**AQUATIC PLANT MANAGEMENT PLAN**

**LEGEND LAKE**
**MENOMINEE COUNTY, WISCONSIN**

July 27, 2005

Prepared for:

Legend Lake Protection and Rehabilitation District
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DNR AIS Grant # ALPL-014-04
Project Number: LLD 08-5500-0675



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## 1.0 EXECUTIVE SUMMARY

Legend Lake, located in southern Menominee County has historically been perceived as a lake with good water quality, but abundant aquatic macrophytes. Water quality data collected in the early 1990s indicate a mesotrophic lake system. Nutrients from both within the lake and from land uses within the watershed e.g. shoreline residences) are likely contributing nutrients to the lake which can enhance aquatic plant growth.

During the July 2004 aquatic plant survey, twenty seven aquatic plant species were found, an indicator of a healthy, diverse aquatic plant community. The two most abundant aquatic plant species found were *Myriophyllum sibiricum* (Northern watermilfoil) and *Potamogeton richardsonii* (Clasping-leaf Pondweed). *Myriophyllum spicatum* (Eurasian watermilfoil/EWM) was not the most abundant aquatic plant found on Legend Lake, it was found on over 150 acres of Legend Lake in 2004. An early summer 2005 screening found EWM on over 250 acres of Legend Lake. EWM has aggressive growth habits and spreads by fragmentation, therefore EWM distribution and density will likely increase on Legend Lake. Left uncheck, EWM poses a threat to the diverse aquatic plant community and recreation on Legend Lake. Many areas of Legend Lake have dense aquatic plant growth of both EWM and other native plants, which causes navigation problems for watercraft. Dense aquatic plants tangle boat props and the riparian landowners report problems getting their boats from their piers to open water areas. As such, the District operates an aquatic plant harvesting program. New Wisconsin Aquatic Plant Management laws require a full evaluation of physical, biological, and chemical management techniques and development of an Aquatic Plant Management (APM) Plan prior to issuance of plant management permits. Northern Environmental evaluated available management techniques and developed this APM Plan. The APM Plan was developed with input from the Legend Lake P&R District, WDNR, and Menominee Tribal Environmental Department input. The APM Plan includes the following components:

Manual Removal: Shoreline Landowners are allowed to hand rake or hand pull nuisance aquatic plants for pier or swim raft access to 30 foot maximum width. Care should be taken to removal all plant fragments.

Harvesting: The District will be allowed to continue mechanical harvesting for navigation purposes subject to depth and area restrictions using District-owned harvesting equipment under an approved WDNR harvesting permit.

Selective Herbicide Treatment: The District will use a Tribe approved aquatic herbicide to treat dense areas of EWM. Approved herbicides have demonstrated selective control of EWM, and low to no impacts to important native aquatic plants. All chemical treatments on Legend Lake are specifically designed to treat EWM. No nuisance levels of native plants are treated chemically.

Pubic education about aquatic invasive species such as EWM is an important component of the APM Plan. Other components include a watercraft inspection program, on-going nutrient control efforts (phosphorus ban), routine AIS monitoring, periodic monitoring of lake wide aquatic plant communities and the public, and active seeking of funding sources for EWM treatments.

## 2.0 INTRODUCTION

Legend Lake is located in the town of Menominee located in southern Menominee County, Wisconsin and is within Menominee Indian Tribe of Wisconsin (the Tribe) tribal lands. Figure 1 depicts the lake location [United States Geological Survey (USGS) 1982].

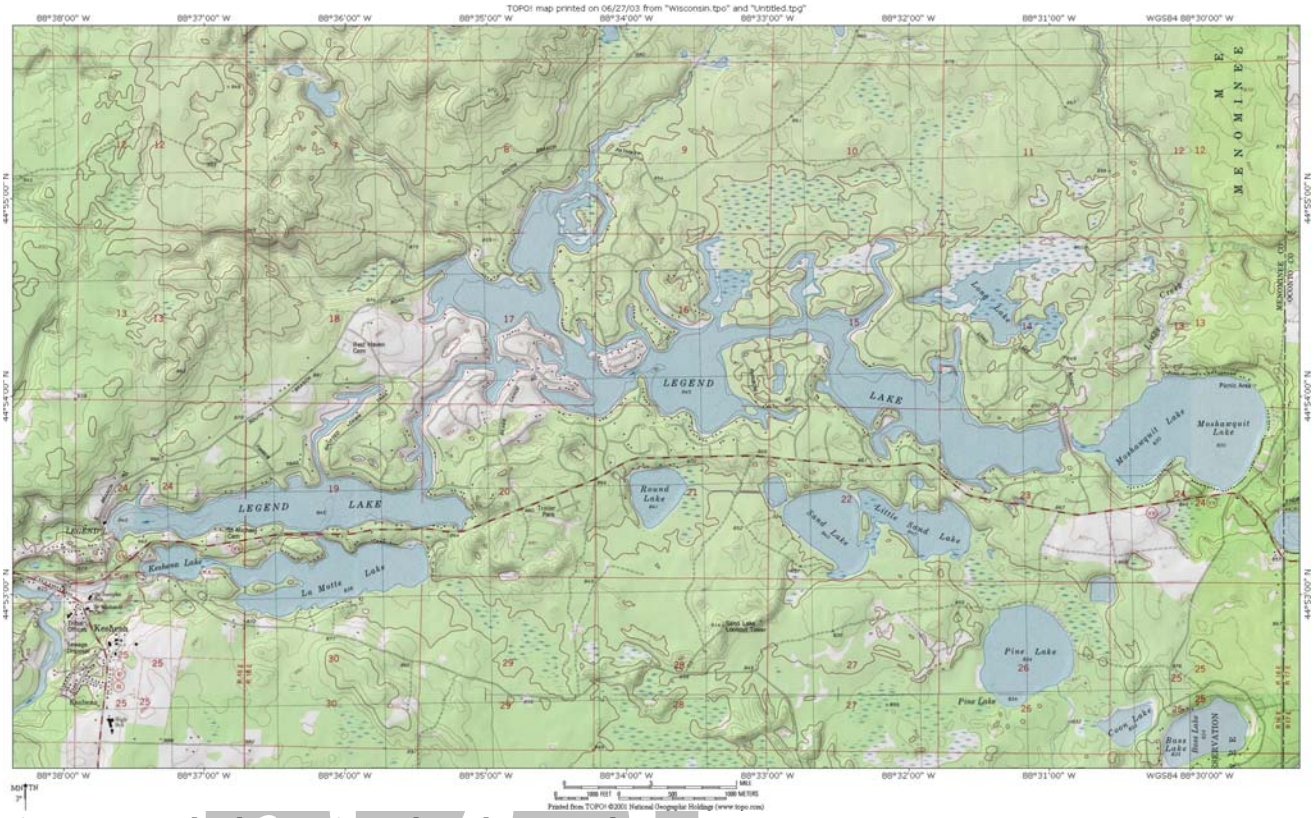



**Figure 1: Legend Lake Location and Local Topography**



Legend Lake properties within the boundaries of the Legend Lake Protection and Rehabilitation District (the District) comprise less than one percent of the land in Menominee County, however provides a majority of tax revenues for Menominee County. The county is dependant on the value of Legend Lake Properties. Historically, properties in channels that did not have access to the main lake due to excessive aquatic plant growth exhibited extremely low property values.

While the aquatic plants on the lake provide important habitat for fish and wildlife, dense aquatic plant growth on Legend Lake has historically interfered with recreation on the lake (e.g. boat navigation). In response to the lake users concerns, the District has operated an aquatic plant harvesting program. The recent (fall 2002) discovery of Eurasian Watermilfoil (EWM) in Legend Lake prompted the District to take a more detailed look at the aquatic plant communities in the Lake. Recent changes in Wisconsin's aquatic plant management laws and the subsequent Wisconsin Department of Natural Resources' (WDNR) administration of their aquatic plant management programs (NR 109 Wis. Adm. Code) also required that the District develop an Aquatic Plant Management Plan (APM Plan).

This APM Plan was designed to meet the needs of the District, the Tribe, and WDNR APM program basics, specifically applying for permits under Chapter NR 107 Wisconsin Administrative Code (NR107

Wis. Adm. Code) and NR109 Wis. Adm. Code for chemical treatment and aquatic plant harvesting, respectively. As described in the amended lake management planning grant application (Northern Environmental 2003), the APM Plan was developed in accordance with the *Recommended Components for Aquatic Plant Management Plans funded by Wisconsin's Lake Planning Grants* (WDNR 2003). This project was initiated prior to issuance of the WDNR draft Guidance on APM Plans, however, this APM Plan includes the main components of the guidance document. This APM Plan summarizes the lake morphology and lake watershed characteristics; reviews historical aquatic plant management activities; discusses the District's, the Tribe's, and lake user's goals and objectives; presents the aquatic plant ecology; presents results of the recent 2004 aquatic plant survey; evaluates feasible aquatic plant management alternatives; and provides a selected suite of aquatic plant management options in a comprehensive and integrated APM Plan.

## 2.1 Lake History and Morphology

A diagnostic feasibility study report for several limnology studies on Legend Lake was completed in 1995. This technical document (Shaw et. al., 1995) summarizes several sub-studies on the lake's history, morphology, aquatic macrophytes, chemical, and physical characteristics completed by graduate students and tribal environmental staff.

Legend Lake is a 1,230-acre impoundment developed in the 1960s by dredging and damming eight natural lake systems. The lake development was to provide sale of recreational property to the public. One outlet dam on the east end and another on the west end maintain current water levels. Figure 2 illustrates the former lake basins and present day Legend Lake.

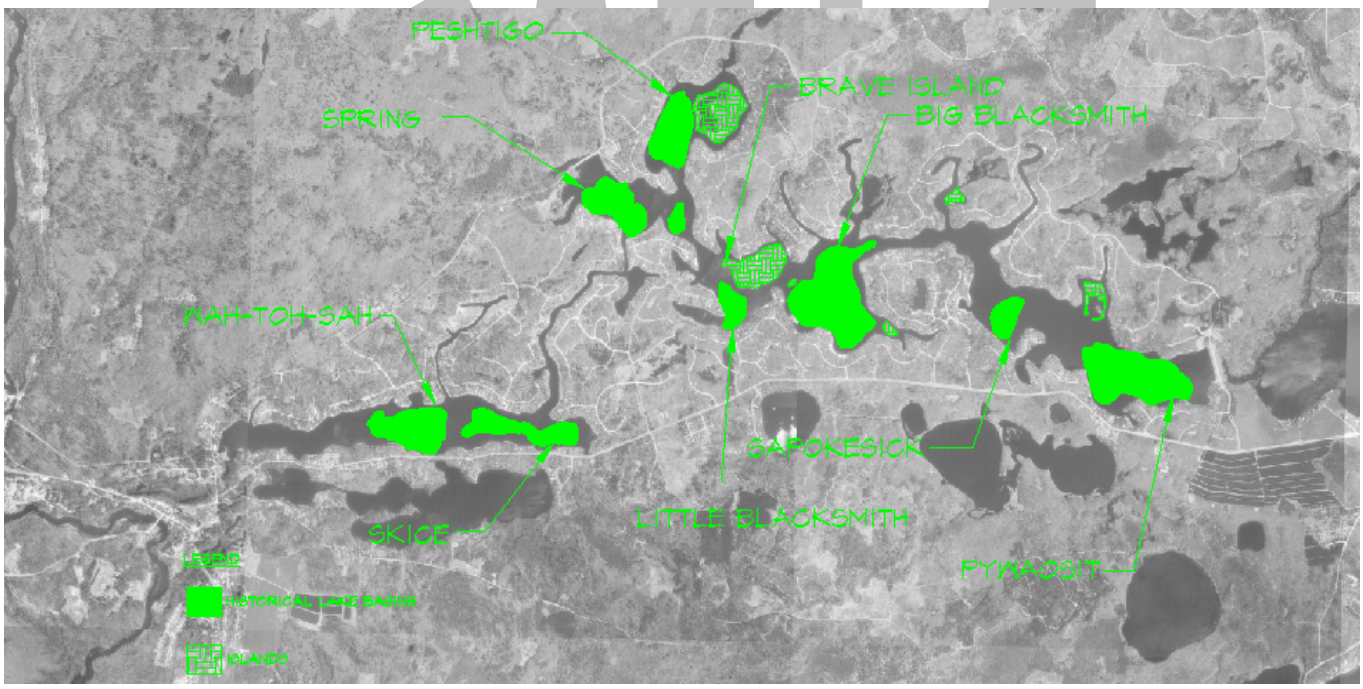



**Figure 2: Historic Lake Basins**

When Legend Lake was formed, wetland areas were flooded to connect the main lake basins. Table 1 lists each main basin's key physical characteristics after the construction of Legend Lake.

| | Mean Depth (ft) | Area (acres) | Max Depth (ft) | Volume (ac-ft) | % Littoral Area |
|---|---|---|---|---|---|
| Wah-to-sah | 10.2 | 311 | 40.0 | 3185 | 84 |
| Skice | 11.5 | (A) | 29.9 | (A) | 77 |
| Spring | 8.3 | 118 | 40.0 | 988 | 87 |
| Peshtigo | 7.8 | 96 | 40.0 | 749 | 87 |
| Little Blacksmith | 6.4 | 94 | 15.1 | 602 | 99 |
| Big Blacksmith | 13.6 | 228 | 72.0 | 3108 | 79 |
| Sapokesick | 7.0 | 180 | 35.1 | 1252 | 95 |
| Pywaosit | 16.3 | 212 | 69.9 | 3446 | 67 |

**Table 1: Lake Basin Physical Characteristics (adopted from Shaw et. al., 1995)**

Figure 3a – 3c (end of text) illustrates the present day Legend Lake bathymetry. Many of the flooded wetland areas contained highly organic sediments. Floating bogs were reportedly sunk when the lake was flooded. The sunken materials were covered with sand in some areas. Dense aquatic plants soon emerged from areas with rich sediments that were covered with sand. Bogs have also floated and sank again. The rich nutrient content of the bottom sediments is likely contributing to dense aquatic macrophyte growth on Legend Lake.

## 2.2 Aquatic Plant Management History

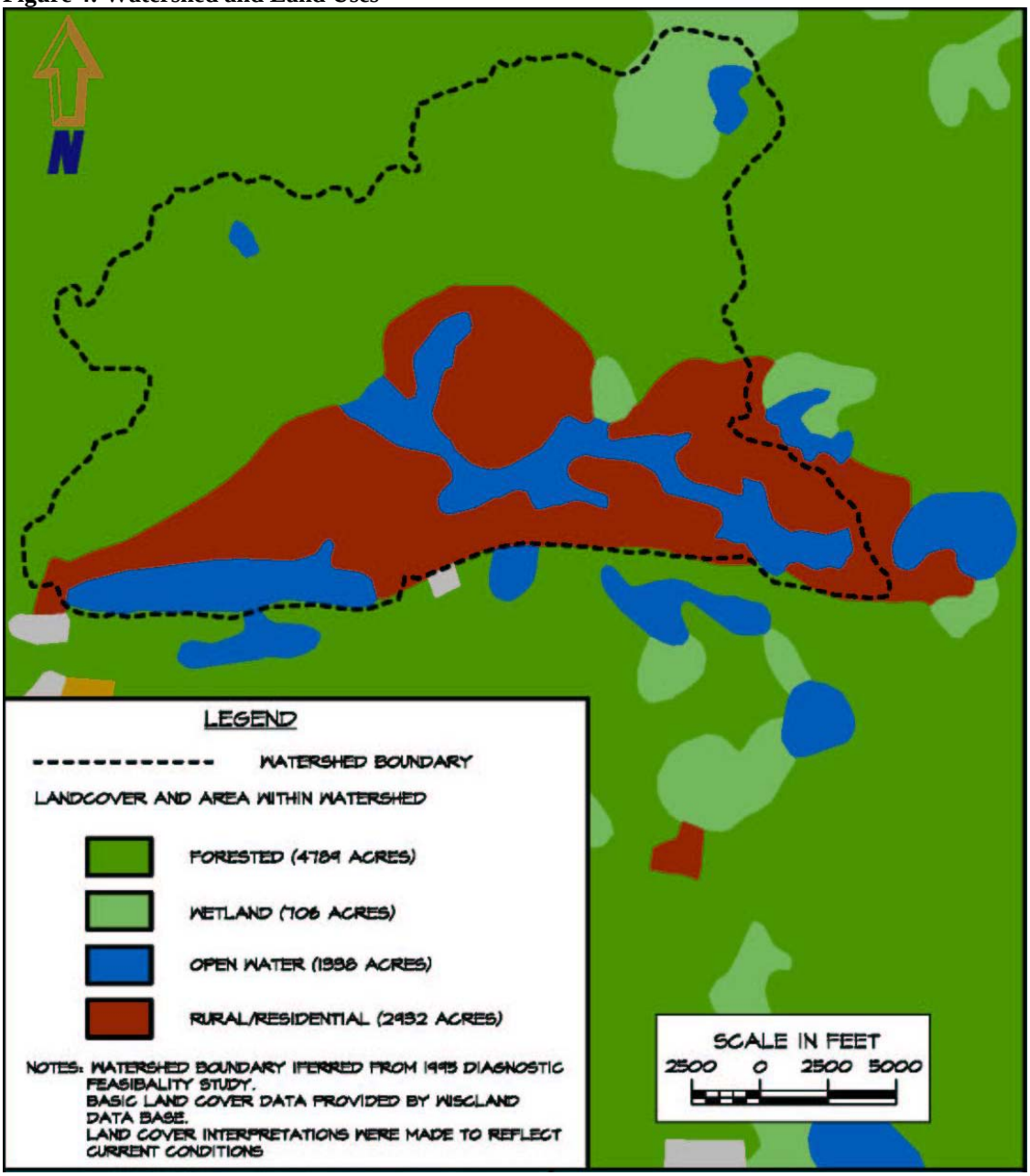
Historical problems during early residential development of Legend Lake include large aquatic macrophyte beds (Shaw et. al., 1995). The Legend Lake Property Owners Association formed in 1973. One of the Association's responsibilities was to manage the excessive aquatic plant growth on Legend Lake. Mechanical harvesting began because the dense growth of aquatic plants made recreational boating in shallow areas of the lake and channels nearly impossible. Aquatic herbicides were used to control floating leaved and submergent aquatic macrophytes, and algae. The chemical treatments were stopped about 30 years ago and mechanical harvesting was begun. Two aquatic plant harvesters were purchased and operated during the summer months to manage the excessive aquatic macrophytes. Boating and personal watercraft use reportedly tear loose aquatic plants creating floating mats, the harvesters collect the mats that may pose safety concerns for boaters, specially skiers and tubers.

Harvesting remained to be the only method of aquatic plant management on Legend Lake until 2004. In late 2002 Eurasian Watermilfoil (EWM), an exotic species was found on Legend Lake. A subsequent survey identified EWM on over 150 acres of Legend Lake (Northern Environmental, 2003). The District contracted the chemical treatment of EWM on approximately 50 acres of dense EWM growth in 2004. Navigate® [active ingredient 2,4-Dichlorophenoxyacetic acid (2,4-D)] was applied to provide nuisance relief from EWM in 2004, in conjunction with the harvesting operations.

## 2.3 Watershed Overview

The Legend Lake Watershed is approximately 10,000 acres (Figure 4). The watershed lies in a region of pitted outwash overlying Precambrian granite (Shaw et al., 1995). Soil types within the watershed are predominately Nimore sands. Localized organic soils are present in topographic depressions (NRCS 1996). Water rapidly infiltrates most of the soils in the watershed. While rain water most likely rapidly infiltrates within the basin, overland flow does occur in areas where soil becomes saturated, when soils become highly compacted, on man made impervious surfaces, and on steeper slopes. Runoff can enter Legend Lake at lake shore properties and three perennial streams that drain the northern area of the watershed. Figure 4 depicts land uses within the watershed.

**Figure 4: Watershed and Land Uses**



Nutrients from runoff within the watershed may contribute to excessive aquatic plant growth on Legend Lake. Potential nutrient loadings to Legend Lake may be occurring from all of the above land uses, however the scientific literature suggest that the residential land uses probably contribute the majority of nutrients to Legend Lake.

## 2.4 Water Quality

Water quality data collected in the early 1990s collectively indicate a mesotrophic lake system. Legend Lake's water budget is complex, but the majority of the lake's water comes from precipitation/runoff and surface water (stream) inlets. Unpublished data from a 1991 limnological survey completed by the University of Wisconsin Stevens Point and the Menominee Tribal staff indicated that premature eutrophication was occurring on Legend Lake. These observations prompted the completion of several lake studies in 1993 – 1995 (Shaw et.al., 1995). Key conclusions drawn from these earlier studies related to aquatic plant management on Legend Lake include the following.

- The eastern lake basins exhibited lower concentrations of nutrients, algae and aquatic plants.
- Most of the north shore had groundwater flow toward the lake, most of the south shore had groundwater flow away from the lake.
- The biomass of aquatic plants was found to be greater at groundwater inflow sites than at groundwater outflow sites.
- Oxygen depletion is frequently seen during winter in several lake basins and in the lower depth of most basins during the summer.
- While the overall direct impact of septic effluent on nutrient inflow was less than expected, it can be expected to increase as more lots are developed and septic system's age.
- Lake shore human activity, including septic systems and lawn fertilizers are probably contributing nutrients to the lake.
- Aquatic plants were present in fairly high abundance in some area, diversity was good, and no major problem species were noted.

Approximately one third of the potential (2,800) properties in the housing development were sold at the time of the 1993-1995 studies. A survey of residents owning property near Legend Lake indicated that:

- The predominant recreational activities were boating, swimming, and fishing.
- Sixty one of the respondents rated the water quality as excellent or very good.
- The top three water quality problem identified was "weeds".
- The factors listed as the top reasons for a decline in water quality were heavy recreation, development pressure, septic tanks, soil erosion, and fertilizers.

Management recommendations were listed in the 1995 study and included:

- Continue harvesting for transportation corridors, aesthetics, and oxygen benefit, but develop a plant management plan to balance recreational interests and impacts to the aquatic ecosystem.
- Minimize the use of fertilizers on lake shore property. Consider requiring a soil test for phosphorus and establishing a minimum application distance from the lake.
- Minimize the use of phosphate containing detergents.
- Maximize setback distances from the lake for new or replacement drainfields, especially in the north shore area. Suggested setbacks of 200 – 250 feet were recommended.
- Consider requiring new septic systems incorporate nitrogen and phosphorus removal. Consider establishment of a sanitary district in areas of groundwater inflow (north shore). Investigate the feasibility of cluster type treatment systems for groups of homes.

Since 1995, EWM was discovered (fall 2003) and other aquatic plants have been perceived to be more of a nuisance. The District and the Tribe have prepared the APM Plan to address the concerns with nuisance aquatic plants and protect the aquatic habitat that the native plants provide.

### 2.5 Goals and Objectives

The District established goals in their grant application to set long-term management goals for nuisance aquatic vegetation and to protect native plant communities and sensitive areas. Specific components of the District's and Tribe's long-term goals included:

- Prevent the spread of EWM and other exotics
- Continue to manage for boat navigation
- Protect Sensitive areas and diverse aquatic plant communities
- Educate the public on value of native plants and problems with exotic plants
- Protect other recreation opportunities
- Develop APM Plan that is easy to use, meets applicable APM permit requirements, satisfies Tribal concerns, and can be used to obtain long-term aquatic plant management permits.

## 3.0 PROJECT METHODS

The goal of this study is to collect and interpret basic data and produce recommendations allowing the District and Tribe to make better-educated decisions regarding APM options. The study includes an existing background information review on the lake's watershed and water quality, an aquatic plant survey, and an evaluation of aquatic plant management alternatives.

### 3.1 Existing Data Review

A variety of resources were consulted to obtain the best understanding of Legend Lake's ecology possible. Information reviewed included:

- Local and regional pedologic, geologic, limnologic, hydrologic, and hydrogeologic research
- Discussions with District members

- Available topographic maps and aerial photographs
- Menominee County Land Information or Geographic Information System (GIS) data
- Data from WDNR files
- Data from Tribal files

These sources are instrumental to understanding the past, current, and potential future conditions of the lake and to ensure that study efforts are not duplicated. Specific references are listed in Section 7.0 of this report.

## 3.2 Aquatic Plant Survey

One aquatic plant survey was completed in July 2004. The aquatic plant survey method used was a point intercept sampling method (Madsen, 1999) completed in general accordance with the DRAFT DNR guidance on APM in Wisconsin. A base map was developed with 438 sampling points established on a 100 meter grid (Figure 5). Sample point coordinates are included in Table 2.
To evaluate the existing emergent, submergent, floating-leaf, and free-floating aquatic plant community, Northern Environmental staff inventoried aquatic plants during July 2004.

Latitude and longitude coordinates and sample id's were assigned to each point on the meter grid. Figure 5 illustrates aquatic plant survey sample locations. A Trimble GeoXT™ global positioning system (GPS) was used to navigate to each sample point. An aquatic rake was typically used in areas where the bottom could not be clearly observed and/or plant density could not be visually estimated. In such cases, the rake was allowed to settle and slowly retrieved. Observations regarding substrate type were recorded along with water depth in feet. At each sample point, the species encountered were identified and recorded. If a specimen could not be identified to the species level, it was referred to by the generic name followed by "sp."

Aquatic plants were sampled using the point-intercept method. The point intercept method used is readily adapted to "whole-lake" or large plot assessments as compared to the transect method that is best used in evaluating study plots or selected areas to evaluate aquatic macrophyte communities.

The objective of the point intercept method is to make measurements at regularly spaced, pre-selected or defined locations and to avoid selecting locations in the field subjectively. At each point, a value of "1" was assigned if species were present and a "0" was assigned if a species was absent. If aquatic invasive species were encountered at a point, a general density rating was also established according to the following:

| Rake Recovery | General Density Rating |
|---|---|
| 0-33 percent of rake teeth filled | 1 |
| 33-66 percent of rake teeth filled | 2 |
| 66-100 percent of rake teeth filled | 3 |

For each sample point and plant species detected during the survey, the following statistics were calculated:

- Frequency of occurrence (the number of sample areas where a particular species was detected divided by the total number of sample areas)
- Relative frequency of occurrence (the number of sample areas where a particular species was detected divided by the number where any species was detected)
- Species mean density for aquatic invasive plant species only (the sum of all density ratings for a particular species divided by the number of sample points where it was detected)

# 4.0 AQUATIC PLANTS

Aquatic plants are vital to the health of a water body. Unfortunately, much too often, people refer to all rooted aquatic plants as weeds and their ultimate goal is to eradicate them. This thought process must be avoided when trying to manage an entire lake ecosystem. Rooted macrophytes are extremely important for the well being of the lake community and posses many positive attributes. These attributes are what make the littoral zone the most important and productive aquatic habitat in freshwater lakes. However, aquatic macrophytes can become a nuisance when exotics plant species occupy large portions of a lake. Excessive aquatic plant growth can negatively affect recreational activities. When "managing" aquatic plants, it is important to maintain a well-balanced, stable, and diverse aquatic plant community that contain high percentages of desirable native vegetation. To be effective, aquatic plant management in most lakes must maintain a plant community that is:

- Stable
- Species rich
- Diverse
- Mostly native

The increased plant productivity of the Lake in recent years has reduced its aesthetic beauty and recreational value. In particular, the dense beds of Eurasian watermilfoil (*Myriophyllum spicatum*) in the Lake:

- Make swimming, water skiing, recreational activities less enjoyable
- Inhibit fish predation on aquatic snails that cause "swimmers itch"
- Inhibit fish predation causing stunted fish populations
- Generate excess organic detritus that causes anoxia, hypoxia, and fish kills

## 4.1 The Ecological Role of Aquatic Plants

Aquatic plants can be divided into two major groups: microphytes (phytoplankton and epiphytes) composed mostly of single-celled algae, and macrophytes that include macroalgae, flowering vascular plants, and aquatic mosses and ferns. Wide varieties of microphytes co-inhabit all hospitable areas of a lake. Their abundance depends solely on light, nutrient availability, and other environmental factors. In contrast, macrophytes are predominantly found in distinct habitats in the littoral (shallow near shore) zone where sufficient light can penetrate to the lake bottom. The littoral zone is subdivided into four distinct transitional zones: the eulittoral, upper littoral, middle littoral, and lower littoral (Wetzel, 1983).

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

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

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

**Lower Littoral Zone:** Extends to a depth equivalent to the limit of the photic zone, which is defined as percent of surface light intensity.

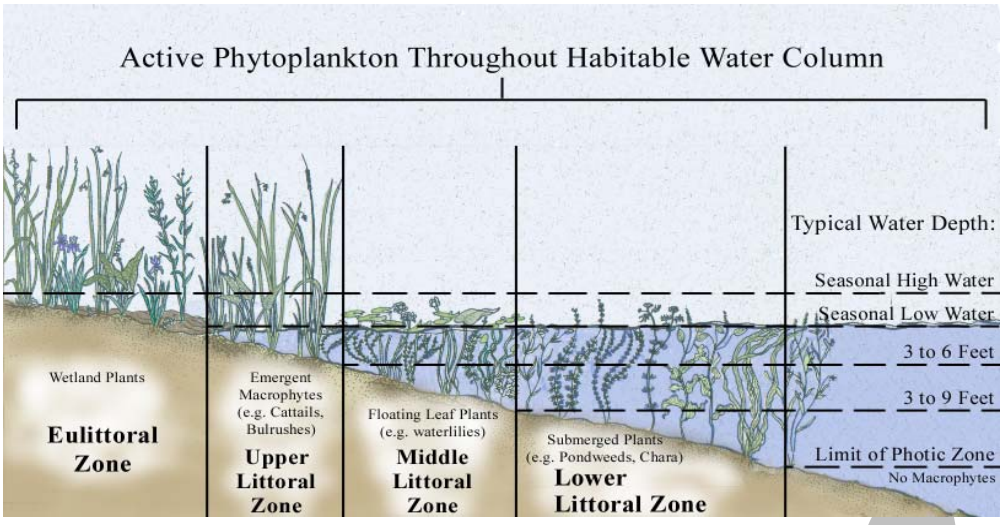



**Figure 6: Aquatic Plant Communities Schematic**

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

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

In general, an inverse relationship exists between water clarity and macrophyte growth. That is, water clarity is usually improved with increasing abundance of aquatic macrophytes. Two possible explanations are postulated. The first is that the macrophytes and epiphytes out-compete phytoplankton for available nutrients. Epiphytes derive essentially all of their nutrient needs from the water column. The other explanation is that aquatic macrophytes stabilize bottom sediment and limit water circulation, preventing resuspension of solids and nutrients (NALMS, 1997).

If aquatic macrophytes are reduced in abundance, water clarity can suffer. Water clarity reductions can further reduce the vigor of macrophytes by restricting light penetration, reducing the size of the littoral zone, and further reducing water clarity. Studies have shown that if 30 percent or less of the area of a lake occupied by aquatic plants is controlled, water clarity will generally not be affected. However, lake water clarity will likely be reduced if 50 percent or more of the macrophytes are controlled (NALMS, 1997).

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

## 4.2 Aquatic Plant Survey

### 4.2.1 2004 Aquatic Plant Survey

Aquatic macrophytes on Legend Lake were surveyed during July 2004. The 2004 aquatic plant survey sample point locations are illustrated in Figure 5. Information gathered during the survey concluded that Legend Lake has moderate species diversity and a low amount of biomass. Twenty seven species of free-floating, floating leaved, emergent, and submerged aquatic vascular plants were identified during the survey and two algal species were identified during the survey. Aquatic macrophyte species identified during 2004 are summarized in Table 3. July distribution of aquatic plant species are illustrated in Figures 7a through 7h, respectively.

During the July survey, the most abundant species found was *Myriophyllum sibiricum* (Northern watermilfoil) with a 49 percent frequency of occurrence (percent of sample points containing that species) (Table 4). *Myriophyllum sibiricum* (Northern watermilfoil) had a 12 percent relative frequency (the frequency of occurrence compared to the occurrence of all species). *Potamogeton richardsonii* (Clasping-leaf Pondweed) was the second most abundant species in July with a 48 percent frequency of occurrence. Clasping-leaf Pondweed had a 12 percent relative frequency. *Chara, sp.* (Muskgrass / Chara) was the third most abundant species in July with a 36 percent frequency of occurrence and a 10 percent relative frequency. Survey data including frequency of occurrence, relative frequency and Simpson's Diversity Index for each species is summarized in Appendix A.

The littoral zone, the depth to which light penetrates permitting photosynthesis and colonization of aquatic macrophytes for Legend Lake is between zero and eighteen feet. Even though the littoral zone can fluctuate based on water quality and the amount of turbidity in the water, historically the photic zone has been around 18 feet. Certain areas of the littoral zone may be more conducive to supporting certain species of aquatic plants. Legend Lake has many areas of semisoft sediments that are able to support higher numbers of aquatic macrophyte populations due to rich sediment mineral content. Aquatic plant distribution is summarized on Table 3. Distribution of all aquatic plant species is illustrated in Figure 7a through 7g.

#### 4.2.1.1 Free-Floating Plants

No free-floating aquatic plant species were identified during the 2004 aquatic plant survey.

#### 4.2.1.2 Floating-Leaf Plants

The submerged aquatic plant species identified during the 2004 aquatic plant survey are listed in Table 3. A brief description of these plant species follows.

*Brasenia schreberi* (Watershield) has floating leaves with elastic stems with the leaf stalk attaching to the middle of the leaves. All submersed portions of the plant are usually covered with a gelatinous coating. Watershield is commonly identified by the lack of a leaf notch and the central location of the petiole. Watershield is most commonly found growing in soft sediments that contain partially decomposed organic matter. The seeds, leaves, stems and buds are a source of food by waterfowl. The floating leaves also offer shelter and shade for fish and

Watershield
Source: University of Florida Website

invertebrates (Borman, et al., 1997). Watersheild is a sensitive aquatic plant this is not tolerant of pollutants and adverse human impacts to the lake ecosystem (Nichols, 1999).

Yellow Pond Lily
Source: University of Florida Website

*Nuphar advena* (Yellow Pond Lily), shows a preference for soft sediment and water that is 6 feet or less in depth. Floating leaves emerge in early summer from rhizomes that are actively growing in the soft sediments. Flowering occurs throughout the summer and supports a yellow flower. Floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

*Nuphar variegata* (Spatterdock)

Spatterdock
Source: University of Florida Website

*Nuphar variegata* (Spatterdock), shows a preference for soft sediment and water that is 6 feet or less in depth. Floating leaves emerge in early summer from rhizomes that are actively growing in the soft sediments. Flowering occurs throughout the summer and supports a yellow flower. Floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

*Nymphaea odorata* (White Water Lily)

White Water Lily
Source: University of Florida Website

*Nymphaea odorata* (White Water Lily) have a flexible stalk with a round floating leaf. Most of the leaves float on the waters surface. White Water Lily is found growing in a variety of sediment types in waters less than 6 feet deep. Floating leaves emerge in early summer from rhizomes that are growing in the soft sediments. Flowering occurs throughout the summer and supports a white flower. The floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

4.2.1.3 Submergent Plants

The submerged aquatic plant species identified during the 2004 aquatic plant surveys are listed in Table 2. Distribution is illustrated in Figure 7a through 7g. A brief description of these plant species follows.

*Bidens beckii* (Watermarigold)

*Bidens beckii* (Watermarigold) is a submergent aquatic plant. Stems from the watermarigold emerge from a buried rootstalk and submersed leaves are finely cut into many thread-like divisions. Often only the underwater portion of the plant is present. Water marigold is usually found growing in soft sediment in clear water lakes. It will grow from ankle-deep water up to almost 10 feet deep (Borman, et al., 1997).

*Ceratophyllum demersum* (Coontail)

Coontail (*Ceratophyllum demersum*) is a submergent aquatic plant. Unlike most other submergent aquatic plants, coontail is not rooted and can drift, making it tolerant to higher water levels. Because it does not have roots, it absorbs nutrients dissolved in the lake water. Coontail provides excellent shelter and foraging opportunities for fish and invertebrates, and waterfowl consume its foliage and fruit (Borman, et al., 1997). Coontail is also commonly misidentified and mistaken for *Myriophyllum spicatum* (Eurasian watermilfoil).

Coontail
Source: UW Herbarium Website

*Chara, sp.* (Muskgrass / Chara)

Chara sp.
Source: University of Florida Website

Although *Chara, sp.* (Muskgrass / Chara) looks like a vascular flowing plant, it actually is a multi-celled algae. Muskgrass is usually found in hard waters and prefers muddy or sandy substrate and can often be found in deeper water than other plants. Waterfowl eat muskgrass spores. Muskgrass beds provide valuable habitat for small fish and invertebrates. Muskgrass is also a favorite waterfowl food and extremely valuable fish habitat. The rhizoids slow the movement and suspension of sediments and benefit water quality in the ability to stabilize the lake bottom (Borman, et al., 1997). Chara has a characteristic "musky" odor.

*Elodea canadensis* (Elodea)

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

Elodea

*Myriophyllum sibiricum* (Northern watermilfoil)

*Myriophyllum sibiricum* (Northern watermilfoil) has light colored stems that emerge from rootstalks and rhizomes. Stems are sparingly branched and fairly erect in water. Leaves are divided like a feather, with 5-12 pairs of thread-like leaflets. Leaves are arranged in whorls. Waterfowl eat the foliage and fruit of northern watermilfoil, while beds of this plant provide cover and foraging opportunities for fish and invertebrates. Northern watermilfoil is usually found growing in soft sediment in fairly clear-water lakes and can grow in depths over 12 feet deep.

Northern watermilfoil
Source: UW Herbarium Website

*Myrionphyllum spicatum* (Eurasian watermilfoil-EWM)


Eurasian watermilfoil
Source: UW Herbarium Website

Eurasian watermilfoil (EWM) is a submersed aquatic plant native to Europe, Asia and northern Africa. It was introduced to the United States by early European settlers. Eurasian watermilfoil has proliferated in waterways across North America. Eurasian watermilfoil was first detected in Wisconsin lakes during the 1960's. In the past three decades, this exotic species has significantly expanded its range to about 61 of Wisconsin's 72 counties. The range of Eurasian watermilfoil continues to expand in Wisconsin from 1994 to 2001 (DNR, 2004). Because of its potential for explosive growth and its incredible ability to regenerate, Eurasian watermilfoil can successfully out-compete most native aquatic plants, especially in disturbed areas.

Eurasian watermilfoil shows no substrate preference, and can grow in water depths greater than 4 meters (Nichols, 1999). Eurasian watermilfoil does not rely on seed for re-production; its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried down or up the Lake by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist. Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the substrate).

As an opportunistic species, Eurasian watermilfoil is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the available light from the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian watermilfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways. For example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl (DNR 2002).

*Najas flexilis* (Slender Naiad)

*Najas flexilis* (Slender Naiad) also known as bushy pondweed has fine branched stems that emerge from a slight rootstalk. Leaves are paired, but there are some sometimes bunches of smaller leaves. Slender Naiad grows in very shallow areas but also up to several meters in depth. Waterfowl, marsh birds, and muskrats consume the stems, leaves, and seeds of naiads. The foliage produces forage and shelter opportunities for fish and invertebrates (Borman, et al., 1997).

Slender Naiad
Source: UW Herbarium Website

*Nitella sp.* (Nitella)

Nitella sp.
Source: Washington State Department of Ecology Website

Nitella (*Nitella sp*.) is another type of algae that looks like a vascular plant. This plant has no conductive tissue and has simple anchoring structures called rhizoids rather than true roots. Nitella is similar in appearance to muskgrass and is often found in similar habitats. However, Nitella spp. can be identified from chara or muskgrass by its smooth stems and branches vs. lined and encrusted in Chara . Nitella also appears somewhat transluscent (Borman, et al., 1997).

*Potamogeton amplifolius* (Large-leaf Pondweed) has robust stems that emerge from black-scaled rhizomes. The submersed leaves are the broadest of any species in the pondweed family and are slightly folded. The blade is also lined with many veins (25-37). Floating leaves are oval and on long stalks. . Stipules of both submersed and floating leaves are large and are free. Large-leaf pondweed is most frequently found in soft sediments in water one to several feet deep. It is sensitive to increased turbidity. Large-leaf pondweed is commonly grazed by waterfowl and offers habitat for invertebrates and offers foraging opportunities for fish (Borman, et al., 1997).

Large-leaf Pondweed
Source: UW Herbarium Website

*Potamogeton foliosus (*Leafy Pondweed)

Leafy pondweed *(Pomatogeton foliosus*) has a freely branched stems that emerge from slender rhizomes. This plant is easily identifiable by a stipule that is found wrapped around the stem. However, leafy pondweed can be confused with small pondweed. Leafy pondweed tends to bloom early in the season with a short flower stalk and a tight cluster of flowers. Waterfowl eat the fruits of this early to mature aquatic and can be of local importance. Muskrat, beaver, and deer eat the foliage and fruit. Invertebrates and fish forage hide in the foliage (Borman, et al., 1997).

Leafy Pondweed
Source: UW Herbarium Website

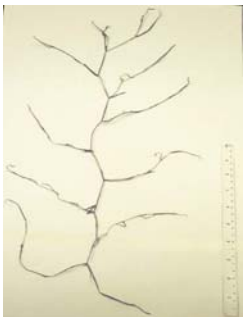
*Potamogeton natans* (Floating-Leaf Pondweed)

Floating-leaf Pondweed
Source: UW Herbarium Website

*Potamogeton natans* (Floating-Leaf Pondweed) has stems that emerge from red-spotted rhizomes. Submersed leaves are stalk-like, with no obvious leaf blade. Floating leaves are heart-shaped at their base. Floating-leaf pondweed is usually found in water less than 5 feet deep. Fruit of floating-leaf pondweed is held on the stalk until late in the growing season.

It provides valuable grazing opportunities for ducks and geese. It may also be consumed by muskrat, beaver and deer. (Borman, et al., 1997).

*Potamogeton pectinatus* (Sago Pondweed)


Sago Pondweed
Source: UW Herbarium Website

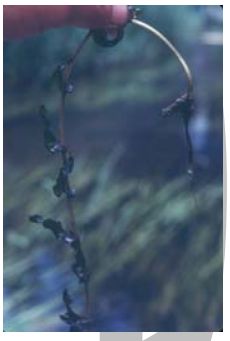
*Potamogeton pectinatus* (Sago Pondweed) resembles two other pondweeds with needle-like leaves, but sago pondweed is much more common. The fruit and tubers of sago pondweed are very important food sources for waterfowl, while leaves and stems provide shelter for small fish and invertebrates (Borman,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

*Potamogeton pusillus* (Small Pondweed)


Small Pondweed
Source: University of Florida Website

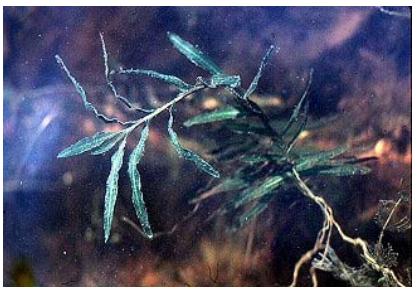
Small pondweed (*Potamogeton pusillus*) has small slender stems and emerge from the slight rhizome and branch repeatedly near the ends. Small pondweed overwinters by rhizomes and winter buds. There is some limited reproduction by seed with leaving fragments overwintering with buds in the sediments. Small pondweed can be locally important as a food source for a variety of wildlife. Waterfowl tend to feed on small pondweed as well as deer, muskrat, and other small fish (Borman, et al., 1997).

*Potamogeton richardsonii* (Clasping Leaf Pondweed)



*Potamogeton richardsonii* (Clasping Leaf Pondweed) is a submergent aquatic plant with sinuous stems that emerge from a spreading rhizome. Oval to somewhat lance-shaped leaves clasp the stem with the heart-shaped base of each leaf covering one-half to three-quarters of the stem circumference. Clasping leaf pondweed can be found growing in a variety of sediment types in water up to 12 feet deep and can tolerate disturbance and is often found growing with *Ceratophyllum demersum* (Coontail) and *Potamogeton pusillus* (Small Pondweed) (Borman, et al., 1997).

*Potamogeton robbinsii* (Fern Pondweed)



*Potamogeton robbinsii* (Fern Pondweed) is a submergent pondweed with robust stems of fern pondweed that emerge from a spreading rhizome. The leaves are strongly two-ranked, creating a feather or fern-like appearance which is most evident when the plant is still in the water. Each leaf is firm and linear, with a base that wraps around the stem. The leaf base is distinctive and has small ear-like lobes at the juncture with the stipule and is fused with the fibrous stipule. The leaves are closely spaced and have a finely serrated margin. Fern pondweed sprouts in the spring and thrive in deeper water. Fern pondweed provides

habitat for invertebrates that are grazed by waterfowl and also offers good cover for fish, particularly northern pike (Borman, et al., 1997).

*Potamogeton zosteriformis* (Flat-Stem Pondweed)

*Potamogeton zosteriformis* (Flat-Stem Pondweed) is a submergent pondweed with freely-branched stems of flat-stem pondweed that emerge from a slight rhizome. The stems are strongly flattened and have a angled appearance. Flat-stem pondweed has a prominent midvein and many fine, parallel veins. Flat stem pondweed is commonly confused with *Zosterella dubia* (water stargrass) by the similar leaf arrangement. However lack of a prominent midvein in water stargrass helps distinguish the two species. Flat-stem pondweed grows in a variety of water depths from shallow to several meters deep and is usually found in soft sediment. Flat-stem pondweed is a locally important food source for a variety of geese and ducks and may also be grazed by muskrat, deer, beaver while providing a food source and cover for fish and invertebrates (Borman, et al., 1997).

*Ranunculus longirostris* (Stiff Water Crowfoot)

*Ranunculus longirostris* (Stiff Water Crowfoot) has long, branched stems with leaves that are finely cut into thread-like divisions and either attach directly to the stem or have a very short leaf stalk. Leaves emerge along the stem in an alternate arrangement and are stiff enough to hold their shape when lifted out of the water. Stiff water crowfoot is found in both lakes and streams with higher alkalinity, usually in less than 6 feet of water. New stems emerge from rhizomes in the spring and flowers come into bloom over several weeks. Both fruit and foliage are consumed by a variety of waterfowl. When it is growing in shallow areas it may also be grazed upon by upland birds. Stems and leaves of water crowfoot provide valuable invertebrate habitat and it is considered a fair producer of food for trout (Borman, et al., 1997).

*Utricularia vulgaris* (Common Bladderwort)

*Utricularia vulgaris* (Common Bladderwort) is a submergent aquatic plant with floating stems that can reach 6-10 feet in length. Along the stem are leaf like branches that are finely divided and are filament-like with no midrib and fork 3-7 times. Scattered on these branches are the bladders that trap prey. Common bladderwort is a carnivorous plant and is free-floating or found in water ranging from a few inches to over 12 feet deep. It is most successful in still water where the bladder traps can function properly and the finely divided stems are not torn by wave action. The trailing stems of common bladderwort provide food and cover for fish. Common bladderwort is able to grow in areas with very loosely consolidated sediment and provides fish habitat in areas that are not readily colonized by rooted plants (Borman, et al., 1997).

*Valinsneria americana (*Wild Celery)


Wild Celery
Source: University of Florida Website

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

4.2.1.3 Emergent Plants

The emergent aquatic plant species identified during the 2004 aquatic plant surveys are listed in Table 3. Distribution of aquatic plants is illustrated in Figures 7a – 7h. A brief description about these plants follows.

*Sagittaria latifolia* (Arrowhead)

*Sagittaria latifolia* (Arrowhead) is a emergent plant the usually produces leaves that are true to its name – shaped like an arrowhead. Leaves emerge in a cluster from tuber tipped rhizomes. The size and shape of the leaf is highly variable with blades that range form a slender "A" shape to a broad wedge. Common arrowhead is found in the shallow water of lakes, ponds, streams and marshes and usually found in water only ankle-deep, but will sometimes grow in water about 1 meter deep. Common arrowhead is one of the highest value aquatic plants for wildlife and waterfowl depend on the high-energy tubers during migration and the seeds are also consumed by a wide variety of ducks, geese, marsh birds and shore birds. Arrowhead beds offer shade and shelter for young fish as well (Borman, et al., 1997).

*Scirpus acutus.* (Hardstem Bulrush)


Hardstem Bulrush
Source: University of Florida Website

*Scirpus acutus.* (Hardstem Bulrush) has tall, sturdy stems that emerge from a shallow rhizome. The cylinrical, olive green stems are firm when pressed between your fingers. Hardstem bulrush can be found in wetlands, lakes, ponds and streams. It usually grows in water less than 7 feet deep, but it is occasionally found considerably deeper. Hardstem bulrush shows a preference for firm substrate with good water movement in the root zone. Hardstem bulrush offers habitat for invertebrates and shelter for young fish, especially northern pike. The nutlets are consumed by a wide variety of waterfowl, marsh birds and upland birds. Bulrushes also provide nesting material and cover for waterfowl, marsh birds and muskrats (Borman, et al., 1997).

*Typha latifolia.* (Broad-leaf Cattail)

Broad-leaved cattail has pale green, sword-like leaves that emerge from a robost, spreading rhizome. Broad-leaved cattail can be distinguished from narrow-leaved cattail by the broad-leaved cattail having the male and female flower spikes immediately adjacent to each other and the leaves tend to be wider and flatter. Cattails provide nesting habitat for many marsh birds (Borman, et al., 1997).


Broad-leaved Cattail
Source: UW Herbarium Website

4.2.2 Floristic Quality Index

Floristic Quality Index (FQI) developed by Stan Nichols (Wisconsin Geological and Natural History Survey) to help assess lake quality using the aquatic plants that live in a lake. A lake's plant community reflects a lake's water quality and its level of disturbance. In calculating FQI you must identify each species that is present in the lake. After each species is identified, a coefficient of conservatism is assigned to each species and used to calculate FQI. Each plant is assigned a number from 1 to 10 with low nutrient and undisturbed conditions given a 10. Plants typically found in more nutrient rich and/or disturbed waters are given a lower coefficient of conservatism. Lake quality is quantified by the number of species found, the identity of plants and the coefficient of conservatism.

FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2. FQI is used to help compare lakes around the state when comparing lakes around the state and to access the lake over time. Higher FQI numbers indicate better lake quality. Legend Lake had a FQI of 28.8 which is above the state of Wisconsin's median of 22.2. A FQI of 28.8 indicates that Legend Lake has above average water quality.

4.2.3 1993 Aquatic Plant Survey

Northern Environmental completed a review of the 1993 aquatic macrophyte survey. The 1993 survey was transect type survey using SCUBA equipment to observe aquatic plants. Thirty-three aquatic plant species were identified in 1993. A species list from the 1993 survey is provided in Table 1. Details about the distribution and abundance of aquatic plants in 1993 is provided in Appendix B. Perhaps the most significant change in the aquatic plant community on Legend Lake since 1993 is the discovery of EWM. Several species identified in 1993 were not found in the 2004 survey. Also, several species found in 2004 were not found in 1993.

## 5.0 CONCLUSIONS AND POSSIBLE MANAGEMENT OPTIONS

### 5.1 Conclusions

Legend Lake has historically been perceived as a lake with good water quality, and abundant aquatic macrophytes. Water quality data collected in the early 1990s indicate a mesotrophic lake system. Legend Lake's water budget is complex, but the majority of the lake's water comes from precipitation/runoff and surface water (stream) inlets. Tribal studies indicated that early eutrophication may be occurring. Nutrients from both within the lake and from land uses within the watershed are likely contributing nutrients to the lake which can enhance aquatic plant growth.

During the July 2004 aquatic plant survey, twenty-seven aquatic plant species were found, an indicator of a healthy, diverse aquatic plant community. The two most abundant aquatic plant species found were *Myriophyllum sibiricum* (Northern watermilfoil) and *Potamogeton richardsonii* (Clasping-leaf

Pondweed). While *Myriophyllum spicatum* (Eurasian watermilfoil) was not the most abundant aquatic plant found (based on frequency of occurrence), it was found on over 150 acres of Legend Lake in 2004. It was dense in over 50 of those acres. An early summer 2005 screening found EWM on over 250 acres of Legend Lake. EWM has aggressive growth habits and spreads by fragmentation, therefore EWM distribution and density will likely increase on Legend Lake. Left uncheck, EWM poses a threat to the diverse aquatic plant community and recreation on Legend Lake.

## 5.2 Possible Management Options

Many areas of Legend Lake have dense aquatic plant growth of both EWM and other native plants, which causes navigation problems for watercraft. Dense aquatic plants tangle boat props and the riparian landowners report problems getting their boats from their piers to open water areas. As such, the District has operated an aquatic plant harvesting program. Historically, the harvesting activities were often largely un-regulated. The WDNR promulgated NR 109, Wis. Adm. Code requiring development of APM Plans in order to obtain an aquatic plant management permit for harvesting activities. The NR 109 program is intended to allow management for nuisance conditions but protect aquatic plant communities from improper management. Based on the presence of high value species and WDNR-designated sensitive areas, some aquatic plant management activities will be restricted or prohibited in sensitive areas. Figure 8 illustrates WDNR-designated sensitive areas. Recreational areas, boat landing and beach clubs are illustrated on Figure 9. These areas featuring dense aquatic plant growth require nuisance relief for navigation channels and pier access. The recent proliferation of the EWM infestation in these areas further necessitates the need for aquatic plant management in these areas.

NR 109 requires that an applicant review all available aquatic plant management techniques before selecting a management strategy. Existing physical, biological, and chemical management techniques and current available research were reviewed in detail. A comprehensive comparision of APM techniques, including descriptions about the technology, benefits, drawbacks, and costs are included in Appendix C. Based on these comparisons and the specific aquatic plant problems on Legend Lake, the following potential management strategies were considered.

### 5.2.1 Manual Removal

Hand raking or hand pulling can be completed to remove aquatic plants from the water. Benefits are low costs and drawbacks are the labor intensive nature of this option. Manual removal by individual landowners can be completed to a maximum width of 30 feet to provide pier or swimming raft access. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed 30 feet. Manual removal exceeding 30 feet in width requires a permit from the WDNR.

### 5.2.2 Mechanical Harvesting

Aquatic plant harvesting allows easy treatment of large areas of nuisance aquatic plant stands. Advantages of this technology include immediate results, removal of plant material and nutrients, and the flexibility to move to problem areas and at multiple times of the year "as needed". Disadvantages of this method include the limited depth of operation in shallow areas, high initial equipment costs, disposal site requirements, creation of plant fragments that may move to other parts of the lake and re-colonize and a need for trained staff to operate the harvester. An operator may also be tempted to harvest in areas where plant management is not allowed. Used harvesters can also be purchased to reduce costs. A full discussion about harvesting is included in Appendix C.

The District currently operates two aquatic plant harvesters, a transport barge, and a shore conveyer. The district recently invested in the purchase of a new aquatic plant harvester. A harvester will typically last 10 years, potentially longer with proper use and maintenance.

### 5.2.3 Selective Herbicide Treatment

Use of an aquatic herbicide was considered as a potential management option. Chemical treatments are discussed at length in Appendix C. Chemical treatment of aquatic plants offers more control in confined areas (e.g. around docks) than harvesters can. The systemic herbicide containing an active ingredient of 2,4-Dichlorophenoxy acetic acid (2,4 D) has demonstrated EWM control and selectivity for protection of native plant species. 2, 4-D results can be seen in 10 to 14 days. A suitable herbicide applied at a suitable dose by an experienced licensed pesticide applicator can target exotic plant species but leave native species relatively unaffected. Navigate, a granular 2,4-D product, has demonstrated watermilfoil control while not affecting white water lilies, yellow water lilies, watershield, or other high value aquatic plant species found in Legend Lake. Disadvantages include: 2,4-D lasts only a short time in water, it can be detected in sediments after application. After the application, water use restrictions may be necessary.

Applications of 2,4 D-based herbicides (i.e. trade name Navigate) by a licensed applicator would be requested. One major treatment per season would be needed, however potential follow up "spot treatment" may also be needed.

The District funded a chemical treatment of nuisance EWM stands at Legend Lake in 2004. The District and Tribe are considering funding options to facilitate further use of this management strategy to target nuisance EWM in the future.

### 5.2.4 Drawdown

Legend Lake's water level is maintained by dam number 3 located on the east end of the Lake. The inlet structure in this dam allows the water level to be lowered. By lowering the lake level, the lake bed could be exposed and subject to freezing conditions. Advantages of drawdowns include the relative inexpense of the proposed action. Drawdowns have the capability to significantly impact populations of aquatic plants, including EWM. Disadvantages include: adverse affects on other aquatic plants; the controversy associated with shoreline landowners if the drawdown and a dry spring result in low water levels once summer returns; complex coordination effort with multiple regulatory agencies; and possible negative affects on fish populations. DNR recently observed good EWM control with a drawdown on Montello Lake in Marquette County, altough Montello Lake also is implementing an aquatic herbicide program for invasive species. A drawdown may be largely successful if there is a cold winter with relatively little snow cover. Mild winters and increased snow limit their effectiveness.

## 6.0 RECOMMENDED ACTION PLAN

Based on the review of aquatic plant management alternatives in Appendix C and Section 5.0, Legend Lake has prepared a comprehensive aquatic plant management plan that integrates several aquatic plant management techniques for the nuisance aquatic plant growth on Legend Lake. These techniques and several other components of the comprehensive APM Plan are discussed in the following sections. Periodically, the District and Tribe should update this APM Plan to reflect current aquatic plant problems, political issues, and the most recent acceptable APM methods. Information is available from the WDNR website: http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm or from Northern Environmental upon request.

## 6.1 Manual Removal

The WDNR, the District, and the Tribe allow hand raking or hand pulling of nuisance aquatic plant growth by individual landowners in front of their properties. Manual removal can be completed to a maximum width of 30 feet to provide pier or swimming raft access. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed 30 feet. Manual removal exceeding 30 feet in width requires a permit from the WDNR and is not allowed under this APM Plan. Requests to exceed 30 foot removal width should be brought to the District's attention and alternative management could be considered (harvesting or chemical treatment).

## 6.2 Mechanical Harvesting

The District will continue mechanical harvesting for navigation purpooses using District-owned harvesting equipment under an approved WDNR harvesting permit. Harvesting for aesthetic reasons is not allowed. Additional information about the Legend Lake harvesting program is included in Appendix D. Harvesting is allowed to provide nuisance relief for navigation subject to the following restrictions.

### *Areas*

Aquatic plant harvesting will be completed on Legend Lake for navigation purposes only in priority navigation channels (Figure 10). Harvester operators shall target nuisance areas of dense aquatic plant growth that interferes with significant boat traffic or other recreation in these areas. Harvesting operators obey the following guidelines:

- When harvesting navigation channels, the operator shall operate the harvester into the wind whenever possible.
- The operator shall be able to chase floating mats of aquatic plants ("floaters") provided they minimize the spread of fragments to the maximum extent practicable.
- The operator shall not harvest water lilies or other floating leaved plants except in navigation channels where they impede navigation
- The operator shall not operate harvesters within WDNR designated sensitive areas (See Figure 8) except for the following conditions:
  - to maintain a narrow (width of harvester) navigation channel in those sensitive areas. Navigation channels in sensitive areas must be provided to give shoreline landowners access to the main lake basins. Navigational access is also provided to undeveloped areas/tribal lands where seasonal homes or camps are set up and access is needed.

### *Depth*

The harvester operator shall obey the following depth limitations.

- No harvesting is allowed in less than 2 feet of water to prevent disruption of the bottom sediments, turbidity, and/or damage to the cutting head. If any sediments are encountered, the cutter head will be raised immediately.

- Harvesters will cut approved harvesting areas at half the water column depth. Full cutter depth (5 feet) is only operated at water depths of 10 feet or greater. The District has considered outfitting harvesters with depth gauges to avoid damage to cutter heads and facilitate compliance with depth restrictions. The District has attended harvesting workshops and discussed the need for a useable depth gauges with other harvesting permit holders, but none have proven effective at this time. The District will continue to consider depth locators and marking cutter head with depth gauges and install items once a suitable design is available.

A harvesting guidance packet is carried on the harvester at all times. A copy of this guidance is included in Appendix E.

***Operators***

Prior to each harvesting season, each operator will be required to review the APM Permit and conditions of the permit. The approved harvesting area map (Figure 10), a copy of the DNR harvesting permit, and the harvesting restrictions listed above will be included in a harvester guidance binder on each aquatic plant harvester (as required in the harvesting permit). Harvester operators will be trained to know the limitations of harvesting (areas and depths). Harvester operators will also be trained to stop harvesting if the bottom or moderate numbers of fish are encountered. Harvester operators will be trained to recognize and gauge the cutter head depth.

Harvesting operators are notified via radio or telephone about their designated harvesting areas approximately every 2 hours throughout their shift by the lake manager or another employee who scouts for dense navigation problems on their way to and from the harvester with the transport barge. Furthermore, the lake manager uses a district owned pontoon boat to scout for dense aquatic plant areas and communicates these areas to the harvester operators.

Harvester operators as well as APM Program managers will learn to identify the common nuisance aquatic plants on Legend Lake. The operators shall learn to identify the following invasive aquatic plants.

- Eurasian watermilfoil
- Curly leaf pondweed

Harvesting in areas of EWM requires special care to minimize excessive fragmentation.

Additional information about these exotic aquatic plants is available in the harvester guidance in Appendix E. Additional information is also available from the WDNR website: http://dnr.wi.gov/invasives/aquatic.htm or from Northern Environmental upon request. The operator shall report any new areas of aquatic invasive plant species or significant increases in abundances of these plants to the lake manager.

***Timing***

Timing of aquatic plant harvesting is a useful tool in selective management and therefore is considered an important component of the APM Program activities. Aquatic plant harvesting activities will normally begin after Memorial Day. This date is protective of April and May fish spawning seasons.

***Fish***

In Legend Lake's experience the harvester motion drives most fish away. Bullheads have occasionally been encountered, but fish trapped in harvested plants has not been a significant problem. Once a sturgeon was encountered, but immediately returned to the water. The operator shall discontinue harvesting in areas where moderate numbers of fish are encountered in harvested loads.

Additional details about the harvesting operation are included in Appendix D. This APM Plan contains all necessary information and maps required to obtain a long term harvesting permit from the WDNR.

## 6.3 Selective Herbicide Treatment

The District will use an approved aquatic herbicide to treat dense areas of EWM. The herbicide approved for use in 2004 was a granular 2,4 D product sold under the trade name of Navigate. This herbicide was approved for aquatic use by the Tribe when applied under an approved WDNR permit. Navigate has demonstrated EWM control while not affecting white water lilies, yellow water lilies, or watershield, or other high value aquatic plant species found in Legend Lake. All chemical treatments on Legend Lake are specifically designed to treat EWM. No nuisance levels of native plants are treated chemically.

Figure 11 illustrates the 2005 distribution. As funds allow, the District and the Tribe will apply for financial assistance to treat the EWM infestations on Legend Lake. WDNR permits will be applied for along with tribal-approved annually to accommodate available grant cycles. A mid-May EWM Assessment will be completed each year to modify the permit application prior to actual treatment of EWM. This modification request will be submitted in writing to WDNR and the Tribe along with a map of proposed treatment areas. An aggressive chemical treatment program can significantly reduce the abundance of EWM on Legend Lake. Post-EWM treatment assessments will be completed annually to apply for permits and funds. Figure 11 will be updated annually. At a minimum, Northern Environmental recommends three years of consistent, aggressive EWM treatment.

Based on past experience on Legend Lake, one major EWM treatment per season will be required. This treatment will occur once water temperatures reach 60°F. However one potential follow up "spot treatment" may also be needed. All NR 107 public notice and water use restriction posting requirements will be followed. A public notice must be filed in the Shawano newspaper and a public hearing held if requested. A yellow sign describing the treatment will be posted by the dock or shoreline of any properties being treated. There is a swimming and water use restriction for 24 hours following the application. Also, the water should not be used to irrigate fruit or vegetable plants for 14 days following treatment as the chemical in the water could affect those plants.

The District also should consider requesting approval from the Tribe for another 2,4-D containing product sold under the trade name Weedar 64, a liquid formulation. This product may offer similar EWM control at a lower chemical cost. A limited treatment area could be treated to evaluate both treatment and cost effectiveness.

Also, curly leaf pondweed, another exotic species, has been identified on Legend Lake (see Figure 7 for distribution). The District should monitor the distribution and density of this invasive plant. If curly leaf pondweed becomes a threat to the aquatic plant diversity or a nuisance for recreation, the District and the Tribal environmental department may consider chemical treatment of that plant. This treatment would need another selective chemical herbicide approved for use on Legend Lake.

## 6.4 Public Education

The district has actively been involved with public education about lake topics since its 1992 inception. Several lake fairs have been held at Legend Lake on a variety of lake topics such as natural shorelines, light pollution, using native plants, sensitive areas, and self help programs. Each of the quarterly newsletters contains at least one article describing some aspect of property owner responsibility. Pubic education has also been an on-going part of this APM Plan development. The District and Tribe have had public information meetings about APM on Legend Lake. One public meeting was held on April 7, 2004 to discuss the aquatic plant problems on Legend Lake. The District, the Tribal Environmental Department and Northern Environmental were present to answer questions about the planned APM Plan and proposed 2004 chemical treatment.

Furthermore, an article about EWM was written for distribution one of the 2004 quarterly edition of the District Newsletter. A copy of the article is included in Appendix F. Several WDNR and UW Extension fact sheets about aquatic plants and aquatic plant management are included in Appendix F. The District and Tribe ensure that these fact sheets are available to all lake users who have questions regarding the APM Plan. A copy of the entire APM Plan is available from the District or Tribe upon request.

Based on the District's report of some of the recent calls from residents, education should include discussions about the illegality of placing chemicals in the water without being a registered pesticide applicator and under an approved chemical treatment permit.

## 6.5 Sensitive Areas

WDNR designated ten sensitive areas on Legend Lake (Figure 8). The WDNR sensitive area report listing concerns about APM within sensitive areas was submitted in 2004. A copy of this letter is provided in Appendix G. A companion document "Guidelines for Protection, Maintaining, and Understanding Lake Sensitive Areas and Critical Habitat" is also included in Appendix G. WDNR concerns, guidances, practices, and recommendations about sensitive areas were ultimately considered when developing this APM Plan. While many of the sensitive areas remain relatively undeveloped, tribal members set up seasonal homes or campers in these areas for the summer months. These areas subsequently require navigational access.

The District will not operate the aquatic plant harvester in any designated sensitive areas other than a navigational channel to provide access to shoreline residences and tribal seasonal housing/camping areas within those sensitive areas. The navigation channel in sensitive areas is limited to a path as wide as the harvester. Chemical treatment in sensitive areas is allowed as all chemical treatment on Legend Lake is strictly limited to treatment of exotic species such as EWM using only WDNR and tribal-approved selective chemical herbicides.

## 6.6 Watercraft Inspection

The District currently participates in a watercraft inspection program and have signs about AIS present in Legend Lake at each boat launch. The Watercraft inspection effort in Wisconsin involves providing information to lake users about what invasive species look like and what precautions they should take to avoid spreading them. It also involves visual inspection of boats to make sure they are "clean" and demonstration to the public of how to take the proper steps to clean their boats and trailers. Watercraft inspectors also install signs at boat landings informing boaters of infestation status, state law, and steps to prevent spreading invasives. The **Clean Boats Clean Waters** Program is sponsored by the DNR, UW Extension, and the Wisconsin Association of Lakes and offers training to volunteers on how to organize a

watercraft inspection program. For more information see the following website: http://www.uwsp.edu/cnr/uwexlakes/CBCW/default.asp. Or contact Laura Felda- Marquardt, Volunteer Coordinator for the Invasive Species Program, UW Extension-Lakes Program at (715) 346-3366 or (715) 365-2659 for details.

## 6.7 Nutrient Controls

Recognizing that nutrients in runoff and from septic systems can contribute to excessive aquatic plant growth on Legend Lake, the District has completed several nutrient control projects and developed ordinances. The District sampled soils on beach club property soils, providing evidence that phosphorus fertilizer was not needed on most soils for plant growth. This information was used to implement a ban on phosphorus fertilizers. The county implemented an ordinance banning phosphorus fertilizers on all county lake frontage. The District provides information on where to purchase phosphorus-free fertilizer at the Legend Lake Lodge and in the newsletter's spring edition.

Legend Lake has both natural and manicured shoreline areas. Natural shorelines are beneficial to a lake's health in that they filter nutrients and sediments from storm water runoff. The District has provided three demonstration sites for natural shorelines. One is the Legend Lake lodge property, the other two are at Morning Star and Blue Heron Beach clubs. The last lake fair at Legend Lake hosted a speaker from "Wild Ones" organization with native plants for sale. Additionally, the District has encouraged natural shoreline restoration by providing a tax relief program. Property owners can apply for this program through the county conservation officer.

Since septic systems also contribute nutrients to Legend Lake, the District began working on an ordinance in 2000. It was passed in 2001 and Menominee County since passed a parallel ordinance. The District mail compliance cards to one third of the owners of lots with septic systems each year. The cards are returned to the District and recorded. Those not in compliance are notified by the County. If action is needed, enforcement action is taken.

## 6.8 Monitoring

To evaluate the effectiveness of the APM Program, monitoring of multiple components should be completed. The District should constantly evaluate their program for potential improvement opportunities, however the following items are considered minimum monitoring components.

### 6.8.1 APM Technologies

The APM technologies listed in Appendix C should be re-visited periodically to evaluate if new or improved technologies are available. The professional environmental science community includes universities, state natural resource regulatory agencies (e.g. WDNR), and federal regulatory agencies (e.g. USFWS, USACE, EPA, and USGS). These parties along with private conservation groups continuously seek government funding for research about exotic species. The District and Tribe are encouraged to "stay current" with this research as the knowledge gained from these endeavors may prove useful for APM activities or overall aquatic ecosystem management in the future.

6.8.2 Public

The District should assess the public's perception of APM on Legend Lake. Periodic questionnaires should be solicited in District mailings to evaluate the opinions of lake users about aquatic plants and management on Legend Lake.

6.8.3 Periodic Aquatic Macrophyte Surveys

In addition to evaluating mapping EWM distribution, Northern Environmental recommends completing lakewide aquatic macrophyte surveys every 5 to 10 years to monitor changes in the aquatic plant community and the effects of APM in the management area. Aquatic plant communities may change with varying water levels, water clarity, nutrient levels, and aquatic plant management. At a minimum, the aquatic plant surveys should duplicate the 2004 point intercept survey.

6.8.4 Water Quality

The Property Owners Association began a Self-Help Monitoring Program several years before the District was formed. In the past 5 years the District monitored water clarity in the 9 lake basins and water chemistry testing in Big Blacksmith Lake basin. Although the District maintains all records, Perceived water quality problems are reported to the Menominee Tribal Environmental Services, who take prompt action on finding the cause of the problem(s).

## 6.9 Funding

The District and Tribe should consider multiple funding sources for facilitation of the APM Plan. Examples of funding sources follow:

- WDNR Lake Management Planning Grants
- WDNR Aquatic Invasive Species
- WDNR Lake Management Protection Grants
- Bureau of Indian Affairs (BIA) Grants
- Other Tribal financial assistance

For more information about these and other potential funding sources, please contact Northern Environmental.

## 6.10 Record Keeping

The District will maintain detailed records including harvesting dates, harvesting areas, types, and amounts of aquatic plants harvested, and fish encounters. A sample record keeping form is included in Appendix E. Chemical treatment records are also be maintained in District and Tribal Environmental Department files.

## 7.0 REFERENCES

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

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**APPENDIX A**

**AQUATIC PLANT SURVEY DATA**

**APPENDIX B**

**1993 AQUATIC PLANT SURVEY DATA**

# APPENDIX C

# SUMMARY OF AQUATIC PLANT MANAGEMENT ALTERNATIVES

**APPENDIX D**

**WDNR HARVESTING WORKSHEET**

# APPENDIX E

# HARVESTER OPERATION GUIDANCE

# APPENDIX F

# PUBLIC EDUCATION MATERIALS

# APPENDIX G

# SENSITIVE AREA INFORMATION

# AQUATIC PLANT MANAGEMENT PLAN

## LEGEND LAKE
## MENOMINEE COUNTY, WISCONSIN

July 27, 2005