Horseshoe Lake Five Year Aquatic Plant Management Plan

Horseshoe Lake Aquatic Plant Management Planning

Washburn County, WI

DNR WBIC No. 2470000
SEH No. HORLP 121914

September 7, 2013

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RE: Horseshoe Lake Aquatic Plant Management Planning
Horseshoe Lake Five Year Aquatic Plant Management Plan
Washburn County, WI
WDNR WBIC No. 2470000
SEH No. HORLP 121914

Mr. Edward Wink, Secretary-Treasurer
Horseshoe Lake Property Association, Inc.
127 14th Ave. NW
New Brighton, MN 55112

Dear Edward:

Sincerely,

Lake Scientist

DLB
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Horseshoe Lake Five Year Aquatic Plant Management Plan

Horseshoe Lake Aquatic Plant Management Planning
Washburn County, WI

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Spooner, WI

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Executive Summary

Horseshoe (WBIC 2470000) is a 194-acre, oligotrophic seepage lake located in north-central Washburn County, Wisconsin. The lake's average depth is 7ft, and the bottom substrate is predominantly sand and sandy/muck. Water clarity is good to very good with Secchi values averaging 10ft.

Eurasian water milfoil (*Myriophyllum spicatum*) (EWM), an exotic invasive plant species that is a growing problem in the lakes and rivers of northwestern Wisconsin, was first found in Horseshoe Lake in May 2011. EWM has been present in nearby Nancy Lake since 1991, the Minong Flowage since 2002, and Gilmore Lake since 2009, so, although disturbing, it is not entirely surprising that it was found in Horseshoe Lake.

The vision of the Horseshoe Lake Property Association (HLPA) was to develop a sustainable management plan that provides the direction necessary to address the variety of concerns and needs of the lake community while protecting the lake ecosystem. The primary goal of this plan was to establish long-term and realistic objectives for managing non-native and nuisance native plant growth while protecting valuable native species and their important habitat functions for the lake. To accomplish this, the aquatic plant (macrophyte) community was investigated, possible management alternatives were evaluated to determine preferred management options, and an implementation plan was developed which includes a mechanism to monitor and modify this management plan as needed.

Aquatic plant management in Horseshoe Lake will follow six broad goals, each with a number of objectives and actions, over the course of the next five years. Appendix D is an outline of the aquatic plant management goals and activities, and Appendix E is a five-year timeline for completion of the activities included in this APM Plan. Any major change in activities or management philosophy will be presented to the HLPA and the WDNR for approval. The six goals for this plan are as follows:

1. Native Plant Protection, Preservation, and Enhancement
2. EWM Management and Monitoring
3. AIS Education, Prevention, and Planning
4. Wildlife Appreciation and Awareness
5. Lake Community Understanding and Awareness
6. Aquatic Plant Management Plan Maintenance

This APM Plan will be implemented by the Horseshoe Lake Property Association, their consultants, and through partnerships formed with the WDNR, Washburn County, and other local clubs and organizations. Annual reports and end of project assessments will be completed throughout the duration of this 5-year plan.

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Horseshoe Lake Five Year Aquatic Plant Management Plan

Horseshoe Lake Aquatic Plant Management Planning

Prepared for Horseshoe Lake Property Association, Inc.

1.0 Introduction

Horseshoe (WBIC 2470000) is a 194-acre, oligotrophic seepage lake located in north-central Washburn County, Wisconsin (Figure 1). The lake's average depth is 7ft, and the bottom substrate is predominantly sand and sandy/muck. Water clarity is good to very good with Secchi values averaging 10ft. Eurasian water milfoil (*Myriophyllum spicatum*) (EWM), an exotic invasive plant species that is a growing problem in the lakes and rivers of northwestern Wisconsin, was first found in the eastern lobe of Horseshoe Lake in May 2011. EWM has been present in nearby Nancy Lake since 1991, the Minong Flowage since 2002, and Gilmore Lake since 2009, so, although disturbing, it is not entirely surprising that it was found in Horseshoe Lake.

Figure 1 – Lakes with Eurasian watermilfoil (EWM in the Town of Minong, Washburn County

2.0 Development of an Aquatic Plant Management Plan

After the discovery of EWM and two seasons of rapid response management, the HLPA contracted with SEH in the fall of 2012 to prepare a formal Aquatic Plant Management (APM) Plan for Horseshoe Lake to be completed in the spring of 2013. This plan is a required document if the HLPA intends to continue managing EWM. Once complete, the APM Plan will guide EWM and other aquatic plant management efforts for at least the next 3-5 years.

The goal of aquatic plant management planning is to develop a sustainable management plan that provides the direction necessary to address the variety of concerns and needs of the lake community while protecting the lake ecosystem. The primary goal of the aquatic plant management plan for Horseshoe Lake is to establish long-term and realistic objectives for managing non-native aquatic plant growth while protecting valuable native species and their important habitat functions for the lake. To accomplish this, the aquatic plant (macrophyte) communities were investigated, possible management alternatives were evaluated to determine preferred management options, and an implementation plan was developed which includes a mechanism to monitor and modify this management plan as needed.

2.1 Aquatic Plant Management Strategy: WDNR, VITF, and GLIFWC

The WDNR aquatic plant management guidelines and the Northern Region Aquatic Plant Management Strategy (Appendix A) formed the framework for the development of this APM plan. All existing and new APM Plans and the associated management permits (chemical or harvesting) are reviewed by the WDNR. APM plans developed for northern Wisconsin lakes are evaluated according to the Northern Region APM Strategy goals that went into effect in 2007. Additional review may be completed by the Voit Intertribal Task Force (VITF) in cooperation with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC).

The VITF is composed of nine Tribal members plus the chairperson. The VITF recommends policy regarding inland harvest seasons, resource management issues, and budgetary matters to the Board of Commissioners. The VITF addresses matters that affect the treaty rights of the member tribes in the 1837 and 1842 Treaty ceded territories. The VITF recommends harvest seasons and regulations for each inland season. Those recommendations are then taken to the respective tribal councils for ratification prior to becoming an ordinance.

Formed in 1984, GLIFWC is an agency of eleven Ojibwe nations in Minnesota, Wisconsin, and Michigan, who retain off-reservation treaty rights to hunt, fish, and gather in treaty-ceded lands. It exercises powers delegated by its member tribes. GLIFWC assists its member bands in implementing off-reservation treaty seasons and in the protection of treaty rights and natural resources. GLIFWC provides natural resource management expertise, conservation enforcement, legal and policy analysis, and public information services. All member tribes retained hunting, fishing and gathering rights in treaties with the U.S. government, including the 1836, 1837, 1842, and 1854 Treaties.

This Aquatic Plant Management Plan supports sustainable practices to protect, maintain and improve the native aquatic plant community, the fishery, and the recreational and aesthetic values of the lake. This plan also lays out a plan to prevent the introduction of new aquatic invasive species (AIS) like curly-leaf pondweed (CLP) not currently known to be in the lake, and lays out a monitoring program to aid in early detection of any new AIS. This five-year plan is intended to be a living document which will be evaluated on an annual basis and can be revised to ensure goals and community expectations are being met.

3.0 Public Participation and Input

The Horseshoe Lake Property Association has been around since 1977, and became incorporated in 2011. In 2000, a lake association webpage was developed at www.horseshoelake.org The webpage is used to post lake association meeting minutes, promote lake events, share lake news and happenings, and provides a place for members to post comments and upload photos and other items related to the lake. Links are available to other pertinent lake sites including the Town of Minong, Washburn County, and the WDNR. They produce several newsletters annually which are sent to their constituency. In addition, they have at least one annual meeting where aquatic invasive species and more recently EWM has been a topic of great interest and discussion. Through these media outlets, the HLPA provides information, and solicits public input.

In 2012, the HLPA participated with other Minong area Lake Associations to sponsor an event where Matt Berg Proprietor of Endangered Resource Sciences, LLC presented his findings on the aquatic vegetation in the lake and the management implications of EWM being present in the system.

3.1 Community Involvement

The HLPA has been and will continue to be a supporter and participant in the Town of Minong bi-annual Lake Fair. The public boat landing on Horseshoe Lake has been posted with current WDNR recommended AIS signage and EWM established population warning signs. The HLPA also participates in lake education conferences sponsored by Wisconsin Association of Lakes and the UW-Extension Lakes Program.

3.2 Public Input Regarding the Aquatic Plant Management Plan

4.0 Eurasian Watermilfoil (EWM)

As previously mentioned, EWM was first discovered as a rooted plant and vouchers confirmed in 2011. Once discovered, the Horseshoe Lake Property Association (HLPA) marked the area with buoys, and authorized a June 2011 SCUBA removal of the known bed and a meandering littoral zone survey to look for evidence of further spread. Endangered Resource Sciences (ERS), LLC completed the June survey work. In the June survey, the initial bed of EWM was found to be bigger than anticipated making dive removal unfeasible and rooted plants were found at two additional locations in the east basin (Figure 2). As a result, the Wisconsin Department of Natural Resources (WDNR) authorized a lake-wide systematic point intercept macrophyte survey. This survey was conducted in August 2011 by ERS using points established by the WDNR (Figure 3), and led to a "rapid response" herbicide application on September 15th, 2011, and a post treatment swim-over on October 8th.

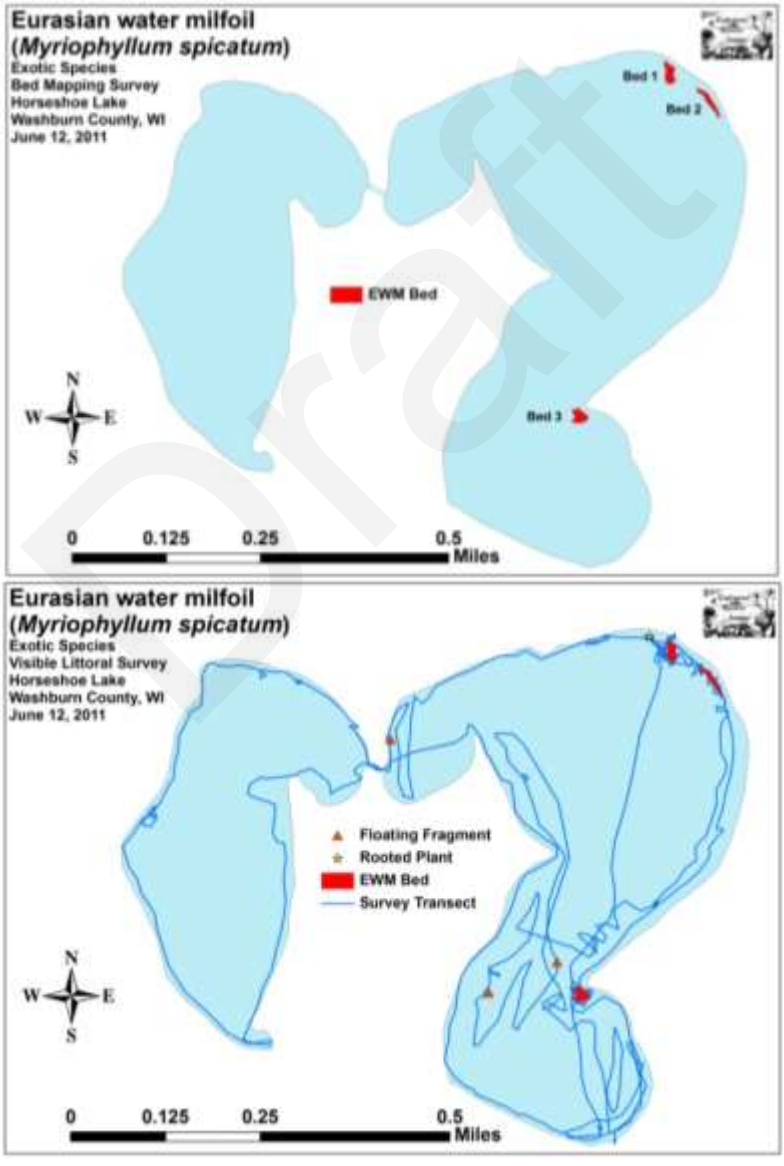

Figure 2 – June 2011 EWM Bed Mapping (top) and Visible Littoral Survey (bottom), ERS LLC

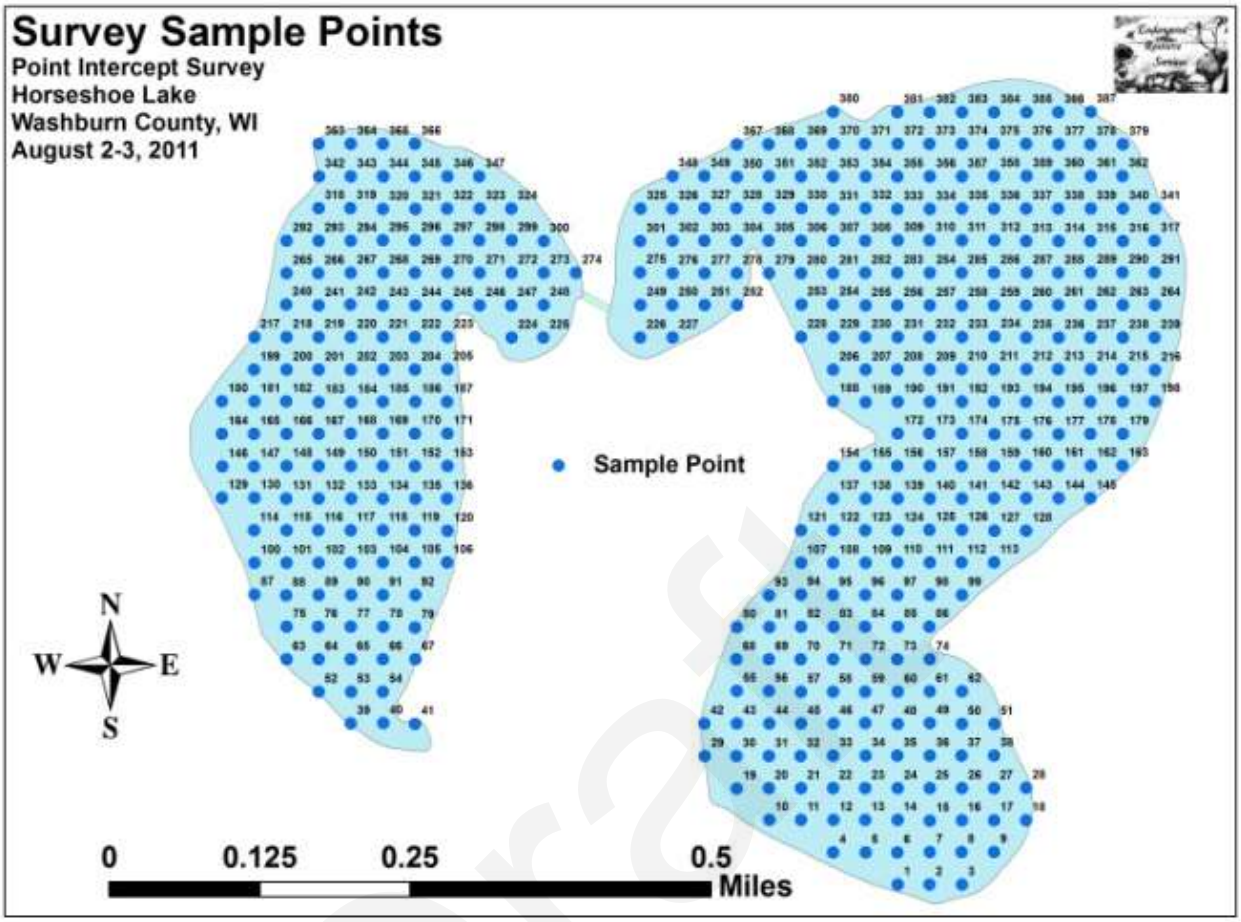

Figure 3 – WDNR Aquatic Plant Survey Points for Horseshoe Lake, Washburn County

4.1 June 2011 Diver Removal and Meandering Survey

On the June 12th, 2011, ERS, along with a host of volunteer helpers, gathered on the shoreline due north of the newly identified bed of EWM to begin what was supposed to be a diver removal of the entire known bed. When divers entered the water, they began to run into EWM plants only 15-20 meters from shore even though the buoyed bed of plants was still well over 40 meters away. The number of plants that were being found quickly ruled out the possibility of completing a successful diver removal, even over a period of several days with multiple divers. The bed originally targeted for diver removal (Bed 1 in Figure 2) was fully canopied in 10.5 ft of water and made up of 1000's of individual stems in a dense mass with a completely intertwined root-ball. The bed was actively fragmenting with perhaps 100's of additional individual plants/small clusters radiating away from it in all directions (1). Because of this, efforts to remove EWM while SCUBA diving was abandoned and more effort was focused on searching the rest of the lake from a boat to better quantify the extent of the infestation.

Approximately 9.4 miles of the lake's visible littoral zone was searched. Two additional beds were found and delineated bringing the total to three beds that covered just over half an acre (Table 1). Bed 2 was located southeast of Bed 1 in 4-7ft of water (Figure 2). Although there were two significant clusters within the bed where plants were canopied, monotypic, and

extremely dense, most of the area had only scattered EWM and both the numbers and sizes of satellite clusters were generally smaller than in Bed 1. Located due south of a rock point and due north of the boat landing, Bed 3 appeared to be the most recently establish. Although EWM was nearly monotypic at the core, the bed became increasing fragmented on the periphery. Most plants were canopied or near canopy as the area was very shallow with the majority of plants in <4.5ft of water. Away from the three beds, an additional single rooted plant and three floating stem fragments sprouting roots were found and removed (Figure 2) (1).

Table 1
EWM Bed Mapping Survey Summary, Horseshoe Lake, Washburn County, June 12, 2011

Bed Number	June 2011 Area in Acres	June 2011 Perimeter in Meters	June 2011 Est. Mean Rakefull
1	0.19	129	<1-3
2	0.16	173	<1-3
3	0.18	118	<1-2
Total: 0.53 acres			

Source: ERS (1)

No evidence of EWM was found on the western side of the lake during the June 2011 survey. Random rake samples taken by the surveyor revealed that most of the substrate was firm sand or sandy muck with little organic matter and extremely limited plant growth. This area of the lake doesn't appear to offer ideal habitat for the growth of EWM (nutrient rich organic muck), but this does not rule out the possibility that EWM will be found in the West Basin in the future.

Despite the local expansion that was occurring around the three beds, the infestation in 2011 appeared contained to these areas. However, water clarity only allowed surveyors to confidently see down to about 6ft during the meandering survey. Rooted plants were found in as much as13ft of water while diving. Because of this, it was not possible to say that all the EWM was found (1). A chemical treatment was completed later in the season to try and control that which was found in the June 2011 survey (2).

4.2 2011 Chemical Management of EWM

Prior to completing a chemical treatment of the EWM beds identified in the June 2011 survey, a whole lake, point-intercept survey of 387 points established by the WDNR (Figure 3) was completed. This survey did not identify any new areas of EWM growth outside of the beds already documents. With this information, an herbicide application using Reward® with the active ingredient diquat dibromide (diquat) was completed on September 15, 2011. Northern Aquatic Services, LLC, an herbicide applicator company out of Dresser, WI was contracted to complete treatment of all the beds identified in the June 2011 survey. Diquat is a fast-acting non-selective contact herbicide which destroys the vegetative part of the plant but does not kill the roots. It is applied as a liquid. Typically diquat is used primarily for short term (one season) control of a variety of submersed aquatic plants. It is very fast-acting and is suitable for spot treatment.

A post treatment dive assessment survey was completed by ERS on October 8, 2011 to assess the effectiveness of the survey. Initial indications were good, as what appeared to be

complete control of all visible plants was achieved. Unlike 2-4 D treated plants on other lakes that look burned (brown to black and withered), the Diquat treated plants just turned pale and fell over rather than disintegrating (1). The only hint of green was in a few stems that were raked up off the edge of the larger bed. However, according to the surveyor, the stems didn't seem viable as there was no evidence of any regrowth, and the roots looked black/dead as well. The surveyor also commented that many if not most of the native pondweeds in the treatment area (primarily Fern, Large-leaf, and White-stem pondweeds) seemed to survive the treatment.

Unfortunately, June 2012 surveying of the lake for EWM showed almost a total lack of control in the beds treated in September 2011. As indicated, diquat is a contact herbicide that is used for seasonal control and not known to substantially impact the root of a target plant affecting longer-term control. This seems to be the case in Horseshoe Lake, as plants that were completely pale and flopped over during the post treatment dive assessment in October 2011 were all back and growing. The giant tower in Bed 1 on the north side of the lake looked as though it was never touched, and it was canopied and actively fragmenting. All the beds as originally mapped in June 2011 were intact, and what were only scattered plants in the past had merged into solid beds (2).

4.3 2012 Chemical Management of EWM

On June 2, 2012 ERS and a lake representative toured the lake to determine possible EWM management areas. Long-term results that were hoped to be achieved by the September 2011 chemical treatment with a diquat-based herbicide were disappointing (2). All the beds that were originally mapped in June 2011 were intact, and what were only scattered plants in the past had merged into solid beds (2). As a result Beds 1 and 2 from June 2011 were combined into one larger bed, and Bed 3 from 2011 was expanded to include a larger area (Figure 4). Together these two areas of EWM now covered 3.73 acres instead of the 0.53 acres in 2011 (Table 2).

Table 2
EWM Bed Mapping Survey Summary, Horseshoe Lake, Washburn County, June 2, 2012

Bed Number	June 2012 Area in Acres	June 2011 Area in Acres	Change in Area	June 2012 Est. Mean Rakefull
1&2	3.18	0.35	+2.83	<1-3
3	0.55	0.16	+0.37	<1-2
	Total: 3.73 acres			

Source: ERS (2)

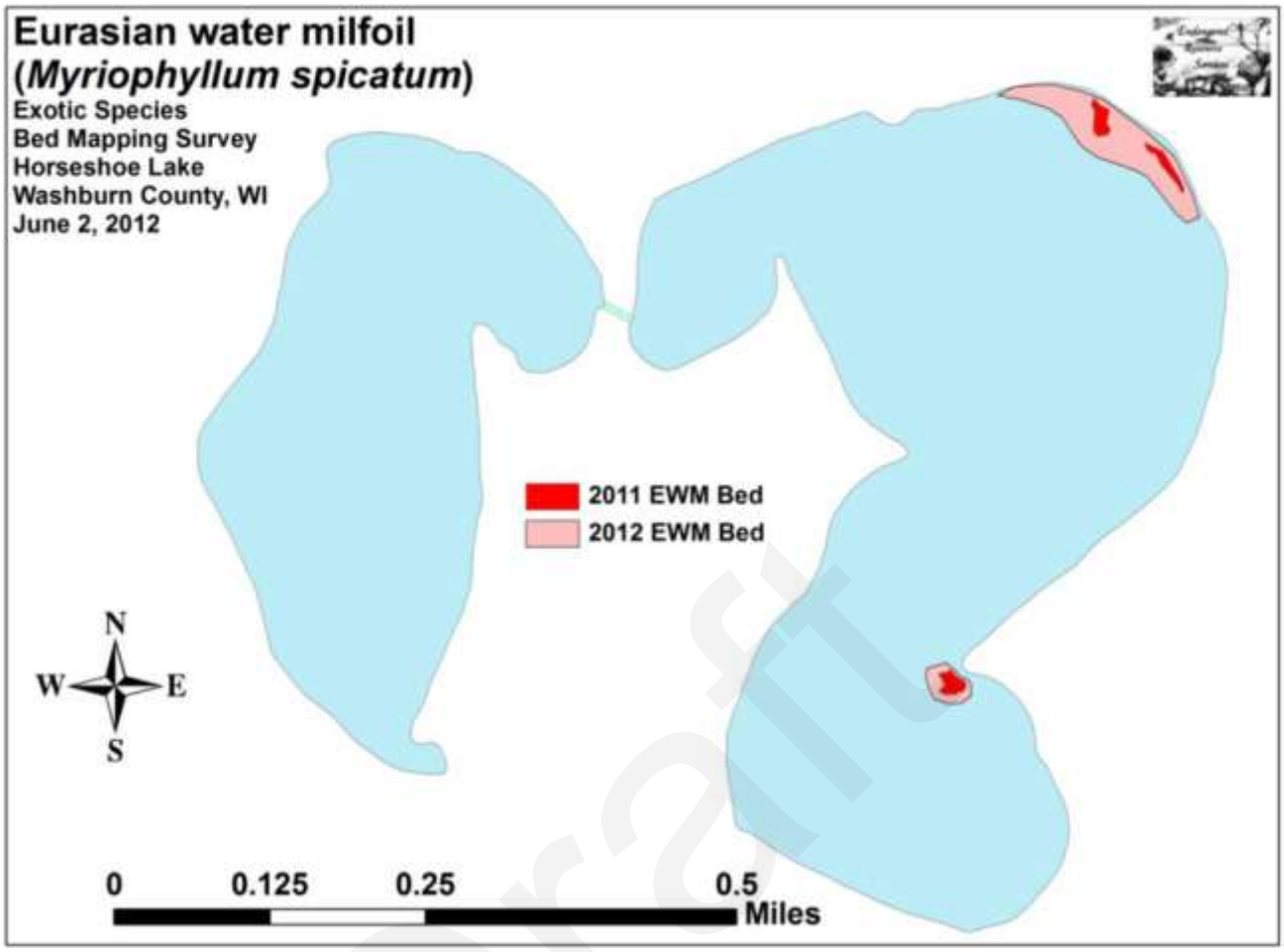

Figure 4 – June 2012 EWM Beds in Horseshoe Lake, Washburn County

On June 29, 2012, Northern Aquatic Services was again contracted by the HLPA to complete an herbicide application covering the entire area of the known EWM beds in the lake (3.67 acres). This time though, Navigate® with the active ingredient butoxyethyl ester, 2,4-Dichlorophenoxyacetic acid (2,4-D) at a concentration of 4.0 in what were beds 1 and 2, and at 2.5 ppm in what was bed 3 (7). 2,4-D is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian water milfoil and other broad-leaved, dicot species. 2,4-D has been shown to be selective to Eurasian water milfoil when used at the labeled rate, leaving native aquatic species relatively unaffected. Unlike diquat, a contact herbicide, a systemic herbicide is drawn into the plant affecting the entire plant, including the roots. It is expected to provide longer term control of the target plant.

On September 1, 2012, a follow up search of the lake's visible littoral zone and a dive assessment survey was completed by ERS. Water clarity was fair, with the bottom visible in up to 6ft of water. The perimeter of the entire lake was searched and no rooted EWM plants were found. There was also no evidence of floating fragments of EWM. SCUBA diving was used to assess the treatment of the three beds. No evidence of any EWM, plants or fragments with the exception of a single 4inch strand of rotten tissue was found. The bottom in the treatment areas was covered with large amounts of plant debris, but natives species (primarily Muskgrass (*Chara* sp.), White-stem pondweed (*Potamogeton praelongus*), Large-leaf pondweed (*Potamogeton amplifolius*), and Wild celery (*Vallisneria americana*)) were rapidly filling in the areas vacated by EWM (2).

4.4 2013 Management of EWM

Two meandering shoreline surveys and dive checks of the area in Horseshoe Lake where EWM had previously been identified were completed. During the first survey, completed June 19, 2013 by ERS, no EWM was identified. No fragments were located either. As a result, no EWM treatment was completed in 2013. Subsequent visits to the lake through late August continued to show no EWM.

A fall bed mapping survey will be conducted in September, results of which will be added at that time.

While it is possible that the EWM present in previous years has been eradicated, it is unlikely. Continued monitoring of the entire lake for EWM will become a regular activity on the lake.

5.0 Lake Information

Identifying appropriate aquatic plant management activities for Horseshoe Lake requires a basic understanding of its physical characteristics, including its morphology (size, structure, and depth), critical habitat, and the fishery, as well as factors influencing water quality, such as land use in the watershed. All of these factors have the potential to influence aquatic plant growth. Aquatic plant management will impact certain aspects of a lake including water quality, fish and wildlife habitat, and both target and non-target aquatic plants. Water quality and plant survey data were collected and summarized for the development of this plan. These data along with data collected in the past and future will provide the information necessary to evaluate the effects of aquatic plant management and other management activities on the lake and its ecosystem.

The lake inventory information that follows has been summarized from a number of resources. Some of the information has been updated with more recent data. For example, lake areas were obtained from high-resolution digital orthophotos (WROC imagery) and lake volumes were computed in ArcGIS using digitized bathymetric maps based on historic WDNR and recent plant survey data.

5.1 Physical Characteristics

Horseshoe Lake (WBIC 2470000) is a 194-acre, mesotrophic, seepage, lake located in north-central Washburn County, Wisconsin (Figure 5). It has a well developed shoreline. The lake's maximum depth is 21-ft with an average depth of 7ft, and the bottom substrate is predominantly sand and sandy/muck. The lake is divided into two separate basins connected by a narrow channel that is periodically dredged to maintain clear and open passage between the two basins.

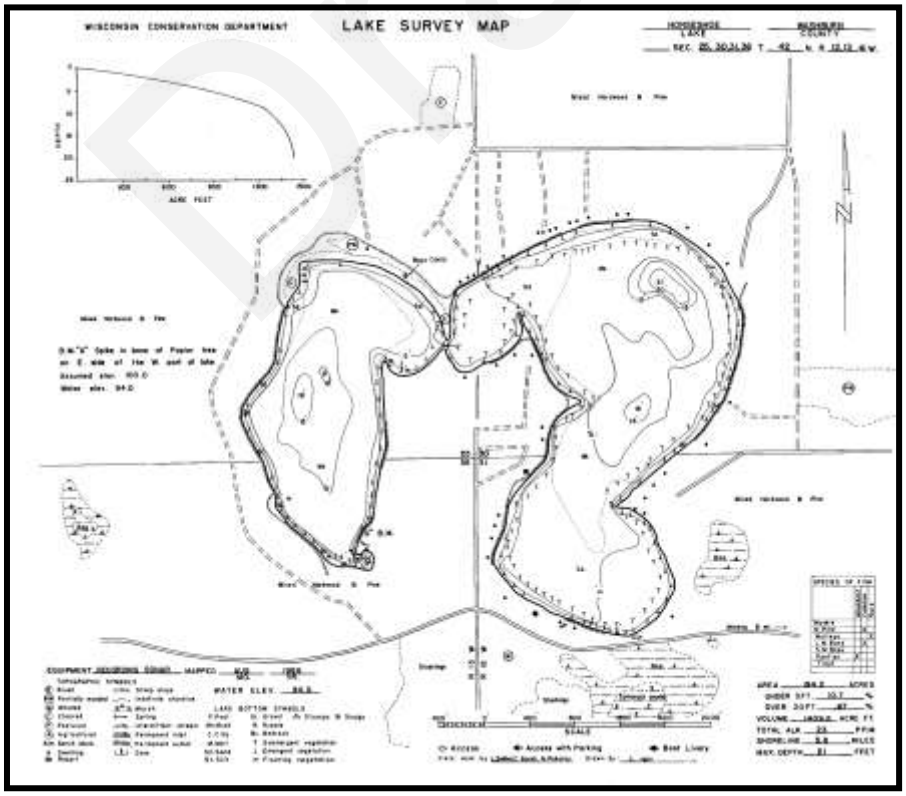

Figure 5 – Horseshoe Lake Map, WDNR (3)

During the 2011 summer point intercept survey, 387 points were surveyed for depth and bottom substrate (Figure 6). Most of the western side of the lake rapidly drops off from shore into at least 7ft of water before leveling out in the 10-12ft range with the exception of the >17.5ft hole on the west side mid-lake. Two 5-8 ft deep, approximately 10-acre flats occur on either side of the channel where the two basins meet. On the eastern side, there is greater underwater topography. An expansive 5-7 ft flat covers the southeast end near the boat landing, and the lake's two deepest holes reach 22ft in the northeast bay and more than 17.5 ft mid-lake.

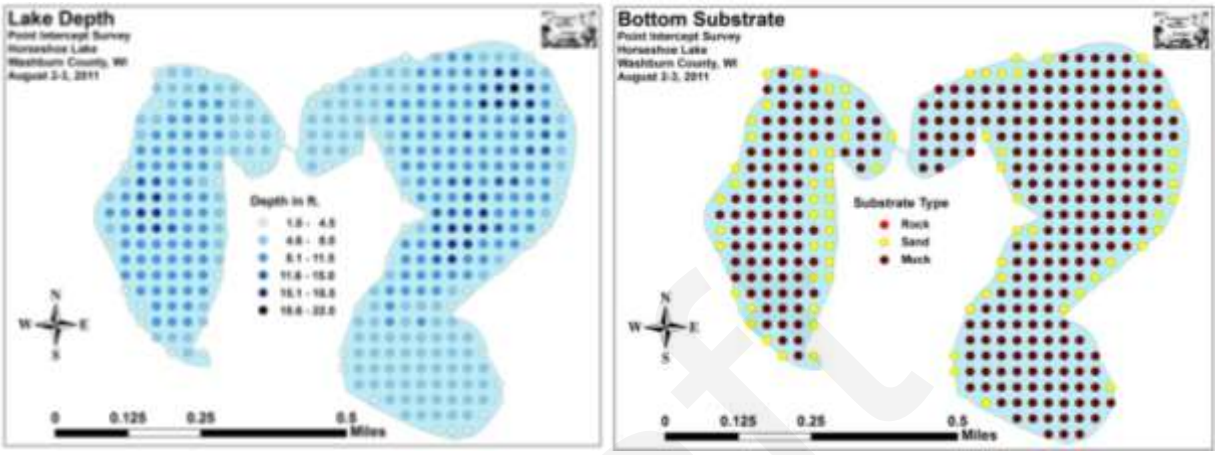

Figure 6 – Lake Depth and Substrate

5.2 Horseshoe Lake Watershed

A watershed is an area of land from which water drains to a common surface water feature, such as a stream, lake, or wetland. The watershed boundary of Horseshoe Lake is 947.2 acres (Figure 7). Land use and land cover in the watershed is primarily natural, comprised of forests (53.57%), wetlands (21.34%), open water (20.04%, including Horseshoe Lake), and grassland/shrub land (1.21%). The balance of the land use in the watershed is developed land (3.85%) (Table 3). Developed areas are primarily associated with areas of low to medium density residential development present around most of Horseshoe Lake, portions of a local golf course, and a small amount of agriculture.

The soils in the area consist of well-drained sandy deposits derived from glacial outwash plains. All of the soils in the Horseshoe Lake watershed are rated Very Limited for septic tank absorption fields. A Very Limited rating indicates that the soil has one or more features that are unfavorable for the specified use and poor performance and high maintenance can be expected (4) (5). The limitations generally cannot be overcome without major soil reclamation, special design (for example, tertiary systems), or expensive installation procedures.

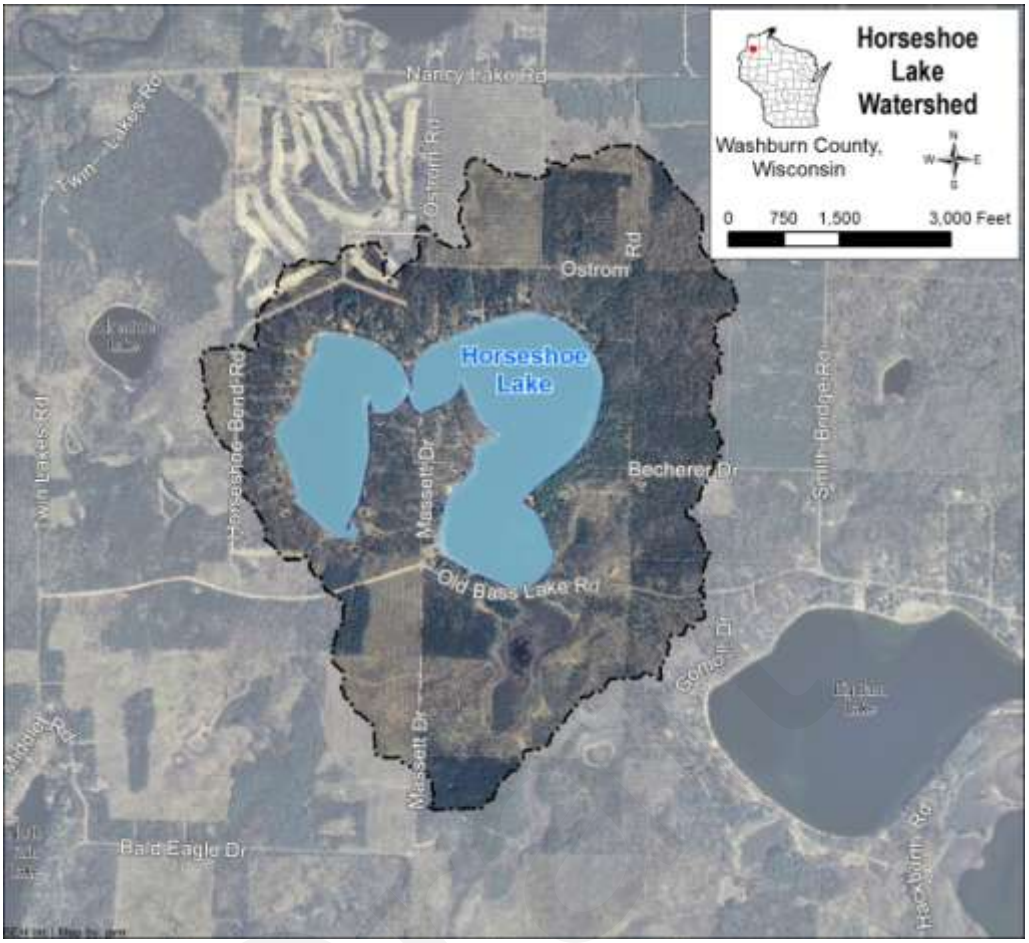

Figure 7 – Horseshoe Lake Watershed

Table 3
Land Use and Cover in the Horseshoe Lake Watershed

Land Use/Cover	Acres	Percent of Total
Medium density residential	10.3	1.09
Low density residential	14.3	1.51
Agriculture	11.8	1.25
Forest	507.7	53.57
Grassland/shrubland	11.5	1.21
Wetland	202.2	21.34
Open Water	189.9	20.04
Total Watershed	**947.2**	**100.0**

Source: 2006 National Land Cover Database (USGS)

6.0 Water Quality

The water quality of a lake influences the aquatic plant community, which in turn can influence the chemistry of a lake. Water clarity, total phosphorus and chlorophyll *a* are measures of water quality that can be used to determine the productivity or trophic status of a lake. The Carlson trophic state index (TSI) is a frequently used biomass-related index. The trophic state of a lake is defined as the total weight of living biological material (or biomass) in a lake at a specific location and time. Eutrophication is the movement of a lake's trophic state in the direction of more plant biomass. Eutrophic lakes tend to have abundant aquatic plant growth, high nutrient concentrations, and low water clarity due to algae blooms (Figure 8). Oligotrophic lakes, on the other end of the spectrum, are nutrient poor and have little plant and algae growth (Figure 8). Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms (Figure 8).

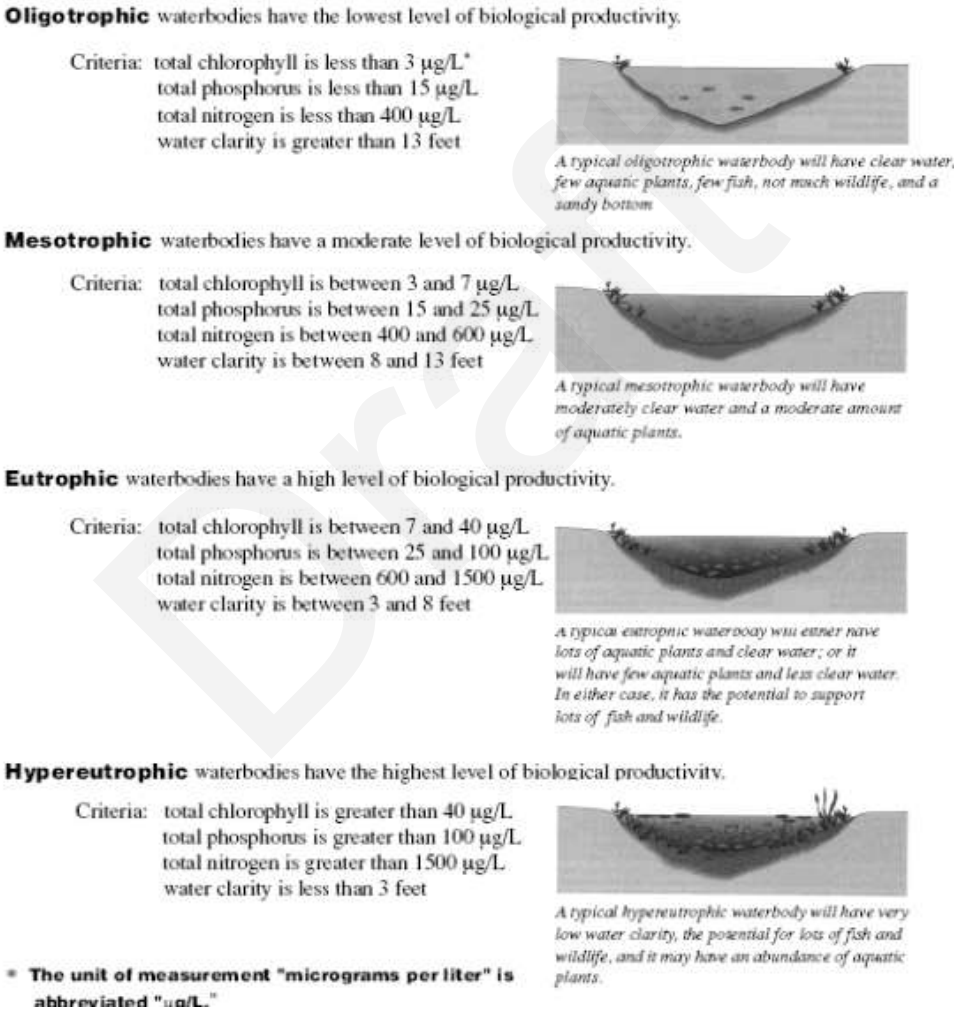

Figure 8 – Trophic status in lakes

Based on satellite images with a water clarity range of 6.6 to 13.1 ft. during the years of 2003-2005 (5), Horseshoe Lake is considered to be a mesotrophic lake. Water clarity in the western basin was higher during the years of 1999-2001 as compared to 2003-2005 (Figure 9).

Figure 9 – Trophic state of Horseshoe Lake in 1999-2001 compared to 2003-2005. Images source LakeSat.org, 2012. (The station identification number 10006919, as indicated by the red star, is linked to water clarity data in the SWIMs database.)

The same satellite images give Horseshoe Lake a Carlson's Trophic State Index in the 40-50 range on a 0-100 scale (Figure 10). The higher the index value the more nutrient rich the lake.

TSI	Description of Associated Conditions
< 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
30 - 40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
40 - 50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
50 - 60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
60 - 70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
70 - 80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
> 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Horseshoe Lake

Figure 10 – The Trophic State Index and Description of Associated Conditions

There is no physical water quality data available for Horseshoe Lake. There have been no Citizen Lake Monitoring Network (CLMN) volunteers on the lake for the purpose of collecting water quality data. CLMN volunteers measure quantitative parameters such as temperature and Secchi depth measurements of water clarity, and in more advanced levels of the program, collect water samples for analysis of total phosphorus and chlorophyll *a*, and

dissolved oxygen profiles. Qualitative observations such as lake level, color, and user perception of water quality are also documented in the program. All this data is entered and stored in the Surface Water Integrated Monitoring System (SWIMS) database maintained by the WDNR

6.1 Water Clarity

Water clarity is a measurement of how deep sunlight can penetrate into the waters of a lake. It can be measured in a number of ways, the most common being an 8" disk divided into four sections, two black and two white, lowered into the lake water from the surface by a rope marked in measurable increments (Figure 11). The water clarity reading is the point at which the Secchi disk when lowered into the water can no longer be seen from the surface of the lake. Water color (like dark water stained by tannins from nearby bogs and wetlands), particles suspended in the water column (like sediment or algae), and weather conditions (cloudy, windy, or sunlight) can impact how far a Secchi disk can be seen down in the water. Some lakes have Secchi disk readings of water clarity of just a few inches, while other lakes have conditions that allow the Secchi disk to be seen for dozens of feet before it disappears from view.

Figure 11 – Black and white Secchi disk for measuring water clarity

Secchi depths vary throughout the year, with shallower readings in summer when algae become dense and limit light penetration and generally deeper readings in spring and late fall. Because light penetration is usually associated with algae growth, a lake is considered eutrophic, or highly productive, when Secchi depths are less than 6.5 feet.

In Horseshoe Lake, water clarity has not been measured using a Secchi disk. However, using data generated from satellite images, average water clarity over the last decade was estimated to be about 10-ft (Figure 12).

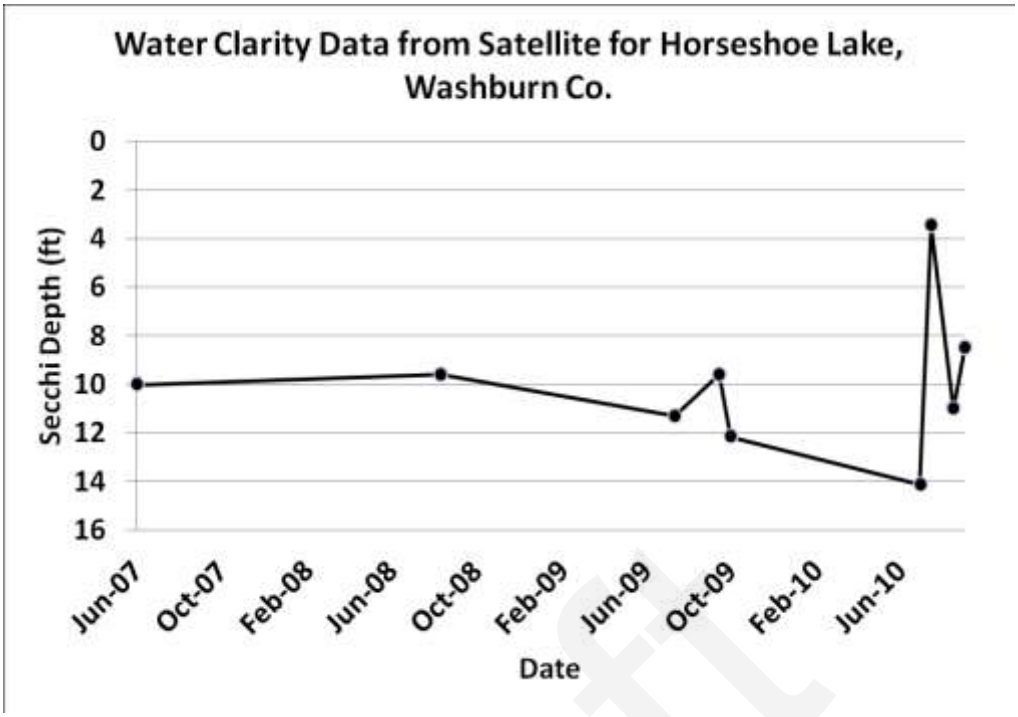

Figure 12 – Water clarity data measured by satellite and downloaded from the SWIMS database. Measurements not displayed for 9/5/2000 (14.93 ft) and 8/7/2001 (11.04 ft).

6.2 Dissolved Oxygen and Temperature

Dissolved oxygen and temperature data were absent for Horseshoe Lake in the SWIMS database.

6.3 Total Phosphorus and Chlorophyll a

Phosphorus is an important nutrient for plant growth and is commonly the nutrient limiting plant production in Wisconsin lakes. When phosphorus is limiting production, small additions of the nutrient to a lake can cause dramatic increases in plant and algae growth.

Chlorophyll *a* is the green pigment found in plants and algae. The concentration of chlorophyll *a* is used as a measure of the algal population in a lake. Concentrations >10 µg/L are considered indicative of eutrophic conditions and concentrations 20 µg/L or higher are associated with algal blooms. For trophic state classification, preference is given to the chlorophyll *a* trophic state index (TSI_{CHL}) because it is the most accurate at predicting algal biomass.

Phosphorus and chlorophyll a data were absent for Horseshoe Lake in the SWIMS database.

7.0 Aquatic Ecosystems

Aquatic plants are a natural part of most lake communities and provide many benefits to fish, wildlife, and people. Native macrophytes have many important functions and values to a lake ecosystem. They are the primary producers in the aquatic food chain, converting the basic chemical nutrients in the water and soil into plant matter, which becomes food for all other life.

Aquatic plants provide valuable fish and wildlife habitat. More food for fish is produced in areas of aquatic vegetation than in areas where there are no plants. Insect larvae, snails, and freshwater shrimp thrive in plant beds. Panfish eat aquatic plants in addition to aquatic insects and crustaceans. Plants also provide shelter for young fish. Northern pike spawn in marshy and flooded areas in early spring and bass, sunfish, and yellow perch usually nest in areas where vegetation is growing.

Many submerged plants produce seeds and tubers (roots) which are eaten by waterfowl. Bulrushes, sago pondweed, wild celery, and wild rice are especially important duck foods. Submerged plants also provide habitat to a number of insect species and other invertebrates that are, in turn, important foods for brooding hens and migrating waterfowl.

The lake aesthetic valued by so many is enhanced by the aquatic plant community. The visual appeal of a lakeshore often includes aquatic plants, which are a natural, critical part of a lake community. Plants such as water lilies, arrowhead, and pickerelweed have flowers or leaves that many people enjoy.

Aquatic plants improve water clarity and water quality. Certain plants, like bulrushes, can absorb and break down polluting chemicals. Nutrients used by aquatic plants for growth are not available to algae, thus reducing algae abundance and improving water clarity. Algae, which thrive on dissolved nutrients, can become a nuisance when too many submerged water plants are destroyed. Aquatic plants also maintain water clarity by preventing the re-suspension of bottom sediments. Aquatic plants, especially rushes and cattails, dampen the force of waves and help prevent shoreline erosion. Submerged aquatic plants also weaken wave action and help stabilize bottom sediment.

Native aquatic plant communities also offer protection from non-native aquatic invasive species. Current scientific literature accepts the concept that invasions of exotic plants are encouraged, and in some cases induced, by the disruption of natural plant communities. Most aquatic invasive plant species are opportunistic; much like lawn and agricultural weeds that germinate in newly disturbed soil, aquatic invasive plant species are more likely to invade areas in which the native plant community has been disturbed or removed. Removing the natural competition from native plants may also open up the door to new invasive species and less desirable plant communities.

As a natural component of lakes, aquatic plants support the economic value of all lake activities. Wisconsin's $13 billion tourism industry is anchored by 15,081 lakes and 12,600 rivers and streams which draw residents and tourists to hunt, fish, camp, and watch wildlife. According to the WDNR, the world class fishery lures more than 1.4 million licensed anglers each year, supports more than 30,000 jobs, generates a $2.75 billion annual economic impact, and $200 million in tax revenues for state and local governments.

7.1.1 Wetlands

In Wisconsin, a wetland is defined as an area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation, and which has soils indicative of wet conditions (Wisconsin Statue 23.32(1)). Wetlands contain a unique combination of terrestrial and aquatic life and physical and chemical processes. Wetlands are protected under the Clean Water Act and state law and in some places by local regulations or ordinances. Landowners and developers are required to avoid wetlands with their projects whenever possible; if the wetlands can't be avoided, they must seek the appropriate permits to allow them to impact wetlands (for example, fill, drain or disturb soils).

According to the National Wetland Inventory, forested, scrub/shrub, emergent/wet meadow and aquatic bed (lake and freshwater pond) wetlands are present in the Horseshoe Lake watershed (Figure 13). Emergent wetlands are wetlands with saturated soil and are dominated by grasses such as redtop and reed canary grass, and by forbs such as giant goldenrod. Forested/shrub wetlands are wetlands dominated by mature conifers and lowland hardwood trees. Forested/shrub wetlands are the dominant form of wetlands in the watershed and are important for stormwater and floodwater retention and provide habitat for various wildlife. Aquatic bed wetlands are wetlands characterized by plants growing entirely on or within a water body that is no more than six feet deep.

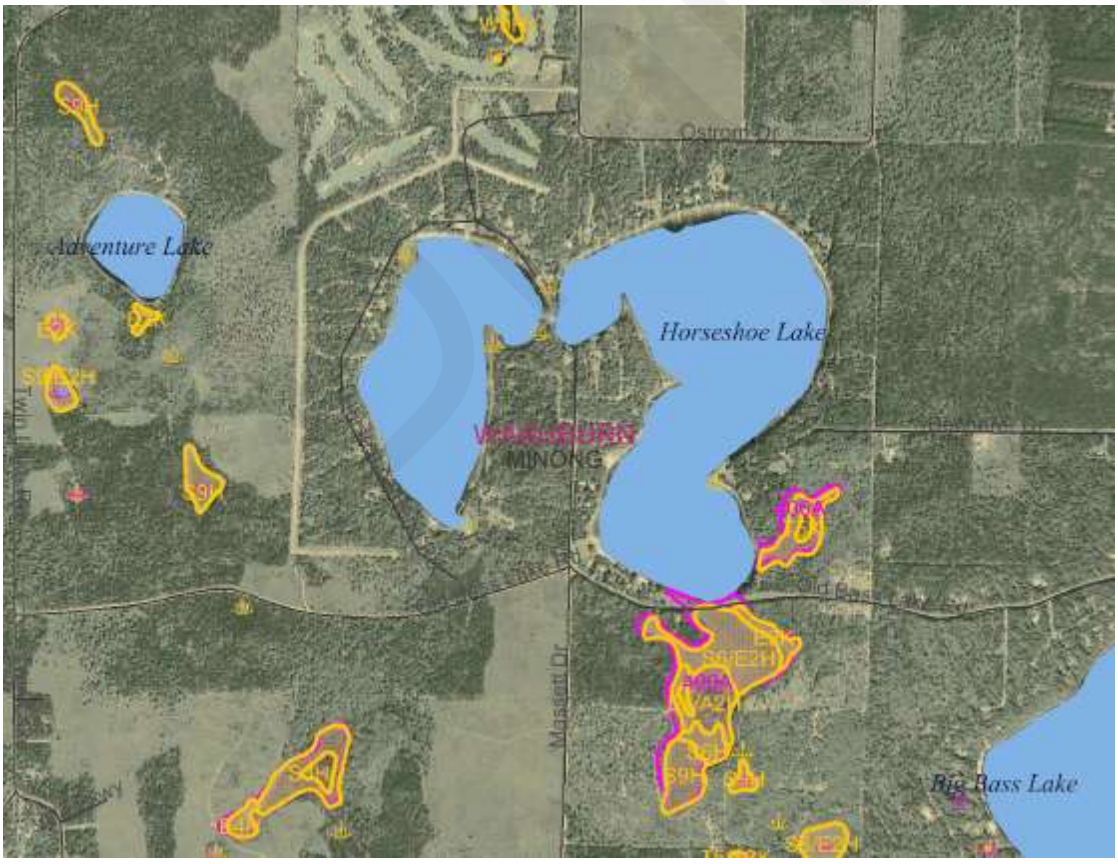

Figure 13 – Wetlands near Horseshoe Lake, Washburn County (Wisconsin Wetlands Inventory, March, 2013)

Wetlands serve many functions that benefit the ecosystem surrounding the Horseshoe Lake. Wetlands support a great variety of native plants and are more likely to support regionally scarce plants and plant communities. Wetlands provide fish and wildlife habitat for feeding, breeding, resting, nesting, escape cover, travel corridors, spawning grounds for fish, and nurseries for mammals and waterfowl. Contrary to popular belief, healthy wetlands reduce mosquito populations; natural enemies of mosquitoes (dragonflies, damselflies, backswimmers, and predacious diving beetles) need proper habitat (that is, healthy wetlands) to survive.

Wetlands provide flood protection within the landscape by retaining stormwater from rain and melting snow and capturing floodwater from rising streams. This flood protection minimizes impacts to downstream areas. Wetlands provide groundwater recharge and discharge by allowing the surface water to move into and out of the groundwater system. The filtering capacity of wetland plants and substrates help protect groundwater quality. Wetlands can also stabilize and maintain stream flows, especially during dry months.

Wetland plants and soils provide water quality protection by storing and filtering pollutants ranging from pesticides to animal wastes. Wetlands also provide shoreline protection by acting as buffers between the land and water. Wetland plants protect against erosion by absorbing the force of waves and currents and by anchoring sediments. This is important in waterways where high boat traffic, water currents, and wave action may cause substantial damage to the shore.

There are a few small (two acres or less) wetlands scattered throughout the watershed. Although these wetlands may not appear to provide significant functional values when assessed individually, they may be very important components of a larger natural system. Not only do small wetlands provide habitat functions, they also store phosphorus and nitrogen and trap pollutants such as heavy metals and pesticides. Draining these small wetlands, which often do not appear on maps, not only requires the proper permits, but can also release the once-stored pollutants and nutrients into lakes and streams.

7.1.2 Critical Habitat

Every body of water has areas of aquatic vegetation or other features that offer critical or unique aquatic plant, fish and wildlife habitat. Critical Habitat areas include important fish and wildlife habitat, natural shorelines, physical features important for water quality (for example, springs), areas of natural scenic beauty, and navigation thoroughfares. These areas, which can be located within or adjacent to the lake, are selected because they are particularly valuable to the ecosystem or would be significantly and negatively impacted by most human induced disturbances or development. Critical Habitat areas include both Sensitive Areas and Public Rights Features. Sensitive Areas offer critical or unique fish and wildlife habitat, are important for seasonal or life-stage requirements of various animals, or offer water quality or erosion control benefits. Public rights features include: physical features of waterbodies that ensure protection of water quality, reaches of bank, shore or bed that are mostly natural in appearance (not man-made or artificial) or that screen man-made or artificial features, navigation thoroughfares or areas traditionally used for navigation during normal recreational activities such as boating, angling, hunting, or enjoyment of natural scenic beauty.

Critical Habitat Areas on Horseshoe Lake have not been officially identified or mapped, however, areas of ecological importance have been identified via plant surveying (high value aquatic plants) and fishery assessments (spawning habitat). Management activities completed on the lake should be limited only to the amount necessary to maintain and protect these

ecologically sensitive areas from negative impacts that may be caused by the presence of EWM.

It is particularly important to maintain vegetated shoreland buffers not just in the ecologically significant areas, but throughout the lake. Also, stumps and woody habitat, which provide fish cover, should not be removed from the near-shore area. In the event of a treefall into the lake, unless it is causing a navigational impairment it should be left in the lake. It may take decades or longer for woody debris to decay in a lake, thus having limited impacts on water quality, but tremendous impact on creating desirable habitat. Because much of Horseshoe Lake contains such features, the WDNR document *Guidelines for Protecting, Maintaining, and Understanding Lake Sensitive Areas*, which provides excellent guidance on how to approach management activities in ecologically sensitive areas, is included as Appendix B of this plan.

7.1.3 Rare and Endangered Species and Habitat

The Wisconsin Natural Heritage Inventory (NHI) program is part of an international network of programs that focus on rare plants and animals, natural communities, and other rare elements of nature. It is important for lake managers to consider impacts to these valuable species and communities, nearly all of which can be directly affected by aquatic plant management. Choosing the proper management techniques and the proper timing of management activities can greatly reduce or prevent negative impacts. Each species has a state status including Special Concern, Threatened, or Endangered. Species are listed by township: Horseshoe Lake and its watershed are in the Town of Minong (T42N, R12&13W).

Five Special Concern species (the least darter fish, *Etheostoma microperca*; the gray wolf, *Canis lupus*; bald eagle, *Haliaeetus leucocephalus*, Franklin's ground squirrel *Spermophilus franklinii*, and prairie sagebrush *Artemisia frigid*); and three Threatened species (Blanding's turtle *Emydoidea blandingii*, wood turtle *Glyptemys insculpta*, and Northern bur-reed *Sparganium glomeratum*) are listed for the Town of Minong (data current as of November 2011). Descriptions of these species can be found at: http://dnr.wi.gov/topic/EndangeredResources/biodiversity.html/ (last accessed 2013-03-05).

In addition, small purple bladderwort (*Utricularia resupinata*), listed as Species of Special Concern in Wisconsin, was identified during the 2011 warm-water aquatic plant survey for Horseshoe Lake. Species of Special Concern are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose for classifying plants in this category is to focus attention on them before they become threatened or endangered.

7.1.4 Wildlife

At the present time, there is no wildlife monitoring or management occurring on Horseshoe Lake.

7.1.5 Fishery

The WDNR was very involved with manipulating the fishery in Horseshoe lake over a twelve year study period ending in the early 1990's. They were trying to see if activities like walleye stocking (Table 4) and direct removal of bullheads and stunted panfish could help improve the quality of stunted panfish populations. The problem has been that panfish (except crappie) grow so slowly that most live out their life time without reaching decent size. Walleye like to feed on bluegill but efforts to develop a walleye population high enough (even with experimental stocking of very large walleye fingerlings (10 inches or bigger) to make a

difference in thinning out stunted panfish did not succeed. Direct removal of bullheads and panfish did cause a significant growth spurt in remaining panfish but the effects only lasted a couple years. With fewer panfish and bullheads and only a small walleye population more of the eggs laid survived so things quickly went back to as stunted as before. Regular stocking of walleye continued through at least 2005, but it is believed that the actual population is still very low (Horseshoe Lake Property Association Webpage, www.horseshoelake.org).

A bass size limit went into effect in 1989 in order to increase predation on stunted panfish. Currently bass are more abundant than they were in the early 1990's and suffer from slow growth.

During the 12 years the WDNR was studying the lake, crappie were never very abundant. Crappie populations typically are cyclical with a peak in fishing every 4 or 5 years and then several years of low populations.

Table 4
Horseshoe Lake Walleye Stocking Records.

Year	Age Class	Number Stocked	Average Fish Length (in)
2005	Small Fingerling	9700	1.70
2003	Small Fingerling	9836	1.60
1999	Small Fingerling	9700	1.30
1997	Small Fingerling	9700	1.60
1995	Fingerling	9676	2.50
1993	Fingerling	10428	4.50
1992	Fingerling	14254	3.00
1991	Fingerling	5000	3.00
1990	Yearling	1000	7.00
1990	Fingerling	10080	3.00
1989	Fingerling	12725	5.67
1988	Fingerling	20032	2.33
1987	Fingerling	75510	3.00
1986	Fry	194000	1.00
1986	Fingerling	19952	3.00
1985	Fingerling	10106	3.00
1984	Fingerling	15050	3.00
1982	Fry	200000	
1980	Fingerling	2000	7.00
1979	Fingerling	1998	5.00
1978	Fingerling	1579	7.00

Source: WDNR Horseshoe Lake Webpage, 2012

7.2 Aquatic Plant Communities

Aquatic plants play an important role in lakes. They anchor sediments, buffer wave action, oxygenate water, and provide valuable habitat for aquatic animals. The amount and type of plants in a lake can greatly affect nutrient cycling, water clarity, and food web interactions. Furthermore, plants are very important for fish reproduction, survival, and growth, and can greatly impact the type and size of fish in a lake.

Unfortunately, healthy aquatic plant communities are often degraded by poor water clarity, excessive plant control activities, and the invasion on non-native nuisance plants (6). These

disruptive forces alter the diversity and abundance of aquatic plants in lakes and can lead to undesirable changes in many other aspects of a lake's ecology (Figure 14). Consequently, it is very important that lake managers find a balance between controlling nuisance plant growth and maintaining a healthy, diverse plant community.

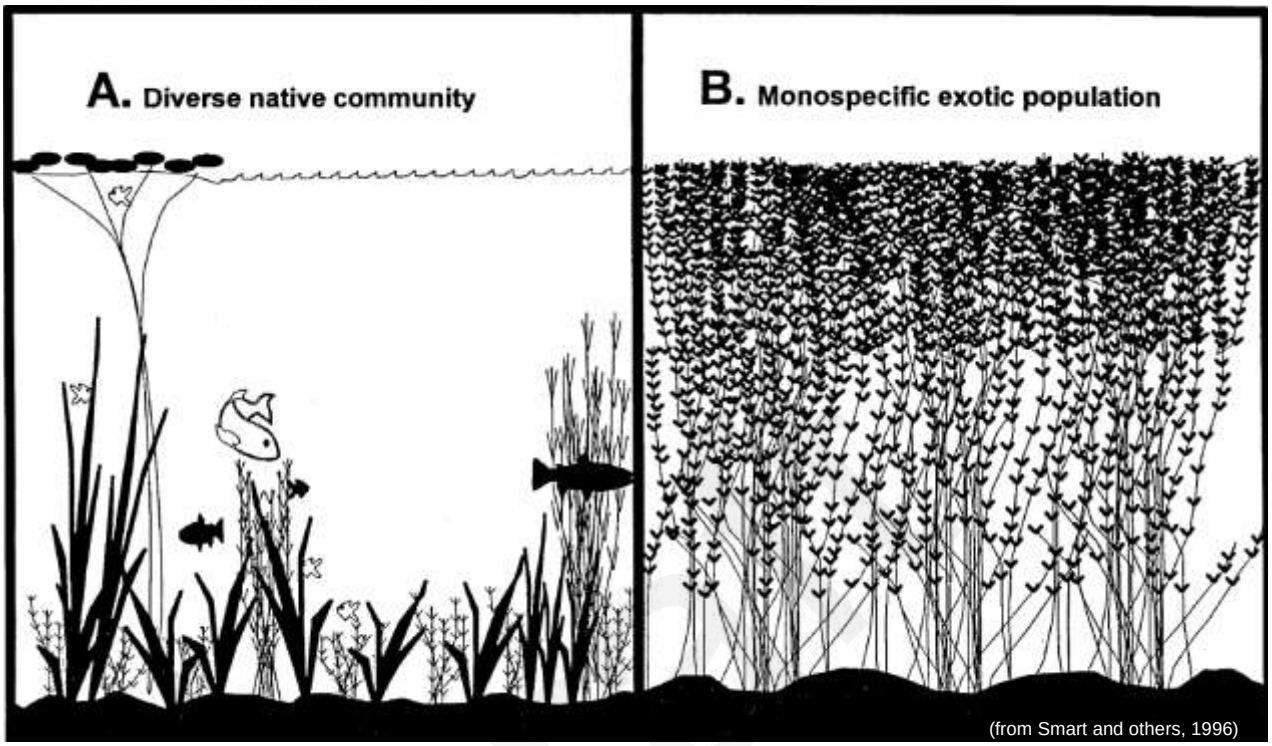

Figure 14 – Submersed Aquatic Plant Communities

7.3 Aquatic Plant Survey in Horseshoe Lake

An extensive summer point-intercept survey of the aquatic plant community in Horseshoe Lake was completed in early August, 2011 by Endangered Resources Services, LLC (ERS). The data collected through the survey followed the WDNR point intercept whole-lake survey protocol and provides information on the diversity, distribution and density of the aquatic plant community in Horseshoe Lake. Detailed statistical assessments of the 2011 data (available in the Aquatic Plant Survey Report completed by ERS in 2011) establish baseline conditions for evaluating any changes in the plant community that may occur over the coming years due to management actions, and help guide responsible aquatic plant management planning. Generally, aquatic plant management plans can be developed using data from a plant survey up to 5 years old. The 2011 survey was requested by the WDNR for the development of this plan.

7.4 2011 Point Intercept Aquatic Plant Survey Results

Aquatic plants need sunlight and appropriate substrate to growth in a lake. The area of a lake where aquatic plants get enough energy from the sun to grow, and has appropriate substrate for growth is called the littoral zone. In 2011, the littoral zone in Horseshoe Lake extended to 18ft, but plants were only widely scattered throughout with just over 65.8% of the lake's available substrate being colonized (Figure 15). *Essentially the entire lake bottom was in the littoral zone, though not all of it had aquatic plant growth.*

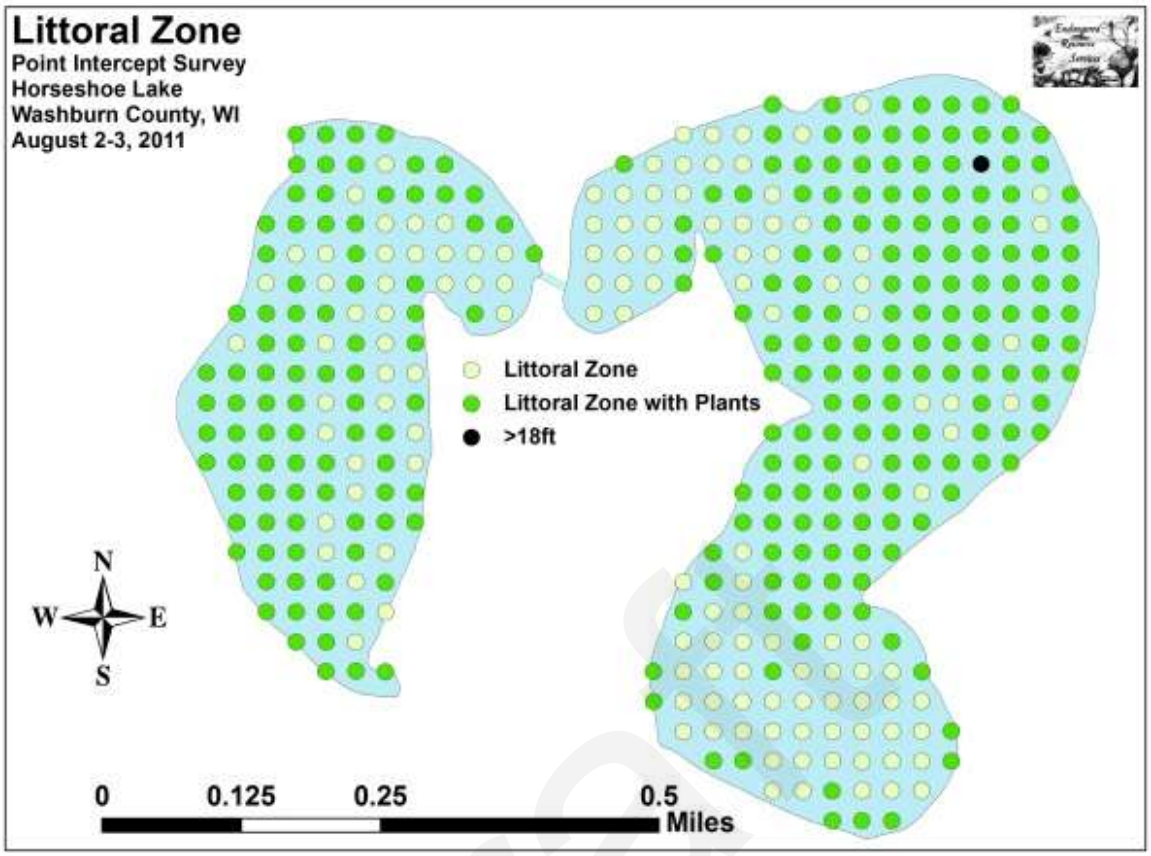

Figure 15 – Horseshoe Lake Littoral (plant growing) Zone

Overall plant density was moderate with a mean rake fullness of 1.70 on a 1-3 scale (Figure 16). *Plant density was as much a product of bottom type as depth*, meaning plants only grew where bottom substrate and water clarity supported it.

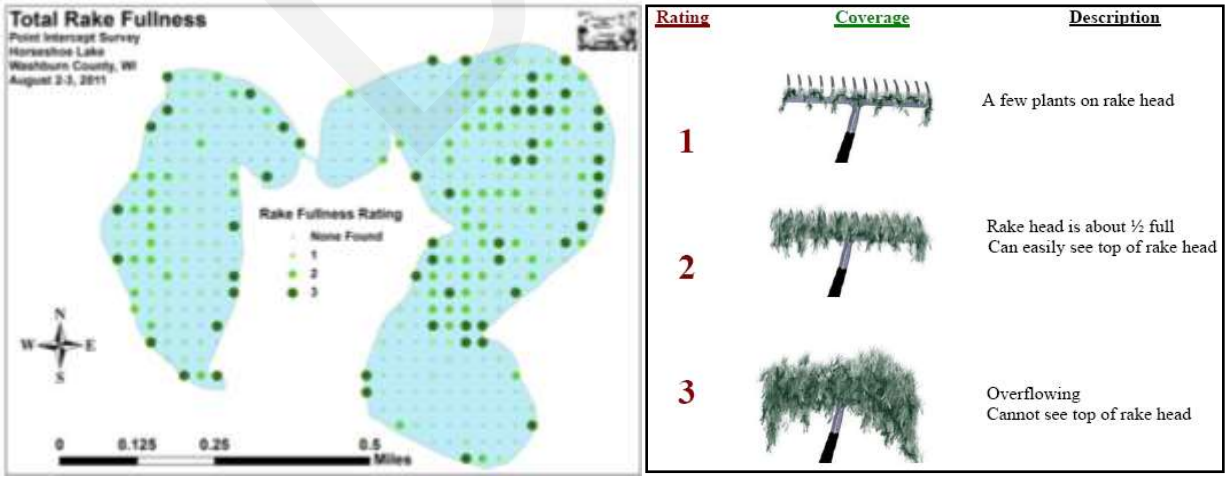

Figure 16 – Plant Density in Horseshoe Lake and Rake Density Guide

Overall diversity was high with a Simpson Diversity Index value of 0.91. The Simpson's Diversity Index represents the probability that two individually and randomly selected plants in the lake will be different species. The index value ranges from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the

same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be more resistant to invasion by exotic species.

Species richness was also relatively high for such a small lake with 41 total species found growing in and immediately adjacent to the lake; however, the average number of native species per site was low with only 2.03 species/vegetative site (Figure 17). Slender naiad, Muskgrass, Fern pondweed, and Wild celery were the most common species. *They were found at 28.35%,* 27.95%, 25.20% and 23.23% of survey points with vegetation respectively. Collectively, *they accounted for 51.65%* of the total relative frequency. Although many other species were relatively common and widely distributed, only Variable pondweed (7.18), Crested arrowhead (6.41), Brown-fruited rush (5.63), Small purple bladderwort (5.24), and Dwarf water milfoil (5.05) had relative frequencies over 5%. Aquatic moss, a non-vascular plant, was actually the most common macrophyte being found at 66.30% of vegetative sites, but because it is non-vascular, WDNR plant survey protocol excludes Aquatic moss from all statistical calculations including species richness, relative frequency, and establishment of the lake's littoral zone.

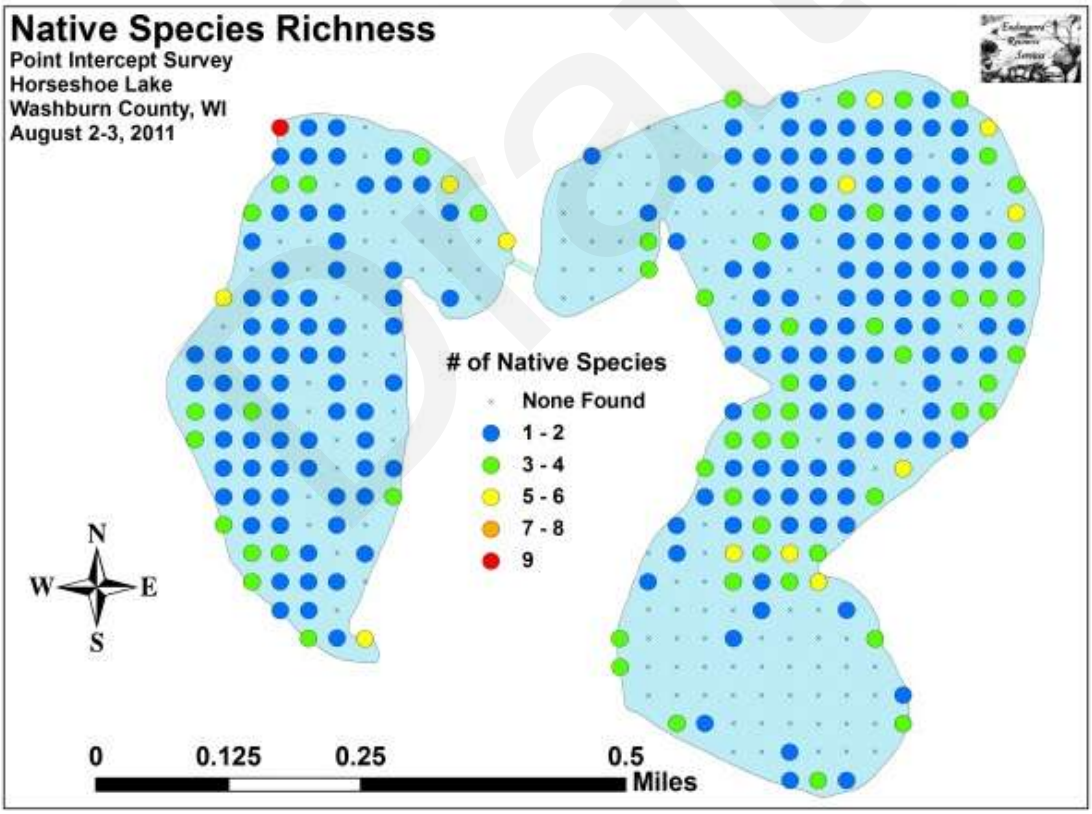

Figure 17 – Native Species Richness in Horseshoe Lake

A total of 23 native index plants were identified on the rake during the point intercept survey. Native index plants are those plants that are native and vascular in nature, so not all vegetation in the lake is included. The plants that are included however provide valuable information about the health of the vegetation in a given lake. Plants on the native index are given a rating from a 1-10 called a Coefficient of Conservatism (C). The average C from all

the plants on the list identified in the lake and a Floristic Quality Index (FQI) value provide a measurement of how sensitive an aquatic plant community in a given lake is to human disturbances and give an indication of how impacted the lake already is by human disturbances. The higher the values, the more undisturbed a body of water is, and the more sensitive to human disturbances (like development and management) the lakes' aquatic plant community is.

The plants identified in Horseshoe Lake generate an average C of 7.4 and an FQI of 35, well above the median C and FQI for the Northern Lakes and Forest Region (Nichols 1999) where Horseshoe Lake is located. These high values are likely the result of the many pristine shoreline areas and variety of habitats that Horseshoe Lake offers. Specifically, index plants like Three-way sedge (*Dulichium arundinaceum*) (C = 9), Dwarf water milfoil (C = 10), Waterwort (*Elatine minima*) (C = 9), Pipewort (C = 9), Creeping spearwort (C = 9), Crested arrowhead (C = 9), Narrow-leaved bur-reed (*Sparganium angustifolium*) (C = 9), and the State Species of Special Concern ** Small purple bladderwort (C = 9) would not be present if Horseshoe Lake had not enjoyed a history of apparent good water clarity and quality. Two other high value species, Narrow-leaved woolly sedge (*Carex lasiocarpa*) (C = 9) and Smooth Sawgrass (C = 10) were found growing on the lake's shoreline.

There were no native water milfoils identified in the lake in 2011. This should make it easier to identify suspicious plants that may be EWM. If any lake resident or boater discovers a plant they even suspect may be EWM, they are encouraged to report it to one of the contacts included in the Rapid Response Plan included with this APM Plan.

More information about these and other plants that make up the aquatic plant community of Horseshoe Lake can be found in the 2011 ERS Plant Survey Report.

7.5 Wild Rice

Wild rice is not present in Horseshoe Lake. When wild rice is present in a lake, it is afforded numerous protections due to its ecological and cultural significance and management is therefore focused on harvest goals and protection of the resource rather than removal. Any activity included in a comprehensive lake or aquatic plant management plan that could potentially impact the growth of wild rice in any body of water that has in the past, currently has, or potentially could have wild rice in the future requires consultation with the Tribal Nations. This consultation is usually completed by the WDNR in cooperation with GLIFWC during their review of lake management documents.

Wild rice is an annual aquatic grass that produces seed that is a nutritious source of food for wildlife and people (Figure 18). As a native food crop, it has a tremendous amount of cultural significance to the Wisconsin and Minnesota Native American Nations. Wild rice pulls large amounts of nutrients from the sediment in a single year and the stalks provide a place for filamentous algae and other small macrophytes to attach and grow. These small macrophytes pull phosphorous in its dissolved state directly from the water. Wild rice can benefit water quality, provide habitat for wildlife, and help minimize substrate re-suspension and shoreland erosion.

In Wisconsin, wild rice has historically ranged throughout the state. Declines in historic wild rice beds have occurred statewide due to many factors, including dams, pollution, large boat wakes, and invasive plant species. Renewed interest in the wild rice community has led to large-scale restoration efforts to reintroduce wild rice in Wisconsin's landscape. Extensive information is available on wild rice from GLIFWC and the WDNR.

Figure 18 – Wild Rice

8.0 Aquatic Invasive Species

Except for EWM, no other aquatic invasive species have been identified in Horseshoe Lake. However several aquatic invasive species are present in nearby lakes and could pose a risk to Horseshoe Lake.

8.1 Curly-leaf Pondweed (*Potamogeton crispus*)

Curly-leaf pondweed is a submerged aquatic perennial that is native to Eurasia, Africa, and Australia. It was introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant and was planted in Michigan lakes as a food source for ducks. Curly-leaf pondweed has been documented throughout the U.S. In some lakes, curly-leaf pondweed coexists with native plants and does not cause significant problems; in other lakes, it becomes the dominant plant and causes significant problems (7). Dense growth can interfere with late spring and early summer recreation and the release of nutrients into the water column from the decaying curly-leaf during the height of the growing season can fuel algal blooms. Phosphorus release rates from the senescence of monotypic curly-leaf beds have been reported as high as nearly 10 pounds per acre and averages about 5 pounds per acre (8) (9) (10).

The leaves of curly-leaf pondweed are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed (Figure 19). The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. Curly-leaf is commonly found in alkaline and high nutrient waters, preferring soft substrate and shallow water depths. It tolerates low light and low water temperatures.

Figure 19 – Curly-leaf Pondweed

Curly-leaf pondweed spreads through burr-like winter buds called turions (Figure 20). These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making curly-leaf one of the first nuisance aquatic plants to emerge in the spring, often starting to grow late in the fall and staying green under the ice. Growth is accelerated in spring when light and temperature conditions are best suited for growth. Turions begin to grow in June and by late June and early July, the warm water conditions cause curl-leaf to senesce, dropping turions to the sediment while the rest of the plant decays (Figure 20).

Figure 20 – Curly-leaf Life Cycle

8.2 Habitat Suitable for EWM and CLP Growth

Both CLP and EWM can establish themselves in a wide array of habitats, but like most species there appears to be a niche where both do exceptionally well. Both plants seem to do best in relatively alkaline, phosphorus rich lakes, and nuisance growth is generally restricted to moderately fertile lakes or fertile locations in less fertile lakes. EWM will grow in low alkaline lakes but not generally as vigorously (11). EWM grows best on fine-textured, inorganic sediments with an intermediate density. It grows relatively poorly on highly organic sediments which intrinsically have a low sediment density and on coarse substrates

like sand and gravel which have a high sediment density (11). Both plants begin their growth early in the season when water temperatures may be too cold to support other plant growth. While CLP usually completes its life stages by early summer, EWM persists and actually does better under higher temperatures during the summer.

8.3 Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a perennial herb 3 to 7 feet tall with a dense bushy growth of 1 to 50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5 to 6 petals aggregated into numerous long spikes, and bloom from July to September. It is easiest to distinguish in late July and August as it has a very distinctive flowering head. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat (Figure 21).

Figure 21 – Purple Loosestrife

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. This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions.

Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many wetlands, lakes, and rivers. By law (NR 40), 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.

8.4 Rusty Crayfish and Chinese Mystery Snail

Rusty crayfish are omnivores, meaning they forage on both plant and animal material. Originally from parts of the United States south of Indiana, they are larger and more aggressive than species of crayfish native to Wisconsin (Figure 22). Rusty crayfish prefer hard bottoms and tend to avoid soft sediment or mucky areas of lakes. When introduced they tend to replace native populations of crayfish, and then multiply rapidly. As omnivores they eat many things, including plant material, fish eggs, minnows, invertebrates and other

crustaceans. In some lakes, they have devastated the aquatic plant community. Often, after reaching large populations, the number of rusty crayfish in the system declines rapidly. Some research suggests that this is because of a parasite infecting the crayfish. Management of this invasive species is limited, focusing on trapping or removal by residents.

Little is known about the ecological impact of Chinese mystery snails (Figure 22) except that large die-offs are particularly offensive to the nose and impair lake aesthetics. Management is limited and basically consists of landowner removal and disposal of snails and empty shells washed up on shore.

Figure 22 – Rusty Crayfish (left) and Chinese Mystery Snail (right)

9.0 Aquatic Plant Management Alternatives

Problematic aquatic plants in a lake can be managed in a variety of ways. The eradication of non-native aquatic invasive plant species such as EWM is generally not feasible, but preventing them from becoming a more significant problem is an attainable goal. Aquatic invasive species can negatively impact the native plant species that are beneficial to the lake ecosystem. Targeted early- and mid-season removal or treatment can minimize some of these impacts by preventing the AIS from becoming the dominant plant species in the lake which allows for the growth of more desirable native aquatic plants.

Control methods for nuisance aquatic plants can be grouped into five broad categories:

- Chemical control
- Manual removal
- Mechanical removal
- Biological control
- Physical habitat alteration

Chemical application is typified by the use of herbicides. Manual and mechanical removal methods include pulling, cutting, raking, harvesting and other means of removing the plants from the water. Biological control methods include organisms that use the plants for a food source or parasitic organisms that use the plants as hosts. Biological control may also include the use of species that compete successfully with the nuisance species for resources. Physical habitat alteration includes dredging, flooding, and drawdown. In many cases, an integrated approach to aquatic plant management that utilizes a number of control methods is necessary.

Regardless of the target plant species, native or non-native, sometimes no manipulation of the aquatic plant community is the best management option. Plant management activities can be disruptive to areas identified as critical habitat for fish and wildlife and should not be done unless it can be shown that it will be beneficial and occur with minimal negative ecological impacts.

Not all plant management alternatives can be used in a particular lake. What other states accept for aquatic plant management may not be acceptable in Wisconsin. What is acceptable and appropriate in southern Wisconsin lakes may not be acceptable and appropriate in northern Wisconsin lakes. Informed decision-making on aquatic plant management options requires an understanding of plant management alternatives and how appropriate and acceptable each alternative is for a given lake. Possible aquatic plant management alternatives are described below, beginning with the most appropriate options for Horseshoe Lake.

9.1 Chemical Control

Aquatic herbicides are chemicals specifically formulated for use in water to kill or control aquatic plants. Herbicides approved for aquatic use by the United States Environmental Protection Agency (EPA) have been reviewed and are considered compatible with the aquatic environment when used according to label directions. Some individual states, including Wisconsin, also impose additional constraints on their use.

9.1.1 How Chemical Control Works

Aquatic herbicides are sprayed directly onto floating or emergent aquatic plants or are applied to the water in either a liquid or pellet form. Herbicides affect plants through either systemic or direct contact action. Systemic herbicides are capable of killing the entire plant. Contact herbicides cause the parts of the plant in contact with the herbicide to die back, leaving the roots viable and possibly able to re-grow.

Herbicides can be classified as broad-spectrum (kill or injure a wide variety of plant species) or selective (effective on only certain species). Non-selective, broad spectrum herbicides will generally affect all plants that they come in contact with. Selective herbicides will affect only some plants. Depending on the chemical used, dicots (like Eurasian water milfoil, native water milfoils, and coontail), or monocots (such as common waterweed and the many pondweeds) will be affected, but not generally both. Greater selectivity of a particular herbicide can be achieved by modifying the method and/or timing of application, formulation, and concentration used.

Applying some systemic and contact herbicides together has a synergistic effect leading to increase selectivity and control (12). Single applications of the two could result in reduced environmental loading of herbicides and monetary savings via a reduction in the overall amount of herbicide used and of the manpower required for application.

9.1.2 Toxicity of Chemicals

The toxicity of a chemical is determined by several factors: dose or concentration, persistence in the environment, and fate in animal tissue. Before any herbicide can be used in a specific environment, the EPA runs up to 140 different kinds of tests and analyses including acute toxicity (how much to cause immediate death), chronic toxicity (how much to cause death over a longer period of time), carcinogenicity (ability to cause cancer), and mutagenicity (ability to cause genetic defects) (13). The toxicity of the herbicides tested applies if it were drank right out of the jug, or injected directly into a subject. When an herbicide is applied to a body of water it is going to be greatly diluted, making for extremely low concentrations (13).

Chemical compounds like 2,4-D, triclopyr, fluridone, and glysophate (see Section 9.2) have very specific sites of action and only affect processes that occur in plants, and not in humans and animals (13). The toxicity of these chemicals is very low suggesting that huge volumes of the chemical would have to be ingested to have negative consequences.

Herbicides can be removed from the environment they are applied to by three primary mechanisms: adherence to particles in the water the settle out to the bottom, microbial degradation of the herbicide in the sediment; and photo-degradation as the herbicide is exposed to the sunlight (13). With the few herbicides approved by the EPA for use in aquatic environments, breakdown into innocuous (non-toxic) compounds occurs in a few hours to at most a few weeks (13).

Different chemicals have different solubility in water and fat. Solubility is the propensity to dissolve in a given medium (like water or fat). If a chemical is fat soluble, if can build up in fatty tissue over time causing possible harm. Mercury is a chemical that has been shown to build up in fatty tissue over time, which is why many lakes and rivers have fish consumption advisories. The longer a fish is a system where mercury is introduced, the more mercury builds up in that fishes fatty tissue. When we eat that fatty tissue the mercury is transferred to our fatty tissues and can cause problems at high enough concentrations. Other chemicals

have high solubility in water, and may have zero solubility in fats, meaning they cannot accumulate in fatty tissue. Water soluble chemicals can be taken into animal bodies (like inadvertently swallowing lake water while swimming) but the chemical would stay in the water ingested, not transferred to fatty tissues, and thus be discarded through urination (13).

Of concern is whether or not a given aquatic herbicide has been shown to cause cancer or mutations. The EPA uses an alphabetical system (A-E) to categorize the potential of a chemical to be carcinogenic. "A" compounds have been shown through tests to cause cancer. "E" compounds have been shown through tests to not cause cancer (13). All aquatic herbicides approved by the EPA except one (Copper sulfate) have been given a rating of "D" (2,4-D) or "E" (endothall, diquat, fluridone, and glysophate) meaning existing data suggests or confirms that the compound is non-carcinogenic.

Herbicides are chemicals, and even though extensive testing has and continues to be done to determine the best and safest use of them, when misused they can cause many problems, many of which are not associated with human health at all. All herbicides that are approved for use in an aquatic environment have restrictions for use that are clearly spelled out on the label of the product. Responsible use by the applicator, understanding of the label restrictions, and appropriate planning is necessary to use them safely to achieve desired goals. When used wisely, aquatic herbicides can be a safe and effective tool to aid in lake improvement management (13).

9.2 EPA-approved Aquatic Herbicides in Wisconsin

There are currently six aquatic herbicides registered for use in Wisconsin. A brief summary of each is presented below.

9.2.1 2,4-D

There are two formulations of 2,4-D approved for aquatic use. The granular formulation contains the low-volatile butoxy-ethyl-ester formulation of 2,4-D (2,4-D BEE; trade names include AquaKleen® and Navigate®). The liquid formulation contains the dimethylamine salt of 2,4-D (2,4-D DMA). Trade names include DMA*4. 2,4-D is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian water milfoil and other dicots. 2,4-D has been shown to be selective to Eurasian water milfoil when used at the labeled rate, leaving native aquatic species relatively unaffected. It is not effective against elodea or hydrilla. 2,4-D can impact early season wild rice growth so should not be used in areas where the target species and wild rice cohabitate (14).

9.2.2 Triclopyr

Common trade names for triclopyr are Renovate 3 and Garlon 3A. There are two formulations of triclopyr. It is the TEA formation of triclopyr that is registered for use in aquatic or riparian environments. Triclopyr, applied as a liquid, is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian water milfoil and other dicots. It is also available in a granular formulation under the trade name Renovate OTF. Triclopyr can be effective for spot treatment of Eurasian water milfoil and is relatively selective to Eurasian water milfoil when used at the labeled rate. Many native aquatic species are unaffected by triclopyr. Triclopyr is very useful for purple loosestrife control since native grasses and sedges are unaffected by this herbicide. Triclopyr degrades quickly in an aquatic environment making its use most effective in systems with low water-exchange where contact with target plants can be maintained for longer periods of time. It does not appear to significantly affect pondweeds and coontail.

9.2.3 Fluridone

Trade names for fluridone products include Sonar® and Whitecap®. Fluridone is a slow-acting systemic herbicide used to control Eurasian water milfoil and other underwater plants. It may be applied as a pellet or as a liquid. Fluridone can show good control of submersed plants where there is little water movement and an extended time for the treatment. Its use is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. It is not effective for spot treatments of areas less than five acres. It is slow-acting and may take six to twelve weeks before the dying plants fall to the sediment and decompose. When used to manage Eurasian water milfoil, fluridone may be applied several times during the spring/summer to maintain a low, but consistent concentration in the water. Granular formulations of fluridone are proving to be effective when treating areas of higher water exchange or when applicators need to maintain low levels over long time periods. Although fluridone is considered to be a broad spectrum herbicide, when used at very low concentrations, it can be used to selectively remove Eurasian water milfoil. Some native aquatic plants, especially pondweeds, are minimally affected by low concentrations of fluridone.

9.2.4 Diquat

A trade name for diquat is Reward®. Diquat is a fast-acting non-selective contact herbicide which destroys the vegetative part of the plant but does not kill the roots. It is applied as a liquid. Typically diquat is used primarily for short term (one season) control of a variety of submersed aquatic plants. It is very fast-acting and is suitable for spot treatment. However, turbid water or dense algal blooms can interfere with its effectiveness. Diquat is strongly attracted to clay particles in the water and thus is not effective in lakes or ponds with muddy water or plants covered with silt. For this reason, care must be taken to not disturb bottom sediments during application.

9.2.5 Endothall

Trade names for endothall include Aquathol K or Super K, and Hydrothol 191. Endothall is a fast-acting non-selective contact herbicide which destroys the vegetative part of the plant but generally does not kill the roots. Endothall may be applied in a granular or liquid form. Typically endothall compounds are used primarily for short term (one season) control of a variety of aquatic plants. However, there has been some recent research that indicates that when used in low concentrations, endothall can be used to selectively remove exotic weeds; leaving some native species unaffected. Because it is fast acting, endothall can be used to treat smaller areas effectively. Endothall is not effective in controlling Canadian waterweed or Brazilian elodea. Endothall can impact early season wild rice growth so should not be used in areas where the target species and wild rice cohabitate (14).

9.2.6 Glyphosate

Trade names for aquatic products with glyphosate as the active ingredient include Rodeo®, AquaMaster®, and AquaPro®. This systemic broad spectrum herbicide is used to control floating-leaved plants like water lilies and shoreline plants like purple loosestrife. It is generally applied as a liquid to the leaves. Glyphosate does not work on underwater plants such as Eurasian water milfoil. Although glyphosate is a broad spectrum, non-selective herbicide, a good applicator can somewhat selectively remove targeted plants by focusing the spray only on the plants to be removed. Plants can take several weeks to die and a repeat application is often necessary to remove plants that were missed during the first application.

9.2.7 Copper Complexes

Copper sulfate and chelated coppers have been widely used as non-selective, fast-acting, contact herbicides or algaecides. These chemicals have been used to control aquatic plants and algae, often in conjunction with endothall and diquat. Copper compounds are primarily used for algae control but can be effective against certain submerged plant species. Copper can build up in sediments, can be toxic to fish and invertebrates, and certain species of algae can build up a resistance (15). The use of copper compounds to control algae was once widely accepted in Wisconsin, but in recent years it has not been supported as a viable control method because of the potential negative impacts inherent in its use.

9.2.8 Timing and Impacts

When properly applied, herbicides can control aquatic vegetation without harming fish and other wildlife. A WDNR permit is required for the use of aquatic herbicides and a certified pesticide applicator is required for application on most Wisconsin lakes. Full-season control is often achieved with herbicide application and control may extend into the following year. Because the plants remain in the lake and decay, treating too much plant matter can lead to a depletion of dissolved oxygen. Also, algal blooms may occur as nutrients are released into the water by the decaying plants. Spring and early summer are preferred for application because exotic species such as CLP and EWM are actively growing, whereas many native plants are not, fish spawning has ceased, and recreational use is generally low thereby limiting human contact.

9.2.9 Pre and Post Treatment Aquatic Plant Surveying

When introducing new chemical treatments to lakes where the treatment size is greater than ten acres or greater than 10% of the lake littoral area and more than 150-ft from shore, the WDNR requires pre and post chemical application aquatic plant surveying. The purpose of the pre and post surveys is to satisfy grant funded treatments conditions where restoration is a goal or where performance results are needed. The protocol for pre and post treatment survey is applicable for chemical treatment of CLP or EWM.

The WDNR protocol assumes that an Aquatic Plant Management Plan has identified specific goals for non-native invasive species and native plants species. Such goals could include reducing coverage by a certain percent, reducing treatments to below large-scale application designations, and/or reducing density from one level to a lower level. A native plant goal might be to see no significant negative change in native plant diversity, distribution, or density. Results from pre and post treatment surveying are used to improve consistency in analysis and reporting, and in making the next season's management recommendations.

The number of pre and post treatment sampling points required is based on the size of the treatment area. Ten to twenty acres generally requires at least 100 sample points. Thirty to forty acres requires at least 120 to 160 sampling points. Areas larger than 40 acres may require as many as 200 to 400 sampling points. Regardless of the number of points, each designated point is sampled by rake recording depth, substrate type, and the identity and density of each plant pulled out, native or invasive.

9.2.10 Residual Testing

Chemical concentration or residual testing is often done in conjunction with treatment to track the fate of the chemical herbicide used in a particular lake. Residual testing is completed to determine if target concentrations are met, to see if the chemical moved outside its expected zone, and to determine if the chemical breaks down in the system as expected.

Water samples are collected prior to treatment and for a period of hours and/or days following chemical application (for example: 1,3,6,12, and 18 hours after application; and 1, 4, 7, 14, and 21 days after application). Monitoring sites are located both within and outside of the treatment area, particularly in areas that may be sensitive to the herbicide used, where chemical drift may have adverse impacts, where movement of water or some other characteristic may impact the effect of the chemical, and where there may be impacts to drinking and irrigation water.

9.3 Manual Removal

Except for wild rice, manual removal of aquatic plants by means of a hand-held rake or by pulling the plants from the lake bottom by hand is allowed by the WDNR without a permit per NR 109 (Appendix C). The zone of manual removal cannot exceed 30 shoreland feet and all raked or pulled plant material must be taken completely out of the lake and removed from the shoreline (Figure 23). Plant fragments can be composted or added directly to a garden.

Although up to 30 feet of shoreland vegetation can be removed, removal should only be done to the extent necessary. Clearing large swaths of macrophytes not only disrupts lake habits, it also creates open areas for non-native species to establish. If an aquatic invasive species such as CLP is the target species, then removal by this means is unrestricted as long as native plants are not damaged or eliminated.

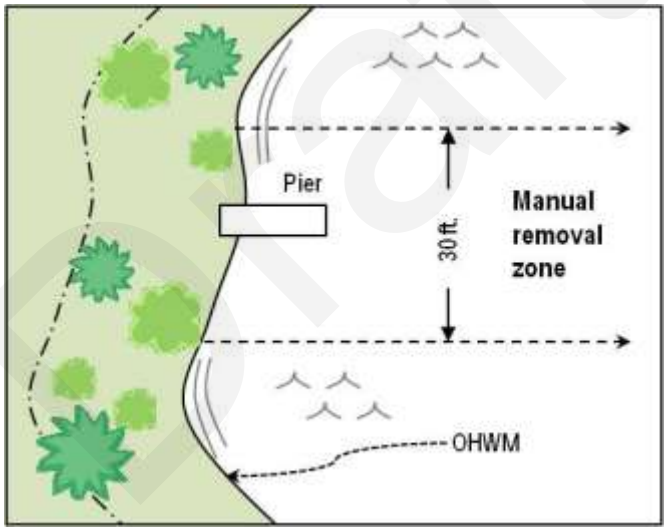

Figure 23 – Aquatic Vegetation Manual Removal Zone

Manual removal can be effective at controlling individual plants or small areas of plant growth. It limits disturbance to the lake bottom, is inexpensive, and can be practiced by many lake residents. In shallow, hard bottom areas of a lake, or where impacts to fish spawning habitat need to be minimized, this is the best form of control. Pulling aquatic invasive species while snorkeling or scuba diving in deeper water is also allowable without a permit and can be effective at slowing the spread of a new aquatic invasive species infestation within a lake when done properly.

9.3.1 Larger-scale Manual Removal

Larger scale hand or diver removal projects have had positive impacts in temporarily reducing or controlling aquatic invasive species. Typically hand or diver removal is used when a AIS has been newly identified and still exists as single plants or isolated small beds,

but at least in one lake in New York State, it was used as a means to control a large-scale infestation of EWM. Kelting and Laxson (16) reported that from 2004 to 2006 an "intensive management effort" which involved "the selective removal of Eurasian water milfoil using diver hand harvesting of the entire littoral zone of the lake at least twice each summer for three years" followed by three years of maintenance management successfully reduced the overall distribution of EWM in the lake.

Overall costs ranged from a high of $796 per hectare of EWM removed during the three years of intensive management effort, to about $300 per hectare during the three year maintenance period (16). In the first two years of intensive management effort, the cost per kg of EWM removed was relatively low. As the efforts proved to be successful at knocking down the distribution and density of the EWM, the cost per kilogram of EWM went up as it took an equal amount of time and money to find and remove a much lower amount of EWM. The authors also commented that during the maintenance period the amount of EWM trended back up, indicating that limiting intensive management effort allowed for the EWM to make a comeback (16).

Several lake groups have and continue to use large-scale physical removal of EWM. Horseshoe Lake in Barron County uses diver removal on small or isolated areas of EWM, and uses chemical herbicides on larger, more expansive EWM beds. Early in the management phase, Sand Lake in Barron County attempted diver removal, but stopped using divers as the EWM expanded too rapidly for the divers to keep up with.

In 2011, the Red Cedar Lakes Association (RCLA) in Barron County performed diver removal on a dense, isolated one acre bed of CLP in Red Cedar Lake. This large-scale effort engaged a group of about 10 local high school students (members of the Conservation Club) and an RCLA representative. Water depths and inexperience made removal difficult; however, the effort was fairly successful and the divers were able to remove a large boat load of CLP.

9.4 Mechanical Removal

Mechanical removal of aquatic plants involves the use of motorized accessories to assist in vegetation removal. Mechanical control can be used for both small- and large-scale control efforts. WDNR permits are required regardless of the size of the area to be managed with mechanical control.

9.4.1 Small-Scale Mechanical Management

There are a wide range of small-scale mechanical management techniques, most of which involve the use of boat mounted rakes, scythes, and electric cutters. As with all mechanical harvesting, removing the cut plants is required. Commercial rakes and cutters range in prices from $200 for rakes to around $3000 for electric cutters with a wide range of sizes and capacities. Harvesting rakes could be purchased by the HLPA and rented out to cover costs or its use offered as a service by the association.

Although not truly considered mechanical management, plant disruption by normal boat traffic is a legal method of management. Active use of an area is often one of the best ways for riparian owners to gain navigation relief near their docks. Most macrophytes won't grow well in an area actively used for boating and swimming. It should be noted that purposefully navigating a boat in circles to clear large areas is not only potentially illegal it can also re-suspend sediments, encourage aquatic invasive species growth, and cause ecological disruptions.

9.4.2 Large-scale Mechanical Harvesting

The most common form of mechanical control is the use of large-scale mechanical weed harvesters on the lake. The harvesters are generally driven by modified paddle wheels and include a cutter that can be raised and lowered, a conveyor system to capture and store the cut plants, and the ability to off-load the cut plants. The depth at which these harvesters cut generally ranges from skimming the surface to as much as five-feet deep.

Large-scale plant harvesting in a lake is similar to mowing the lawn. Plants are cut at a designated depth, but the root of the plant is often not disturbed. Plant composition can be modified by cutting away dense cover which may increase sunlight penetration enough to stimulate growth of underlying species (Figure 24) (17). Cut plants will usually grow back after time, just like the lawn grass. Re-cutting during the growing season is often required to provide adequate annual control (18). Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (18). Some research indicates that after cutting, reduction in available plant cover causes declines in fish growth and zooplankton densities. Other research finds that creating deep lake channels by harvesting increases the growth rates of some age classes of bluegill and largemouth bass (19).

Harvesters can remove thousands of pounds of vegetation in a relatively short time period. They are not, however, species specific. Everything in the path of the harvester will be removed including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone (20).

9.4.3 Other Mechanical Management

Cutting without plant removal, grinding and returning the vegetation to the water body, and rotovating (tilling) are also methods employed to control nuisance plant growth in some lakes. Cutting is just like harvesting except the plants are left in the waterbody. Grinding incorporates cutting and then grinding to minimize the biomass returned to the lake. Smaller particles disperse quicker and decay more rapidly. Rotovating works up bottom sediments dislodging and destroying plant root crowns and bottom growth.

Bottom rollers and surface sweepers are devices usually attached to the end of a dock or pier and sweep through an area adjacent to the dock. Continued disruption of the bottom area causes plants to disappear and light sediments to be swept out. The use of rollers may disturb bottom dwelling organisms and spawning fish. Plant fragmentation of nuisance weeds may also occur. In soft bottom areas, sediment disturbance can be significant. These devices are generally not permitted in Wisconsin. A permit under Section 30.12(3) is required which governs the placement of structures in navigable waters.

Another common method for removing aquatic plants from a beach or dock area is for riparian owners to hook a bed spring, sickle mower blade, or other contraption to the back of a boat, lawn mower, or ATV and drag it back and forth across the bottom. This type of management is considered mechanical and would require a harvesting permit.

Suction dredging is a form of mechanical harvesting where diver-operated suction tubes connected to barge- or pontoon-mounted pumps and strainer devices with hoses, are used to vacuum plants uprooted by hand. This management technique is considered harvesting because plants are removed directly from the sediments by divers operating this device. The

suction tube is then used to transfer the uprooted plant to the surface without fragmentation. Suction dredging is mostly used for control of isolated, new infestations of AIS.

9.5 Biological Control

Biological control (biocontrol) for aquatic plant management involves using animals, fungi, insects, or pathogens as a means to control nuisance plants. The goal of biocontrol is to weaken, reduce the spread, or eliminate the unwanted population so that native or more desirable populations can make a comeback. A special permit is required in Wisconsin before any biocontrol measure can be introduced into a new area.

Biological control of nuisance plants in aquatic systems has both positive and negative attributes. One positive is that control agents are often host specific, so effects to non-target species may be reduced. Control agents can also reproduce in response to increases in nuisance species density often without reapplication of the agent. Development and registration (where necessary) of biological control agents is generally less expensive than chemical agents.

Biocontrol can have many potential disadvantages. A substantial risk is involved when new species are introduced as bio-control agents. To be considered successful, these species are expected to persist indefinitely in the environment where they are used, and may spread to new locations. Therefore, if there are any adverse effects resulting from the bio-control agent, these effects may be difficult or impossible to control. Other drawbacks include unpredictable success and rates of control that are slower than with other methods. Resistance in host species is unlikely to develop but can occur. Finally, agents that work in one area may not be suitable in all ecosystems. Climate, interference from herbicidal application, hydrological conditions, and eutrophication of the system can influence the effectiveness of bio-control agents. As is the case with other forms of invasive species management, the growth of nuisance weeds can be suppressed with the use of bio-control agents, but not fully eliminated (18).

9.5.1 Biological Controls in Wisconsin

Many herbivorous insects have been and continue to be studied for their impacts on unwanted aquatic plant species. An herbivorous aquatic moth (*Acentria ephemerella*), two native herbivorous weevils (*Euhrychiopsis lecontei* and *Phytobius* spp.), and a midge species (*Cricotopus* spp.) have been associated with the decline of EWM in lakes. Several species of insect are being used to control purple loosestrife infestations very effectively, notably two *Galerucella* spp. The Galerucella beetles are easy to rear and can be extremely effective at reducing large populations of purple loosestrife. After nearly 20 years of use, Galerucella appear to have no negative effect on the areas in which they are introduced.

There are currently no biological controls for CLP, but research to identify and establish biological controls are on-going. Studying naturalized and native herbivores and pathogens that impact nuisance aquatic and wetland plants increases the number of potential biological control agents that could be incorporated into invasive plant management programs. The groundwork has been laid for conducting future biological control research and experimentation. Although not all of the native and naturalized organisms researched can be successful, the information and expertise is now available for potential insects and pathogens to be collected, analyzed, and studied. A continuation of the work that has been started is needed to make available for the future more successful native bio-control agents (21).

There are several forms of biological control that have been used in other states, but are not approved for use in Wisconsin. The grass carp (*Ctenopharyngodon idella*), also known as the

white amur, feeds on aquatic plants and has been used as a biological tool to control nuisance aquatic plant growth in other states. In addition to grass carp, common carp and tilapia (a fish species) have been added to ecosystems to reduce aquatic vegetation. Wisconsin does not permit the use of these fish for aquatic plant control.

Plant fungi and pathogens are currently still in the research phase. Certain species for control of hydrilla and EWM have shown promise, but only laboratory tests in aquariums and small ponds have been conducted. Methods are not available for widespread application. Whether these agents will be successful in flowing waters or large-scale applications remains to be tested (22).

9.5.1.1 EWM Weevils

While many biological controls have been studied, only one has proven to be effective at controlling EWM under the right circumstances. Euhrychiopsis lecontei are an aquatic weevil native to Wisconsin that feed on aquatic milfoils. Their host plant is typically northern water milfoil; however they prefer EWM when it is available. Milfoil weevils are typically present in low numbers wherever northern or Eurasian water milfoil is found. They often produce several generations in a given year and over winter in undisturbed shorelines around the lake. All aspects of the weevil's life cycle can affect the plant. Adults feed on the plant and lay their eggs. The eggs hatch and the larva feed on the plant. As the larva mature they eventually burrow into the stem of the plant. When they emerge as adults later, the hole left in the stem reduces buoyancy often causing the stem to collapse. The resulting interruption in the flow of carbohydrates to the root crowns, reduce the plants ability to store carbohydrates for over wintering reducing the health and vigor (23).

The weevil is not a silver bullet however. They do not work in all situations. The extent to which weevils exist naturally in a lake, adequate shore land over wintering habitat, the population of bluegills and sunfish in a system, and water quality characteristics are all factors that have been shown to affect the success rate of the weevil.

It may be possible for EWM weevils to be used in Horseshoe Lake if the density and distribution of EWM expands rapidly. However, before undertaking actions to introduce or to supplement an existing population, more data should be collected, including a quantifiable estimation of current weevil densities, a better assessment of the bluegill and sunfish population, and a formal analysis of the over wintering habitat available. Should all these variables prove to be in line with apparent conditions that warrant success, then EWM control with weevils could be attempted.

9.5.2 Biological Manipulation

Biological manipulation is defined as manipulating a particular trophic level in a body of water to make changes in the trophic status of a lake that may benefit management goals. Chase and Knight 2006 (24) suggest that the presence of snails can limit EWM growth. This is an example of biological manipulation of the various trophic levels found in a water body. A trophic level is considered one layer in the many layers that make a lake system work. For example, small often microscopic critters called zooplankton feed on algae, like cows feed on grass. If there a significant decline in zooplankton, perhaps because an over-abundance of small panfish eat them, then it is possible for the levels of algae to go up in a lake. It may be possible to reduce the number of small panfish by introducing larger predator fish. If panfish are reduced, then zooplankton can rebound again impacting the amount of algae in a system. Many snails feed on algae. In their study, Chase and Knight 2006 found that the presence of

snails was one variable that helped decrease algae and EWM density while increasing native plant biomass.

Another version of this is to reduce predators on insects that may help to control a given undesirable species. The EWM weevil is a favorite food source for small panfish. Reducing the number of panfish by introducing predators, may support greater survival of the biological control agents introduced.

9.6 Physical Habitat Alteration

EWM is an opportunistic species, meaning it does well in areas that have been disturbed by human activity including shoreline development, clearing vegetation from beaches and near docks, and boat launching areas. Where these disturbed areas exist, potential habitat for EWM also exists. Restoring these areas can be one way of controlling the spread of EWM.

Physical habitat alteration also involves management activities that alter the environment in which aquatic plants are growing. Several techniques are commonly used: drawdown or flooding, dredging, benthic barriers, shading or light attenuation, and nutrient inactivation. While not prohibited in Wisconsin, these plant management alternatives will undergo much greater scrutiny by the WDNR, and in most cases will not be permitted.

9.6.1 Shoreland Improvement and Native Plant Restoration and Enhancement

Native plant restoration, in particular shoreland restoration, is used on many lakes to reduce erosion, increase and improve native habitat, and improve water quality. Restoration not only improves the lake aesthetic enjoyed by so many, it also keeps invasive species ay bay. A study performed in west-central Wisconsin found the mean occurrence of non-native aquatic invasive species to be significantly greater at disturbed shoreline sites than at natural shorelines (25). The study also found that the occurrence of non-native species and filamentous algae increased with the amount of disturbed shoreline on a lake.

To minimize locations in a lake where invasive species like EWM can get established, making improvements to the shoreland and shallow water areas adjacent to that shoreland can be important. Figure 24 demonstrates the difference between a healthy, invasive species resistant, shoreline and a shoreline that invites and invasive species to become established. There are many public and free resources available for planning and implementing shoreland restoration projects.

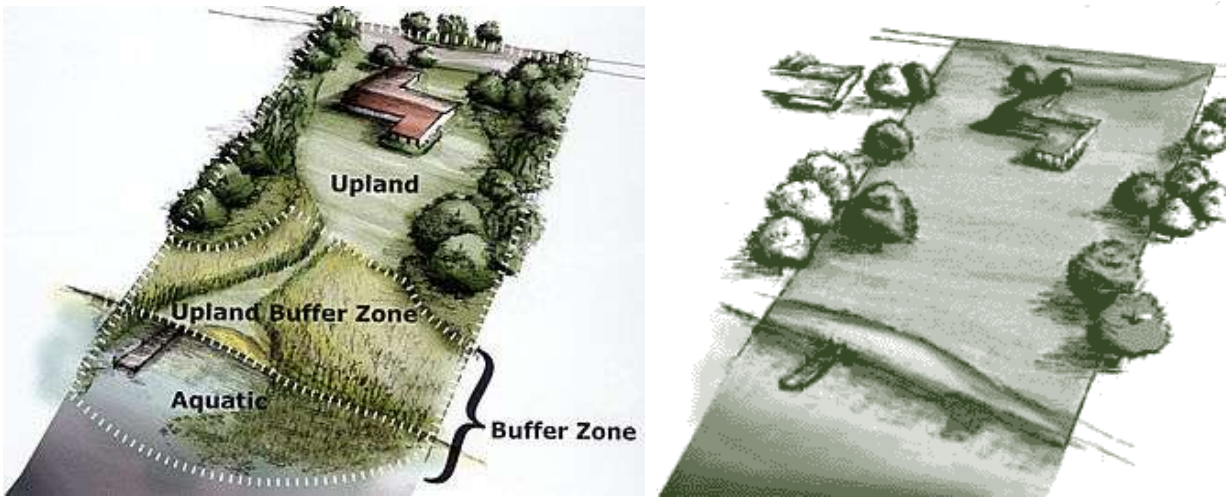

Figure 24 – Healthy, AIS resistant shoreland (left) vs. shoreland in poor condition

In areas where dense growth of invasive species exists, native plants may re-establish naturally once the invasive species is removed if seeds and other propagules are still present. But in some cases, artificially restoring this habitat is required. If desirable native plants do not come back by themselves, it may be possible to collect plant stock from other areas of the lake. It may also be necessary to collect plants from other lakes or to purchase then from commercial vendors. Collecting plants from the same or other water bodies may require a permit. If commercial plants are purchased, care should be taken to not introduce unwanted vegetation at the same time. Because many submergent and floating leaf plants are susceptible to failure during restoration, a good rule of thumb to follow is to plant as many as possible. Emergent plant species may not be as susceptible to failure.

Artificially reintroducing native aquatic plants is often difficult and costly and requires a fairly large source of new plants and substantial short-term labor for collecting, planting, and maintaining the stock. Maintenance of plantings may require protection from fish and birds and temporary stabilization and protection of sediment in the planting area from wind and waves (Figure 25).

Figure 25 – "Buffer Blocker" System for Protecting Native Macrophyte Plantings

There are many sources for more information regarding native aquatic plant restoration. Smart and others (6) discuss numerous techniques for establishing native aquatic plants in reservoirs with an absence of vegetation or low species diversity. The Langlade County, Wisconsin Land Records and Regulations Department has a Shoreland Restoration Web Site which provides a great deal of information for re-establishing native plants: http://lrrd.co.langlade.wi.us/shoreland/index.asp (last accessed: March 2013). A complete review of these techniques and others should be completed before undertaking a planting project.

9.6.2 Nutrient Management to Reduce Less Desirable Aquatic Plant Growth

Research has shown that as human development on the lake shore increases, the amount of native aquatic plant growth near that lake shore decreases. In a Minnesota study of 44 lakes with varying amounts of developed shoreline, the average loss of aquatic plants in developed areas verse undeveloped areas was 66% (26). On a lake wide basis, this loss of aquatic plant growth can lead to higher levels of phosphorus and an increase in the growth of algae, including filamentous algae (Figure 26) that may attach to structures within the littoral zone or form surface mats.

Figure 26 – Surface Mat of Filamentous Algae

Runoff from a developed property may increase the amount of available phosphorus in the littoral zone immediately adjacent to that property causing greater algae growth in place of plant growth. Plant survey work completed in the region suggests at least an anecdotal relationship between developed shorelines (specifically those properties with mowed and apparently fertilized lawns to the edge of the lake) and an increase in more problematic native plant species like coontail and common waterweed, and filamentous algae. While it is not clear if the installation of buffer strips and other runoff reducing best management practices can directly improve conditions within the littoral zone immediately adjacent to a property, it is known that if enough of these best management practices are installed around an entire lake system, nutrient levels within the lake can be reduced (27) (28).

9.6.3 Dredging

Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, have inadequate pelagic and

hypolimnetic zones, need deepening for navigation, or require removal of toxic substances. A WDNR permit is required to perform any dredging in a waterbody or wetland. In deep water, the plants do not receive enough light to survive. This method can be detrimental to desired plants, as all macrophytes would be prevented from growing for many years. This high level of disturbance may also create favorable conditions for the invasion of other invasive species.

9.6.4 Benthic Barriers and Light Reduction

Benthic barriers or other bottom-covering approaches are another physical management technique that has been in use for many years. 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. WDNR approval is required and screens must be removed each fall and reinstalled in the spring to be effective over the long term.

9.6.5 Water Level Manipulation

Dropping the lake level to allow for the desiccation, aeration, and freezing of lake sediments has been shown to be an effective aquatic plant management technique. Repeated drawdown lasting 4 to 6 months that include a freezing period are the most effective. Control of aquatic plants in these cases can last a number of years. The low lake levels may negatively affect native plants, provides an opportunity for adventitious species such as annuals, often reduces the recreational value of a waterbody, and can impact the fishery if spawning areas are affected. The cost of a drawdown is dependent on the outlet of the lake; if no control structure is present, pumping of the lake can be cost prohibitive whereas costs can be minimal if the lake can be lowered by opening a gate.

Raising water levels to flood out aquatic plants is uncommon and has a number of negative effects including the potential for shoreland flooding, shoreland erosion, and nutrient loading.

9.7 No Manipulation

No manipulation of the aquatic plant community is often the easiest, cheapest, and in some cases most effective aquatic plant management alternative even for non-native invasive species like curly-leaf pondweed. No manipulation should be considered a viable alternative in areas where excess aquatic plant growth does not impact lake uses, where the benefit of management is far out-weighed by the cost of management, where water quality or other lake characteristics limit nuisance growth conditions, and where highly valued native plants would be negatively impacted by treatment.

10.0 Chemical Management of EWM in Horseshoe Lake

Chemical herbicides were used in 2011 (diquat) and 2012 (2,4-D) to treat EWM in Horseshoe Lake, and along with physical removal, will remain one of the most appropriate management methods. The following sections provide more detail into the actual use of chemical herbicides in Wisconsin lakes.

10.1 Liquid vs. Granular Formulations

Rapid dissipation of aquatic herbicides due to various water exchange processes can lead to poor submersed weed control in a variety of situations. The ability to target herbicide placement and maintain the desired concentration in the plant mass within the 3-dimensional aquatic environment is critical to maximize efficacy of herbicides. Additional variables such as temperature and plant density can also alter herbicide distribution. Applications of liquid formulations in areas that are relatively deep with low growing vegetation, potential for rapid water exchange, and/or areas adjacent to or surrounded by a large percentage of untreated water could be impacted greatly by dilution (29). Custom subsurface injection application systems with trailing hoses have been suggested for improved delivery of liquid herbicides in deeper water areas (30).

Granular formulations also have been developed to assist in delivering aquatic herbicides. The active ingredient is added to inert ingredients like clay particles that dissolve more slowly. Theoretically these formulations maintain placement of the herbicide longer or increase the exposure time of the target plant to the herbicide. These formulations often sink to the bottom in and around submersed aquatic plant communities (depending on plant density and frequency) and provide delayed release of the herbicide and are less vulnerable to dilution (29). More recent data collected by the WDNR and Army Corp of Engineers suggests that there is little difference is dispersion rates between granular and liquid herbicides when applied. Unless very small treatment are proposed (1/4 acre or less) or site characteristics such as water movement, depth, location in the lake in some way suggest a granular formulation would do better, it is recommended that a liquid formulation of the chosen herbicide be used.

Granular formulations are generally more expensive than their liquid counterparts. Granular applications are usually based on a specific amount of herbicide being applied to a designated surface area of a body of water. Depth of the treatment area and density of plant growth may also be considered when determining an appropriate treatment concentration. Liquid herbicides can be applied on the surface, but more recently, subsurface injection is more supported by the industry. Liquid application is based on the volume of water in the treatment area, and in general is used when flowing water or additional dilution is not a factor.

10.2 Small-scale Herbicide Application

Small-scale herbicide application involves treating small areas of less than 10 acres combined on a given body of water. Small-scale chemical application is usually completed in the early season (April through May). It is also used as a follow up treatment to retreat areas missed or not impacted by large-scale applications. Pre- and post-treatment aquatic plant surveys and testing for herbicide residuals are not required by the WDNR for small-scale treatments. Even though not required by the WDNR, participating in these activities is recommended as it helps to gain a better understanding of the impact and fate of the chemical used.

10.3 Large-scale Herbicide Application

Large-scale herbicide application involves chemical treatment of more than 10% of a given lakes' surface area or more than 10 acres combined on a given body of water. Like small-scale applications, this is usually completed in the early-season (April through May) for control of non-native invasive species like EWM and CLP while minimizing impacts on native species. Pre- and post-treatment aquatic plant surveying is required by the WDNR when completing large-scale chemical treatments. Residual testing is not required by the WDNR, but highly recommended, as is pre and post treatment aquatic plant surveying to gain a better understanding of the impact and fate of the chemical used.

10.4 Whole Lake (Basin Wide) Herbicide Application

In some cases, chemically treating the entire body of a lake or in the case of Horseshoe an entire lobe or basin of the lake, is prudent management. If the target plant species is wide-spread, or has the potential to be wide spread, or is suspected to be in deeper water where it may be difficult to identify on a consistent basis, but not necessarily dense, then treating an entire body of water or portion of the waterbody with a very low concentration of herbicide that is expected to maintain contact with the target plant for a longer period of time may provide the best results. Whole lake treatments can be done with 2,4-D, triclopyr, or flouridone. They can be done at any time during the growing season of plants, and when concentrations are low enough can have limited impacts to non-target plants.

10.5 Spot Treatments

Spot treatments are used in a manner similar to how small-scale herbicide application is used to follow up a large-scale herbicide application. More commonly used when treating EWM, a spot treatment is defined as treatment of a single plant or small cluster of plants that covers an area no greater than 25-sqft. It is administered by spreading approximately 1/4 cup (approximately 2.0 oz) of granular herbicide by hand from a boat in approximately 5-ft of water, based on a treatment rate of 200 lbs/acre. Target plants are visually located by trained inspectors on the day of treatment. Treatment occurs immediately upon locating a plant or cluster of plants.

This treatment method depends on several things: 1) water clarity in a given lake needs to be sufficient enough to allow for trained inspectors to identify individual plants and small clusters in the water, even when they are not at or near the surface; 2) the spotters must know the difference between the target plant and native plants not only when they are side to side out of the water but also when they are in the water, potentially interspersed with other look-alikes; and 3) since this method of treatment often involves many sites, herbicide application must be completed by a professional applicator.

While there is no specific WDNR protocol set up for spot treatments, the following guidelines are recommended:

- Chemical application must be completed by a commercial applicator
- At least one representative from the Lake Organization or a resource professional must accompany the commercial applicator during treatment
- Inspections and subsequent treatments should be completed between 10:00am & 4:00pm
- Inspections and treatment (if necessary) should be completed at least once a month June – September

- When the observer and applicator do not agree, a rake sample must be retrieved for positive ID
- An appropriate inspection and treatment path should be established prior to beginning inspection/ treatment
- GPS tracking of all movement on the lake should be completed and saved for future reference
- Record GPS coordinates for each individual spot treatment along with the density of the target plant species (single, small cluster, or bed), the depth at spot treatment site, and the presence of other plants within 5-ft of the spot treatment
- Sites determined to be beds and that exceed an area larger than 20 × 20 ft must be recorded as small-scale treatment sites
- A bed is defined as an area where at least 50% of existing aquatic plants are the target species and has a definable boundary
- Aquatic plant inspectors must wear polarized glasses
- Water clarity on the day of treatment (measured by a Secchi disk) should not be less than 75% of the mean depth of plant growth as established by previous plant surveys
- Weather conditions must be appropriate for treatment (mostly sunny, minimal waves)

More recently, the WDNR has discouraged the use of spot treatments as they are not viewed as being very effective long term. Aquatic plants treated in this fashion will often die in the year of treatment, but return the following season as if no treatment was completed. In some cases, annual relief is sufficient, so spot treatments remain a viable treatment alternative. When spot treatments are used, residual testing should be incorporated to determine how long herbicide/plant contact time is maintained and at what concentration. If a sufficient contact time is not established, initial herbicide concentrations may need to be higher. A few lakes have experimented with different methods of herbicide application including binding granular herbicides in cheesecloth or some other medium to slow its dispersion; multiple doses in succession; and barriers to reduce normal water flow through a treated area.

11.0 Documentation of Problems and Need for Management

Horseshoe Lake has a rich, diverse and rare aquatic plant community that is unique to sand bottomed, seepage lakes with good water quality. Unfortunately, the introduction of Eurasian water-milfoil will pose a continued threat to that diversity and the resource as a whole moving forward as it is unlikely that EWM will ever be totally eliminated from the lake. With this reality in mind, working to minimize the spread of EWM within the lake, and quickly identifying and eliminating new beds that appear will be a high priority management goal moving forward. Physical removal by property owners and/or divers will continue to be an important tool to remove isolated individual plants or small clumps of EWM in shallow water. Seasonal treatment of larger areas using herbicides will likely be needed to supplement efforts at physical removal.

Despite what appears to be very positive results following the June 2012 treatment using a granular formulation of 2,4-D (Navigate), EWM will very likely continue to show up in Horseshoe Lake. After a 2009 chemical treatment and physical removal of EWM in nearby Gilmore Lake (sponsored by the Gilmore Lake Association), it was thought they had a pretty good handle on the EWM in the system. For two years after 2009, herbicide application was not implemented as an aggressive diver removal program had been implemented. Hundreds of EWM plants were physically removed from the original bed of EWM located in the south west basin of the lake. Even so, it became apparent in the fall of 2011, that the EWM could not be contained in its current location by diver removal alone. A new area with EWM in Little Gilmore Lake was identified in late 2011, and plants in the original bed continued to expand. Herbicide application was again used in 2012 (supplemented by physical removal), and is now the most viable management alternative.

This trend is fairly common in northwest Wisconsin lakes with EWM with Sand, Horseshoe, Echo, and Vermillion Lakes in Barron County all using an integrated approach to managing EWM that includes herbicide application supported by physical removal. Each of these lakes started with relatively small infestations that for several years were well controlled by physical removal. After a year or two however, diver removal alone proved no longer effective for successful, long term control on any of these lakes. The Gordon-St. Croix Flowage Association in Douglas County also started with a one-time chemical application when EWM was first discovered, that was followed up by several years of diving. They too are now using an integrated approach to control EWM.

Continual monitoring of both the east and west basins should be completed at least on a monthly basis throughout the open water season on the lake. Any individual or small clumps of plants that are identified should be mapped, and if possible, physically removed.

12.0 Aquatic Plant Management Goals, Objectives, and Actions for Horseshoe Lake

As previously established, management of EWM is necessary in Horseshoe Lake. A combination of management alternatives will be used to help minimize the negative impacts of EWM on native plants and water quality, and provide relief for navigation impairment and nuisance aquatic plant growth caused by EWM. EWM management options to be utilized include small-scale physical removal, diver removal, and targeted use of aquatic herbicides. Other AIS will continue to be monitored for, but no specific management is recommended at this time.

There are six broad goals for aquatic plant management in Horseshoe Lake, each with a number of objectives and actions to accomplish over the course of the next five years. Appendix D is an outline of the aquatic plant management goals and activities, and Appendix E is a five-year timeline for completion of the activities included in this APM Plan. Any major change in activities or management philosophy will be presented to the HLPA and the WDNR for approval. The six goals for this plan are as follows:

1. Native Plant Protection, Preservation, and Enhancement
2. EWM Management and Monitoring
3. AIS Education, Prevention, and Planning
4. Wildlife Appreciation and Awareness
5. Lake Community Understanding and Awareness
6. Aquatic Plant Management Plan Maintenance

This APM Plan will be implemented by the Horseshoe Lake Property Association, their consultants, and through partnerships formed with the WDNR, Washburn County, and other local clubs and organizations. Annual reports and end of project assessments will be completed throughout the duration of this 5-year plan.

12.1 Goal One – Native Plant Protection, Preservation, and Enhancement

The objective of any aquatic plant management is to protect and enhance diversity and distribution of native aquatic plants in the lake. Over the course of this management plan, the current diversity and distribution of native plants will not be reduced. An additional objective is to increase native plant diversity within areas designated for EWM management. Success will be measured by comparing post treatment survey results annually. No loss of diversity will be measured when the full lake point intercept aquatic plant survey is completed in 2015.

12.1.1 Risks Posed by Native Plant Removal

The Horseshoe Lake Property Association will educate riparian owners of the risk posed by removing native vegetation from around their docks and swimming areas. The removal of natives opens up space for non-natives like EWM to establish. If a landowner has to remove native plants, the HLPA will help make sure that the landowner is familiar with EWM and ask that they continually monitor their area for EWM.

12.1.2 Wild Rice Awareness

Even though wild rice has not currently been identified in Horseshoe Lake, lake residents will be made aware of it and efforts undertaken to educate lake users about wild rice. The

objective of this action is to increase awareness of lake users so as not to inadvertently negatively affect waters where wild rice could be present.

12.1.2.1 Lake Community Education

The HLPA will provide lake property owners with educational and informational materials related to the value of wild rice as a resource found in the lakes. Wild rice resources are available from the WDNR, GLIWC, and on the internet. An example of such promotions would be to invite a speaker on wild rice to one of the HLPA annual events.

12.1.2.2 Wild Rice Monitoring

At least once annually in the late summer, HLPA volunteers trained in identifying wild rice will monitor Horseshoe Lake for the presence of wild rice. If found, new locations will be mapped using a hand-held GPS unit.

12.1.3 Critical Habitat Survey

Should the WDNR ever reactivate its Critical Habitat Survey program and chose to do one on Horseshoe Lake, the HLPA will support its completion. During a Critical Habitat Survey, WDNR field staff, compile and review the most current scientific data about the water body. Data is also solicited from local units of government, conservation organizations, federal agencies, local businesses and anyone who may have resource knowledge and information. This information is used to assemble maps to identify targets of focus related to fish, wildlife, endangered resources, and their habitats. Public rights features including lake access and navigation are also identified and added to the data. The resulting maps and supporting data are compiled into a draft Critical Habitat Designation report, which is posted on the Department's website for public review. The WDNR must also give notice of the draft report to the local media, the county clerk, and legislators. If requested or if concerns are anticipated, the WDNR typically holds informational meetings to answer questions and receive comments. Once public comment is received and the report is complete, Critical Habitat Designations are posted on the DNR website.

Critical Habitat designation can be used to guide appropriate management actions that do not negatively impact the most sensitive areas in the lake. It does not necessarily prevent management in those areas, but does insure that adequate consideration is given as to the impacts that management would have.

12.1.4 Aquatic Plant Management Impacts to the Fishery

All lakes have habitat of critical importance to one of more parts of the overall lake ecosystem. The HLPA will manage non-native aquatic plants like EWM in a manner that will not suffer any of these ecosystems. To protect and maintain the current fishery, plant management other than physical removal, will not be implemented in water less than 3-ft deep or in water designated as critical habitat unless said management would improve that habitat.

12.1.5 Woody Debris

The HLPA will promote the protection of woody debris already in Horseshoe Lake, and evaluate the potential to increase woody debris through the use of tree drops or other acceptable fisheries management activities.

12.2 Goal Two – Eurasian Watermilfoil Management and Monitoring

The HLPA and resource professionals retained by the HLPA will continually monitor the littoral zone of Horseshoe Lake in an effort to identify any new EWM sites while they are still in a pioneering or manageable stage. Any new EWM identified will be immediately removed or managed in some way as a zero tolerance for new infestations is one of the main objectives of this goal. A second objective is to reduce the EWM in the existing EWM zone to annual levels below an acre in size by implementing an integrated approach to management.

12.2.1 Pre and Post Treatment Survey and Fall Bed Mapping

Management of EWM will be based on information obtained annually by either trained HLPA volunteers or resource professionals retained by the HLPA. This information includes annual fall survey and bed mapping of EWM, pre treatment survey of annually proposed treatment areas, and post treatment aquatic plant survey in the areas treated.

Pre and post treatment surveying is not required by the WDNR unless the chemically treated area covers more than 10 acres or 10% of the littoral zone. However, completing these tasks is highly recommended in any treatment program as they provide a means to measure success.

12.2.2 Management Alternatives

The HLPA will undertake EWM management that includes physical removal, diver removal, and the targeted use of aquatic herbicides. Physical removal will be completed by educated landowners who monitor their own shorelines or by a trained EWM Management Team sponsored by the HLPA. Diver removal will be completed by HLPA volunteers and/or resource professionals retained by the HLPA.

Herbicides will be used to manage existing EWM and any existing or new area deemed too large for physical removal. Specifics for what herbicide to use and when will be determined annually during the proposed treatment phase of planning. Granular or liquid herbicide could be used, as well as one or more different but approved herbicides in Wisconsin. Spring application of herbicides is preferred as this usually provides less impact to native plants and other lake concerns. However, mid-season application of herbicides will be implemented if new beds of EWM are discovered or as follow up to a spring application.

12.2.3 Residual Testing

Once an herbicide is used, it is expected that that herbicide will have no unintended impact. One way to determine if this is true is to complete herbicide concentration testing after treatment occurs. Residual testing may be done every hour for the first 6-12 hours immediately following treatment, and may be extended over a period of several weeks at less frequent intervals. Water samples would be collected by HLPA volunteers and then analyzed for the presence of the herbicide used. Though not currently required by the WDNR, it is a good management tool to use at as it helps answer the question "What happens to the herbicide that is put in the lake?"

As long as EWM management remains below what is considered large-scale management, residual testing will only be completed if supported by grant funding or if Horseshoe Lake is a participant in a WDNR/Army Corp of Engineers concentration testing program.

12.2.4 EWM Weevil Survey

If EWM becomes more prevalent in Horseshoe Lake, it is recommended that the HLPA begin a monitoring program for the Eurasian watermilfoil weevil. Weevil monitoring is a part of the CLMN AIS Monitoring Program, and if conditions warrant, weevils may be reared by volunteers using protocol established by Golden Sands RC&D.

12.3 Goal Three – AIS Education, Prevention, and Planning

The objective of AIS education, prevention, and planning in this plan is to create a lake community that is aware of the problems associated with AIS and has enough knowledge about certain species to aid in detection, planning, and implementation of management alternatives.

An AIS Rapid Response Plan has been developed for Horseshoe Lake as a part of this plan. The Rapid Response Plan contains information on what to do if a suspect AIS is found, who to contact, and what should be done if a positive ID is made. A copy of this plan is in Appendix F.

12.3.1 Watercraft Inspection and Signage

The HLPA will develop an active water craft inspection program modeled after WDNR/UW-Extension Clean Boats, Clean Waters guidelines. It is recommended that the HLPA participate in the annual WDNR 4th of July Landing Blitz. All watercraft inspection data collected annually will be submitted to the WDNR SWIMS database. The HLPA will maintain and update AIS signage located at the Horseshoe Lake public access. The goal of this action is to keep new AIS from being introduced to the lake, and to prevent EWM from being carried out of the lake by an unwary lake user.

12.3.2 In-Lake AIS Monitoring

No AIS other than EWM has been indentified to date in Horseshoe Lake. The objective for AIS monitoring is to have trained HLPA volunteers and resource professionals retained by the HLPA look for and document when necessary, the presence of any other AIS in the lake. The Citizen Lake Monitoring Network sponsored by the WDNR and UW-Extension offers an AIS Monitoring Program that costs nothing to be a part of. This program provides volunteer training and supplies for EWM, purple loosestrife, Chinese Mystery Snails, Rusty Crayfish, zebra mussels, curly-leaf pondweed, and several other species. If new AIS are identified, procedures outlined in the AIS Rapid Response Plan for Horseshoe Lake will be implemented. The success of this objective will be measured by the level of lake volunteer participation, recording of AIS monitoring time, and tracking of results. All data will be recorded annually and submitted to the WDNR SWIMS database.

12.3.3 Lake Community Education Events

The objective of lake community education is to establish and maintain lake community participation in actions implemented to manage the lake. This gives the lake community voice in management decisions, and garners support and understanding for the management decisions made. Success will be measured by the level of satisfaction and involvement HLPA members have for the management efforts undertaken.

In each year of this APM Plan, the HLPA will host/sponsor at least one education event focused on some aspect of AIS. This event could be a lake fair, a workshop targeting a specific topic (watercraft inspection, shoreland restoration, aquatic plant identification, aquatic plant management, wild rice awareness and education, etc), or a special meeting or

presentation. This event could be held by itself, or in combination with some other regularly scheduled event like the Town of Minong Lakes Fair or HLPA annual meeting.

12.3.4 Distribution of Information and Education Materials

The HLPA will keep its membership informed as to the events happening in and around the lake. A newsletter will be developed and distributed at least twice annually, the Lake Association webpage will be maintained and updated on a regular basis, and AIS materials will be distributed to lake residents. Lake related documents like this APM Plan and the results of aquatic plant surveys will be posted on the webpage, and a portion of every HLPA annual meeting will be devoted to AIS and EWM management.

12.4 Goal Four – Wildlife Appreciation

The objective of wildlife appreciation planning and implementation is to improve the knowledge of the lake community of how management actions in and around the lake effects the wildlife living there. Success will be measured in the amount of interest and participation HLPA members have in numerous monitoring programs.

12.4.1 Monitoring Program Information and Participation

The HLPA will provide education and informational materials related to wildlife and wildlife monitoring programs during events, in newsletters, on the webpage, and during meetings. Wildlife monitoring information is available from the Sigurd Olson Institute (Loonwatch), the Citizen Based Monitoring Network of Wisconsin (Citizen Science), and other sources. Riparian owner participation will be encouraged and recognized by the HLPA.

12.5 Goal Five – Lake Community Understanding

The objective of this goal is to educate the lake community about how what they do impacts the aquatic plants and water quality in the lakes. Success will be measured in the number of projects HLPA members participate in and in the understanding the lake community gains in this endeavor. The completion of at least three or four shoreland or habitat improvements projects over five years and uninterrupted long-term trend monitoring via the CLMN water quality program would indicate that this objective is being successfully completed.

12.5.1 Shoreland Restoration and Habitat Improvement

It is recommended that the HLPA encourage riparian owner participation in shoreland restoration and habitat improvement programs sponsored by Washburn County, WDNR, and other shoreland improvement programs. Information about these programs will be made available to HLPA members through the newsletter, on the webpage, and/or during HLPA or other sponsored events.

12.5.2 Riparian Owner Best Management Practices

It is recommended in this plan that the HLPA encourage riparian owner participation in best management practices that may reduce shoreland runoff and nutrient loading into the lakes. Informational and educational materials will be made available to HLPA members through the newsletter, on the webpage, and/or during HLPA sponsored events. Best management practices could include but are not limited to the establishment of buffer strips, runoff diversions, rain gardens, septic system maintenance, non-impervious surfaces, and no mow areas.

12.5.3 CLMN Water Quality Monitoring Program

The HLPA will participate in the CLMN Water Quality Monitoring Program. This APM Plan recommends completing all CLMN expanded monitoring parameters (Secchi, temperature, dissolved oxygen, total phosphorus, and chlorophyll a) at two sites, one in the west basin and one in the east basin. In addition to the normal spring, June, July, and August sampling dates this APM Plan recommends adding October sampling as well. October sampling will help to identify changes that maybe brought about late in the season by EWM management actions. October sampling would only be completed if supported by grant funding.

As the HLPA implements aquatic plant management alternatives it is possible that the water quality in the lake could be impacted. Participating in basic, long-term trend water quality monitoring may help identify additional changes due to plant management activities.

To aide in the collection of dissolved oxygen and temperature data, this APM Plan recommends the purchase of an WDNR approved DO/Temp Meter be included in any grant application to support further management.

At some point in the next five years, the HLPA should consider completing comprehensive water quality lake management planning for Horseshoe Lake and its watershed.

12.5.4 Lake Level and Precipitation Monitoring

It is recommended in this APM Plan that water levels in Horseshoe Lake be monitored on a weekly basis. This can be accomplished by installing a staff gage at a property owned by a HLPA volunteer who is a permanent resident on the lake. A staff gage is a measuring tool installed on a permanent structure in the lake or placed in reference to a permanent and unchanging structure on the shore whereby fluctuating water levels can be recorded.

It is recommended that the HLPA install at least one rain gage on the lake and document precipitation as it occurs. Support for this management recommendation can be accessed by HLPA participation in the Community Collaborative Rain, Hail and Snow (CoCoRaHs) Network. CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). By using low-cost measurement tools, stressing training and education, and utilizing an interactive Web-site (www.cocorahs.org), their aim is to provide the highest quality data for natural resource, education and research applications.

12.6 Goal 6 - Aquatic Plant Management Plan Maintenance

This APM Plan is a working document guiding management actions on Horseshoe Lake over the next five years. Complete annual and end of project activity and assessment reports are necessary to make annual adjustments. The following activities will support APM Plan maintenance.

12.6.1 Successful Reporting and Data Sharing

The objective here is to complete project reporting that meets the needs of the WDNR and HLPA, allows for timely reimbursement of expenses, and provides the appropriate data for continued management success. Success will be measured by the efficiency and ease in which these actions are completed.

12.6.2 End of Year and Annual Management Proposals

The HLPA and their retainers will compile, analyze, and summarize management operations, public education, and other pertinent data annually in report form and make it available to

members of the HLPA, Washburn County, Town of Minong, and the WDNR. These reports will also serve as a vehicle to propose following year management recommendations. These reports will be completed by the HLPA and their retainers prior to implementing following year management actions (approximately March 31st annually).

12.6.3 Five Year Redo of the Point Intercept Aquatic Plant Survey

It is recommended that the HLPA complete another whole lake, point intercept aquatic plant survey of the lake in 2016. Results will be compared to 2011 survey results to determine long-term impacts on both target and non-target aquatic plants over the five years of management.

12.6.4 End of Project Five-Year Project Evaluation and Assessment

At the end of this five year project, all management efforts and related activities will be compiled, analyzed, and put in report form. This document will discuss the successes and failures of the existing APM Plan and be the basis for making revisions to a new APM Plan. The report will be compiled by the HLPA and their retainers and made available to HLPA membership, Washburn County, the Town of Minong, and the WDNR. The report will be completed by June 30th in the year after the final year of this APM Plan.

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Appendix A

2007 WDNR 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

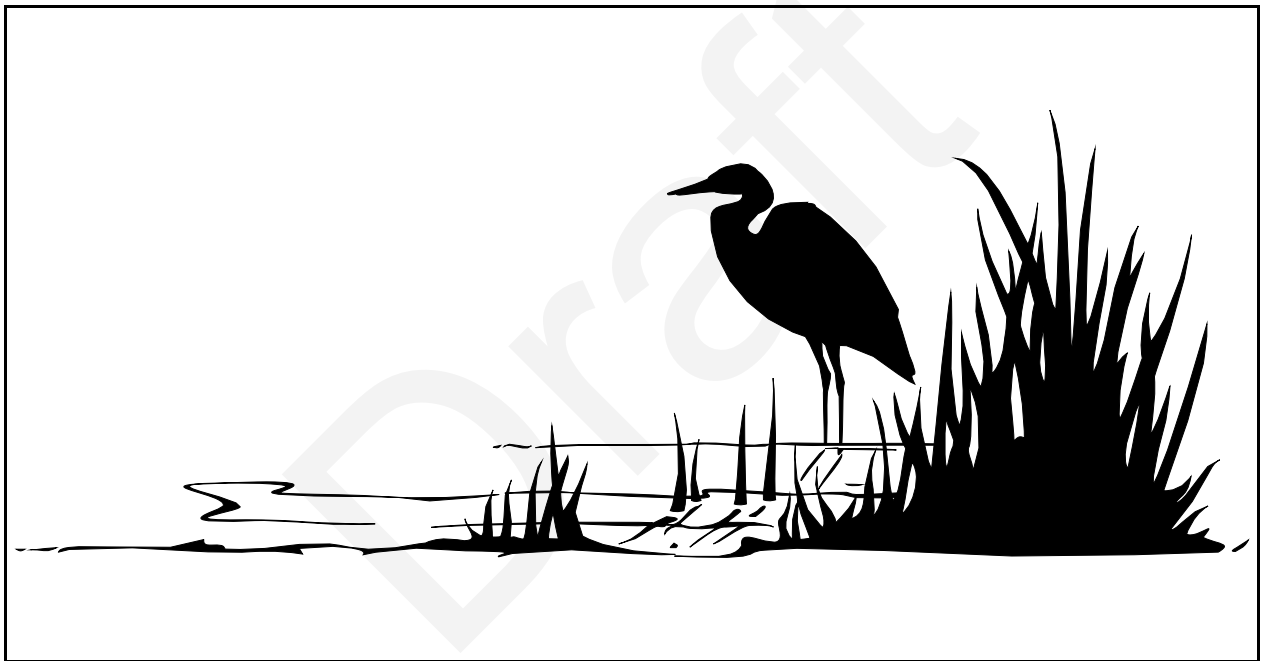
DEFINITIONS

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.

Appendix B

Guidelines for Protecting Sensitive Areas

GUIDELINES FOR PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSITIVE AREAS AND CRITICAL HABITAT



A companion document to help understand lake sensitive area and critical habitat reports

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GUIDELINES FOR PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSITIVE AREAS AND CRITICAL HABITAT

A companion document to help understand lake sensitive area and critical habitat reports

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INTRODUCTION TO PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSTIVE AREAS AND CRITICAL HABITAT AREAS

This document was originally designed to be used in conjunction with specific lake sensitive area survey reports; **but it can also be useful to other parties interested in protecting lakes by helping them understand important factors which affect water quality and lake ecosystem health**. This document will concentrate on several main areas within the lake and its' shoreline areas that can be protected or restored to maintain water quality and lake ecosystem health. These main areas include aquatic plant sensitive areas, shoreline land use and lakeshore buffers, gravel and coarse rock rubble habitat, large woody debris, and various water regulations and zoning concerns.

This document will not attempt to deal with land use problems that do not fall within the immediate shoreline areas; although it should be recognized that lakes may have problems that occur in these outlying areas of their watershed resulting in significant nutrient and sediments additions that threaten the overall health of the lake ecosystem and should be dealt with through land acquisition and subsequent deed restrictions and implementation of non-point source control best management practices.

UNDERSTANDING AQUATIC PLANT SENSITIVE AREAS

The importance of aquatic plant communities is frequently underappreciated and their importance to a lake's ecosystem health misunderstood. This is often evident by the way people refer to aquatic plant habitat as problem weeds or weed beds. A weed by definition is a plant that is out of place or a plant of no value. The vast majority of native aquatic plants grow where they should be growing based on available light (water clarity & light penetration), water depth, and bottom substrate or soils and are not out of place and as previously stated are extremely important for the proper functioning of a healthy lake ecosystem and are an integral part of the biotic integrity.

Aquatic plants (macrophytes & algae) are the primary energy source upon which the rest of the lakes food chain is based and dependent upon. Fisheries are dependent upon them for cover, spawning habitat, important habitat and cover for fingerlings and young of the year, critical habitat for aquatic insects and other important food or forage species (minnows). They also serve an important function in reducing the shoreline erosion associated with

wave action while stabilizing sediments in place, and aquatic plants lock up available phosphorus which would otherwise be available to drive undesirable algae blooms.

Aquatic plants also provide many important functional values for wildlife: Loons require aquatic vegetation for their nests, and waterfowl and furbearers require aquatic vegetation for food and cover. Songbirds, shoreline water-birds, frogs and other amphibians, reptiles, and a host of other wildlife require aquatic vegetation for some critical need throughout different life cycles.

Use of Aquatic Herbicides

Because the potential ecological risks associated with aquatic herbicide applications are so high, most aquatic herbicide applications must be approved through the DNR permitting system and the application must be completed by a DATCP certified aquatic herbicide applicator. Those herbicides that don't require a DNR permit are often inappropriate for the existing site conditions or species present resulting in potential impacts without real nuisance relief.

The herbicides that don't require a permit are restricted to granular or pelletized forms and usually will only work in a narrow set of environmental conditions. If the site conditions include much of any fine flocculent sediments effectiveness can be dramatically reduced or eliminated. Many of these herbicides will work on only a limited number of species which may not even occur on the site increasing the importance of having a qualified applicator capable of identifying the species present and the site conditions which can limit herbicide effectiveness. In the long run most people would be far better off trying to limit vegetation by hand pulling or raking and if these are not feasible contacting a DATCP certified aquatic herbicide applicator to have them assess the different control methods suitable for the site.

In most cases aquatic herbicide applications should be discouraged because:

I. Less invasive or less destructive methods of control are feasible for the site and may include one or more of the following: mechanical harvesting, hand pulling, hand raking, hand cutting, and nutrient controls within the watershed. All too often herbicide treatments are conducted adjacent to private docks in situations where hand pulling or raking were easily a viable option and should have been the only allowable practice.

Before taking action, a careful assessment of existing conditions should be conducted and should include: importance of existing habitat areas, actual needs for clearing of aquatic plant habitat (navigational access does not require removal of all vegetation; only a reduction in density), and consideration of the cumulative impacts of removing aquatic plant habitat or treating it and the organisms living in it or around it with herbicides.

II. Can result in an overall reduction or fragmentation of important native aquatic plant habitat.

III. Creates openings in areas that should be colonized by native aquatic plant species. These openings provide increased opportunities for exotic species to become established in the lake and once established provide opportunities for their expansion.

IV. Results in direct and indirect mortality of sensitive or intolerant immobile species such mussels and other invertebrates. Some treatments can also result in the gradual build up of copper in the lake bed sediments to the point of being toxic to aquatic organisms. Several lakes in Northwestern Wisconsin have already reached or are approaching copper concentrations or levels that would be toxic or considered a lethal dose to 50% (LD50) of selected aquatic organisms exposed to similar concentrations under laboratory conditions. A serious problem that needs to be carefully considered is that copper does not break down, and it continues to build in concentration in the lake bed sediments with each subsequent treatment containing copper.

If people are going to treat aquatic plants they must understand that the available phosphorus will be expressed in larger plants or algae. Any attempts to suppress the expression of the available phosphorus will usually be very short term (7 days). It is difficult to justify adding toxic chemicals which do not break down and continue to build up towards toxic levels with each subsequent treatment. For this reason, aquatic herbicide treatments containing copper should be restricted to exceptional circumstances and not used on a regularly reoccurring basis.

V. If the average landowner width is l00’ or less and the minimum effective herbicide treatment width of 30’ is applied by most shoreline property owners around a lake, the cumulative impacts of the treatment could eliminate or seriously impact greater than 30% of the available habitat. This reduction in available habitat can result in an even greater percentage reduction in the overall fish populations for the lake. Elimination of habitat in even a small percentage of a lake, especially in critical habitat areas, can cause the collapse of a fishery.

VI. Aquatic plants lock up available phosphorus which would otherwise be available to drive undesirable algae blooms.

VII. Aquatic plants serve an important function in reducing the shoreline erosion associated with wave action while stabilizing sediments in place.

VIII. Aquatic plant management staff routinely hears complaints from shoreline property owners who expected their contracted aquatic herbicide application to eliminate all of the vegetation from the treatment area for a significant portion of the summer period. Most aquatic herbicides are effective on only a portion of the total aquatic plant community at a given site (species selective).

Free-floating species such as coon tail (*Ceratophyllum* sp.) and duckweed (*Lemna* sp.) also often drift back into treated areas with the next pervasive wind, eliminating the benefits they had expected from the chemical treatment. Other species such as Elodea, curly-leaf pondweed, milfoil, and other species easily fragment at times of the year and also drift into treatment areas eliminating or reducing the benefits of the previous treatment.

Hand raking or pulling near docks and in front of private developed properties eliminates the guess work out of what will be removed or eliminated when compared to expensive herbicide treatments with health concerns, use restrictions, and limited effectiveness.

Recent changes affecting mechanical removal and hand pulling of aquatic vegetation

Prior to the passing of Senate Bill 55 in September 2001, mechanical removal of aquatic plants was unregulated provided the lake bottom was not disturbed, the cut plants were removed from the lake and not allowed to drift free, and the plants cut and removed did not include rice or those that are a part of a floating bog mat.

As exotic species, such as Eurasian Watermilfoil, expand their distribution within the state, more opportunities for spreading these exotics will occur. The risk of an exotic becoming established in a new lake is dramatically increased if the native species of aquatic plants that normally occupy a specific habitat type have been eliminated or reduced. When exotics are introduced into an area they have to find a suitable location to become established. If all the suitable growing sites are occupied by native species the exotic will have a much more difficult time establishing a reproducing population.

The Department has recently developed the necessary administrative rules within NR 109 to comply with the legislative mandates of SB 55. These focus on protecting native aquatic plant habitat to reduce the risk of exotic species invasions, while also recognizing the importance of protecting and maintaining the native aquatic plant habitat and the functions it performs in maintaining overall lake health. These rules limit shoreline removals of aquatic plant habitat without a permit to less than a 30' width; with the restrictions that this 30' width also include docks and other human activity areas that result in the loss or degradation of aquatic plant habitat.

If individual shoreline owners would like to consider removing vegetation by hand pulling or raking in widths greater than 30' they must apply for an aquatic plant management permit with their local DNR aquatic plant management specialist. It is unlikely that the Department will approve many alterations beyond the standard 30' width because of the concerns related to: creating more areas devoid of native vegetation which increases opportunities for possible colonization sites for exotics, cumulative losses of overall habitat, and the fragmentation and degradation that impairs the remaining habitat.

Summary of management recommendations for the protection and restoration of aquatic plant communities

The following management recommendations provide some basic concepts that can be used or implemented to insure the long term health of aquatic plant communities and the overall health of lakes ecosystems.

1. Prohibit chemical treatment of aquatic plants accept under extenuating circumstances such as:
    A. The habitat to be treated is a dominant feature in the lake and the cumulative treatment of small areas will not reduce the overall percentage of coverage from historic coverages.
    B. There is no other management alternative that will work to clear necessary navigational access channels identified in a Department approved management plan (post 2000)
    C. Treatment will not result in a loss of critical habitat
    D. It can be shown that chemical treatment will result in an improvement to the overall health of the ecosystem.
    E. A serious use problem clearly exists
2. Discourage mechanical harvesting of aquatic plants in most circumstances. Clear only Department approved NR 109 permitted navigational channels 20'-30' wide. If small areas adjacent to docks are to be cleared of vegetation hand raking or pulling should be used if at all possible. Please consider the cumulative impacts if everyone was to duplicate the actions you take on your property around the rest of the lake.
3. Educate lake users about the value and importance of native aquatic plant habitats. Lake districts and associations should try to educate new property owners as soon as possible about the value of critical habitat and the laws associated with protecting lakes and lake front property.
4. Apply aggressive erosion control measures to all bare soil areas
5. **Protect** existing natural plant cover in upland areas within at least a 50'-60' corridor of the water's edge and **reestablish** an **effective buffer** of natural plant cover where it has been eliminated. This corridor or buffer is an important component in protecting water quality and habitat against eutrophication and sedimentation and provides critical habitat for our shoreline species of wildlife. Lake districts and associations should try to educate new property owners as soon as possible about the value of **shoreline buffers** and the laws associated with protecting lakes and lake front property.

6. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening and uniform enforcement.
7. Provide follow through and feed back with public officials when it comes to waivers and variances of existing zoning regulations and building codes
8. Encourage the requirement of mandatory erosion control plans for all building permits that require ground breaking
9. Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is clear evidence that such an alteration would benefit the lake's ecosystem.
10. Lake districts should carefully consider the value of purchasing shallow water bays with extensive aquatic plant communities to insure that future development does not result in an impact or a loss of this valuable habitat.

SHORELINE LANDUSE AND LAKESHORE BUFFERS

The impacts that can result from shoreline development can be greatly reduced if done carefully with respect to the many important functional values that must exist to maintain a healthy lakes ecosystem. Natural shoreline vegetation provides important protection for lake water quality as well as ecosystem health and should be maintained for at least a 50-60' buffer strip adjacent to any waterbody. If shorelines have a steeper gradient than 10-15% the buffer strip width should be increased. Access corridors through this buffer zone are restricted by most county zoning regulations. Restrictions usually prevent the clearing of woody vegetation and mowing to no more than a 30' width of the shoreline. Property owners that care about the health of their lake's ecosystem can go a step further by reducing the clearing of vegetation to a narrow foot path. The best design for a foot path is an irregular trail that does not go in a direct line to the lake but has irregular meanders much like a stream with small berms and humps to prevent runoff from flowing directly down the path and preventing the path from become an area of concentrated flow for the direct delivery of sediments and nutrients.

The importance of maintaining the zone of no disturbance of the natural vegetation along the lake shoreline is important for several reasons. As land is cleared and developed irregular surface areas are lost, leveled, and filled in by earth moving equipment, reducing infiltration and increasing runoff. The natural spongy layer of decaying leaves and plant matter is also

removed further reducing infiltration and increasing runoff. Soil porosity is also decreased, decreasing infiltration and increasing runoff. As we lose or simplify the layers present (trees, shrubs, and unmowed herbaceous ground cover) in the shoreline areas we decrease the layers present for the interception of rainfall; each layer present reduces the energy and volume of rainfall striking the grounds surface thereby reducing what is available for the mobilization and transport of sediments and nutrients from the ground's surface to the lake. The greater the volume of runoff the more energy available for the transport of nutrients and sediments from surrounding land uses into the lake to drive algae blooms and bury important shoreline habitats.

Shoreline buffers also increase the buildup of leaf litter forming a spongy layer to absorb more precipitation and runoff reducing the amount of sediment and nutrients reaching the lake and negatively impacting water quality and habitat. The denser unmowed vegetation also filters sediments and nutrients from runoff.

Each of these three layers (trees, shrubs, and herbaceous ground cover) provides different important habitat components for different life cycle requirements of various wildlife. If any one layer is missing the ability of certain wildlife species to survive may be compromised. Leaving wider areas of uncut vegetation (Buffer Zones) increases the likelihood that adequate habitat will exist for many species of songbirds, which are at risk from the loss of this valuable lake shoreline habitat. Furbearers, raptors, frogs, deer, and other wildlife also benefit from these wider natural areas.

The aesthetic perspective also needs to be evaluated. Everyone likes to look out and see the lake, but very few people like to look at an intensively developed shoreline that reminds them of the urban yards and hectic pace they were trying to get away from. Maintaining the natural wild character of a lake should be the highest priority guiding any development activities. Both man and wildlife will lose if the natural character is allowed to be manipulated to the point our lakeshores begin to resemble urban yards and lawns. This emphasizes the importance of insuring that development is done carefully to maintain as many of the important functional values that the natural undeveloped shoreline had.

The restoration of a naturally vegetated buffer for at least 50'-60' from water's edge should be a very high priority for properties that have been cleared or converted. As previously stated a healthy buffer includes the native trees, shrubs, and herbaceous ground cover that would naturally have

existed on a given site or location. The native species can usually be identified by looking at undeveloped shoreline areas.

Summary of management recommendations for the protection and restoration of natural vegetative shoreline buffers

1. Educate landowners about the importance of a healthy lakeshore buffer
2. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening and uniform enforcement.
3. Provide follow through and feed back with public officials when it comes to waivers and variances of existing zoning regulations and building codes
4. Encourage the requirement of mandatory erosion control plans for all building permits that require ground breaking
5. Provide direct oversight of all building crews and insure that as little as possible of the natural plant cover is disturbed during the construction phases.
6. Utilize only the native indigenous species for shoreline buffer restoration efforts and carefully consider site limitations (soil type, soil moisture regime, and shade preferences of plantings) when selecting appropriate species. Restoration efforts should follow a least disturbance scenario; by first halting mowing within at least the shoreline buffer zone (35' back from the water's edge and with no more than 30' width of the shoreline cleared for access purposes; landowners that care about the health of their lake ecosystem are encouraged to go beyond the minimum requirements of the law and increase buffer width and decrease the length of shoreline cleared of vegetation for access). It is important to remember that any ground breaking activities increases the opportunity for transport of sediments and nutrients into the lake; especially within the lakeshore buffer zone.

   Landowners should expect that initial recovery of the natural vegetation within the ground cover layer may take one or two full growing seasons, after halting mowing activities. Vegetation can usually re-establish itself from the natural seed bank available within the existing soils and from the seeds and rootstalks of adjacent plant communities. Plug plantings of the native herbaceous groundcover species can be used to achieve adequate density and diversity if recovery appears to be sparse in successive years. Supplemental

plantings to establish adequate densities for the tree and shrub layer will have to be used in most situations.

The native species that should be used to restore the lakeshore buffer in order to provide the proper habitat and water quality protection functions necessary to insure a healthy Northern Wisconsin lake ecosystem are available through County Land and Water Resources District Conservation staff; please refer to the list of contact names and numbers at the end of this document.

ZONING AND REGULATION CONSIDERATIONS FOR LAKE PROTECTION

Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is clear evidence that such an alteration would benefit the lake's ecosystem. Sea-walls should not be used and sand blankets should not be allowed in almost all situations. Rock rip-rap should be used only when anchoring difficult shorelines with problematic erosion which cannot be handled with just restoration of the native vegetation. If questions arise or problem areas exist, lakeshore property owners should call their local DNR Water Regs Staff for assistance or to report a problem area which may be negatively impacting lake water quality or habitat. A list of locally available technical assistance contact names and phone numbers is provided at the end of this document for easy reference.

County shoreland and wetland zoning regulations apply to the areas within 1000 feet of lakes, ponds, and flowages and within 300 feet of rivers, streams, and creeks. The intent of zoning regulations is to promote wise land use planning while allowing careful development around our precious surface water resources. Most of the counties in northwestern Wisconsin now have lakes classifications which require or prescribe certain setbacks for all structures and the maintenance or re-establishment of shoreline buffers to protect water quality and habitat needs. Most of them **as a minimum** allow for reasonable use of shoreline areas by allowing a 30' wide access/viewing corridor through the buffer. The remainder of the lot from the water's edge back 35'should be restored to a natural condition with trees, shrubs, and unmowed herbaceous ground cover including various grasses, sedges, forbs, and wildflowers.

On more sensitive lakes, county classifications may require or prescribe a wider buffer width and lakeshore property owners are encouraged to contact

their **local county conservationist** and determine what the specific requirements are for shoreline buffers on their lake. A list of locally available technical assistance contact names and phone numbers is provided at the end of this document for easy reference.

In all cases during development, the maintenance of a naturally vegetated buffer zone is critical to preserve a healthy lake ecosystem. In situations where the vegetation has been removed or altered landowners are encouraged to reestablish a buffer zone composed of the natural plant communities that belong there. For technical assistance in restoring your shoreline buffer please contact your local county conservationist or county shoreline BPM technician using the names and numbers provided at the end of this document. This ensures that you not only get water quality protection, but you also get the important functional values that the native plants provide for food and cover for shoreline species of wildlife dependent upon them.

EROSION CONTROL DURING LOT DEVELOPMENT

This is one area that can have a dramatic effect on water quality and habitat if it is not done correctly. The volume of sediments and nutrients that can be transported to a lake during the construction phase can equal the amount that would normally have only come off from the same parcel of land over a period of hundreds of years. The compounding effect of this nutrient load can have a dramatic effect on long term lake water quality. By following some basic rules during the construction phase we can keep most of these sediments and nutrients in place and prevent them from becoming a part of the lakes internal nutrient cycle that could cause a shift from a clear lake to one that has ample nutrients to drive extensive algae blooms each year.

Adequate soil erosion control measures and their proper maintenance during construction are very important and should become a very high priority for individual property owners. Lake association members could play an active part in reaching property owners before the damage is done or minimizing impacts by identifying active sites that need erosion control measures and contacting property owners to encourage proper implementation of erosion control measures. County zoning staff and officials need public support to get more effective zoning regulations on the books. Public support needs to be expressed if adequate county staff are to be hired to meet the increasing demands that are being placed on them by expanding development. As is most counties suffer from inadequate staff to deal with existing work demands. Mandatory erosion control plans should be a requirement for all

building permits that will involve ground breaking. This needs to be coupled with adequate staff to insure that erosion control plans are being followed and properly implemented and that erosion control measures are properly maintained. More recently county governments have begun to deal with these difficult issues.

Until county wide erosion control ordinances can be established it is strongly recommended that individuals require contractors to develop erosion control plans prior to the initiation of any construction, then the landowner should ensure that it is adequate. Aggressive follow through after construction has begun is also important to insure erosion control practices are properly implemented and maintained.

By giving erosion control careful consideration prior to construction serious impacts to our lakes and streams can be minimized or avoided entirely. Yards can be designed with subtle berms to divert runoff into internally drained areas or into constructed depressions to allow sediments and nutrients to settle out and be trapped before reaching our streams and lakes. Silt screen fences, properly installed during construction can protect against "sheet" runoff. Other erosion control methods are required on steep slopes or difficult sites. Your county land conservation staff or DNR technical support can provide expert advice about erosion control.

Protect all top soil piles by properly locating them away from drainage ways and as far away from the lake as possible. Surround them with a ring of silt screen fence while also seeding them down with an annual rye grass to provide additional stabilization until they are needed.

Never divert rainfall runoff from driveways, roofs, or access roads directly to the lake through drain tiles, culverts, or waterways. Instead, divert runoff into internally drained areas, constructed depressions to allow for settling of sediments and nutrients, or at least into a thickly vegetated site that will provide some degree of filtration and infiltration of runoff.

Management recommendations for constructions site erosion control

1. Minimize disturbance of natural plant communities within shoreline areas (50'-60' from water's edge) so they can continue to act as a buffer protecting lake water quality by filtering runoff and providing for infiltration before it reaches the lake.
2. Provide direct oversight of the construction crew during development. Insure that clearing of vegetation is kept to the minimum needed to accomplish the desired construction and avoid any disturbances within at least 50'-60' of any shoreline
    A. Insure that silt screen fences are installed and maintained.
    B. Apply mulch to all bare soil areas that may be exposed to precipitation during none work hours, and especially make sure mulch is applied before weekends. Purchase and use excelsior erosion control mats and other products where necessary.
    C. Provide coarse gravel and crushed rock cover for all areas that have regular heavy equipment traffic, i.e. driveways. Keep all vehicle traffic confined to these protected road surfaces.
    D. Include landscape designs for the protection of water quality i.e., such as holding ponds and depressions which provide for the opportunity to capture and hold runoff while maximizing infiltration and allowing sediments and nutrients to settle out.
    E. Try to eliminate or minimize areas of concentrated flow by reducing the surface area draining through a single path or channel and encouraging flow over multiple paths into depressional areas through the use of berms and other best management practices (BMPs).
3. Report serious erosion control problems that aren't being dealt with in a timely manner; before, they can result in significant impacts to water quality and habitat.

PROTECTION OF GRAVEL AND COARSE ROCK RUBBLE HABITAT

Gravel and coarse rock rubble free of silt and sediments are critical to the successful reproduction of some walleye stocks. Gravel and coarse rock rubble free of silt and sediments are also critical to the survival of different components of the aquatic food chain that supports a healthy lake ecosystem, including aquatic insects, crayfish, and other forage or food species. The greatest threat to these critical habitats is shoreline development that is not accomplished in a manner that maintains an adequate buffer of undisturbed land and does not implement and maintain proper erosion control measures. This buffer is particularly important during ground breaking and construction of lake shoreline areas, because it traps sediments and nutrients within the vegetation and irregular surface areas and small depressions preventing them from reaching the lake and driving algae blooms or burying important habitat.

Summary of management recommendations for the protection of rock rubble *walleye spawning* habitat

1. Educate landowners about the importance of a healthy lakeshore buffer (filter out sediments)
2. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening and uniform enforcement.
3. Provide follow through and feed back with public officials when it comes to waivers and variances of existing zoning regulations and building codes
4. Encourage the requirement of a mandatory erosion control plan for all building permits that require ground breaking
5. Provide direct oversight of all building crews and insure that as little as possible of the natural plant cover is disturbed during the construction phases.
6. Do not use sand blankets to convert natural bottom types to sterile beach sand.
7. Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is clear evidence that such an alteration would benefit the lake's ecosystem.

MAINTENANCE OF LARGE WOODY DEBRIS

Large woody debris or trees should be left in the lake as they naturally collapse and fall into the lake. Large woody debris is often overlooked for its importance in providing critical fish habitat. Species such as largemouth bass require some sort of cover to successfully nest and rear offspring. Bluegills and other species also benefit from the presence of large woody debris. The conversion or removal of natural plant cover within a 50'-60' corridor of the lake reduces or eliminates completely the opportunity for the replacement of large woody debris as well as other important functional areas important the any lake's ecosystem health and should be discouraged. The way we look at large woody debris should in the context of its importance to the health of the lake ecosystem. Pre-formulated perceptions drawn from urban experiences or practices used in urban areas can be very destructive to the way natural environments function in a complex interconnected fashion. A shoreline ringed with fallen trees should not be looked at as untidy or unkempt but one that is providing important habitat for fish and wildlife. Fishermen have recognized for decades that fallen trees are often some of the best habitat to fish for bass and panfish. This emphasizes the need to re-assess our value system and begin leaving them for important habitat. Fisheries managers in recent years have begun to increase their educational efforts in this particular area but still have a majority of the public to reach with this important message.

Management recommendations for woody debris

1. Educate lake shore owners about the value of allowing trees to fall into the lake naturally in order to provide valuable habitat for fish and wildlife.
2. Encourage lake shore property owners to become involved in the long term planning for woody debris on their property. Plant young trees for the replacement of older trees.

USE OF FERTILIZERS ON LAKE SIDE LAWNS

From a water quality standpoint lawn fertilizers are a recognizable source of nutrients that property owners can eliminate or control through proper application. More is not better. Landowners are also encouraged to strongly consider the consequences of having a large lawn that extends into the recommended buffer area (within 50'- 60' of the lakeshore). By reducing your lawn size you not only reduce the amount of sediments and nutrients entering the lake you also provide important habitat necessary to support Wisconsin's wildlife species dependent upon this important shoreline habitat that is quickly disappearing in the face of increasing development pressures. Another benefit to decreasing lawn size is the reduction in work load necessary to maintain it; hence you can spend more time relaxing and enjoying your property.

If you feel the need to fertilize your lawn have your soil tested for phosphorus and potassium levels. When applying fertilizers consider the need to have soil phosphorus levels at the maximum recommended level. By applying fertilizers at a lesser rate you can still enhance your lawn without the increased risk of having excess drain into the lake to drive undesirable algae blooms. Remember that fertilizer suppliers are in the business to sell chemicals. The recommended bag application rates are often too high. Get advice from your county or university extension offices and remind them that you are applying the fertilizers to a lakeshore lawn and do not want to over-apply.

Never burn brush or leaves, especially along the lakeshore, in road ditches, or in drainage ways that drain into the lake. The ashes are very high in phosphorus and nitrogen and are soluble in rainwater. The best way to deal with leaves is to compost them. Spreading them in a wooded area that does not drain to the lake is also a good way to deal leave disposal. If neither of these is an option, bag your leaves and take them to a yard waste collection site for proper disposal.

Do not remove grass clippings from lawns. They contain all the nitrogen and phosphorus your lawn needs which you will not have to replace with annual fertilizer applications. Use a mulching lawnmower it recycles the clippings into your lawn more efficiently. Never spread wood stove ashes in areas draining to the lake; instead dispose of them with your household garbage during normal refuse pickup times.

Management recommendations for fertilizer use

1. Apply fertilizers only if a soils test has determined that it is nutrient deficient and add less than the maximum recommended.
2. The use of a low phosphorus content fertilizers or no-phosphorus fertilizers is strongly recommended if the fertilizer is to be applied on lakeshore property.

SEPTIC SYSTEM MAINTENANCE AND NECESSARY REPLACEMENT OF OLD FAILING SYSTEMS

Failing septic systems can pose a significant threat to water quality, especially when large portions of shoreline are developed and when the overall percentage of a lakes watershed is dominated by lakeshore properties. Septic systems that are older than 20 years should be looked at to insure that the filtration field is properly functioning and that waste is not perching above the drain field and entering the lake directly without adequate filtration of nutrients and other components. There is no specific rule that septic systems have to be evaluated to determine if they are functioning properly, unless there is a complaint filed.

It is generally recommended that you have your septic system pumped of the normal sludge buildup every two to three years. This sludge removal is essential for maintaining the absorptive capacity of your drain field.

Inspect your system regularly for surfacing effluent around the drain field. Are there wet areas or strong odors? Do the drains in your home seem to work properly or are they sluggish? Do they make noisy gurgling sounds? If your septic system has any of these systems you should have it inspected by a licensed installer.

Never make any changes to your sanitary system or wastewater piping. This work must be done by a licensed installer. It is not only dangerous to health and human safety, as well as water quality, it is also illegal and can result in fines or penalties.

Avoid using a garbage disposal with private septic systems. Put kitchen scraps in a compost pile if at all possible; otherwise, as a last resort put them in with your household garbage. Limit the use washing machines, if possible. Laundry wash water is high in lint, synthetic fibers, and pet hair all of which can cause premature failure of your drain field. Use a commercial laundry if possible or if you are a weekend resident with a lakeshore septic

system wait until you return to your midweek residence with public water and sewer.

A septic system is only intended to break down organic wastes. Never put solvents, furniture stripping solutions, degreasers, petroleum compounds, oil based paints and stains, or other chemicals into your sanitary system.

Diverting sink and shower drains (so called gray water) to lawns and other properties adjacent to the lake will not only impact lake water quality it is also illegal. Gray water must be run through your septic system to allow for the proper filtration of pollutants. There are no exceptions to this without first obtaining necessary permits.

Appendix C

NR 109

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL AND MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.07, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter. Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non−native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03; **correction made under s. 13.92 (4) (b) 7., Stats., Register March 2011 No. 663.**

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

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

NR 109.03 Definitions. In this chapter:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Note: Scientific collectors permit requirements are still applicable.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

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

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

(g) An education and information strategy.

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

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

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

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

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

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

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

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

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

Appendix D

Outline of Aquatic Plant Management Goals, Objectives, and Actions

Horseshoe Lake, Washburn County Aquatic Plant Management Plan

Outline of Goals, Objectives, and Actions 2014-2018

- Goal One: Native Plant Protection, Preservation, and Enhancement
    - Objective 1 – Limit removal of native aquatic plants around property owner docks and beaches
        - Action: Educate riparian owners about the AIS risk posed by removal of native aquatic plant
    - Objective 2 – Promote Wild Rice Awareness in lake property owners and users
        - Action: Provide educational and informational materials related to wild rice
        - Action: Invite a speaker to talk about wild rice at an annual education event
        - Action: Monitoring the lake for the presence of wild rice at least once annually
    - Objective 3 – Support the designation of critical habitat in Horseshoe Lake
        - Action: Support WDNR, should they reactivate the program
    - Objective 4 – Minimize aquatic plant management impacts to the existing fishery
        - Action: Implement no aquatic plant management actions except physical removal in areas of the lake < 3-ft deep
    - Objective 5 – Maintain or enhance the amount of coarse woody debris in Horseshoe Lake
        - Action: Riparians will not remove woody debris from their shoreline unless it interferes with lake use
        - Action: Promote and pursue lake projects that may increase the level of woody debris in the lake
- Goal Two: Eurasian Watermilfoil Management and Monitoring
    - Objective 1 – Complete pre and post treatment aquatic plant surveying and fall bed-mapping of EWM annually
        - Action: Contract with a resource professional to complete pre and post treatment aquatic plant surveying
        - Action: Contract with a resource professional to complete fall EWM bed mapping
    - Objective 2 – Incorporate and integrated approach to EWM management
        - Action: Complete physical removal
        - Action: Complete diver removal
        - Action: Complete limited, early season herbicide application in areas too big to control with physical or diver removal
    - Objective 3 – Complete herbicide residual testing

        - Action: Partner with WDNR and USACOE programs to complete a residual testing program at least once during the five years included in this APM Plan.
    - Objective 3 – Incorporate an EWM weevil monitoring program if the amount of EWM increases to >10 acres
        - Action: Implement the CLMN Weevil Monitoring Program
- Goal Three: Aquatic Invasive Species (AIS) Education, Prevention, and Planning
    - Objective 1 – Maintain and update an AIS Rapid Response Plan
        - Action: Use the AIS Rapid Response Plan to guide responses to any new AIS that may be discovered in Horseshoe Lake
    - Objective 2 – Implement a watercraft inspection and AIS signage program at the public access
        - Action: Incorporate CLMN/UW-Extension Lake Clean Boat Clean Water Program at the public access
        - Action: Participate in the annual 4th of July Landing Blitz
        - Action: Install and maintain current AIS boat landing signage at the public access
    - Objective 3 – Implement an in-lake and shoreland AIS monitoring program on Horseshoe Lake
        - Action: Incorporate CLMN/UW-Extension Lakes AIS Monitoring Program in the lake
    - Objective 4 – Host and/or sponsor annual lake community education events
        - Action: Sponsor AIS identification and education workshops
        - Action: Distribute information and education materials to lake property owners and lake users
        - Sponsor or participate in at least one public education event annually
- Goal Four: Promote Wildlife Appreciation
    - Objective 1 – Encourage education and participation in wildlife appreciation programs
        - Action: Provide program information materials related to wildlife monitoring
        - Action: Promote and recognize property owner participation in wildlife monitoring programs like LoonWatch
- Goal Five: Promote Lake Community Understanding
    - Objective 1 – Promote shoreland restoration and habitat improvement
        - Action: provide education and information materials to property owners and lake users
        - Action: Sponsor workshops and related public events to encourage participation

        - Action: Recognize property owners who participate in and/or complete shoreland restoration and habitat improvement projects
    - Objective 2 – Implement Shoreland Best Management Practices
        - Action: Promote implementation of best management practices that reduce runoff and nutrient loading from properties into the lake
    - Objective 3 – Implement a consistent, uninterrupted water quality monitoring program on Horseshoe Lake
        - Action: Incorporate the CLMN volunteer water quality monitoring program on the lake, both water clarity and expanded monitoring when possible
        - Action: Purchase a dissolved oxygen/temperature meter to aide in collecting data
    - Objective 4- Implement a lake water level and precipitation monitoring program on Horseshoe Lake
        - Action: Purchase and install a staff gauge and record lake level on a weekly basis
        - Action: Record precipitation amounts by installing at least two rain gauges on Horseshoe Lake
        - Participate in the Community Collaborative Rain, Hail, and Snow Monitoring Program
- Goal Six: Aquatic Plant Management Plan Maintenance and Operation
    - Objective 1 – Complete timely reporting of management actions taken on the lake
        - Action: Complete annual reports summarizing activities completed during the year and there results
        - Action: Share annual reports with resource professionals, property owners, and lake users
    - Objective 2 – Complete annual management proposals based on previous year data and historic management actions
        - Action: Submit management proposals early in the season
        - Action: Solicit public input on all management proposals
        - Action: Share management proposals with resource professionals, property owners, and lake users
    - Objective 3 – Complete a five year management summary of all management actions
    - Objective 4 – Repeat an aquatic plant point-intercept survey after 3-5 years of active aquatic plant mangement

Appendix E

Five Year Implementation Timeline

Recommended Implementation Plan for the Horseshoe Lake Aquatic Plant Management Plan

	Objectives/Activities	AIS Grant Eligibility	LPL Grant Eligibility	Implementers	2014	2015	2016	2017	2018
Native Plant Protection, Preservation, and Enhancement									
1	Native Plant Awareness	x	x	HLPA, CO, RP, WDNR	x	x	x	x	x
2	Wild Rice Awareness	x	x	HLPA, RP, CO, GLIFWC, UW-Ex	x	x	x	x	x
3	Critical Habitat	x	x	HLPA, RP, CO, WDNR	?	?	?	?	?
4	Minimize Impacts to the Fishery	x	x	HLPA, RP	x	x	x	x	x
5	Protect and Promote Woody Debris	x	x	HLPA, CO, WDNR, Riparians	x	x	x	x	x
2. EWM Management									
1	Pre and Post Treatment Survey and Fall Bed Mapping	x		HLPA, RP, WDNR	x	x	x	x	x
	a) Only required if management exceeds 10 acres or 10% of the littoral zone								
2	Management Alternatives								
	a) Physcial (hand, rake and diver) removal - inc. annual coordinated effort	x		Riparians, HLPA, RP	x	x	x	x	x
	c) Chemical herbicide application (early season, systemic or contact herbicide as determined on an annual basis)	x		HLPA, RP, WDNR	?	?	?	?	?
3	Residual Testing	x		HLPA, RP, WDNR	?	?	?	?	?
	a) Not required, but highly recommended if management exceeds 10 acres or 10% of the littoral zone								
4	EWM Weevil Survey	x		HLPA, RP, UW-Ex, CLMN	?	?	?	?	?
	c) Only if EWM exceeds 10 acres or 10% of the littoral zone								
3. AIS Education, Planning, and Prevention									
1	Watercraft inspection at the public access (inc. participation in 4th of July Landing Blitz)	x		HLPA, CLMN, CO, UW-Ex	x	x	x	x	x
2	In-lake and shoreline aquatic invasive species monitoring	x		HLPA, CLMN, RP	x	x	x	x	x
3	Education events	x		HLPA, RP, UW-Ex	x	x	x	x	x
4	Distribution of information and education materials	x		HLPA, RP, UW-Ex	x	x	x	x	x
4. Wildlife Appreciation									
1	Provide education opportunities and information on wildlife and wildlife monitoring programs	x		HLPA, RP, CBE, SOEI	x	x	x	x	x
2	Particpation in wildlife monitoring programs like Loonwatch	x		HLPA, Riparians	x	x	x	x	x
5. Lake Community Understanding									
1	Sshoreland Restoration and Habitat Improvement	x	x	HLPA, CO, RP, WDNR, UW-Ex	x	x	x	?	?
2	Riparian Owner Best Management Practices	x	x	HLPA, CO, RP, WDNR, UW-Ex	x	x	x	x	x
3	Water Quality Monitoring	x	x	HLPA, RP, CLMN, WDNR	x	x	x	x	x
4	Precipitation and Lake Level Monitoring	x	x	HLPA, RP	x	x	x	x	x
6. Aquatic Plant Management Plan Maintenance									
1	Successful reporting and data sharing	x		HLPA, RP	x	x	x	x	x
2	Annual reports (summary of events/activities, suggested strategy revisions, future management plans)	x		HLPA, RP	x	x	x	x	x
3	Whole-lake point intercept aquatic plant survey	x		RP, HLPA, WDNR	x	x	x	x	x
4	End of project report (review successes/failures, revise APM plan)	x		HLPA, RP	x	x	x	x	x

Implementers: HLPA, Horseshoe Lake Property Association; RP, resource professionals/consultant; CO, Washburn County AIS Coordinator/LWCD; GLIFWC, Great Lakes Indian Fish & Wildlife Commission; Riparian, property owner or appointee; UW-Ex, UW-Extension, WDNR, Wis. Department of Natural Resources; CLMN, Citizen Lake Monitoring Network program; CBM, Wis. Citizen-based Monitoring Network; SOEI, Sigurd Olson Env. Institute;

Note: Implementer list is not exhaustive and may change

Appendix F

AIS Rapid Response Plan

EWM Rapid Response Plan for Horseshoe Lake, Washburn County, Wisconsin

Monitoring

Continuous monitoring of the lake and the public access points for the presence of AIS will be completed by trained Horseshoe Lake Property Association (HLPA) volunteers, Citizen Lake Monitoring Network (CLMN) volunteers, watercraft inspectors, and others. HLPA volunteers will patrol the shorelines of Horseshoe Lake at least three times annually from May through October. In-lake inspection at all boat access sites will be completed at least once a month from May through October by HLPA, CLMN, and other lake volunteers. Volunteers completing any monitoring will collect suspicious plants and document where they were found. Suspicious plants will be submitted to designated HLPA personnel, this consultant, Washburn County AIS representatives, or the WDNR for vouchering.

Specimen Vouchering

Volunteers are asked to collect at least two samples of the suspicious plant including roots if possible and place them in a zip-lock bag marked with the date, time, and location in the lake where it was found. The samples should be kept refrigerated until they can be submitted to one of the following appropriate personnel:

Horseshoe Lake Property Association	
Edward Wink	612-239-8722
SEH	
Dave Blumer, Lake Scientist	715.861.4925
Jake Macholl, Lake Scientist	715.861.1944
Washburn County Soil and Water Conservation Department	
Lisa Burns, County AIS Coordinator	715.468.4654
Wisconsin Department of Natural Resources	
Craig Roesler, Water Resources Biologist - Spooner	715.637.4076
Kris Larsen, AIS Specialist - Spooner	715.635.4072
Pamela Toshner, Lakes Coordinator - Spooner	715.635.4073
Mark Sundeen, Aquatic Plant Management Permits - Spooner	715.635.4074

Positive Identification

If an AIS is positively identified in Horseshoe, the WDNR and HLPA volunteers will install AIS warning signs at all private and public access points.

APM Plan Modification

If new AIS are identified in the lake, the existing aquatic plant management plan will need to be modified to include the treatment of that AIS. An evaluation will be completed to determine and implement the most effective short-term management option. If necessary, a WDNR AIS Early Detection and Response grant will be applied for to help implement recommendations made in the modified plan.

AIS Activity Funding

The HLPA collects annual dues from its members. If these monies are not enough to cover the cost of an AIS treatment program, the HLPA will seek donations from its constituency and benefactors, undertake fundraisers and apply for an AIS Rapid Response and Early Detection grant if appropriate to obtain funds. AIS Rapid Response and Early Detection grants can be applied for at any time as they are not subject to pre-determined application dates. Up to $20,000.00 is available for management implementation and planning activities.

Table 1. Volunteer Monitoring Timetable. Life stages of some invasive plant and animal species and the best times of the open water season to monitor for them.

	April	May	June	July	August	September
Eurasian watermilfoil						
Sprout						
Growth						
Bloom						
Die Back						
Curly-leaf pondweed						
Sprout	→					
Growth	→					
Bloom						
Die Back						
Purple Loosestrife						
Sprout						
Growth						
Bloom						
Die Back						
Zebra mussel						
Rusty crayfish						
Spiny water flea						

Source: Scholl, C., 2006. Aquatic Invasive Species: A Guide for Proactive and Reactive Management. Wisconsin Department of Natural Resources Project No. ASPL-001-04. Available at: http://dnr.wi.gov/Aid/documents/AIS/AISguide06.pdf (last accessed 2012-06-12).