild rice and a species of concern, *Eleocharis robbinsii* (Robbin's spikerush). There are also large amounts of floating and emergent vegetation. This area is used extensively by birds, waterfowl, and mammals. Loons have used this area for nesting in past years. Numerous species of amphibians and reptiles can be observed here too.
E	Area E is located at the west shore of North Twin Lake. Much of this area is part of a large floating, acidic bog. This bog includes tamarack, orchids, and cape sundew. The littoral zone includes floating vegetation that provides important cover.
F	Area F is a large tract of natural vegetation/undisturbed riparian zone which is limited on North Twin Lake. The plant species include large amounts of emergent vegetation with many birds using this area for habitat. There is a gravel bar near the east end of this area that could provide spawning habitat for walleye (if any natural reproduction is occurring).
G	Area G is basically all the area of York Park on Pike Lake. This is a large portion of the lake shore on Pike Lake that is not developed. There are important sand areas for panfish spawning and rearing (with nearby plant beds for cover). The eastern most portion of this area is a speculated water recharge area for Pike Lake. Numerous floating and emergent plants are contained here as well.
H	Area H is the only natural/undeveloped portion of South Twin Lake. This area has a large amount of floating and emergent vegetation. The riparian zone is very thick with a shrub and grass cover and functions as an important buffer to the golf course which abuts the lake.

Critical Habitat Areas

The Department of Natural Resources has transitioned from sensitive area designations to designations of *critical habitat areas* that include both *sensitive areas* and *public rights features*. S*ensitive areas* offer critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). Wisconsin Department of Natural Resources is given the authority for the identification and protection of sensitive areas of the lake in this code. *Public rights features* are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty. Protecting these *critical habitat areas* requires the protection of shoreline and in-lake habitat. A *critical habitat area* designation would provide a framework for management decisions that impact the ecosystem of the lake.

Functions and Values of Native Aquatic Plants

Naturally occurring native plants provide a diversity of habitat, help maintain water quality, sustain the fishing quality for which the Amery Lakes are known, and support common lakeshore wildlife from loons to frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algae growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent resuspension of sediments from the lake bottom. Stands of emergent plants (with stems that protrude above the water surface) and floating plants help to blunt wave action and prevent erosion at the shoreline.

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for fish. Other fish such as bluegills graze directly on the plants themselves. Plant beds provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material. Birds eat both the invertebrates that live on plants and the plants themselves.[3]

Protection against Invasive Species

Non-native invasive species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that these "invaders" benefit where an opening occurs from removal of plants. Without competition from other plants, invasive species 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. This concept is easily observed on land where bared soil is quickly taken over by weeds that establish themselves as new occupants of the site. While not a providing a guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established in a lake. Invasive species 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.[4]

[3] Above paragraphs summarized from Through the Looking Glass. Borman etal. 1997.

[4] Taken from Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

Fish Community

The Amery Lakes District developed a Fisheries Management Plan for Pike Lake, North Twin Lake and South Twin Lake to guide the Amery Lakes District's actions in assisting the Wisconsin Department of Natural Resources in managing the lakes. (Amery Lakes P&R District, 2011) Fisheries information is from this management plan with updates from Aaron Cole, WDNR Fisheries Biologist.[5]

Fish Species

According to Aaron Cole, WDNR Fisheries Biologist, the fish community in North Twin, South Twin, and Pike Lakes largely consists of a bass, panfish, northern pike, and a stocked walleye fishery. The species present in these lakes include: bluegill *(Lepomis macrochirus)*, pumpkinseed *(Lepomis gibbosus)*, black crappie *(Pomoxis nigromaculatus)*, yellow perch (*Perca flavescens)*, largemouth bass *(Micropterus salmoides)*, northern pike *(Esox lucius)*, walleye (*Sander vitreus)*, bullhead species (*Ameiurus spp.)*, white sucker *(Catostomus commersonii)*, and several minnow species.

Largemouth bass and northern pike have excellent reproduction in all three lakes. However, natural walleye production is limited in the lakes, and a regular stocking program occurs.

The next WDNR electrofishing surveys for Pike Lake and North Twin are planned for 2018, and a survey for South Twin Lake is planned for 2015.

Fish Stocking

The WDNR and Amery Lakes District stocked walleye fingerling beginning in 1997. Table 7 summarizes the stocking efforts. Large fingerlings are stocked because of poor survival rates for small fingerlings. Up until about 2008, WDNR recommended stocking large fingerlings at a rate of 10 per acre. Since 2008, WDNR has allowed the Amery Lakes District to stock large fingerlings at a rate of 30 per acre.

South Twin Lake was restocked with fish after a partial winter kill in 2001-2002 (Heath Benike, WDNR, 2008). Oxygen levels in South Twin Lake were also reported to be low (1 mg/L) in February 2014. This occurred while the South Twin aerator was running, but the inlet culvert from North Twin Lake was obstructed with snow and ice.[6]

[5] Email communication, February 4, 2014.

[6] Schieffer, Steve. Email communication, February 24, 2014.

Table 7. Walleye Stocking in Amery Lakes

Year	Source	Age Class	Numbers Stocked - Pike	Numbers Stocked – North Twin
1997	WDNR	Large Fingerlings	3,975	3,400
1999	WDNR	Small Fingerlings	3,975	3,375
2001	WDNR	Small Fingerlings	3,975	3,375
2002	Lake District	Large Fingerlings	1,500	1500
2003	WDNR	Small Fingerlings	3,975	3,375
2004	Lake District	Large Fingerlings	1,500	1,500
2005	WDNR	Small Fingerlings	7,042	7,042
2006	Lake District	Large Fingerlings	1,500	1,500
2008	Lake District	Large Fingerlings	1,700	1,500
2009	WDNR	Small Fingerlings	5,723	4,960
2009	Lake District	Large Fingerlings	2,100	2,100
2010	Lake District	Large Fingerlings	2,500	2,500
2011	Lake District	Large Fingerlings	3,000	3,000
2012	Lake District	Large Fingerlings	3,000	3,000
2013	Lake District	Large Fingerlings	3,000	3,000
2013	WDNR	Large Fingerlings	2,385	2,025

Fishing Activity

North Twin and Pike Lakes are both favorite family fishing lakes, especially during the summer months. South Twin is not fished as heavily but also offers excellent fishing. Ice fishing is also a popular activity on the lakes. Anglers are targeting pan fish, walleyes, northern pike and largemouth bass. It is common to see twenty to twenty-five ice fishing houses on North Twin in January and February and a lesser number on Pike Lake. As in the summer months, ice fishing pressure on South Twin Lake is not as high.

Amery Lakes District Fisheries Management

The Amery Lakes District will manage fisheries with the following activities:

- Encourage maintenance and installation of woody habitat to improve fish habitat and shoreline restoration to improve riparian habitat.
- Consider supporting restocking in South Twin if a fish kill occurs, but do not support aeration of the lake.
- Continue stocking large walleye fingerlings at a rate of 30 per acre and encourage WDNR to do the same.
- Manage all three lakes for quality but not stunted pan fish populations.
- Encourage catch and keep to manage the numbers of largemouth bass and northern pike in at least North Twin and Pike Lakes.
- Continue efforts to maintain or improve the water quality of the lakes.
- Continue an aggressive position of invasive species prevention and management.

Plant Community

Plant surveys were completed for project lakes according to standard WDNR protocol. Plant survey methods are found in Appendix C.

Aquatic Plant Survey Results – Pike Lake

Ecological Integrity Service conducted a pro bono point intercept aquatic macrophyte survey in June and August 2012 to evaluate the plant community in Pike Lake. The survey used a 464 sample point grid generated by the Wisconsin Department of Natural Resources. The sample points are shown in Figure 17. At each sample point where plants are likely to grow, a rake is used to collect plant samples. The samples are evaluated for plant density for each species with rake density ratings as described in Table 8 and illustrated in Figure 16 below. These rankings are reported as plant density (1 to 3) in several figures that follow.

Table 8. Aquatic Plant Survey Rake Density Ratings

Rake density rating	Criteria for rake density rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space
v	Plant not sampled but observed within 6 feet of boat

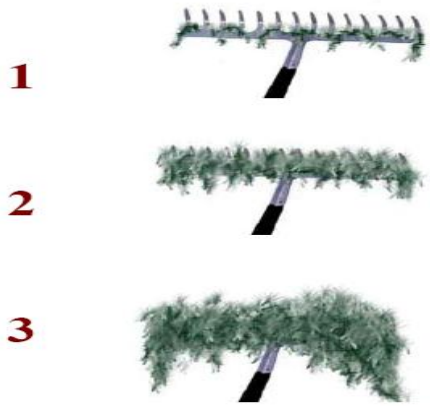


Figure 16. Illustration of Rake Plant Density

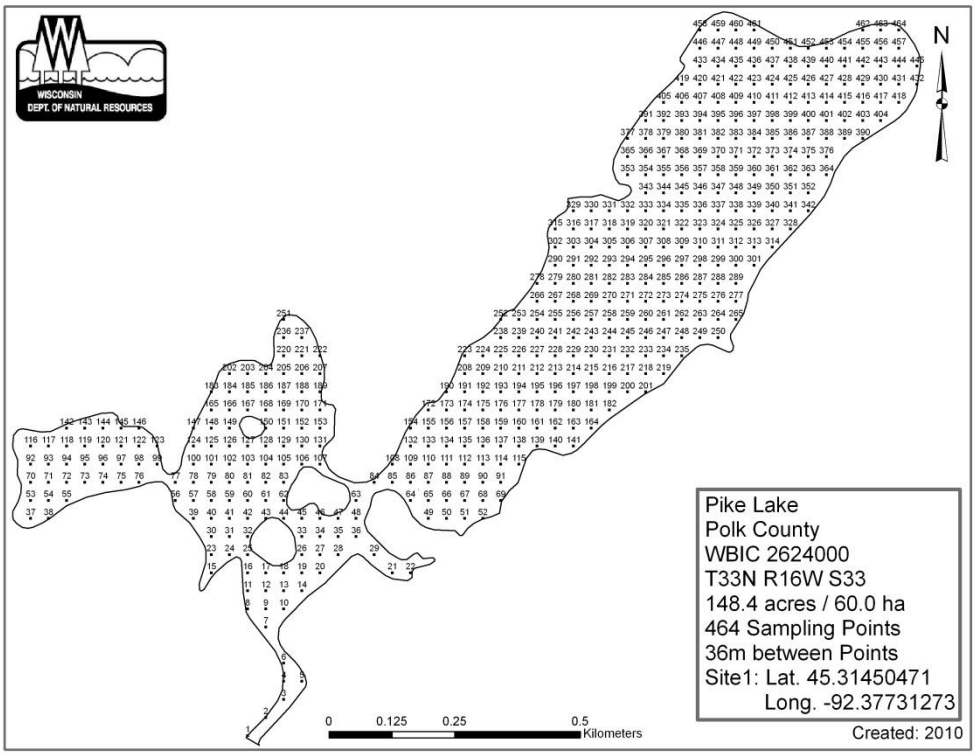


Figure 17. Pike Lake Sample Point Grid

Pike Lake has extensive coverage of aquatic plants with plants sampled as deep as 20.2 feet. This depth defines the littoral zone with 213 of the 464 sample points falling within the littoral zone. Of these 213 littoral points, 205 had plants present, which is 96.2% coverage. In some cases, plant presence was observed, but navigation to sample points was not possible. Figure 18 shows the littoral zone map. Points of green had plants present, white points show depths less than 20.2 feet without plants, and "x" points are beyond the littoral zone.

Table 9. Pike Lake Aquatic Plant Survey Statistics 2012

Total number of sites in grid	**464**
Total number of sites with vegetation	**205**
Total number of sites shallower than maximum depth of plants	**213**
Frequency of occurrence at sites shallower than maximum depth of plants	**96.24**
Simpson Diversity Index	**0.94**
Maximum depth of plants (ft)**	**20.20**
Average number of all species per site (shallower than max depth)	**3.55**
Average number of all species per site (veg. sites only)	**3.69**
Average number of native species per site (shallower than max depth)	**3.49**
Average number of native species per site (veg. sites only)	**3.63**
Species Richness	**45**
Species Richness (including visuals)	**46**

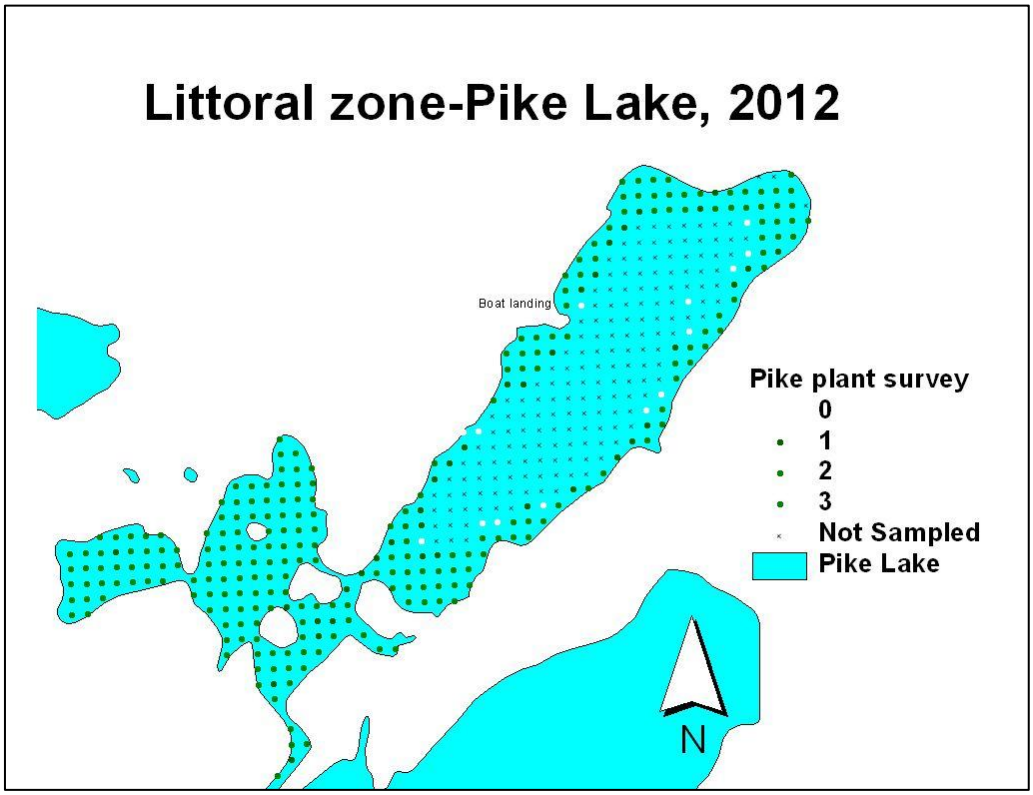


Figure 18. Pike Lake Littoral Zone

Plant growth is quite dense in some areas of Pike Lake, especially in the west basin, often referred by locals as the "bass hole." This area had such thick growth that many sample points could not be reached for sampling. While navigation is impeded in this area, there is limited human development. The area provides key habitat for various fauna.

Figure 19 shows the rake density rating at each sample point. As described previously, "1" is lowest rake density where plants are present and "3" is the highest. The northeast end (bay) of the lake also had quite extensive areas of plant growth, but again, had limited human development. High density in the rest of the lake is primarily from the growth of chara species, which are low growing plants on the lake bottom.

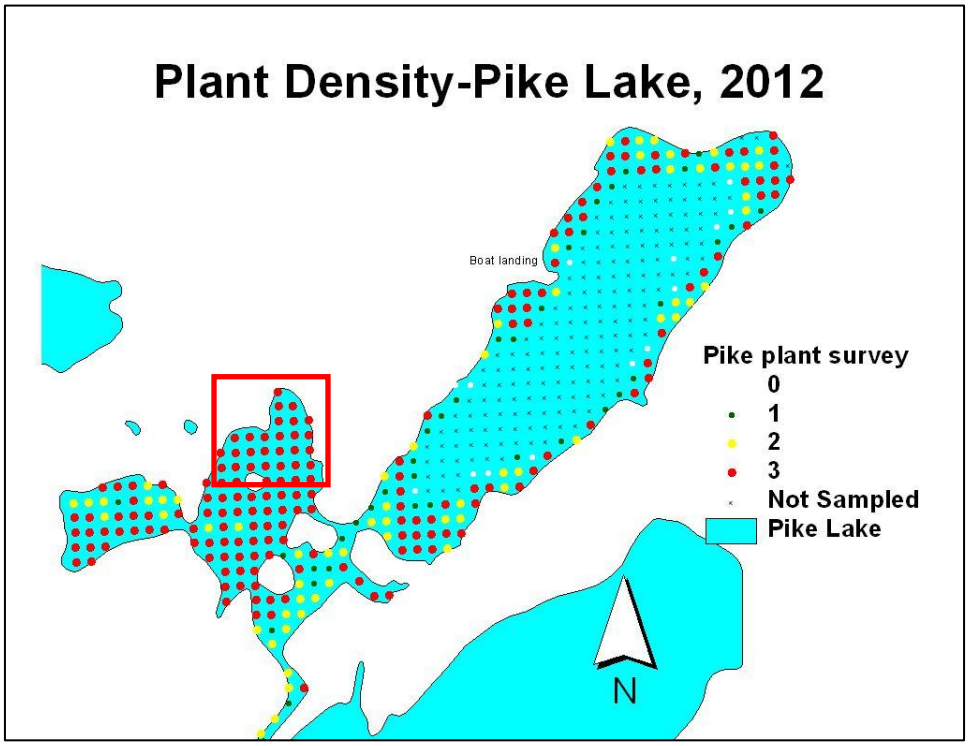


*Figure 19. Pike Lake Sample Point Rake Density**
** The red box outline indicates an area where many of the sample points could not be accessed. Rake density is therefore estimated here.*

There were 45 aquatic plant species, with one invasive plant species (*Potamogeton crispus*) and 44 plants native to Wisconsin lakes found in the plant survey. Eurasian water milfoil is also present in Pike Lake but was not sampled within the sample grid. The Simpson's diversity index is very high at 0.94.

Figure 20 shows the species richness or number of different species sampled at each point. There was an average of 3.63 species of native plants sampled at each sample point with vegetation. This is a very high diversity plant community. The highest diversity occurs in the west basin or "bass hole." Some areas of this west basin likely have high diversity, but the points could not be sampled due to low water conditions and thick plant growth/floating bottom areas. The northeast end also has high diversity areas.

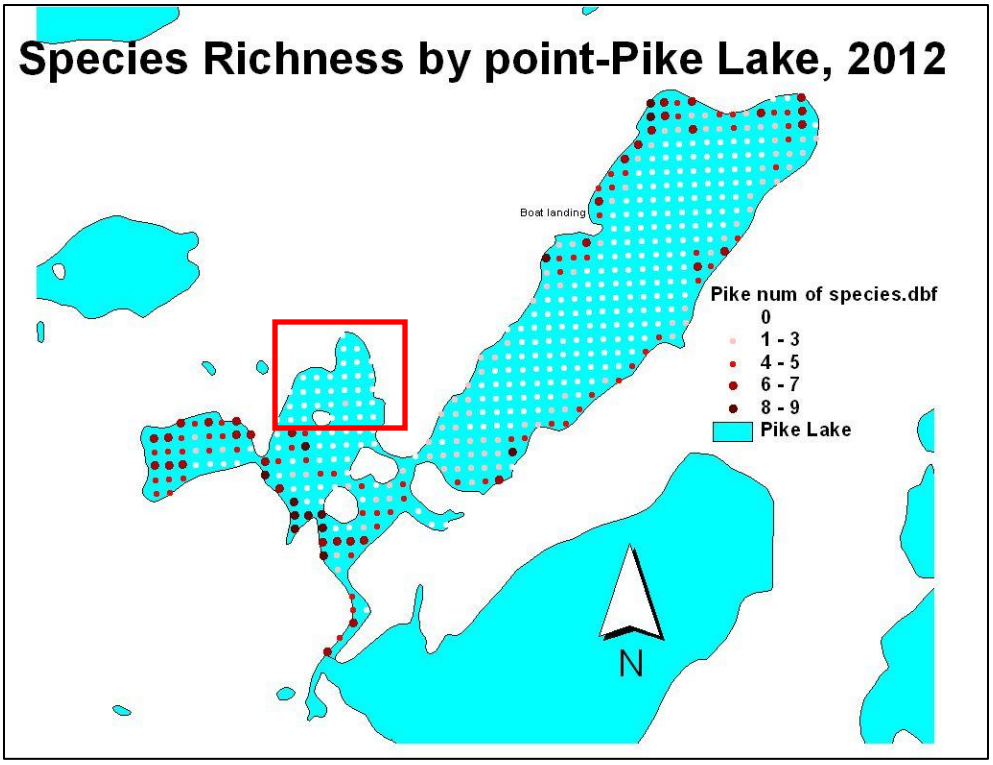


*Figure 20. Pike Lake Species Richness**

** There is no data for species richness for the area outlined in red because it was not navigable.*

Table 10. Plant Species of Pike Lake

Species	Freq. veg. littoral	Freq. littoral depth	Rel. freq.	# sampled	Mean density	# viewed
Nymphaea odorata, White water lily	36.10	34.74	9.95	74	1.04	8
Ceratophyllum demersum, Coontail	34.63	33.33	9.54	71	1.55	2
Chara sp., Muskgrasses	34.15	32.86	9.41	70	2.13	
Myriophyllum sibiricum, Northern water milfoil	33.66	32.39	9.27	69	1.12	5
Potamogeton zosteriformis, Flat-stem pondweed	25.37	24.41	6.99	52	1.13	
Utricularia vulgaris, Common bladderwort	24.88	23.94	6.85	51	1.41	
Potamogeton natans, Floating-leaf pondweed	23.41	22.54	6.45	48	1.15	
Nuphar variegata, Spatterdock	19.51	18.78	5.38	40	1.00	3
Potamogeton robbinsii, Fern pondweed	18.05	17.37	4.97	37	1.27	
Potamogeton richardsonii, Clasping-leaf pondweed	15.12	14.55	4.17	31	1.03	4
Vallisneria americana, Wild celery	11.22	10.80	3.09	23	1.09	1
Zizania palustris, Northern wild rice	9.66	9.39	2.60	20	1.00	
Lemna trisulca, Forked duckweed	8.29	7.98	2.28	17	1.06	
Eleocharis robbinsii, Robbins' spikerush	6.34	6.10	1.75	13	1.00	2
Brasenia schreberi, Watershield	5.85	5.63	1.61	12	1.17	
Potamogeton amplifolius, Large-leaf pondweed	5.37	5.16	1.48	11	1.00	1

Species	Freq. veg. littoral	Freq. littoral depth	Rel. freq.	# sampled	Mean density	# viewed
Potamogeton praelongus, White-stem pondweed	5.37	5.16	1.48	11	1.00	5
Elodea canadensis, Common waterweed	4.88	4.69	1.34	10	1.10	
Stuckenia pectinata, Sago pondweed	4.88	4.69	1.34	10	1.00	7
Potamogeton illinoensis, Illinois pondweed	3.90	3.76	1.08	8	1.00	1
Potamogeton pusillus, Small pondweed	3.90	3.76	1.08	8	1.13	1
Pontederia cordata, Pickerelweed	3.41	3.29	0.94	7	1.00	
Utricularia purpurea, Large purple bladderwort	2.93	2.82	0.81	6	1.00	
Potamogeton gramineus, Variable pondweed	2.44	2.35	0.67	5	1.00	
Bidens beckii, Water marigold	1.95	1.88	0.54	4	1.00	
Heteranthera dubia, Water star-grass	1.95	1.88	0.54	4	1.00	1
Pontederia cordata, Pickerelweed	1.95	1.88	0.54	4	1.00	
Schoenoplectus subterminalis, Water bulrush	1.95	1.88	0.54	4	1.00	
Sparganium fluctuans, Floating-leaf bur-reed	1.95	1.88	0.54	4	1.00	2
Utricularia gibba, Creeping bladderwort	1.95	1.88	0.54	4	1.00	
Potamogeton friesii, Fries' pondweed	1.46	1.41	0.40	3	1.00	
Sagittaria rigida, Sessile-fruited arrowhead	1.46	1.41	0.40	3	1.00	1
Lemna minor, Small duckweed	0.98	0.94	0.27	2	1.00	
Myriophyllum verticillatum, Whorled water milfoil	0.98	0.94	0.27	2	1.00	
Ranunculus aquatilis, White water crowfoot	0.98	0.94	0.27	2	1.00	
Sagittaria graminea, Grass-leaved arrowhead	0.98	0.94	0.27	2	1.00	
Sparganium eurycarpum, Common bur-reed	0.98	0.94	0.27	2	1.00	1
Utricularia intermedia, Flat-leaf bladderwort	0.98	0.94	0.27	2	1.00	
Eleocharis acicularis, Needle spikerush	0.49	0.47	0.13	1	1.00	
Eleocharis palustris, Creeping spikerush	0.49	0.47	0.13	1	1.00	
Najas flexilis, Slender naiad	0.49	0.47	0.13	1	2.00	1
Nitella sp., Nitella	0.49	0.47	0.13	1	1.00	
Schoenoplectus tabernaemontani, Softstem bulrush	0.49	0.47	0.13	1	1.00	
Typha angustifolia, Narrow-leaved cattail	0.49	0.47	0.13	1	1.00	
Filamentous algae	2.44	2.35	n/a	5	1.00	
Schoenoplectus acutus, hard-stem bulrush	n/a	n/a	n/a	0		1

Pike Lake Most Common Plants

The most common (highest relative frequency) plant sampled was white water lily. This is a common native plant found in Wisconsin lakes. It provides key habitat for fish and other wildlife. White water lily can also dissipate wave energy and protect shorelines and stabilize sediments. It is very common in the west basin of Pike Lake.

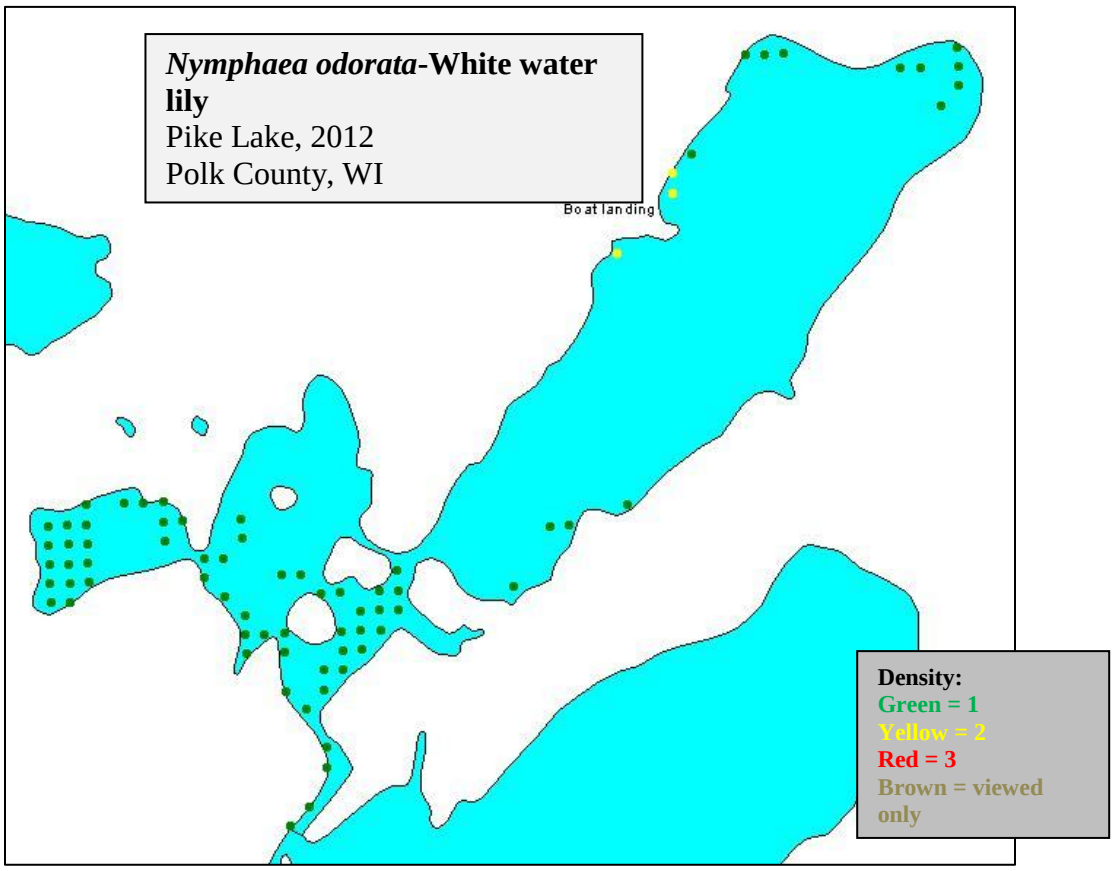


Figure 21. Pike Lake Distribution of White Water Lily

Coontail had the second highest relative frequency. This is another common Wisconsin lake plant that provides key habitat for invertebrates and fish. Coontail tends to be very common in high nutrient lakes and can absorb large amounts of nutrients from the water column. Coontail was found in numerous locations around Pike Lake with the highest density in the northeast end of the lake.

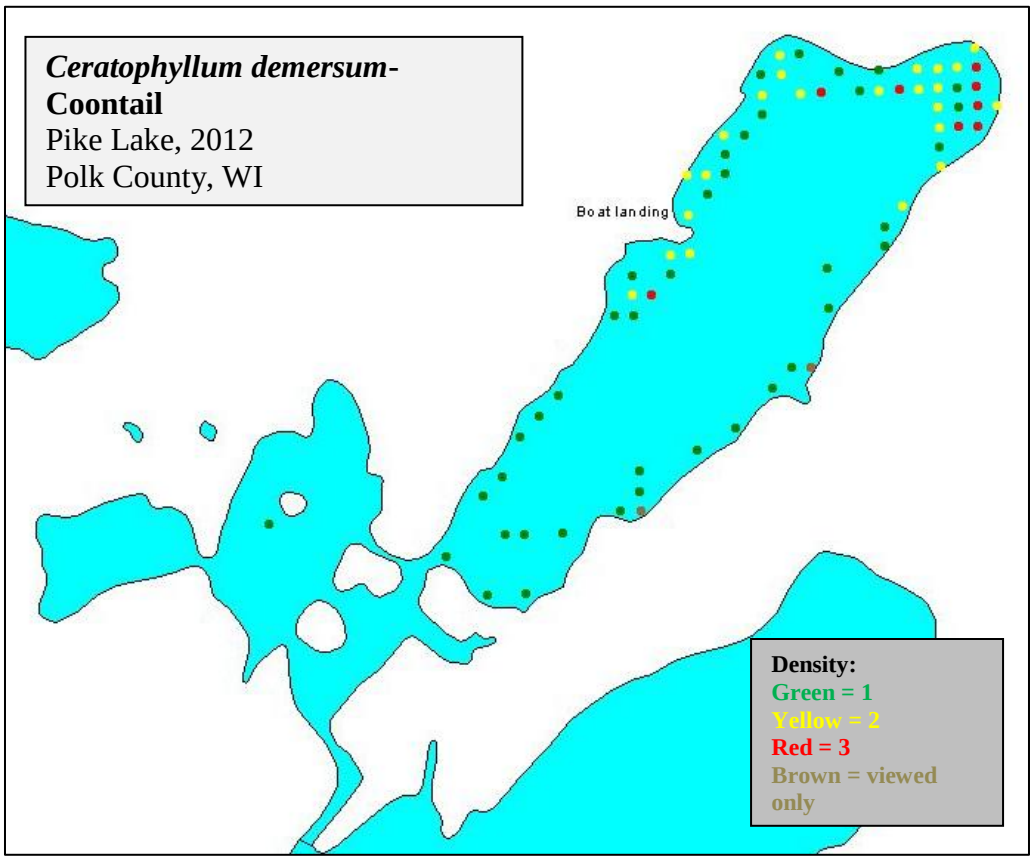
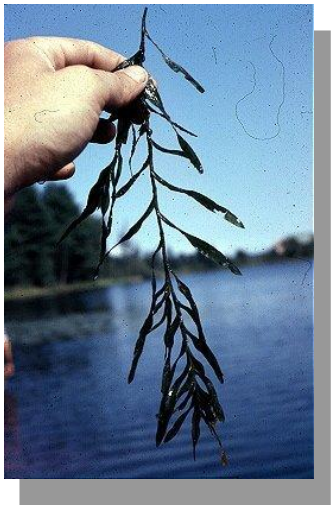


Figure 22. Pike Lake Distribution of Coontail



Potamogeton robbinsii

Ceratophyllum demersum

The third most common plant is actually an algae. *Chara sp*. or muskgrass is a large algae that looks like a plant. This plant grows in a wide variety of habitat and is typically rather sparse in coverage. However, in Pike Lake it grows as a mat on the bottom. This provides great habitat for fish. The coverage of muskgrass in Pike Lake is quite extensive in areas. It is hoped that these mats may compete with Eurasian water milfoil and keep the spread of that invasive plant limited.

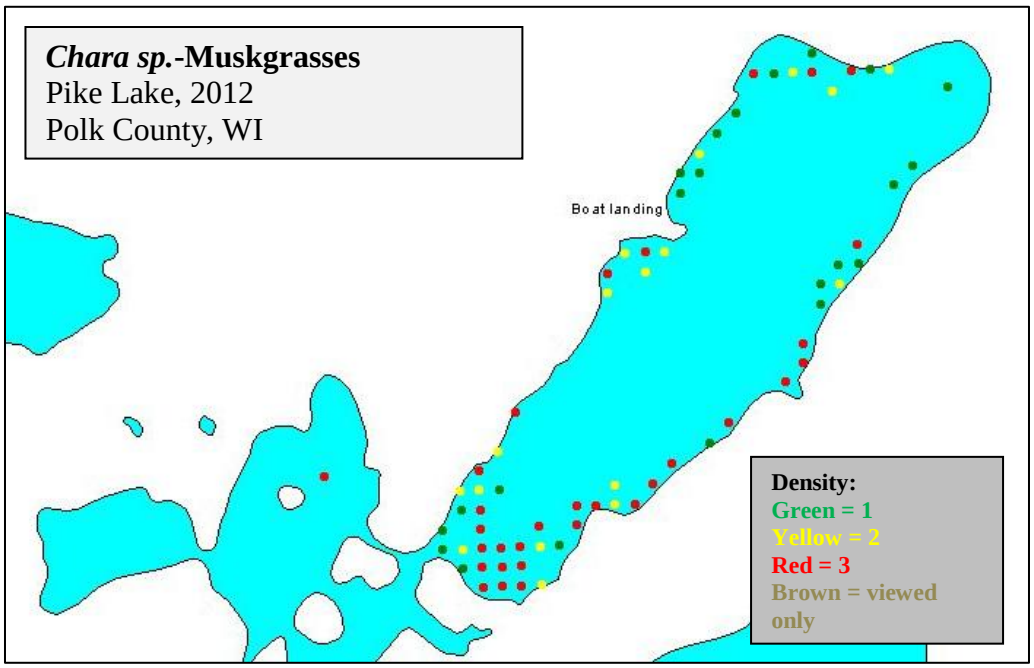


Figure 23. Pike Lake Distribution of Chara Species

Special Concern Species

One Pike Lake species, Robbin's spikerush (*Eleocharis robbinsii*), is listed as a species of special concern in Wisconsin. Robbin's spikerush was sampled in thirteen locations in the narrows between Pike Lake and North Twin Lake.

With special concern species there is a suspected, but not yet proven, problem of abundance or distribution. This category is designed to focus conservation efforts on certain species before they become endangered or threatened hopefully heading off more expensive or restrictive regulatory actions. (WDNR 2014) The presence of this special concern species should be considered with any management efforts in this portion of the lake.

Wild Rice (*Zizania palustris*)

Wild rice is an aquatic plant with special significance to Native American Tribes. Wild rice is both ecologically and culturally important on the landscape. Rice beds provide diverse habitat for wildlife and fish acting as brood rearing and nursery areas. Waterfowl also use rice beds as a food source for both the abundant seeds and the diverse invertebrate community found attached to stalks. An annual grass dependent on flowing water, rice can exhibit a fair amount of variation in abundance from year to year in the same bed. Densities can fluctuate from bumper crops to poor production years. Being a plant of shallow water means that beds will not expand out further than 4 feet deep, preferring water depths from 6 inches to 3 feet. Culturally rice has played a prized role in the lives of the Ojibwe and others who have realized the nutritional value of this important resource.

Tribal Interests

Native American Tribal representatives have special interest and rights related to aquatic plant management in Pike Lake because of the wild rice present. Pike Lake is located within Tribal ceded territories. Staff members from the St. Croix Tribal Environmental Services Department were invited to participate in the planning process. Draft and final copies will be distributed to the Tribe and the Great Lakes Indian Fish and Wildlife Commission.

When Ojibwe tribes living in the western Great Lakes region ceded lands by treaty to the United States, they retained the right to fish, hunt, trap, and gather resources from the lands they ceded. These treaties and the agreements in them have been upheld by modern courts, and remain in effect today. In Wisconsin, roughly the northern third of the state (including all of Polk County but the southwest corner) consists of ceded territory where tribal rights were retained. On these lands, the state has the legal obligation to provide consultation with the tribes whenever a permit, decision, or management action may affect the wild rice resources upon on which their harvest rights depend.

Wild rice was sampled in the narrows between Pike Lake and North Twin Lake. This plant is of great interest to many and there are concerns about its reduction in many Wisconsin lakes. For this reason, the map showing the locations of wild rice is included. Wild rice coverage, which is quite extensive in the narrows, is not completely reflected by the map because the plant grew where there were no sample points.

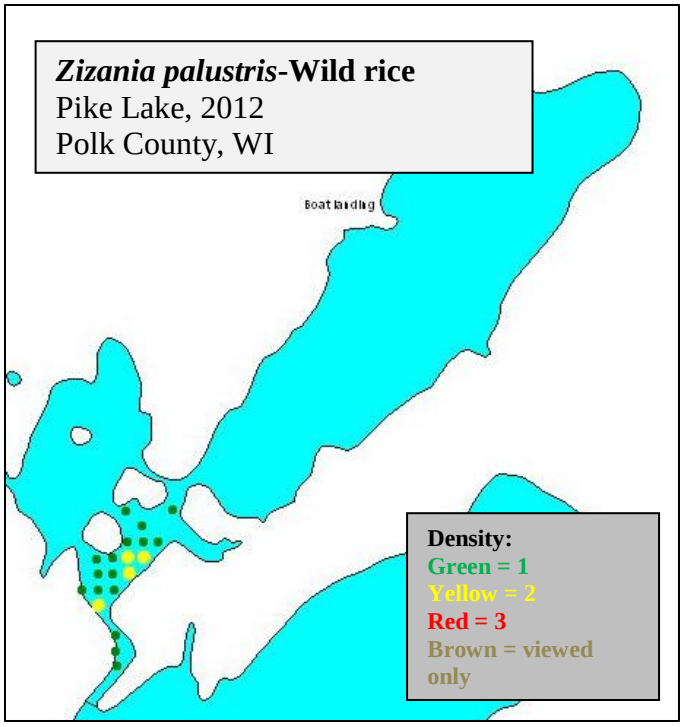


Figure 24. Pike Lake Wild Rice Distribution

Aquatic Plant Survey Results – North Twin

The plant community in North Twin Lake was evaluated in June and July 2012. There were 364 sample points in the sample grid generated by the Wisconsin Department of Natural Resources.

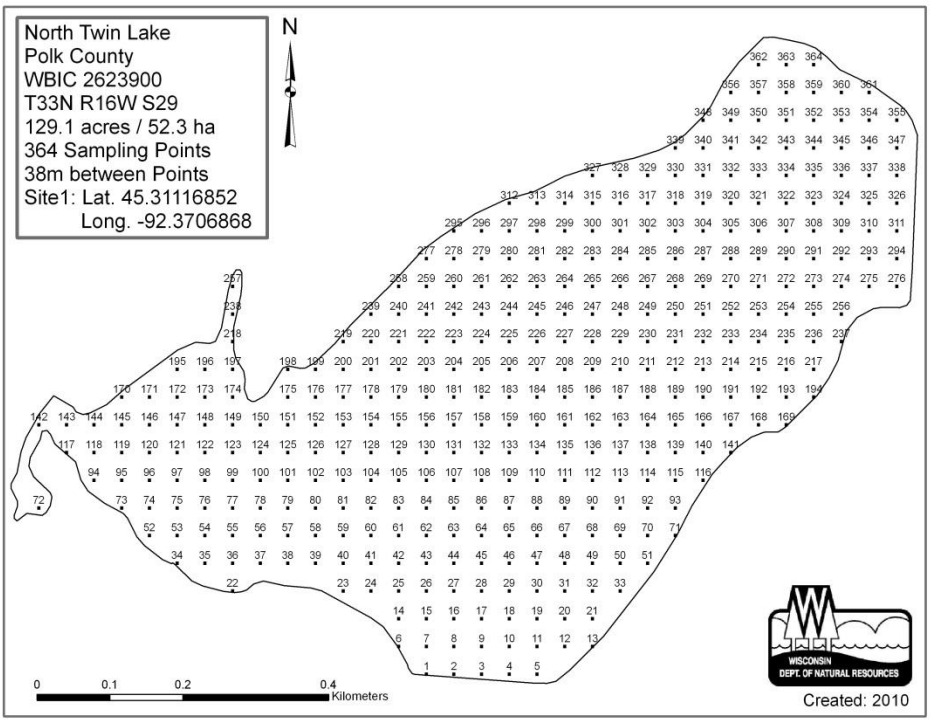


Figure 25. North Twin Sample Point Grid

The maximum depth of plants (limit of the littoral zone) was 18.5 feet. Plants grow to this depth because of good light penetration. There were 321 sample points in the littoral zone, and plants were sampled in 313 of these points, or 97.5%. This is high plant coverage within the littoral zone.

Table 11. North Twin Plant Survey Statistics

Total number of sites in grid	364
Total number of sites with vegetation	313
Total number of sites shallower than maximum depth of plants	321
Frequency of occurrence at sites shallower than maximum depth of plants	97.51
Simpson Diversity Index	0.87
Maximum depth of plants (ft)	18.50
Average number of all species per site (shallower than max depth)	3.10
Average number of all species per site (veg. sites only)	3.19
Average number of native species per site (shallower than max depth)	3.07
Average number of native species per site (veg. sites only)	3.16
Species Richness	29
Species Richness (including visuals)	31

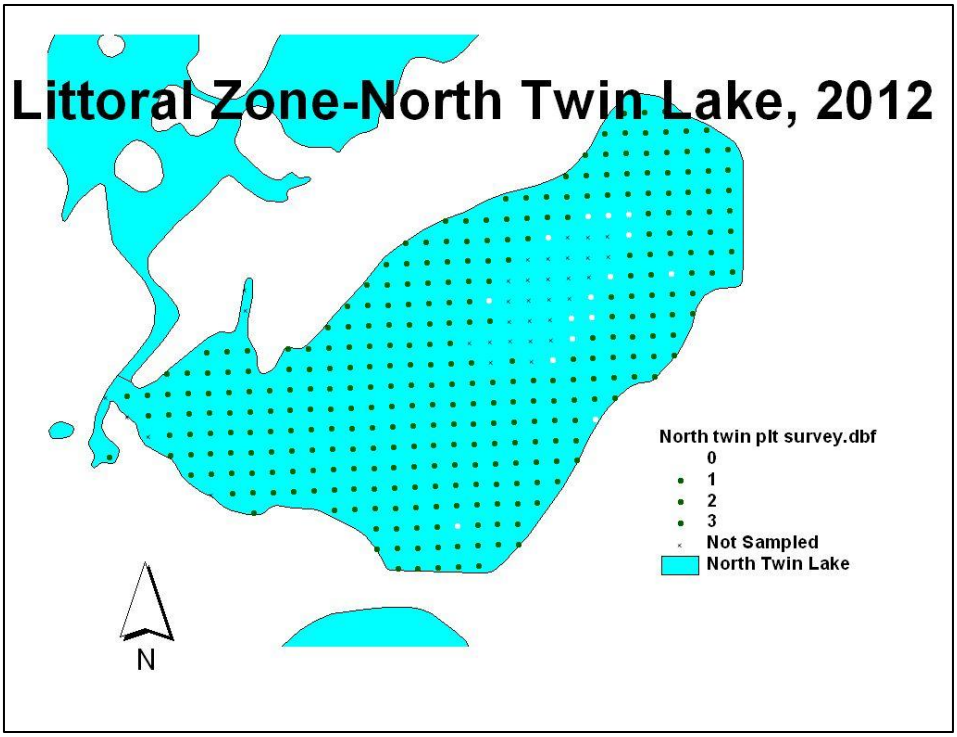


Figure 26. North Twin Lake Littoral Zone

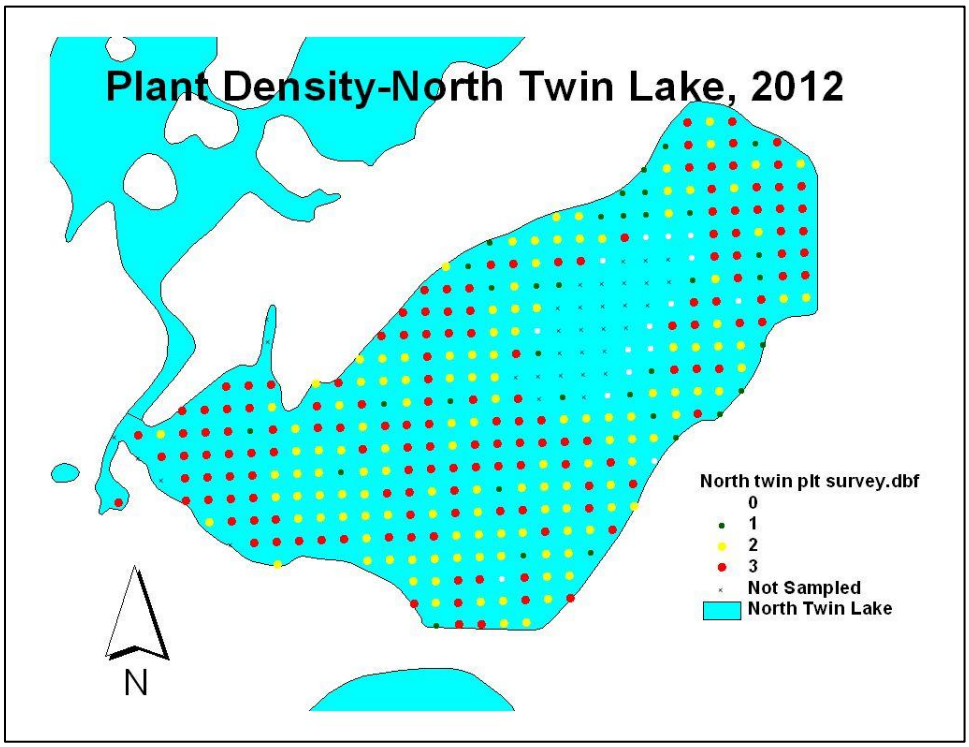


Figure 27. North Twin Plant Density

The density of plant growth in North Twin Lake is quite high. There were numerous sample points with a rake density rating of "3", which is the highest rating. Most of the plant growth

consists of submergent plants which remain largely under the surface. There are a few areas, especially the west basin near the narrows coming in from Pike Lake, where plants reach the surface and create thick plant cover. This did not appear to create a navigation issue at the time of the survey.

Table 12. North Twin Aquatic Plants

Species	Freq. Littoral	Freq. Veg.	Rel. Freq.	# Sampled	Mean Density	# Viewed
Ceratophyllum demersum, Coontail	68.05	66.36	21.3	213	1.60	1
Potamogeton robbinsii, Fern pondweed	63.26	61.68	19.8	198	1.43	
Myriophyllum sibiricum, Northern water milfoil	41.85	40.81	13.1	131	1.04	10
Potamogeton zosteriformis, Flat-stem pondweed	34.19	33.33	10.7	107	1.42	
Elodea canadensis, Common waterweed	33.87	33.02	10.6	106	1.19	
Potamogeton praelongus, White-stem pondweed	19.17	18.69	6	60	1.28	4
Potamogeton richardsonii, Clasping-leaf pondweed	13.74	13.40	4.3	43	1.30	3
Vallisneria americana, Wild celery	13.10	12.77	4.1	41	1.20	1
Nymphaea odorata, White water lily	3.83	3.74	1.2	12	1.17	
Potamogeton crispus, Curly-leaf pondweed	3.19	3.12	1.2	12	1.50	
Potamogeton amplifolius, Large-leaf pondweed	3.51	3.43	1.1	11	1.00	4
Potamogeton pusillus, Small pondweed	3.19	3.12	1	10	1.10	
Lemna trisulca, Forked duckweed	2.24	2.18	0.7	7	1.00	
Brasenia schreberi, Watershield	1.92	1.87	0.6	6	1.00	
Chara sp., Muskgrasses	1.92	1.87	0.6	6	1.00	
Heteranthera dubia, Water star-grass	1.92	1.87	0.6	6	1.00	
Potamogeton natans, Floating-leaf pondweed	1.60	1.56	0.5	5	1.40	
Bidens beckii, Water marigold	1.28	1.25	0.4	4	1.00	1
Nuphar variegata, Spatterdock	1.28	1.25	0.4	4	1.00	
Potamogeton gramineus, Variable pondweed	1.28	1.25	0.4	4	1.00	
Sagittaria sp., Arrowhead	0.96	0.93	0.3	3	1.00	
Stuckenia pectinata, Sago pondweed	0.96	0.93	0.3	3	1.00	2
Potamogeton illinoensis, Illinois pondweed	0.64	0.62	0.2	2	1.00	
Ranunculus aquatilis, White water crowfoot	0.64	0.62	0.2	2	1.00	
Utricularia vulgaris, Common bladderwort	0.64	0.62	0.2	2	1.00	
Eleocharis acicularis, Needle spikerush	0.32	0.31	0.1	1	1.00	
Elodea nuttallii, Slender waterweed	0.32	0.31	0.1	1	1.00	
Isoetes sp., Quillwort	0.32	0.31	0.1	1	1.00	
Najas flexilis, Slender naiad	0.32	0.31	0.1	1	1.00	
Lythrum salicaria, Purple loosestrife	view	only				1
Sagittaria rigida, Sessile-fruited arrowhead	view	only				1

The North Twin Lake plant community is fairly diverse, with a species richness of 29. The Simpson's diversity index is 0.87, which is moderate for diversity. On average, there were 3.16

different native plant species sampled per sample point where vegetation was present. The highest diversity occurred in the west basin near the narrows connecting to Pike Lake and in the southern most bay near the outlet. Figure 28 shows the species richness (number of different plant species) at each sample point.

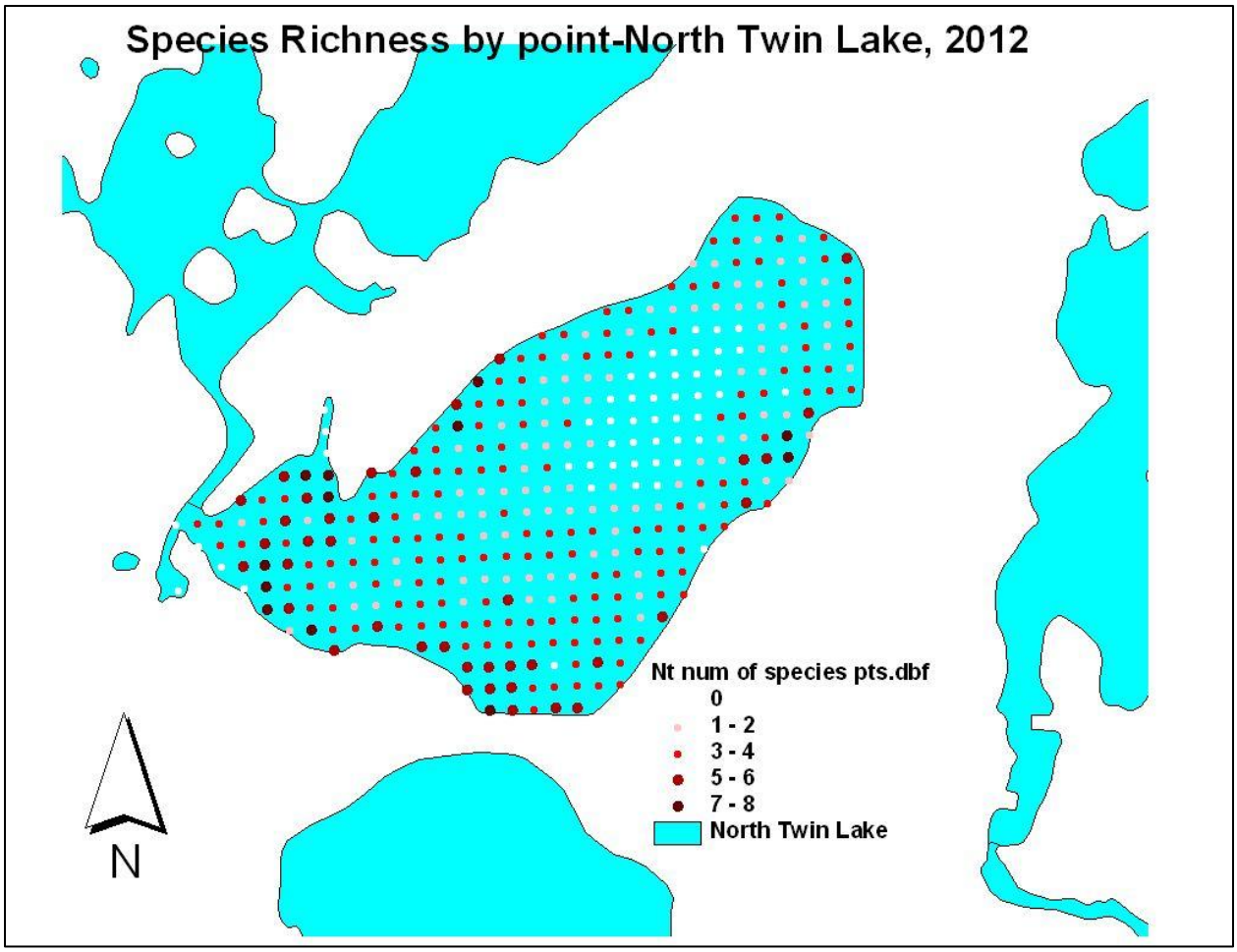


Figure 28. North Twin Lake Species Richness

Coontail (*Ceratophyllum demersum*) was the most common plant sampled. Coontail has finely branched leaves that provide excellent habitat for invertebrates. It also serves as an important habitat for fish. Coontail can absorb large amounts of nutrients, is often common, and can dominate in high nutrient lakes.

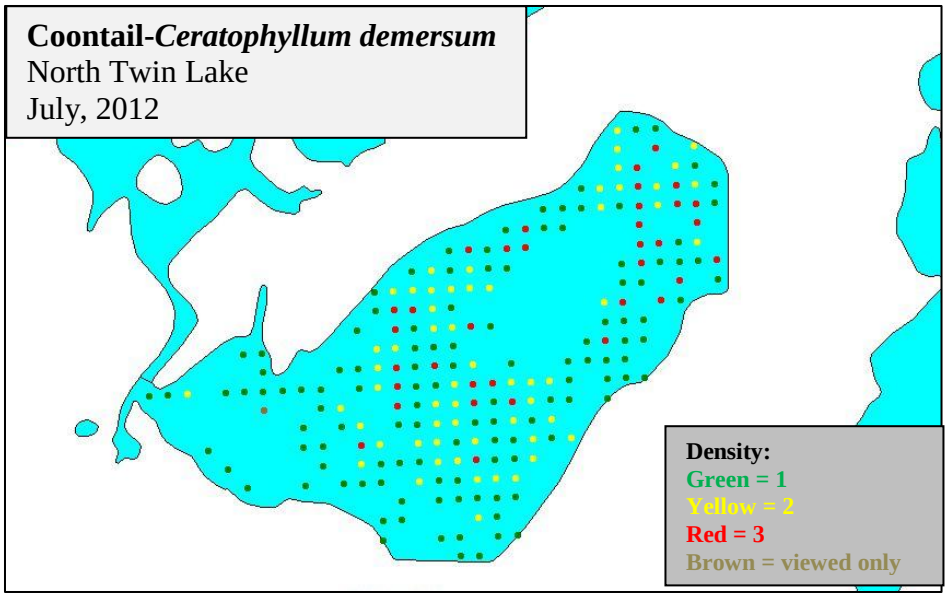


Figure 29. North Twin Distribution of Coontail

Fern pondweed (*Potamogeton robbinsii*) was the second most common plant sampled in North Twin Lake. Fern pondweed is very common in Wisconsin lakes. It provides good habitat for fish and invertebrates. This plant also has the ability to survive in the lower light conditions of deep water. As a result, fern pondweed frequently covers deep areas of the littoral zone edge. Fern pondweed also can survive and remain robust throughout winter.

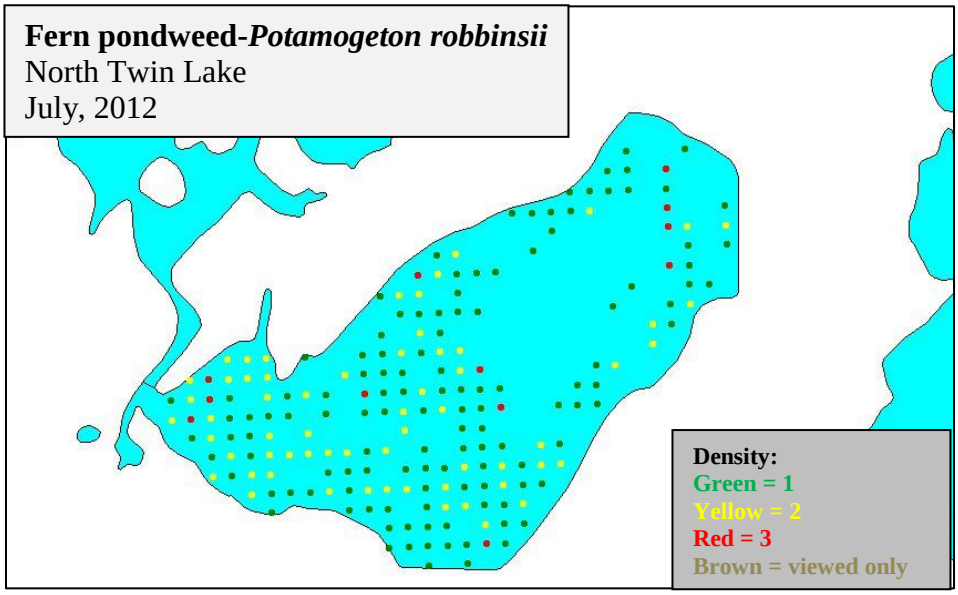


Figure 30. North Twin Distribution of Fern Pondweed

Northern water milfoil (*Myriophyllum sibiricum*) was the third most abundant plant sampled. This plant is a common native water milfoil. Its finely divided leaves provide excellent habitat for planktonic organisms, thus providing an integral habitat in the lake ecosystem.

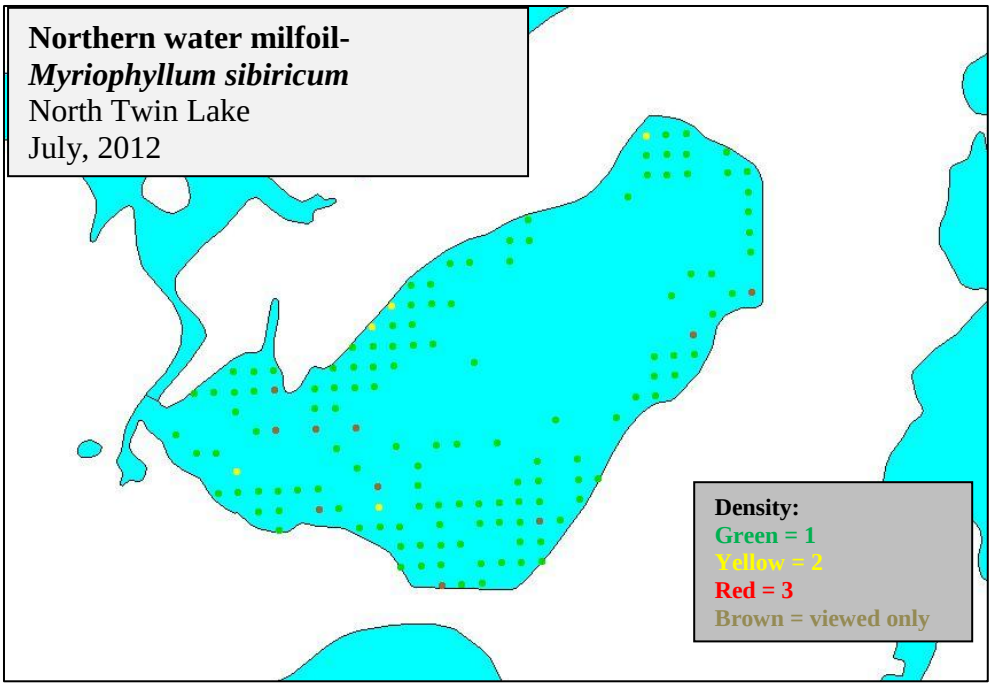


Figure 31. North Twin Distribution of Northern Water Milfoil

Aquatic Plant Survey Results – South Twin

The plant community in South Twin Lake was evaluated by Jeremy Williamson July 31 and August 4, 2006. The Department of Natural Resources established 273 sampling points for South Twin Lake. Selected points were then sampled in field. Of the 233 points selected, all sites had vegetation except two (Figure 32).

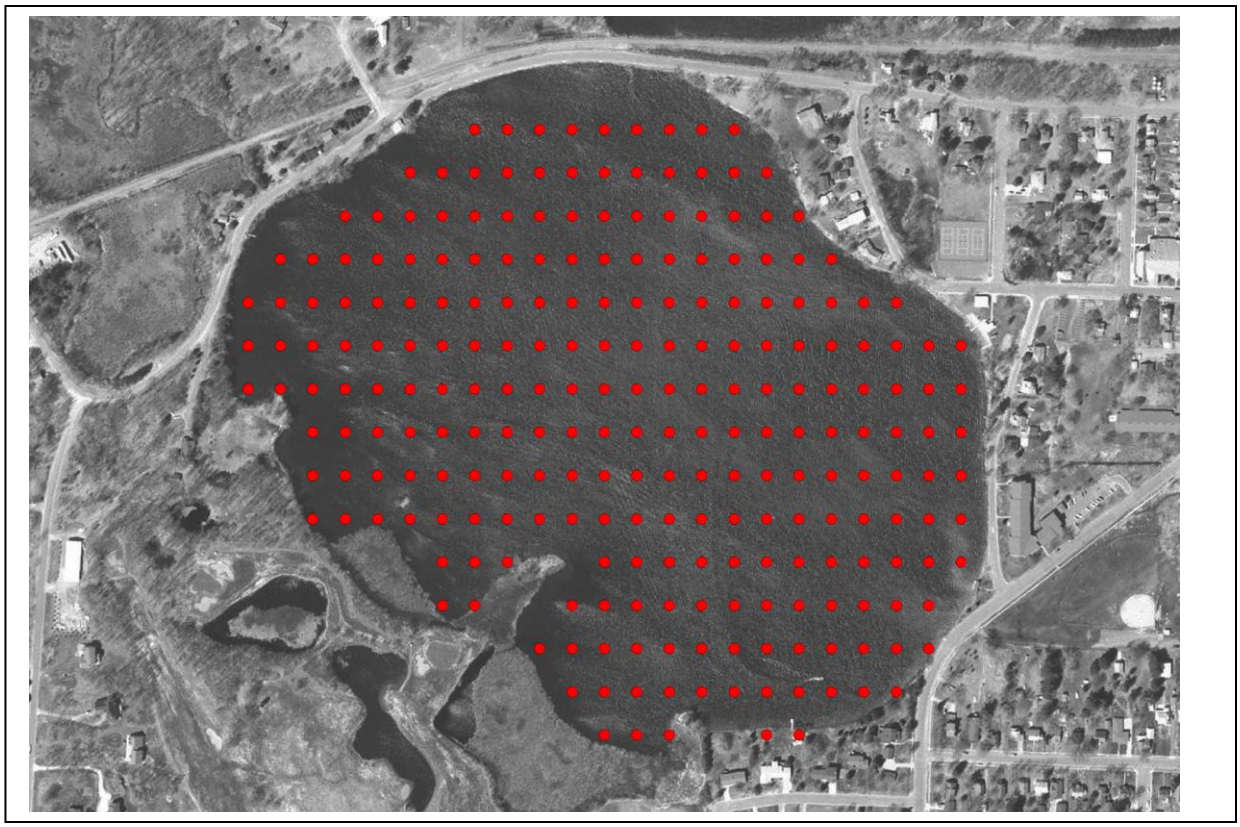


Figure 32. South Twin Sample Point Grid

The maximum depth of plants (limit of the littoral zone) was 8.80 feet. Plants grow throughout the lake, so the entire lake is littoral.

Table 13. South Twin Plant Survey Statistics

Total number of sites in grid	233
Total number of sites with vegetation	231
Total number of sites shallower than maximum depth of plants	233
Frequency of occurrence at sites shallower than maximum depth of plants	99.14
Simpson Diversity Index	0.90
Maximum depth of plants (ft)	8.80
Average number of all species per site (shallower than max depth)	5.03
Average number of all species per site (veg. sites only)	5.07
Average number of native species per site (shallower than max depth)	5.03
Average number of native species per site (veg. sites only)	5.07
Species Richness	32
Species Richness (including visuals)	37

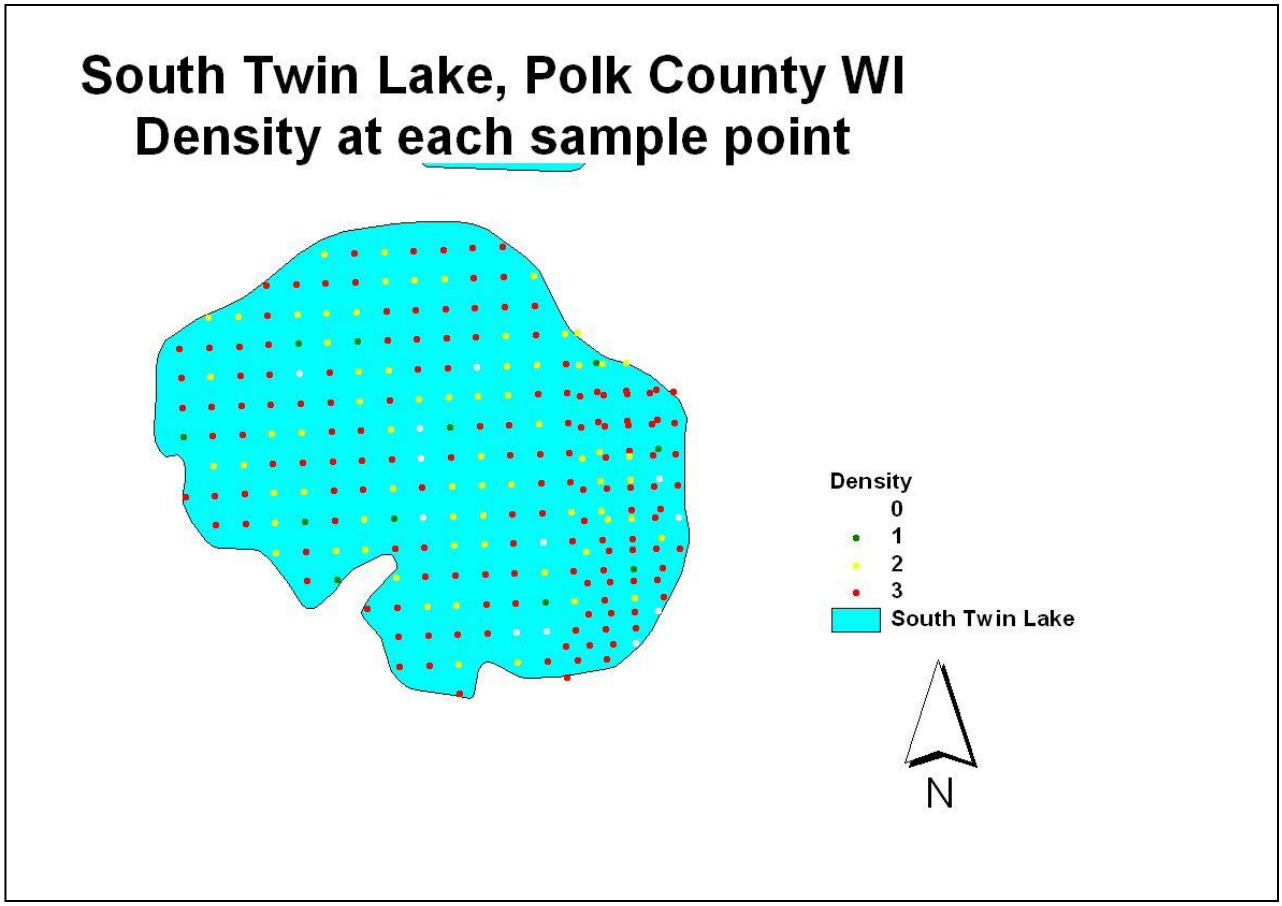


Figure 33. South Twin Plant Density

The density of plant growth in North Twin Lake is quite high. There were numerous sample points with a rake density rating of "3", which is the highest rating. There is dense plant growth throughout the lake, especially on the east shore. Many of the plants normally considered submergent reach to near or at the lake surface.

Table 14. South Twin Aquatic Plants

Species	Freq. Littoral	Freq. Veg.	Rel. Freq.	# Sampled	Mean Density	# Viewed
Potamogeton robbinsii, Fern pondweed	89.27	90.04	17.7	208	2	
Ceratophyllum demersum, Coontail	81.97	82.68	16.3	191	1	
Elodea canadensis, Common waterweed	69.10	69.70	13.7	161	1	
Potamogeton zosteriformis, Flat-stem pondweed	46.35	46.75	9.2	108	1	
Myriophyllum sibiricum, Northern water milfoil	37.77	38.10	7.5	88	1	1
Potamogeton amplifolius, Large-leaf pondweed	33.91	34.20	6.7	79	1	3
Potamogeton illinoensis, Illinois pondweed	20.60	20.78	4.1	48	1	
Lemna trisulca, Forked duckweed	19.74	19.91	3.9	46	1	
Vallisneria americana, Wild celery	19.31	19.48	3.8	45	1	
Potamogeton pusillus, Small pondweed	18.45	18.61	3.7	43	1	
Heteranthera dubia, Water star-grass	13.73	13.85	2.7	32	1	
Potamogeton foliosus, Leafy pondweed	7.73	7.79	1.5	18	1	
Potamogeton praelongus, White-stem pondweed	7.30	7.36	1.5	17	1	
Ranunculus aquatilis, White water crowfoot	6.44	6.49	1.3	15	1	
Brasenia schreberi, Watershield	5.58	5.63	1.1	13	1	1
Nymphaea odorata, White water lily	5.15	5.19	1	12	2	1
Potamogeton natans, Floating-leaf pondweed	3.00	3.03	0.6	7	1	
Potamogeton gramineus, Variable pondweed	3.00	3.03	0.6	7	1	
Najas flexilis, Slender naiad	3.00	3.03	0.6	7	1	
Chara sp., Muskgrasses	2.58	2.6	0.5	6	1	
Nuphar variegata, Spatterdock	2.15	2.16	0.4	5	1	
Eriocaulon aquaticum, Pipewort	1.72	1.73	0.3	4	1	
Myriophylum vertidilatum, Whorled water milfoil	0.86	0.87	0.2	2	1	
Sagittaria sp., Arrowhead	0.86	0.87	0.2	2	1	
Stuckenia pectinata, Sago pondweed	0.43	0.43	0.1	1	1	
Potamogeton richardsonii, Clasping-leaf pondweed	0.43	0.43	0.1	1	1	
Bidens beckii, Water marigold	0.43	0.43	0.1	1	1	
Eleocharis palustris, Creeping spikerush	0.43	0.43	0.1	1	1	
Eleocharis acicularis, Needle spikerush	0.43	0.43	0.1	1	1	
Isoetes sp., Quillwort	0.43	0.43	0.1	1	1	
Juncus paleocarpus f. submersus, Brown fruited rush	0.43	0.43	0.1	1	1	
Nitella sp.	0.43	0.43	0.1	1	1	
Sparaganium americanum, American bur-reed						2
Pontederia cordata, Pickeral weed						2
Typha angustifolium, Narrow-leafed cattail						1

The South Twin Lake plant community is very diverse, with a species richness of 37. The Simpson's diversity index is 0.90, which is moderate for diversity. On average, there were 5.07 different native plant species sampled per sample point where vegetation was present. Figure 34 shows the species richness (number of different plant species) at each sample point.

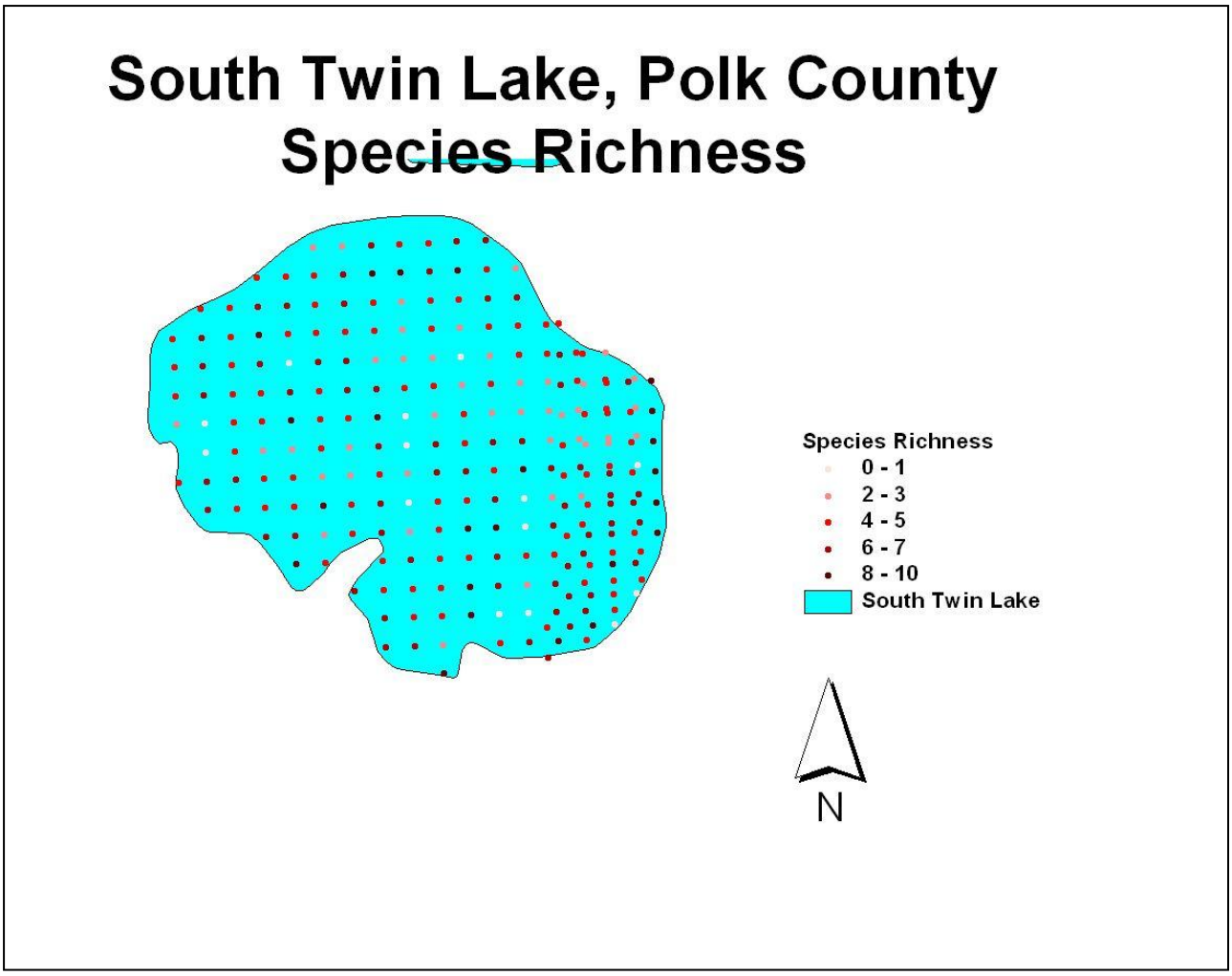


Figure 34. South Twin Lake Species Richness

Fern pondweed (*Potamogeton robbinsii*) was the most common plant sampled in South Twin Lake. Fern pondweed is very common in Wisconsin lakes. It provides good habitat for fish and invertebrates. This plant also has the ability to survive in the lower light conditions of deep water. As a result, fern pondweed frequently covers deep areas of the littoral zone edge. Fern pondweed also can survive and remain robust throughout winter.

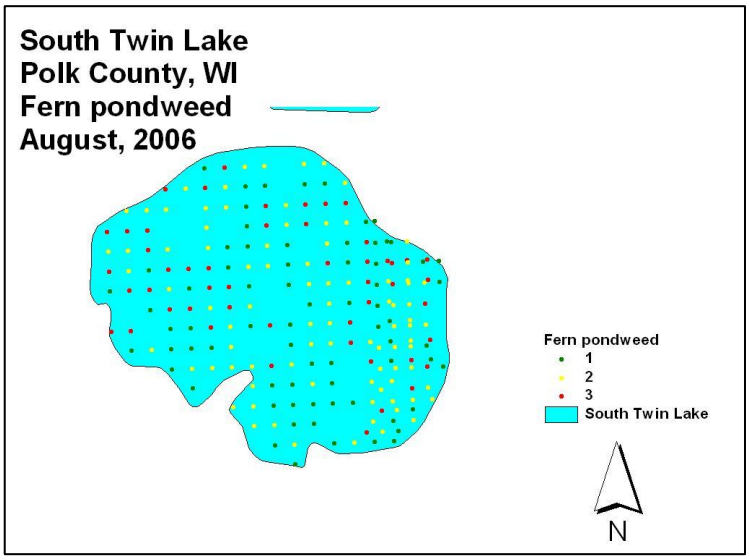


Figure 35. South Twin Distribution of Fern Pondweed

Coontail (*Ceratophyllum demersum*) was the second most common plant sampled. Coontail has finely branched leaves that provide excellent habitat for invertebrates. It also serves as an important habitat for fish. Coontail can absorb large amounts of nutrients, is often common, and can dominate in high nutrient lakes.

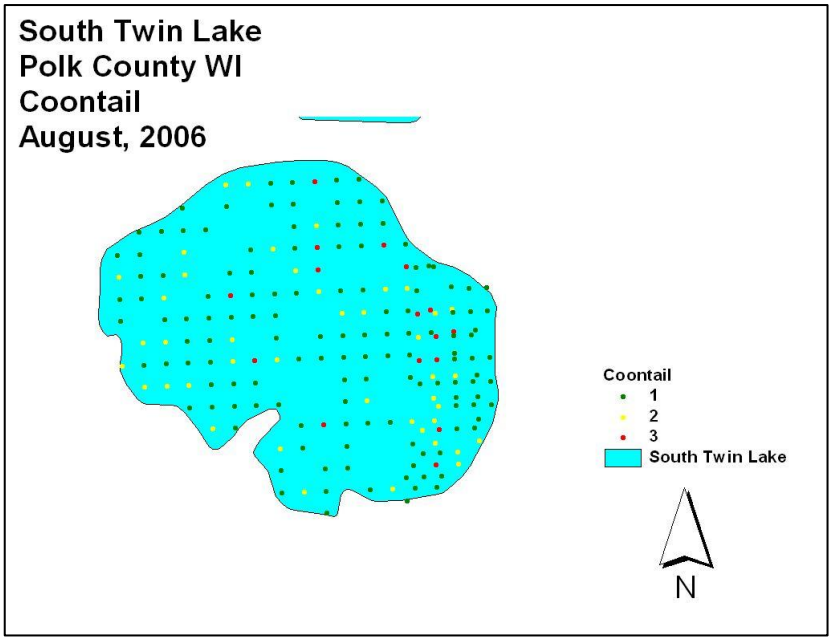


Figure 36. South Twin Distribution of Coontail

Floristic Quality Index

Evaluation of the plant community can indicate changes in habitat and water quality from human development using a tool known as the Floristic Quality Index (FQI). This index uses the number of species sampled on the rake and a conservatism value given to certain plants. The greater the conservatism value (ranges from 1-10), the less tolerant the plant is to changes in habitat disturbances. The habitat changes are compared to pre-development characteristics in the lake (prior to human disturbances in lakes).

Dr. Stanley Nichols of UW-Extension surveyed numerous lakes in various eco-regions around Wisconsin. He then calculated the median number of species, median conservatism value, and the median FQI for each eco-region. (Nichols, 1999) FQI results for Amery Lakes are reported below and compared to the eco-region median. All parameters in the FQI for Amery Lakes are higher than the eco-region median for North Central Hardwood Forests. The FQI for Amery Lakes demonstrates that the plant community is healthy and is showing little negative response to habitat changes.

Table 15. Amery Lakes Floristic Quality Index Data

FQI value	Eco-region median	Pike Lake 2012	North Twin 2012	South Twin 2006
Number of Species	14	43	27	36
Mean Conservatism	5.6	6.46	6.15	6.44
FQI	20.9	42.39	31.95	36.87

Invasive Species

Curly Leaf Pondweed

Ecological Integrity Service conducted a survey to assess the location of the invasive species curly leaf pondweed *(Potamogeton crispus*) in Pike and North Twin Lakes in June 2012. Curly leaf pondweed (CLP) is most robust in early summer.

Pike Lake CLP

The majority of the CLP is located in the northeast end of Pike Lake. The west side of this bay has a rather large, fairly dense bed, which is shown in Figure 37. There are also a few plants or clumps of plants in the eastern bay on the end of the lake. This area has more sporadic growth with no real beds present. CLP was not sampled or viewed in any other regions of the lake in June 2012.

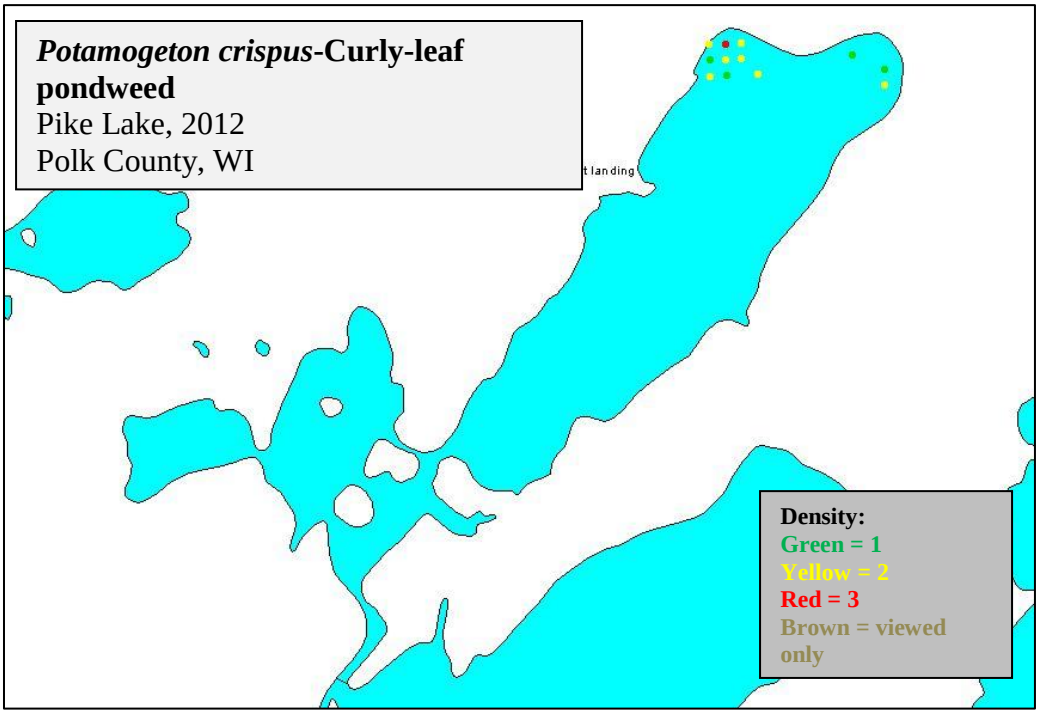


Figure 37. Pike Lake Curly Leaf Pondweed Distribution June 2012

North Twin CLP

CLP was sampled in 12 locations in North Twin Lake. There were small beds in the northeast and southeast bays (see density ratings of 3 in Figure 38). Consistent CLP was present in the west basin near the narrows. This area has a scattered CLP bed with a wide range of density.

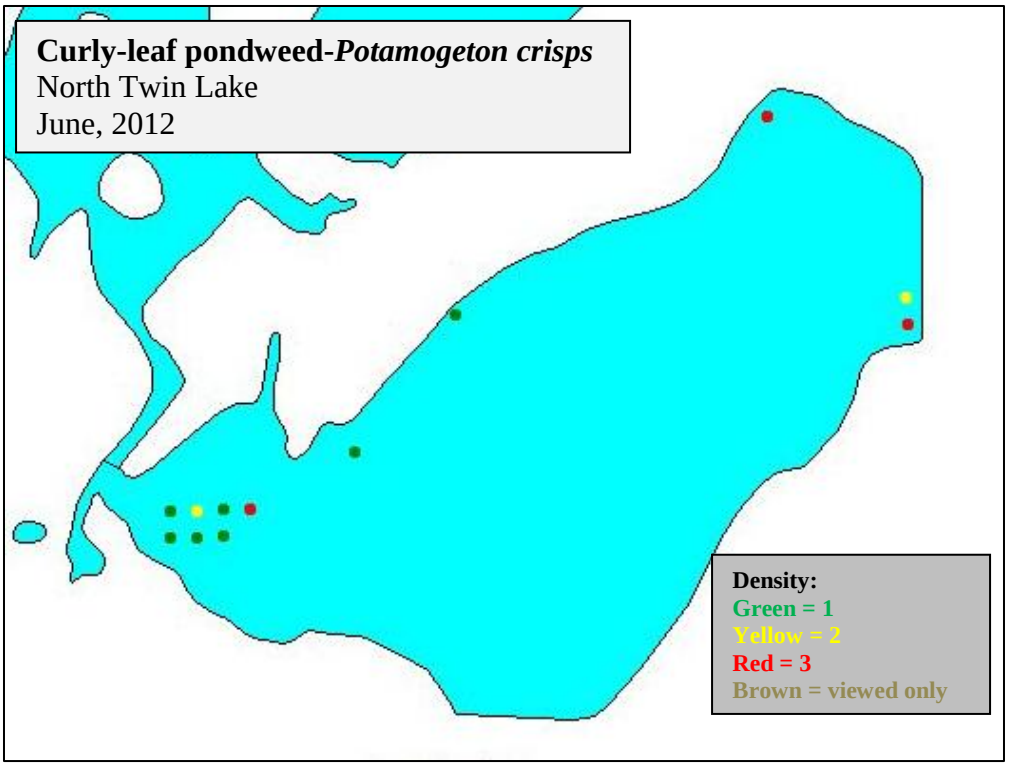


Figure 38. North Twin Curly Leaf Pondweed Distribution

South Twin CLP

Curly leaf pondweed point intercept results are not available for South Twin Lake because the lake was not sampled early enough in the year. Although the lake has not been formally sampled for curly leaf pondweed, plant surveyors observed CLP on other occasions in South Twin.[7]

Eurasian Water Milfoil

Eurasian water milfoil was first found in Pike Lake in 2010. This pioneer stand was located along the northern shore, east of the boat landing. This stand was delineated and treated with herbicide in 2010 (Figure 39). The herbicide treatment was very successful with a 100% frequency prior to treatment and a 5% frequency following treatment.

When EWM was found during subsequent monitoring it was pulled by hand. Figure 40 shows the locations of EWM during the point intercept survey of 2012. In years 2010, 2011 and 2012, divers have removed EWM from the same area where it was originally found and treated.

[7] Williamson, Jeremy, personal communication, March 20, 2014.

Monitoring and hand pulling has limited herbicide treatments used since the original treatment. The EWM had spread very little, but did show up by the landing in 2013.

Figure 39. Pike Lake Eurasian Water Milfoil Bed Treated in 2010

EWM became dense enough again in 2013 to warrant herbicide treatment. Figure 41 shows the areas delineated and treated in 2013. In 2013 the pretreatment frequency of EWM in treatment beds was 84%. Following treatment, the EWM frequency was 8%. Because the spread of EWM is a high concern, monitoring of this plant is recommended on a regular basis.

EWM Monitoring

Pike and North Twin Lakes have been surveyed very thoroughly for Eurasian water milfoil three times each year (spring, summer, and fall) since 2010. South Twin was checked once each in 2010 and 2013. Amery Lakes plant monitor, Steve Schieffer, recommends surveying Pike Lake every other week for EWM in the future. No EWM has been found in North or South Twin Lake to date.[8]

[8] Schieffer, Steve. Personal email communication. February 2014.

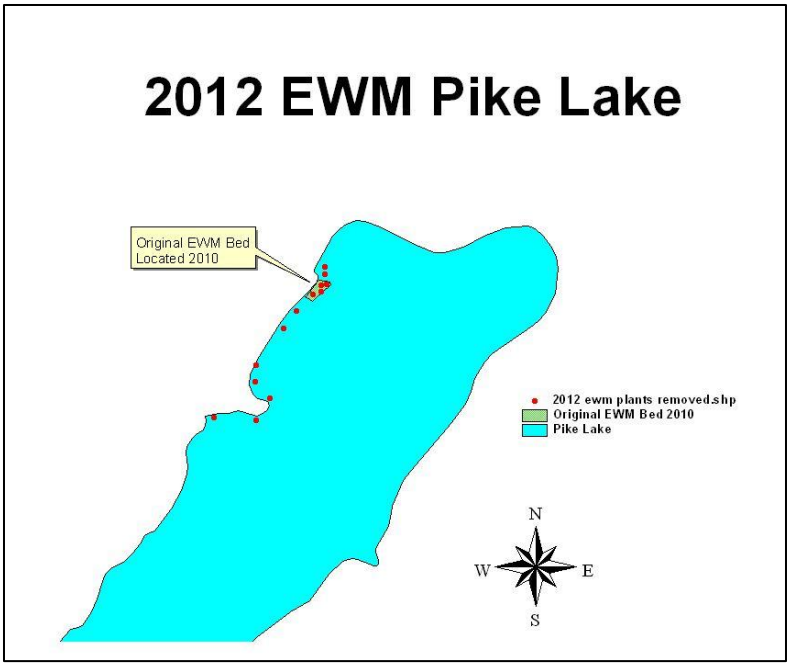


Figure 40. Pike Lake Eurasian Water Milfoil Distribution 2012

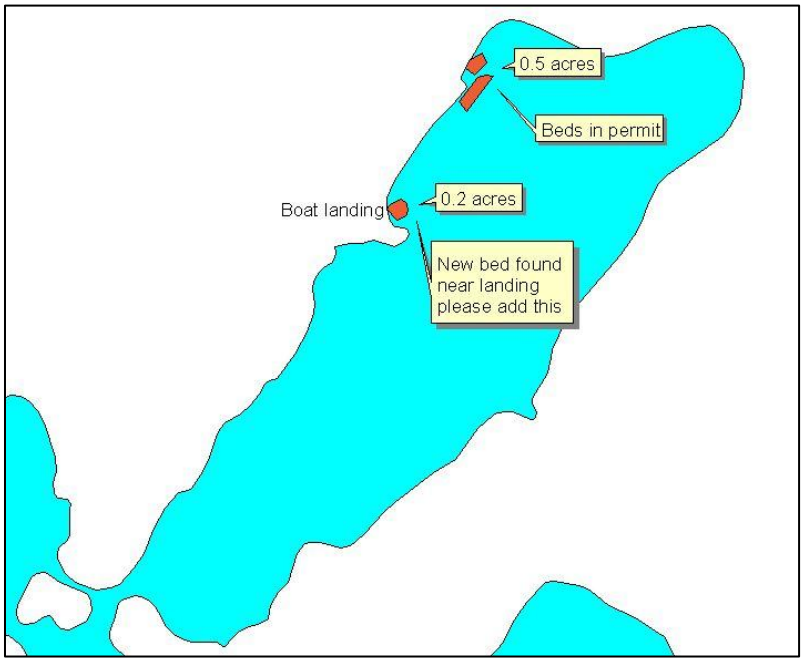


Figure 41. Pike Lake Eurasian Water Milfoil Delineated Beds 2013

Purple Loosestrife

Purple loosestrife, another invasive species, was observed on North Twin Lake in the 2012 survey as shown in Figure 42. A few plants were seen growing along the bog area in the western shore. These plants were removed. A similar number of purple loosestrife plants were found in this same area around 2004 and have been removed as discovered since that time.[9] Purple loosestrife can spread rapidly, and therefore should be monitored carefully in this important bog habitat.

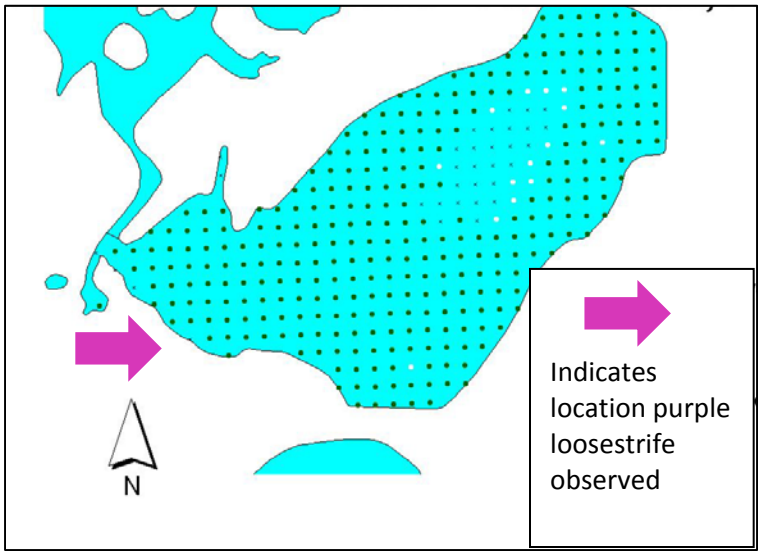


Figure 42. North Twin Lake Purple Loosestrife Observed

Figure 43. South Twin Lake Purple Loosestrife Observed

[9] Personal communication. Steve Schieffer, February 2014.

Invasive Species Information

Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a "non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)."

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

> It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.[10]

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish, and some waterfowl species feed on the seeds and winter buds.[11]

[10] Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species. Prepared by Wisconsin DNR. September 2003.

[11] Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

Curly Leaf Pondweed (*Potamogeton crispus*)[12]

Identification
Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters 1 to 3 meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as 2 meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and now spread throughout most of the United States and southern Canada.

Characteristics
New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and Dispersal
Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, they germinate in the fall, over-wintering as a small plant. The next summer they mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological Impacts
Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish

[12] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

Curly Leaf Pondweed Control[13]

Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Eurasian Water Milfoil[14]

The ecological risks associated with an infestation of Eurasian water milfoil (EWM) appear to surpass those associated with curly leaf pondweed. This plant is not yet present in North or South Twin Lakes. However, there is a high risk that Eurasian water milfoil may become established in North or South Twin because of the potential to transfer it from Pike Lake and other nearby lakes.

Department of Natural Resource scientists have also found Eurasian water milfoil in Polk County (Long Trade, Horseshoe, and Pike Lakes) and in nearby counties of Burnett (Ham, Little Trade, Shallow and Round Lakes), Barron (Beaver Dam, Sand, Kidney, Duck, Horseshoe, Lower Vermillion, and Echo Lakes), and St. Croix County (Bass Lake (T30N, R19W, S23), Goose Pond, Little Falls Lake, Mallallieu Lake, Perch Lake, The New Richmond Flowage, and Lake St. Croix) in Wisconsin. Lake users carrying plants from one of these lakes into Amery Lakes can dramatically increase the chance for colonization of EWM.

The following Eurasian water milfoil information is taken from a Wisconsin DNR fact sheet. Both Northern water milfoil and coontail, frequently mistaken for Eurasian water milfoil, are present in Amery Lakes.

Identification

Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or

[13] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter).

[14] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives.

without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Characteristics

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lakebeds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Reproduction and Dispersal

Unlike many other plants, Eurasian water milfoil 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. Milfoil is readily spread attached to boats, motors, trailers, bilges, live wells, and bait buckets. It can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring.

Ecological Impacts

Eurasian water milfoil's ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil 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.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. 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 Eurasian water milfoil may lead to deteriorating water quality and algae blooms in infested lakes.

Control Methods

Preventing a Eurasian water milfoil invasion requires various efforts. The first component is public awareness of the necessity to remove weed fragments at boat landings. Inspection programs should provide physical inspections as well as a direct educational message. Native plant beds must be protected from disturbance caused by boaters and indiscriminate plant control that disturbs these beds. A watershed management program should decrease nutrients reaching the lake and reduce the likelihood that Eurasian milfoil colonies will establish and spread.

Monitoring is also important, so introduced plants can be controlled immediately. The lake district and lakeshore owners should check for new colonies and control them before they spread. The plants can be hand pulled or raked. It is imperative that all fragments be removed from the water and the shore.

Because Eurasian water milfoil has been introduced into Pike Lake, additional control methods should (and have been) considered including mechanical control, chemical control, and biological control. As always, prevention is the best approach to invasive species management.

A good strategy for a systematic monitoring program is to target areas where the native northern water milfoil (*Myriophyllum sibiricum)* is found. This plant is often confused with Eurasian water milfoil, which looks somewhat similar. Unlike Eurasian water milfoil (EWM), northern water milfoil is native and a desirable plant to have in the lake. It has very fine leaves that provide habitat for small planktonic organisms, which make up an important part of the food chain. From a management perspective, the location of northern water milfoil can be important, because EWM and northern water milfoil grow in similar conditions. However, northern water milfoil is common throughout all Amery Lakes. As a result, all littoral regions of each lake must be monitored for EWM.

Purple Loosestrife[15]

Purple loosestrife (*Lythrum salicaria)* is a non-native plant common in Wisconsin, and found along the shore of North Twin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. 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 (underground stems) that form a dense mat.

Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river 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.

Reproduction and Dispersal

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. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems

[15] Wisconsin DNR Invasive Species Factsheets from http:/dnr.wi.gov/invasives.

of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

Ecological Impacts
Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Mechanical Control
Purple loosestrife can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps, nor root tips. Large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full 12 months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

Chemical Control
This is usually the best way to eliminate PL quickly, especially with mature plants. Chemicals used have a short soil life. Timing is important: Treat in late July or August but before flowering to prevent seed set. Always back away from sprayed areas as you go to prevent getting herbicide on your clothes. Generally, the formula designed for use on wet sites should be used. The best

method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

Glyphosate herbicides: Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Currently, glyphosate is the most commonly used chemical for killing loosestrife. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used, and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife, and there is no cost. Contact your regional Aquatic Plant Management Coordinator for a permit. He will want to know about your site, may make control suggestions, and will issue the permit.

Biological Control

Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles (*Galerucella calmariensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratu*s) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

Aquatic Plant Management

This section reviews the potential management methods available, existing management activities, and presents aquatic plant management goals and strategies for Amery Lakes.

Discussion of Management Methods

Techniques to control the growth and distribution of aquatic plants are discussed in following text. The application, location, timing and combination of techniques must be considered carefully.

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. A permit is required for any aquatic chemical application in Wisconsin. This includes granular herbicides available through mail order and internet purchase. A Department of Agriculture, Trade, and Consumer Protection pesticide applicator certification (aquatic nuisance control category) is required to apply liquid chemicals in the water.

The requirements for manual and mechanical plant removal are described in NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline limited to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.[16]

Manual Removal[17]

Manual removal involving hand pulling, cutting, or raking plants will effectively remove plants from small areas. It is likely that plant removal will need to be repeated during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seedhead production. For plants that possess rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to thirty feet wide.

[16] More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site www.dnr.wi.gov.

[17] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

Mechanical Control

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. Department of Natural Resources permits under Chapter NR 109 are required for mechanical plant removal.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from one to six feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. A harvester can also be used to gather dislodged, free-floating plant fragments such as from coontail or wild celery. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and consequently the harvesting capabilities, of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases, the plants are transported to shore by the harvester itself for disposal, while in other cases, a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm to be used as compost (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Sediment suspension and shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures do not make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since contracted machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines. Contract harvesting is not readily available in Polk County.

The 2007/08 Aquatic Plant Management Committee discussed harvesting as an option for clearing navigation channels. However, native plant growth has not reached a threshold where management has been necessary. Harvesting is not a proven successful method for CLP management. Harvesting is not recommended for native plant management at this time because of the lack of demand and likely small acreage of navigation impairment.

Diver dredging operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology should be considered. To be effective, the entire plant including the subsurface portions should be removed.

Plant fragments can be formed from this type of operation. Fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated to be effective. When applied toward a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates can play an important part in the effectiveness of a diver dredging operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little problem. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

Rotovation involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling sediments that are contaminated could possibly release toxins to the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

Biological Control[18]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

While this theory has worked in practice for control of some nonnative aquatic plants, results have been varied (Madsen, 2000). Beetles are commonly used to control purple loosestrife populations in Wisconsin with good success. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations. Grass carp introduction is not allowed in Wisconsin.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, as well as plant-specific control. On the other hand there are several disadvantages to consider, including very long control times of years instead of weeks, lack of available agents for particular target species, and relatively narrow environmental conditions for success.

Biological control is not without risks; new non-native species introduced to control a pest population, may cause problems of its own. Biological control is not currently proposed for management of aquatic plants in Amery Lakes.

[18] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

Re-vegetation with Native Plants
Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant removal is probably not necessary on Amery Lakes because a healthy, diverse native plant population is present.

Physical Control[19]

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a lake remediation technique.

Dredging is not suggested for Amery Lakes as part of the aquatic plant management plan.

Drawdown, or significantly decreasing lake water levels, can be used to control nuisance plant populations. With drawdown, the water body has water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980). Drawdown requires a mechanism to lower water levels.

Although drawdown is inexpensive and has long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and often not in a consistent fashion

[19] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

(Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals. Drawdown is not a feasible option for Amery Lakes.

Benthic Barriers, or other bottom-covering approaches, are another physical management technique. The basic idea is that the plants are covered over with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and combinations of the above (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from decomposition of plants and sediment decomposition collect under and lift the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill plants under them within 1 to 2 months, after which they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, benthic barriers are too expensive to use over widespread areas, and they heavily affect benthic communities by removing fish and invertebrate habitat. A Department of Natural Resources permit would be required for a benthic barrier.

Shading or light attenuation reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general, these techniques are of only limited applicability. Physical control is not currently proposed for management of aquatic plants in Amery Lakes.

Herbicide and Algaecide Treatments

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. Wisconsin Department of Natural Resources permits under Chapter NR 107 are required for herbicide application. **Aquatic herbicides must be applied only by licensed applicators.**

General descriptions of herbicide classes are included below.[20]

Contact Herbicides
Contact herbicides act quickly and are generally lethal to all plant cells that they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat,** and **copper** are contact aquatic herbicides.

Systemic Herbicides
Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides, and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

Broad Spectrum Herbicides
Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but they can also be used selectively under certain circumstances.

Selective Herbicides
Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

[20] This discussion is taken directly from: Managing Lakes and Reservoirs. North American Lake Management Society.

Environmental Considerations
Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community that can, in turn, affect other organisms. Or, weed control operations can affect water chemistry that in turn affects organisms.

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[21] Chemicals commonly used in Wisconsin lakes are listed and described in Table 16 below.

Table 16. Herbicides used to manage aquatic plants in Wisconsin

Brand Name(s)	Chemical	Target Plants
Captain, Nautique, Cutrine Plus	Copper compounds	Free floating and filamentous algae, also coontail, curly leaf pondweed, water celery, pondweeds
Aquathol K, Hydrothal	Endothall	Curly leaf pondweed also other submergent plants: coontail, milfoil, pondweed, water celery
Reward	Diquat	Pondweeds, coontail, Eurasian water milfoil
Aquakleen, Navigate	2,4-D	Eurasian and other milfoils

Copper[22]
Copper is an essential trace element that tends to accumulate in sediments and can be toxic to aquatic life at elevated concentrations (United States Environmental Protection Agency, June 2008).

A study completed by MacDonald et al. (2000) developed consensus based numerical sediment quality guidelines for metals in freshwater ecosystems. This study provides guidelines for metals in freshwater ecosystems that reflect threshold effect concentrations (TECs, below which harmful effects are unlikely to be observed) and probable effect concentrations (PECs, above which harmful effects are likely to be observed). The consensus based TEC for copper is 31.6 mg/kg and the consensus based PEC for copper is 149 mg/kg. Copper sediment concentrations are not available for Amery Lakes.

21 These descriptions are taken from Hoyer/Canfield: Aquatic Plant Management. North American Lake Management Society. 1997.
22 Copper background information is from the Long Lake Management Plan prepared by the Polk County Land and Water Resources Department March 2013.

2,4-D
2,4-D photodegrades on leaf surfaces after applied to leaves and is broken down by microbial degradation in water and sediments. Complete decomposition usually takes about 3 weeks in water and can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

Diquat
When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

Endothall
Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

Fluridone
Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs. Microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter when the sun's rays are less direct and days are shorter result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate
Glyphosate is not applied directly to water for weed control. However, when it does enter the water, it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Algaecide Treatments for Filamentous Algae
Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Curly Leaf Pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Early season herbicide treatment:[23]

Studies have demonstrated that curly leaf can be controlled with Aquathol K (a formulation of endothall) in 50 - 60 degree F water, and treatments of curly leaf this early in its life cycle can prevent turion formation. Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are yet dormant, this early season treatment selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center are conducting trials of this method.

Because the dosage is at lower rates than dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[24]

Eurasian Water Milfoil

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: complexed copper, 2,4-D, diquat, endothall, fluridone, and triclopyr. Early season treatment of Eurasian water milfoil is also recommended by the Department of Natural Resources to limit the impact on native aquatic plant populations. Herbicide use may be necessary to rapidly respond to an infestation if discovered in Amery Lakes.

[23] Research in Minnesota on Control of Curly Leaf Pondweed. Minnesota Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

[24] Personal communication, Frank Koshere. March 2005.

Current and Past Aquatic Plant Management Activities

Aquatic Invasive Species Management

Amery Lakes Aquatic Invasive Species (AIS) Management includes resident education which occurs primarily through its newsletter, the Clean Boats Clean Waters Program, and Lake Monitoring.

Clean Boats Clean Waters (CBCW) Program

Clean Boats Clean Waters educators provide boaters with information on the threat posed by Eurasian Milfoil and other invasive species. They offer tips on how to keep boats, trailers and equipment free of aquatic hitchhikers. They also collect information on boater behavior, concerns, and knowledge of existing local and state laws related to anti-AIS measures.

CBCW staffing is provided on the North Twin and Pike Lake Landings. In 2012, landings were staffed for 120 hours in total. Because of low traffic at the North Twin Landing, most of the time is spent on Pike Lake. The Amery Lakes District received a WDNR grant to support the CBCW in 2014. Staff members are students hired in cooperation with the City of Amery which provides payroll administrative support.

Figure 44. Scuba Diving to Monitor for Eurasian Water Milfoil on Pike Lake

Lake Monitoring

The objective of lake monitoring is to look for new invasive species, track the spread of Eurasian water milfoil and curly leaf pondweed , and perform lake chemistry and secchi disk measurements.

Rapid Response for New Aquatic Invasive Species
The activity is intended to control any new invasive species that are found in the lake. The rapid response protocol is found in Appendix B.

Navigation Management

The Amery Lakes District contracted for harvesting and some chemical control of aquatic plants from 1982 until 2001. The location of harvesting or chemical control is not specified, but likely includes the channel between Pike and North Twin Lakes and appears to include private frontages at least in some years. Lake District aquatic plant control expenses ranged from $1,000 to $3,680 (average $2,627) from 1983 to 1989. Expenses ranged from $4,940 to $11, 060 (average $8,911) from 1990 to 2001.[25] Although the WDNR does not have records, aquatic plant harvesting and/or chemical control may have occurred in previous years.

The Amery Lakes District maintained a navigation channel between Pike and North Twin Lakes over the years. A 25 foot by 400 foot navigation channel was treated with herbicides in 1990, 1992, 1994, and 1997 according to WDNR permit records. The channel was also treated to remove lily pads in 1989 according to a Lakes District invoice from the contractor. In 1988 there was a permit for treating algae in the navigational channel.

The Lakes District has not maintained navigation channels on Amery Lakes in recent years.[26] Instead, boat traffic has kept navigation channels open.

The Department of Natural Resources Northern Region Aquatic Plant Management Strategy (May 2007) requires documentation of impaired navigation or nuisance conditions before native plants may be managed with herbicides or harvesting. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface.

Documenting Impaired Navigation or Nuisance Conditions

Impairment of navigation

- Locate navigation routes with GPS coordinates
- Provide dimensions (length, width, and depth)
- Indicate when plants cause problems and how long problems persist
- List adaptations or alternatives considered to lessen problem
- List the species of plants causing the nuisance

Nuisance conditions

- Indicate when plants cause problems and how long problems persist
- Include photos of nuisance conditions
- Provide examples of specific activities that are limited because of presence of nuisance aquatic plants

[25] Lake District Treasurer, Jon Bergquist and Lake District Secretary, Bruce DeLong records. March 2014.
[26] Sundeen, Mark. WDNR, Email Communication, February 24, 2014.

City of Amery Algae and Swimmer's Itch Control

North Twin
The City treated North Twin Lake for algae occasionally (4 or 5 times) during the 1970s and 80s.

South Twin
Slurry applications of copper sulfate were used at the city beach on South Twin in the 1980s in an attempt to control swimmer's itch. Native plants were also sprayed at the beach, generally just prior to the swim season. The City also treated around the lake for algae control, at least occasionally, in the 1970s through the 1980s.

Private Waterfront Herbicide Application[27]

Pike Lake
From the mid 1980s through 2007 private riparian owners contracted with commercial applicators to apply herbicides for aquatic plant control on one to four sites. Recent riparian treatments are summarized in Table 17. Private owners also occasionally cooperatively treated areas of lily pads (25,000 to 45,000 ft^2).

North Twin
From the mid 1980s through 2006 private riparian owners contracted with commercial applicators to apply herbicides for aquatic plant control on three to seven sites on North Twin Lake. There were two to three sites where treatment occurred from 1970 through the early 1980s. Recent treatments are summarized in Table 17.

Table 17. Waterfront Herbicide Treatments on Amery Lakes

Lake/Year	Property Owners	Maximum Allowed Acres
Pike Lake		
2007	4	.68
2006	2	.34
2001	1	.11
2000	1	.11
1999	1	.11
1998	1	.11
North Twin		
2006	2	.34
2005	1	.17
2004	1	.17
2003	2	.34
2002	4	?
2001	1	.17
2000	5	.63
South Twin		
2000-2002	1	?

[27] Sundeen, Mark, WDNR, Email Communication, February 26, 2014, from permit records since 1970.

The WDNR Northern Region released an Aquatic Plant Management Strategy in the summer of 2007 to protect the important functions aquatic plants provide in lakes. As part of this strategy, the WDNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.[28] Permits for waterfront corridors were issued in 2008 only for formerly permitted sites where impairment of navigation and/or nuisance conditions were demonstrated. Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners is carefully reviewed. The WDNR has not allowed removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented.

The WDNR recommends (and may require) that residents who wish to maintain an opening for boating and swimming use rakes or other hand methods.

[28] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

Plan Goals, Objectives, and Strategies

Plan goals, objectives and strategies or actions are detailed below. The implementation plan or work plan details how action steps will be carried out over the next two year period. This implementation plan will be updated annually in June to keep actions and budgets current.

Goals are broad statements of direction.
Objectives are the detailed direction or desired result under each goal.
Strategies and actions are the means to reach the selected goals and objectives.

GOALS (in priority order)

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

GOAL 2. Preserve our diverse native plant community

GOAL 3. Increase understanding regarding aquatic plants and their management

GOAL 4. Allow navigation for fishing and boating

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

Definition: Aquatic Invasive Species (AIS) are non-native plant species that can out-compete and overtake native plant species damaging native lake habitat and sometimes creating nuisance conditions. AIS currently in Amery Lakes include Eurasian water milfoil (EWM - Pike Lake only), curly leaf pondweed (CLP - all lakes), purple loosestrife (PL - North and South Twin. Additional AIS threaten Amery Lakes.

OBJECTIVES

A. Limit EWM coverage in Pike Lake to < ¼ acre (original area discovered in 2010)
B. Prevent EWM spread into North and South Twin Lakes
C. Control CLP only if navigation is impaired or threatened by expanded area (10 acres in a given lake) that remains over several years (at least 3)
D. Remove PL as it is discovered
E. Be ready to rapidly respond to new AIS introduction

MANAGEMENT STRATEGIES/ACTIONS

1. Establish and follow protocols for regular AIS monitoring of Amery Lakes. (OBJ A-E)

   Involve professionals, students, and citizens in AIS monitoring

Table 18. Amery Lakes AIS Monitoring Matrix

	Professional Surveys[29]	**Student Survey**[30]	**Volunteer AIS**
Eurasian Water Milfoil			
Pike Lake	July, August, September. Monitor entire littoral zone by cruising in a boat. Monitor areas around landings and public docks by kayak with a scope viewer. In area near landing, take additional 20 random samples.	Annually first week of May and first week of June. Monitor entire littoral zone for AIS. Sample all milfoil observed to verify native from non-native.	Monitor specific assigned areas
North Twin	July, August, September. Monitor entire littoral zone by cruising in a boat. Monitor areas around landings and public docks by kayak, with scope viewer. In area near landing, take additional 20 random samples.	Annually first week of May and first week of June. Monitor entire littoral zone for AIS. Sample all milfoil observed to verify native from non-native. View areas around/adjacent to narrows connection more thoroughly.	Monitor specific assigned areas
South Twin	July, August, and September: landings and inlet	Monitor entire lake each year the second week of May.	Monitor specific assigned areas
Curly Leaf Pondweed			
Pike Lake		Annually- May/June: Bed Maps and Sample Points	
North Twin		Annually- May/June: Bed Maps and Sample Points	
South Twin		Annually- May/June: Bed maps and sample points	
Purple Loosestrife			
All Lakes	Monitor riparian zones in all lakes in late July (when flowering).		Lake Perimeters Each July/August

[29] Professional surveys are currently provided by Jeremy Williamson, Polk County Land and Water Resources Department and Steve Schieffer. Both are currently Amery Lakes District board members.

[30] Student surveys are currently provided by students in Amery High School Freshwater Ecology led by Steve Schieffer, teacher and Amery Lakes District Chair.

- All monitoring records to be sent to and compiled by the Polk County Land and Water Resources Department (LWRD) AIS Coordinator.

- Volunteers will be recruited and trained through an Amery Community Education Class provided by Polk County LWRD, University of Wisconsin Extension, and/or the Department of Natural Resources. Volunteer tools and reporting will be developed for this training. Citizen Lake Monitoring Protocols will be followed when available. Training will be included for all AIS species mentioned above and others that are a likely threat.

2. Control Eurasian water milfoil as quickly as possible. (OBJ A and B)
   - Scattered growth or clumps of less than (200 ft^2) will be pulled by hand when discovered during monitoring; locations will be recorded with GPS points.
   - Discrete beds of EWM growth greater than (400 ft^2)[31] will be controlled with aquatic herbicides using accepted procedures.
   - Discretion will be used to select appropriate management for beds in between sizes indicated above.

EWM Herbicide Treatment Procedures

1) Identify and treat beds with mean density of 2 or higher that are at least 500 ft^2. Small beds in close proximity may be combined into one bed to provide better treatment results.

2) Apply for APM permits in February based on monitoring from the previous year and adjusted as needed from the spring pretreatment survey.

3) Treat beds using 2,4-D at accepted dosage levels. Liquid or granular forms may be used. Treatment times and water temperatures are targeted to limit damage to native aquatic plants.

- Treatment concentration: Granular (at 3-4 ppm) or liquid (at 2-3 ppm) 2,4-D.
- Treatment will occur when water temperatures are between 45 and 58 degrees F. No treatment will occur once temperatures exceed 60 degrees F.
- Herbicide must be applied when conditions are calm *as authorized by Amery Lakes District*. The maximum wind speed at time of application will be <10 mph as measured on-site. The forecast wind speed (including gusts) for the 24 hours following application will not be greater than 15 mph.

4) Complete pre and post monitoring using standardized WDNR protocols.

[31] Sundeen, Mark, email communication. DNR has no minimum size for treatment.

3. Control curly leaf pondweed when navigation is impaired or plant coverage is rapidly expanding. (OBJ C)
   - Encourage hand-pulling by lake residents at any time.
   - Control areas of severe navigation impairment or rapid expansion using a low-dose, early season Endothall treatment according to accepted procedures as outlined below or updated with new information.

CLP Herbicide Treatment Procedures

1) Standards for when CLP treatment may be warranted:
   - identified as a severe spring navigation impairment or rapid expansion
   - CLP growth on an individual lake maintains 10 acres
   - May/June curly leaf pondweed stem growth reaches surface and is thick enough to impede navigation (stem height > 1 meter)
   - bed has a coverage of at least 50%
   - density rating averages >2 (on a 0-3 scale)
   - treatment success is likely (not near substantial drop-off (greater than 10 feet mean depth change), wide rather than narrow band, etc.)

2) Apply for APM permits for CLP early season Endothall treatment for spring navigation channels and/or CLP beds in February based on monitoring from the previous year.

3) Conduct treatment according to permit conditions.

4) Pre and post monitoring procedures to be completed by a professional volunteer or consultant hired by the District Board and supervised by the AMERY LAKES DISTRICT according to standard DNR methods.

5) Monitor sediment turions in treated beds annually after each treatment and at least 3 years beyond last treatment.

6) Adapt treatment methods according to best available information.
   - Use application rates of liquid Endothall of 1.5 to 2.0 ppm for beds and 2 ppm for navigation channels.
   - Treatment will occur when water temperatures are between 45 and 58 degrees F. No treatment will occur once temperatures exceed 58 degrees F.
   - Herbicide must be applied when conditions are calm *as authorized by Amery Lakes District*. The maximum wind speed at time of application will be <10 mph as measured on-site. The forecast wind speed (including gusts) for the 24 hours following application will not be greater than 15 mph.

4. Control PL as it is discovered. (OBJ D)
    - Volunteer monitors will contact Polk County LWRD AIS Coordinator if PL is located. Volunteers will record location with GPS point, address, or owner description. They will then control the plant or indicate it is has not been removed when reporting.
    - Amery Lakes District will control purple loosestrife by hand pulling OR cutting and treating stem with herbicide.
    - Biocontrol may be used to control PL for large areas of growth, especially if areas are difficult to access.

5. Rapidly respond to new AIS introduction using procedures described in Appendix B. (OBJ E)

GOAL 2. Preserve our diverse native plant community

OBJECTIVES

A. Flagpole pond native plantings are managed to minimize invasive species and nuisance algae growth.

B. The value of Amery Lakes' excellent water quality and habitat and the functions and values of diverse native plants are acknowledged when considering any aquatic plant management activity.

MANAGEMENT STRATEGIES/ACTIONS

1. An Amery Lakes District liaison will work with the City of Amery staff and volunteers to ensure that native plants on the pond perimeter are managed to reduce growth of invasive species. (OBJ A)

2. Investigate means to control algae in Flagpole Park stormwater wetlands when and if control is needed. (OBJ A)

GOAL 3. Increase understanding regarding aquatic plants and their management

EDUCATION MANAGEMENT STRATEGIES/ACTIONS

Audiences
General public
Amery residents and surrounding area
Valhalla Campground residents (do not currently receive lake district mailings)
Lake visitors
Students in schools
Fishing tournament participants

Messages

- Celebrate Amery Lakes, which are very high value lakes with excellent water quality and aquatic plant diversity.
- Aquatic plants provide the base for fish and wildlife habitat. They also keep water clean by stabilizing sediments and taking up nutrients.
- Native aquatic plants are not weeds.
- Only hand removal of aquatic plants is legal without a permit in Wisconsin. Removal of aquatic plants by hand methods (such as raking) must be limited to an area no more than thirty feet wide on each waterfront property.
- Aquatic invasive species like curly leaf pondweed can be pulled by hand along the entire length of the shoreline. Be sure you know how to identify AIS before pulling, and dispose of the plants properly.
- Aquatic plants removed by hand make great compost and mulch for gardens.
- Any removal of native plants by mechanical (harvesting) or chemical (herbicide) means requires a permit.
- The aquatic plant management plan guides Amery Lakes District plant management efforts. Provide description of activities planned and completed.
- Identify common aquatic invasive species with photographs and descriptions.
- Practice good lawn care: keep grass clippings, fertilizer with phosphorus, herbicides and pesticides out of the lakes.
- Shoreline vegetation/buffers can prevent sediment runoff thereby preventing undesirable aquatic plant growth.

Methods[32]

1. **Clean Boats, Clean Waters outreach at the landings**
2. **Articles in the Amery Free Press**
3. **The Amery Lakes District newsletter**
4. **A "State of the Lakes Report" including monitoring results in Amery Free Press and newsletter**
5. **Maintain existing boat landing signs**
6. **Additional signage for Pike Lake: EWM is present, map of general EWM locations**
7. **Lakes District web page on the City of Amery website**
8. **Volunteer program/community service for Flagpole Park vegetation maintenance**
9. **Community education classes**
10. **Educational materials for elementary school**
11. Lakes District email list to contact interested people (1)
12. If North Twin landing is expanded, consider a kiosk for lake information (1)
13. Library displays, information distribution, and presentations (1)
14. A countywide lakes fair held in North Park (1)
15. Radio programs
16. Local cable TV programs
17. Outreach at fishing tournaments

Initiate an Amery Lakes Education Committee to carry out selected methods.

[32] Methods chosen for initial implementation are shown in bold.

GOAL 4. Allow navigation for fishing and boating

OBJECTIVE

A. Address severe navigation impairment if caused by aquatic plants.

MANAGEMENT STRATEGIES/ACTIONS

1. Use manual removal methods to open access to lake residences. (OBJ 2B)
2. Allow boat traffic to open navigation in the narrows and bass hole (south bay of Pike Lake). (OBJ 2B)
3. Pursue curly leaf pondweed control only if navigation is impaired or seriously threatened by sustained increased aerial coverage. (OBJ 4A)

IMPLEMENTATION CHART 2014-15

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

Actions[33] a. steps	**Timeline (each year if not indicated)**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Responsible Parties/ Partners[34]**	**Funding Sources**	**Board/Committee Assignment**
1a. Professional EWM Monitoring	July, August September	$1,500 (if contracted)	20	Lakes District Polk LWRD	Amery Lakes District WDNR AIS Grants	Schieffer Williamson
1b. Student EWM and CLP Monitoring	May and June		40	AHS FW		Schieffer
1c. Develop EWM and PL Volunteer Monitoring Training and Procedures	April 2015		?	Polk LWRD (?) WDNR		Williamson
1d. Conduct AIS Monitoring Training	June 2015 and annually		6	Polk LWRD (?) Amery Community Ed		Williamson Schieffer
1e. Coordinate Volunteer EWM Monitoring	Growing Season		8	Lakes District Polk LWRD		?

[33] See previous pages for action item detail. Estimates are for annual budgets once implementation begins.

[34]
AHS FW = Amery High School Freshwater Ecology
Lakes District = Amery Lakes Protection and Rehabilitation District
LWRD = Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources
CITY = City of Amery

IMPLEMENTATION CHART 2014-15

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

Actions[35] a. steps	**Timeline**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Responsible Parties/ Partners[36]**	**Funding Sources**	**Board/Committee Assignment**
2a. Hand pull scattered clumps of EWM	July, August Sept.	$1,000 (if contracted)	12			Schieffer Williamson
2b. Coordinate treatment for beds > 500 ft^2	As needed	$2,000	8		Lakes District AIS Control Grant	Schieffer Williamson
4. Control PL as it is discovered	July, August		5			Volunteer Monitors

[35] See previous pages for action item detail. Estimates are for annual budgets once implementation begins.

[36]
AHS FW = Amery High School Freshwater Ecology
Lakes District = Amery Lakes Protection and Rehabilitation District
LWRD = Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources
CITY = City of Amery

IMPLEMENTATION CHART 2014-15

GOAL 2. Preserve our diverse native plant community

Actions[37] a. steps	Timeline	$ Estimate (annually)	Vol. Hours (annually)	Responsible Parties/ Partners[38]	Funding Sources	Board/Committee Assignment
1. Coordinate volunteers to manage invasive plants at Flagpole	Monthly during growing season		??	Lakes District City of Amery		Hancock Erickson
2. Assess algae growth in Flagpole wetlands	Monthly during growing season		??	Lakes District		Williamson Bergquist

[37] See previous pages for action item detail. Estimates are for annual budgets once implementation begins.

[38]
AHS FW = Amery High School Freshwater Ecology
Lakes District = Amery Lakes Protection and Rehabilitation District
LWRD = Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources
CITY = City of Amery

IMPLEMENTATION CHART 2014-15

GOAL 3. Increase understanding regarding aquatic plants and their management

Actions[39] a. steps	Timeline	$ Estimate (annually)	Vol. Hours (annually)	Responsible Parties/ Partners[40]	Funding Sources	Board/Committee Assignment
Initiate an Amery Lakes Education Committee	2014	$975	40	Lakes District		DeLong
1. Clean Boats, Clean Waters Education	May through Sept.	$2,500		Lakes District CITY		Schieffer
2. Amery Free Press Articles	Monthly			Lakes District		Lakes District Board
3. Lakes District Newsletter	August	$2,800		Lakes District		Bergquist
4. State of the Lakes Report	August		8			Schieffer
5/6. Boat Landing Signs – including new sign for Pike Lake	June 2014	?				Williamson
7. Lakes District Web Page	Sept. 2014	?		Lakes District CITY		? Ok w/City

[39] See previous pages for action item detail. Estimates are for annual budgets once implementation begins.

[40]
AHS FW = Amery High School Freshwater Ecology
Amery Lakes District = Amery Lakes Protection and Rehabilitation District
LWRD = Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources
CITY = City of Amery

IMPLEMENTATION CHART 2014-15

GOAL 3. Increase understanding regarding aquatic plants and their management

Actions[39] a. steps	**Timeline**	**$ Estimate (annually)**	**Vol. Hours (annually)**	**Responsible Parties/ Partners[40]**	**Funding Sources**	**Board/Committee Assignment**
8. Volunteer Coordination for Flagpole Maintenance			40			Hancock Erickson

Appendix A. Committee Input for Aquatic Plant Management

Amery Lakes Aquatic Plant Management Plan (APM)

First Meeting Notes
March 20, 2014

Present
Terry Christopherson
Bruce Delong
Kay Erickson
Jeanne Hancock
Warren Nelson
Jon Bergquist
Jeremy Williamson
Cheryl Clemens

Agenda

6:30 p.m.	Welcome and Introductions	
6:40 p.m.	Review APM plan basics and background	Cheryl Clemens, project consultant
7:00 p.m.	Review plant survey and recs.	Cheryl and Jeremy Williamson
7:30 p.m.	Discuss aquatic plant concerns	Committee
8:20 p.m.	Adjourn	

Powerpoint presentations are available for the APM plan basics, background, plant survey and recommendations. The information is also included in background information provided.

Example aquatic plant management plans can be found on the following web sites:
http://arprd.org/management-plan/ (Apple River Flowage P&R District)
http://pcalr.org/library/ (Many Polk County plans including Deer Lake and Bone Lake plans)

Committee Aquatic Plant Management Concerns/Issues

Education

Aquatic Invasive Species(AIS)

- Need to reach property owners and visitors including at campground by Shoreview
- AIS signs are present at all landings
- Clean Boats, Clean Waters student staff provide AIS prevention information at the landings, especially at Shoreview which is used most heavily

Water Quality

- Amery Lakes have excellent water quality. Water quality is important to people. We need to acknowledge this in education efforts.
- Topics: plants provide the base for fish and wildlife habitat
- Topics: lawn care practices: keep grass clippings, fertilizer with phosphorus, herbicides and pesticides out of the lakes
- Topic: shoreline vegetation/buffers, explain how buffers can prevent sediment runoff and prevent undesirable aquatic plant growth

Navigation

Waterfront/Riparian Owners

- Owners may desire to remove plants around docks for navigation and along shoreline for swimming.
  Legal limits in WI are removal only by hand methods, such as raking, in an area no more than 30 feet wide
- Lake owners may not be aware of limits for aquatic plant removal and herbicide use (can't be applied by owner without permit and license)

Narrows between Pike and North Twin

- Some lake users/residents are concerned about navigation through the narrows
- This area is reported to have been dredged in the 1950s, but has filled in since then.
  Related information: Wild rice grows in close proximity to the narrows. Any removal of native plants requires a permit. Native American Tribes review all aquatic plant management permits in Ceded Territories (including Amery Lakes). Tribes are likely to be opposed to any management that threatens wild rice growth. In the recent past this has included any herbicide treatments anywhere nearby, including those for invasive species.

  Any removal of native plants by mechanical (harvesting) or chemical (herbicide) means requires a permit. Severe navigation impairment must be demonstrated for a permit to be issued.

  Question: Is harvesting available by contract? A: probably not. Cheryl and Jeremy are unaware of any service providers.
  Question: Is using Apple River Flowage harvester an option? A: probably not, because of concern in transporting invasive species between water bodies.
  We will gather additional information about historical harvesting on Amery Lakes

  Robbins spikerush, a special concern species, is also present on the east side of the narrows. This may limit management allowed.

Aquatic Invasive Species Management

Eurasian Water Milfoil

Prevention, monitoring, control need to be addressed
It is critical to limit further growth and spread of EWM
EWM can be spread by boat props

Curly leaf pondweed

Should the Amery Lakes District pursue management?

Prevention/monitoring for additional invasive species

Amery Lakes Aquatic Plant Management Plan (APM)

Second Meeting Notes
April 3, 2014

Present
Terry Christopherson
Bruce Delong
Kay Erickson
Warren Nelson
Jon Bergquist (first 30 minutes)
Jeremy Williamson
Steve Schieffer
Cheryl Clemens

Agenda
Draft Lake Management Goals and Objectives

Aquatic Invasive Species Management (Presentation available)

Navigation (Presentation available)

NOTES

DRAFT GOALS AND OBJECTIVES

GOAL. Prevent the introduction and spread of aquatic invasive plant species

GOAL. Preserve our diverse native plant community

GOAL. Increase understanding regarding aquatic plants and their management

GOAL. Allow navigation for fishing and boating

Acknowledge lake and stormwater plans in the aquatic plant management plan.
Incorporate management of native plants and algae in Flagpole stormwater wetlands in the Aquatic Plant Management Plan

AQUATIC INVASIVE SPECIES

Smart AIS Protocol completed for Pike in 2011 (Jeremy and Katelin from Polk County, Alex Smith from DNR) and North Twin in 2012 (Jeremy and Katelin)

Eurasian Water Milfoil (EWM) Recommendations:
Stay the course: monitoring, hand pulling, herbicide treatment when needed
Consider volunteer monitoring (Wapo or Bone Lake as models)
AIS monitoring should be planned and documented

Reports of monitoring could be contained in a "State of the Lakes Report"
Additional signage for Pike Lake: EWM is present (is this sign there already?), map of general EWM locations
Discussed using buoys to mark EWM areas: probably too small an area, and buoys may attract boaters

Curly Leaf Pondweed (CLP) Recommendations
Monitor, but don't control CLP unless certain thresholds are exceeded.

Education Recommendations
If North Twin landing is expanded, consider a kiosk like at Bone Lake for lake information

AIS Objectives

- Limit EWM coverage in Pike Lake to < ¼ acre (original area discovered in 2010).
- Prevent EWM spread into North and South Twin Lakes.
- Involve citizens in volunteer AIS monitoring.
- Control CLP only if navigation is impaired or threatened by expanded area (*how much?* acres in individual bed and total) that remains over several years (*how long?*).
- Be ready to rapidly respond to new AIS introduction.

NATIVE PLANTS
Native Plant Protection Objectives

- Protect the excellent water quality and habitat of Amery Lakes by preserving existing native plants (Bruce stated this more eloquently, but I didn't record. (Please suggest revision, Bruce)

NAVIGATION
Navigation Objectives

- Use manual removal methods to open access to lake residences.
- Allow passive boat traffic to open navigation in the narrows and bass hole.
- Navigation in the narrows is currently impaired by shallow water, not aquatic plants.
- Pursue curly leaf pondweed control only if navigation is impaired or seriously threatened by sustained increased aerial coverage.

Amery Lakes Aquatic Plant Management Plan (APM)

Third Meeting Notes
April 10, 2014 updated April 15

Present
Bruce Delong
Kay Erickson
Jean Hancock
Warren Nelson
Jan Tietyen
Jane Tietyen
Jon Bergquist
Jeremy Williamson
Cheryl Clemens

Draft Plan for Committee Review – April 15, 2014
Draft Plan for Public Review – May 5, 2014 (public notice)
Public Meeting - Thursday, May 8, 6:30 p.m.
Finalize Plan – May 15, 2014 (submit to DNR for review)
DNR Review Complete – July 15, 2014
AEPP (Education) AIS Grant Due – December 10, 2014
ACEI (Control) AIS Grant Due – February 1, 2015

Notes from the meeting reflect current draft of the implementation plan

GOALS and OBJECTIVES (in priority order)

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

GOAL 2. Preserve our diverse native plant community

GOAL 3. Increase understanding regarding aquatic plants and their management

GOAL 4. Allow navigation for fishing and boating

GOAL 1. Prevent the introduction and spread of aquatic invasive plant species

Definition: Aquatic Invasive Species (AIS) are non-native plant species that can out-compete and overtake native plant species damaging native lake habitat and sometimes creating nuisance conditions. AIS currently in Amery Lakes include Eurasian water milfoil (EWM - Pike Lake only), curly leaf pondweed (CLP - All Lakes), purple loosestrife (PL - North Twin only). Additional AIS threaten Amery Lakes.

OBJECTIVES

A. Limit EWM coverage in Pike Lake to < ¼ acre (original area discovered in 2010)
B. Prevent EWM spread into North and South Twin Lakes
C. Control CLP only if navigation is impaired or threatened by expanded area (10 acres in a given lake) that remains over several years (at least 3*)*
D. Remove PL as it is discovered
E. Be ready to rapidly respond to new AIS introduction

MANAGEMENT STRATEGIES/ACTIONS

1. Establish and follow protocols for regular AIS monitoring of Amery Lakes. (OBJ A-E)

   Involve professionals, students, and citizens in AIS monitoring

Amery Lakes AIS Monitoring Matrix

	Professional Surveys[1]	**Student Survey[2]**	**Volunteer AIS**
Eurasian Water Milfoil			
Pike Lake	July, August, Sept. Monitor entire littoral zone by cruising by boat. Monitor areas around landings and public docks by kayak with a scope viewer. In area near landing, take additional 20 random samples.	Annually first week of May and first week of June. Monitor entire littoral zone for AIS. Sample all milfoil observed to verify native from non-native.	Monitor specific assigned areas
North Twin	July, August, Sept. Monitor entire littoral zone by cruising by boat. Monitor areas around landings and public docks by kayak, with scope viewer. In area near landing, take additional 20 random samples.	Annually first week of May and first week of June. Monitor entire littoral zone for AIS. Sample all milfoil observed to verify native from non-native. View areas around/adjacent to narrows connection more thoroughly.	Monitor specific assigned areas
South Twin	July, August, and Sept.: landings and inlet	Monitor entire lake each year the second week of May.	Monitor specific assigned areas

[1] Professional surveys are currently provided by Jeremy Williamson, Polk County Land and Water Resources Department and Steve Schieffer. Both are currently Amery Lakes District board members.
[2] Student surveys are currently provided by students in Amery High School Freshwater Biology led by Steve Schieffer, teacher and Amery Lakes District Chair.

	Professional Surveys[3]	Student Survey[4]	Volunteer AIS
Curly Leaf Pondweed			
Pike Lake		Annually- May/June: Bed Maps and Sample Points	
North Twin		Annually- May/June: Bed Maps and Sample Points	
South Twin		Annually- May/June: Bed maps and sample points	
Purple Loosestrife			
All Lakes	Monitor riparian zones in all lakes in late July (when flowering).		Lake Perimeters Each July/August

- All monitoring records to be sent to and compiled by the Polk County Land and Water Resources Department (LWRD) AIS Coordinator.

- Volunteers will be recruited and trained through an Amery Community Education Class provided by Polk County LWRD, University of Wisconsin Extension, and/or the Department of Natural Resources. Volunteer tools and reporting will be developed for this training. Citizen Lake Monitoring Protocols will be followed when available. Training will be included for all AIS species mentioned above and others that are a likely threat.

2. <u>Control Eurasian Water Milfoil as quickly as possible</u>. (OBJ A and B)
   - Scattered growth or clumps of less than (200 ft^2) will be pulled by hand when discovered during monitoring; locations will be recorded with GPS points.
   - Discrete beds of EWM growth greater than (500 ft^2)[5] will be controlled with aquatic herbicides using accepted procedures.
   - Discretion will be used to select appropriate management for beds in between these sizes.

3. <u>Control Curly Leaf Pondweed when navigation is impaired or plant coverage is rapidly expanding.</u> (OBJ C)
   - Encourage hand-pulling by lake residents at any time.
   - Control areas of severe navigation impairment or rapid expansion using a low-dose, early season Endothal treatment according to accepted procedures as outlined below or updated with new information.

[3] Professional surveys are currently provided by Jeremy Williamson, Polk County Land and Water Resources Department and Steve Schieffer. Both are currently Amery Lakes District board members.
[4] Student surveys are currently provided by students in Amery High School Freshwater Biology led by Steve Schieffer, teacher and Amery Lakes District Chair.
[5] Sundeen, Mark, email communication. DNR has no minimum size for treatment.

4. Control PL as it is discovered. (OBJ D)
    - Volunteer monitors will contact Polk County LWRD AIS Coordinator if PL is located. Volunteers will record location with GPS point or address or owner description. They will then control the plant or indicate it is has not been removed when reporting.
    - Amery Lakes District will control purple loosestrife by hand pulling OR cutting and treating stem with herbicide.
    - Biocontrol may be used to control PL for large areas of growth, especially if areas are difficult to access.

5. Rapidly respond to new AIS introduction using procedures described in Appendix B. (OBJ E)

GOAL 2. Preserve our diverse native plant community

OBJECTIVES

A. Flagpole pond native plantings are managed to minimize invasive species and nuisance algae growth.

B. The value of Amery Lakes' excellent water quality and habitat and the functions and values of diverse native plants are acknowledged when considering any aquatic plant management activity.

MANAGEMENT STRATEGIES/ACTIONS

1. An Amery Lakes District liaison will work with the City of Amery staff and volunteers to ensure that native plants on the pond perimeter are managed to reduce growth of invasive species. (OBJ A)

2. Investigate means to control algae in Flagpole Park stormwater wetlands when and if control is needed. (OBJ A)

GOAL 3. Increase understanding regarding aquatic plants and their management

EDUCATION MANAGEMENT STRATEGIES/ACTIONS

Audiences
General public
Amery residents and surrounding area
Valhalla Campground residents (do not currently receive lake district mailings)
Lake visitors
Students in schools
Fishing tournament participants

Messages

- Celebrate Amery Lakes, which are very high value lakes with excellent water quality and aquatic plant diversity.
- Aquatic plants provide the base for fish and wildlife habitat. They also keep water clean by stabilizing sediments and taking up nutrients.
- Native aquatic plants are not weeds.
- Only hand removal of aquatic plants is legal without a permit in Wisconsin. Removal of aquatic plants by hand methods (such as raking) must be limited to an area no more than 30 feet wide on each waterfront property.
- Aquatic invasive species like curly leaf pondweed can be pulled by hand along the entire length of the shoreline. Be sure you know how to identify AIS before pulling, and dispose of the plants properly.
- Aquatic plants removed by hand make great compost and mulch for gardens.
- Any removal of native plants by mechanical (harvesting) or chemical (herbicide) means requires a permit.
- The aquatic plant management plan guides Amery Lakes District plant management efforts. Provide description of activities planned and completed.
- Identify common aquatic invasive species with photographs and descriptions.
- Practice good lawn care: keep grass clippings, fertilizer with phosphorus, herbicides and pesticides out of the lakes.
- Shoreline vegetation/buffers can prevent sediment runoff thereby preventing undesirable aquatic plant growth.

Methods (number of votes follow each method)

1. A "State of the Lakes Report" including monitoring results in Amery Free Press and newsletter. (3)
2. Maintain existing boat landing signs (1)
3. Additional signage for Pike Lake: EWM is present, map of general EWM locations (4)
4. If North Twin landing is expanded, consider a kiosk for lake information (1)
5. Lakes District email list to contact interested people (1)
6. Lakes District web page on the City of Amery website (if possible) (3)
7. Volunteer program/community service for Flagpole Park vegetation maintenance (2)
8. Library displays, information distribution, and presentations (1)
9. A countywide lakes fair held in North Park (1)
10. Radio programs
11. Local cable TV programs
12. Articles in the Amery Free Press (4)
13. The Amery Lakes District newsletter (1)
14. Community education classes (2)
15. Educational materials for elementary school (2)
16. Clean Boats, Clean Waters outreach at the landings (4)
17. Outreach at fishing tournaments

Initiate an Amery Lakes Education Committee to carry out selected activities.

GOAL 4. Allow navigation for fishing and boating

OBJECTIVE.

A. Address severe navigation impairment if caused by aquatic plants.

MANAGEMENT STRATEGIES/ACTIONS

1. Use manual removal methods to open access to lake residences. (OBJ 2B)
2. Allow boat traffic to open navigation in the narrows and bass hole (south bay of Pike Lake). (OBJ 2B)
3. Pursue curly leaf pondweed control only if navigation is impaired or seriously threatened by sustained increased aerial coverage. (OBJ 4A)

Appendix B. Rapid Response for Early Detection of Aquatic Invasive Species

Definition: Aquatic Invasive Species (AIS) are non-native plant species that can out-compete and overtake native plant species damaging native lake habitat and sometimes creating nuisance conditions. AIS currently in Amery Lakes include Eurasian water milfoil (EWM - Pike Lake only), curly leaf pondweed (CLP - all lakes), purple loosestrife (PL - North and South Twin). Additional AIS threaten Amery Lakes and will be monitored by professional monitors or volunteers when species are added to the training program.

1. Develop and maintain a contingency fund of $3,000 for rapid response to Aquatic Invasive Species discovery in Amery Lakes (Amery Lakes District Board).

2. Conduct monthly volunteer and professional monitoring according to the Amery Lakes AIS Monitoring Matrix (attached). If a suspected AIS is found, contact the Polk County LWRD AIS Coordinator or volunteer AIS Coordinator (if available).

3. Direct lake residents and visitors to contact the Polk County LWRD AIS Coordinator or volunteer AIS Coordinator (if available) if they find a suspected AIS. Signs at the public boat landings, web pages, handouts at annual meeting, and newsletter articles will provide plant photos and descriptions, contact information, and instructions.

4. If plant is likely AIS, the volunteer AIS Coordinator will confirm identification with Polk County LWRD and the WDNR and inform the rest of the Board.[41]
    a. Take a digital photo of the plant in the setting where it was found (if possible). Then collect 5 – 10 intact specimens. Try to get the root system, and all leaves as well as seed heads and flowers when present. Place in a zip lock bag with no water. Place on ice and transport to refrigerator.
    b. Fill out plant incident form http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf
    c. Contact WDNR staff, then deliver collected plants to the WDNR (810 West Maple Street, Spooner, WI 54801) as soon as possible to the location they specify. WDNR may confirm identification with the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.

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[41] **If it is an animal other than a fish**

- Be sure the suspected invasive species has not been previously found on the waterbody
- Take a digital photo of the animal in the setting where it was found (if possible). Then collect up to five specimens. Place in a jar with water; put on ice and transport to refrigerator. Transfer specimen to a jar filled with rubbing alcohol (except for Jellyfish – leave in water).
- Fill out form 3200-126 – Aquatic Invasive Animal Incident Report
- Contact DNR staff

5. Mark the location of suspected AIS (Polk County LWRD AIS Coordinator or volunteer AIS Coordinator (if available). Use GPS points (in decimal degrees and WGS 84 datum), if available, or mark the location with a small float.

6. If identification is positive:
    a. Inform the person who reported the AIS and the board (Polk County LWRD AIS Coordinator or volunteer AIS Coordinator (if available), who will then inform Polk County LWRD and lake management consultant.
    b. Mark the location of AIS with a more permanent marker. Special EWM buoys are available. (Polk County LWRD AIS Coordinator or volunteer AIS Coordinator (if available).
    c. Post a notice at the public landing (WDNR has these signs available) and include a notice in the next newsletter. Notices will inform residents and visitors of the approximate location of the AIS and provide appropriate means to avoid its spread (Board).

7. Use volunteer professional assistance, or hire a consultant to determine the extent of the AIS introduction (Board). A diver may be used. If small amounts of AIS are found during this assessment, the consultant will be directed to identify locations with GPS points and hand pull plants found. Whole plants will be pulled and efforts made to reduce plant fragmentation. All plant fragments will be removed from the lake when hand pulling.

8. Select a control plan in cooperation with the WDNR (Board) and consultant. The goal of the rapid response control plan will be eradication of the AIS. Control methods may include hand pulling, use of divers to manually or mechanically remove the AIS from the lake bottom, application of herbicides, and/or other effective and approved control methods.

9. Implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.

10. Amery Lakes District funds may be used to pay for any reasonable expense incurred during the implementation of the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.

11. The Board will work with the WDNR to confirm a start date for an Early Detection and Rapid Response AIS Control Grant as soon as possible. Thereafter, the Board shall formally apply for the grant.

12. Frequently inspect the area of the AIS to determine the effectiveness of the treatment and whether additional treatment is necessary (APM Monitor, Consultant).

13. Review the procedures and responsibilities of this rapid response plan in each even year. Changes may be made with approval of the Board.

EXHIBIT A[42]

AMERY LAKES PROTECTION AND REHABILITATION DISTRICT

Board Chair and Volunteer AIS Coordinator	Steve Schieffer: 715-554-1168 ecointegservice@gmail.com

POLK COUNTY LAND AND WATER RESOURCES DEPARTMENT

AIS Coordinator	Jeremy Williamson: 715-485-8639 jeremyw@co.polk.wi.us
Director	Tim Ritten: 715-485-8631 TIMR@co.polk.wi.us

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Permits	Mark Sundeen: 715-635-4074 Mark.Sundeen@Wisconsin.gov
Grants, EWM Identification and Notice	Alex Smith: 715-635-4124 Alex.Smith@wisconsin.gov

APM MONITOR

Ecological Integrity Services	Steve Schieffer: 715-554-1168 ecointegservice@gmail.com

HERBICIDE CONTRACTOR

Lake Restoration	763-428-1543

DIVERS

Ecological Integrity Services	Steve Schieffer: 715-554-1168 ecointegservice@gmail.com
Jeremy Williamson	715-485-8639 jeremyw@co.polk.wi.us

[42] This list will be reviewed and updated each year.

Appendix C. Aquatic Plant Survey Methods

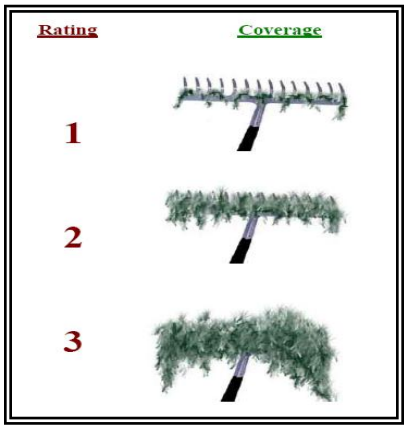
A point intercept method was employed for the aquatic macrophyte sampling. The Wisconsin Department of Natural Resources (WDNR) generated the sampling point grid for each lake.

A handheld Global Positioning System (GPS) located the sampling points in the field. The WDNR guidelines for point location accuracy were followed with the location arrow touching the point using an 80 foot resolution window. Only plants sampled at predetermined sampled points were used in the statistical analysis. If no plants were sampled at a particular depth, one point beyond that depth was sampled.

At each sample point, a double-sided 14-tine rake was used to rake a 1m tow off the bow of the boat. All plants contained on the rake and those that fell off of rake were identified and rated for rake density. The rake density value criteria are shown in the diagram and table below. Those plants that were within 6 feet were recorded as "viewed," but no rake density rating was given.

A boat survey was conducted in areas that appeared to be under-sampled, such as bays. Plants viewed and/or sampled during boat surveys were recorded along with the type of habitat. Boat survey data were not used in the statistical analysis nor was the density recorded.

Rake Density Criteria



	Criteria for rake density rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space
v	Plant not sampled but observed within 6 feet of boat

The depth and predominant bottom type was also recorded for each sample point. Caution must be used in using the sediment type in deeper water as it is difficult to discern between muck and sand with a rope rake. All plants needing verification were bagged and cooled for later examination. Each species was mounted and pressed for a voucher collection and submitted to the WDNR for review. On rare occasions a single plant may be needed for verification, not

allowing it to be used as a voucher specimen, and this species may be missing from the collection.

Data analysis methods

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

- Frequency of occurrence
- Relative frequency
- Total points in sample grid
- Total points sampled
- Sample points with vegetation
- Simpson's diversity index
- Maximum plant depth
- Species richness
- Floristic Quality Index

An explanation of each of these statistics is provided below.

Frequency of occurrence: Frequency is expressed as a percentage by dividing the number of sites the plant is sampled by the number of sites. Frequency of occurrence can be calculated for the entire littoral zone - depths at or less than the maximum depth plants were found, regardless if vegetation was present. Frequency of occurrence can also be calculated for only the percentage of sample points where the plant was sampled for only points containing vegetation. In either case, the greater this value, the more frequent the plant is in the lake. If one wants to compare how frequent a plant is in the littoral zone, we look at the frequency of all points below maximum depth with plants. This frequency value allows the analysis of how common plants are where they could grow based upon depth. If one wants to focus only on where plants are actually present, then one would look at frequency at points in which plants were present. Frequency of occurrence is usually reported using sample points where vegetation was present.

Frequency of Occurrence Example

Plant A sampled at 35 of 150 littoral points = 35/150 = 0.23 = 23%

Plant A's frequency of occurrence = 23% considering littoral zone depths

Plant A sampled at 12 of 40 vegetated points = 12/40 = 0.30 = 30%

Plant A's frequency of occurrence = 30% in vegetated areas

These two frequencies can tell us how commonly the plant was sampled in the littoral zone or how commonly the plant was sampled at points plants actually grow. Generally, the second will have a higher frequency.

Relative frequency: This value shows the frequency of a particular plant relative to other plants as a percentage. Relative frequency is not dependent on the number of points sampled. The relative frequency of all plants will add to 100%. This means that if plant A had a relative frequency of 30%, it occurred 30% of the time compared to all plants sampled or makes up 30% of all plants sampled. This value allows us to see which plants are the dominant species in the lake. The higher the relative frequency, the more common the plant is compared to the other plants, and therefore, the more frequent in the plant community.

Relative Frequency Example

Suppose we were sampling 10 points in a very small lake and got the following results:

	Frequency sampled
Plant A present at 3 sites	3 of 10 sites
Plant B present at 5 sites	5 of 10 sites
Plant C present at 2 sites	2 of 10 sites
Plant D present at 6 sites	6 of 10 sites

So one can see that Plant D is the most frequently sampled at all points with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency is compared the other plants. It is calculated by dividing the number of times a plant is sampled by the total times all plants are sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing the individual frequency by the total.

Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%

Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too thereby giving a lower frequency when compared to those other plants. This then gives a true measure of the dominant plants present.

Total point in sample grid: The WDNR establishes a sample point grid that covers the entire lake. GPS coordinates are provided to locate the points.

Number of points sampled: This may not be the same as the total points in the sample grid. When doing a survey, we do not sample at depths outside of the littoral zone (the area where plants can grow). Once the maximum depth of plants is established, many of the points deeper than this are eliminated to save time and effort.

Sample sites with vegetation: The number of sites where plants were actually sampled. This gives a good idea of the plant coverage of the lake. If 10% of all sample points had vegetation, it implies about 10% coverage of plants in the whole lake, assuming an adequate number of sample points have been established. We also look at the number of sample sites with vegetation in the littoral zone. If 10% of the littoral zone had sample points with vegetation, then the plant coverage in the littoral zone would be estimated at 10%.

Simpson's diversity index: Simpson's diversity index measures plant community diversity. This value can run from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled will be different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The higher the diversity in the native plant community, the healthier the lake ecosystem.

Simpson's Diversity Example

If one sampled a lake and found just one plant, the Simpson's diversity would be "0". This is because if we randomly sampled two plants, there would be a 0% chance of them being different, since there is only one plant.

If every plant sampled were different, then the Simpson's diversity would be "1". This is because if two plants were randomly sampled, there would be a 100% chance they would be different, since every plant is different.

These are extreme and theoretical scenarios, but they demonstrate how this index works. The greater the Simpson's index is for a lake, the greater the diversity, since it represents a greater chance of two randomly sampled plants being different.

Maximum depth of plants: This depth indicates the deepest that plants were sampled. Generally, clearer lakes have a greater maximum depth of plants while lower water clarity limits light penetration and reduces the depth at which plants are found.

Species richness: The number of different individual species found in the lake. There is a number for the species richness of plants sampled and another number that takes into account plants viewed but not actually sampled during the survey.

Floristic Quality Index: The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community response to development (and human influence) on the lake. It takes into account the species of aquatic plants sampled and their tolerance for changing water quality and habitat

quality. The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant while a lower value indicates tolerance. Those plants with higher values are more apt to respond adversely to water quality and habitat changes that are largely due to human influence (Nichols, 1999). The FQI is calculated using the number of species and the average conservatism value of all species used in the index.

The Floristic Quality Index formula is:

FQI = Mean C ·√N

Where C is the conservatism value and N is the number of species (only species sampled on rake).

Therefore, a higher FQI indicates a healthier aquatic plant community, which is an indication of better plant habitat. This value can be compared to the median for other lakes in the assigned eco-region. There are four eco-regions used throughout Wisconsin. These are Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area, and Southeastern Wisconsin Till Plain.

Summary of Northern Central Hardwood Forests Median Values for Floristic Quality Index: (Nichols, 1999)

Median species richness = 14

Median conservatism = 5.6

Median Floristic Quality = 20.9

*Floristic Quality has a significant correlation with area of lake (+), alkalinity (-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as a value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease.

Appendix D. References

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Appendix E. DNR Northern Region Aquatic Plant Management Strategy

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.