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2006 Montello Lake Aquatic Plant Management Plan

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2006 Montello Lake Aquatic Plant Management Plan

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In cooperation with the Wisconsin Department of Natural Resources

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Executive Summary

The purpose of this document is to present the Montello Lake Protection and Rehabilitation District with an overview of past management activities, report on the success of those strategies, and provide guidance for future management practices.

The 1994 survey conducted by Arons & Associates and 2003 through 2006 surveys conducted by AEI did not utilize the same point-intercept approach and are therefore not directly comparable. The 1994 transect survey data do show a wide spread distribution of EWM throughout Montello Lake. This distribution was severely limited in 2003 by the 2002-03 drawdown and subsequent 2003 large-scale herbicide treatments. Curly-leaf pondweed (*Potamogeton crispus,* CLP) was controlled by the drawdown for one season and came back in large areas in 2004. Large-scale herbicide treatments were performed in 2004 and were successful in managing the CLP. EWM started making a recovery in 2005 and required large-scale herbicide treatments to manage. By the summer of 2006 the EWM had made a recovery and large-scale herbicide treatments and extensive harvesting were required to maintain recreational usage of the lake. The District is performing a drawdown for the winter of 2006-07 which should reduce the EWM populations in 2007.

Managing the aquatic invasive species *Potamogeton crispus* and *Myriophyllum spicatum* is the main issue covered in this document. Nuisance conditions created by either species, or both, have occurred for several years. The MLPRD has taken a proactive approach in the past to manage Montello Lake with a multi-faceted plan which utilizes integrated management strategies in order to achieve optimal results. Drawdown, harvesting, and herbicide treatments will continue to be the focus of the District's management effort.

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1.0 Introduction

Montello Lake is a drainage lake located in Marquette County, Wisconsin on the Montello River (WBIC 164300, T15N R10E, S22). It is a eutrophic impoundment with a surface area of 286 acres, a mean depth of approximately 5 feet and a maximum depth of 15 feet. Known sources of impairment to Montello Lake include: a large agriculturally dominated watershed and exotic plants (Ramaker & Associates 2002). This report addresses aquatic plant management and monitoring activities occurring on Montello Lake from the winter of 2002 through summer of 2006. Aquatic Engineering personnel performed annual aquatic plant surveys to evaluate the integrated plant management techniques occurring from 2002 to 2006. In 2003, water quality data were collected at each plant sample site to determine whether local impacts of water chemistry changes could be attributed to aquatic plant growth. In the winter of 2002-03 a 4-foot draw down of the lake occurred. The goal of the drawdown was to alleviate nuisance aquatic plant growth primarily associated with the exotic plant Eurasian water-milfoil (*Myriophyllum spicatum*, EWM). A sediment compaction study was also conducted during the drawdown to assess the amount of compaction resulting from dewatering.

The Montello Lake Management Plan, developed in 2002 by the Montello Lake Inland Protection and Rehabilitation District, recommended performing an aquatic plant survey to evaluate changes since the last survey in 1994. It also encouraged a lake level drawdown as an applicable management tool for Montello Lake. Further suggestions from Wisconsin Department of Natural Resources biologists include integrating mechanical harvesting and selective aquatic herbicides with periodic drawdowns to rehabilitate the native plant community in Montello Lake (Provost 2002).

This report summarizes the 2003 through 2006 aquatic plant surveys on Montello Lake, compares the dominance of exotic species to levels recorded in a 1994 aquatic plant survey and discusses the results of mechanical harvesting, herbicide applications, and the winter 2002-2003 water level drawdown. This report also includes an updated strategy for future aquatic plant management activities.

2.0 Aquatic Plant Information

2.1 The Role of Aquatic Plants

Aquatic plants are a driving force in lake ecosystems. They help maintain water quality by utilizing nutrients that would otherwise fuel algal growth, stabilize bottom sediments, produce oxygen, and provide habitat for fish and other aquatic life (Minnesota Department of Natural Resources 1997). In a healthy lake, the aquatic plant community will be balanced with a number of species common throughout the littoral zone alternating with some non-vegetated areas. This provides habitat for both panfish and open areas for predatory fish. Diversity in the aquatic plant community is also beneficial to wildlife which utilizes different plants as food sources.

Aquatic plant growth is usually isolated to shallow, productive areas of lakes called the littoral zone. While there is variability in the percentage of lake bottom classified as littoral zone, the qualities of littoral zones remain relatively constant in many drainage/impoundment lakes. In general, the littoral zone is the portion of the lake less than 15 feet deep containing nutrient rich sediments that support aquatic plant growth. This depth can increase with clear water and decrease with stained or turbid water.

A healthy aquatic plant community will have a variety of plant types including emergent, floating-leaf, and submerged plants. Each type of plant typically inhabits specific areas of the littoral zone. Emergent aquatic plants are found along the shoreline in water 1-4' deep. Easily recognizable members of this group include Cattails (*Typha* sp.) and Bulrushes (*Scirpus* sp.). They function to buffer against wave action and provide habitat for waterfowl. The floating-leaf plant group consists of a variety of plants with lilies being one of the most common. Floating-leaf plants usually are found in relatively shallow water where there are limited influences from the wind and wave action. These plants provide excellent cover for fish and invertebrates. Submerged plants are the last major group of rooted plants. They grow entirely underwater, but some varieties breach the surface as they flower. Submerged plants grow in near-shore areas to the edge of the euphotic zone which is the maximum depth where light can support plant growth.

Growth forms of this plant type vary from species to species (Minnesota Department of Natural Resources 1997). Most native species grow along the bottom or in groups called stands. In a healthy lake, native plants will usually maintain a relatively low stem density to keep from becoming a nuisance. Exotic plants may grow in densely packed stands at a high stem density. As water conditions become more turbid during the summer, Eurasian water-milfoil will grow until it reaches the water surface and branch out extensively (Valley and Newman 1998). This effectively shades out native plants growing near the bottom (Madsen et al 1991). In addition, these dense areas of plant growth may cause local changes in water chemistry including super-saturation during daylight hours, anoxia during the night, and shifts in pH (Madsen 1998) creating additional stress on lake biota.

2.2 Aquatic Plants and Recreation

As previously mentioned, aquatic plants are linked to the recreational activities in lakes. A healthy aquatic plant community helps maintain water quality, provides habitat for fish and other aquatic life, and stabilizes bottom sediments and shoreline areas which in turn help maintain property values (Krysel et al 2003). Unfortunately, aquatic plants are usually only noticed once they reach nuisance levels and are commonly associated with problems by the average lake patron. Pier areas may become unusable, boating is difficult or impossible, swimming is not desirable, and fishing may be difficult. These symptoms may occur as a result of poor water quality associated with excessive nutrient loading and a general eutrophic state, but is often due to the presence of exotic aquatic plants. Exotic plants grow unchecked by natural control mechanisms such as predation by insects or fish while native plants simply may not be able to compete with their high growth rates. Once a lake is infested with an exotic plant, management activities are usually required to maintain aquatic plants at a level that is healthy for the aquatic community and suitable for recreation.

2.3 Montello Lake Aquatic Plant Problems

An unhealthy or degraded lake usually supports an overabundance of plants or very little aquatic plant growth in an algal dominated system. The primary concern in Montello Lake is overabundance of aquatic plants, especially EWM and CLP. As exotic plant

species invade and populate a lake, available habitat for other forms of aquatic life is restricted by the development of dense, monotypic beds (Madsen et al 1991). Monotypic areas of plant growth contribute to stunted fish populations by preventing predatory fish's ability to capture prey, may drastically affect oxygen levels, and cause localized shifts in water chemistry. Once exotic plants are introduced into an aquatic ecosystem, management activities are required to maintain balance within the plant community.

Overabundance of aquatic plant growth in Montello Lake is caused by excessive nutrient levels. Sources of nutrients in Montello Lake are its tributaries which are influenced by a large agriculture watershed and transport nutrient rich sediment into the lake. Other sources include immediate watershed runoff, failing septic systems, wildlife contributions (geese, gulls, etc.) and decaying plant material but are likely minor compared to tributary contributions.

The result of nuisance aquatic vegetation growth in Montello Lake is a decrease in habitat quality and diversity. A well-balanced lake ecosystem will have alternating zones of submerged, floating leaf, and emergent vegetation. It will also have alternating areas of moderate vegetation and open water. These variations are essential for a diverse fish and wildlife community.

In Montello Lake, predator fish likely have a hard time finding prey panfish when weeds become too thick. As a result, panfish could become overpopulated and eventually stunted. Fish and wildlife are both dependent on the quality or types of plants. Eurasian water-milfoil and curly-leaf pondweed do not offer the quality of food and shelter most native plants do. Mammals, reptiles, waterfowl, and birds are dependent on a healthy plant community to provide a wide array of seeds, flowers, stems, buds, roots, and leaves. When the plant community becomes dominated by a few species, foraging options for these animals decrease.

3.0 Review of Past Management Activities

3.1 Timeline of Past Management Activities

- 1982 Montello Lake Inland Protection and Rehabilitation District *(MLPRD)* was formed. The District was formed to protect and enhance the quality of Montello Lake.
- 1983 MLPRD purchased an aquatic plant harvester. Harvesting operations have been under MLPRD supervision ever since
- 1993 Wisconsin Department of Natural Resources conducted a plant survey as part of a state-wide effort to assess lakes with harvesting programs
- 1994 Aquatic Plant Survey completed by Arons & Associates
- 1994 District completes its first APM Plan
- 1998 Aquatic Plant Management Opinion Survey conducted
- 2000 District Resident Opinion Survey conducted
- 2002 Montello Lake Management Plan created by Ramaker & Associates, Inc.
- 2002 Large-scale CLP herbicide treatments
- 2002 Mechanical Harvesting
- 2002-03 winter drawdown
- 2003 Klawitter Creek classification as cold water community class 1 trout water
- 2003 Large-scale EWM herbicide treatments
- 2003 First year since 1983 NO mechanical harvesting occurred
- 2003 Comprehensive AP survey
- 2004 Large-scale CLP herbicide treatments
- 2004 "Lake Montello Limited Phosphorus Budget" report submitted by Ramaker & Associates, Inc.
- 2004 Mechanical Harvesting
- 2004 Comprehensive AP survey
- 2005 Large-Scale EWM herbicide treatments
- 2005 Mechanical Harvesting
- 2005 Comprehensive AP survey
- 2006 Large-Scale EWM herbicide treatments
- 2006 Mechanical Harvesting
- 2006 Comprehensive AP survey

3.2 Mechanical Harvesting

The Montello Lake District has been implementing mechanical harvesting activities since 1983. Prior to an APM Plan and DNR permitting requirements, the premise of the harvesting program for Montello Lake was to clear-cut as much of the lake as possible while avoiding protected areas. The results of the program went largely undocumented which means data regarding past harvesting efforts are not available.

Mechanical harvesting has played an important role in annual management of aquatic plants within the lake. Because the lake has good water clarity and fertile sediments, the lake will continue to have nuisance aquatic plant growth. Mechanical harvesting allows the District to target the most problematic areas and respond quickly to changing conditions. The practice of mechanical harvesting, because of inherent limitations, has not met every need of the District. The District has wisely chosen to implement two other main aquatic plant management techniques as part of their 2002 Lake Management Plan. Those two other practices are herbicide applications and lake level manipulation (drawdown).

3.3 Herbicide Applications

Herbicide applications were used prior to the acquisition of harvesting equipment as the primary tool for aquatic plant management in Montello Lake. The effort, however, was mainly taken on by individual property owners and only benefited areas of the lake they chose to treat. DNR records show that fewer than 5 acres were treated each year from 1988 to 1993.

More recently, large scale herbicide applications have been made to control certain exotic species (EWM and CLP). These applications have been performed under the current Lake Management Plan written in 2002. Treatments have been performed targeting exotic species. Although treatments were performed for CLP in 2003, EWM treatments from 2004 to 2006 have been the most beneficial.

3.4 Drawdown

Drawing the lake level down over winter to control aquatic vegetation the following spring was a specific recommendation in the 2002 Lake Management Plan. The plan called for a 6-month drawdown beginning in September and ending by March. The potential benefits would last one to three years and would control target species within the affected area. The plan did note that ideal conditions (cold and dry winter) would be

necessary for drawdown success and that a mild winter and snow cover would reduce effectiveness.

Montello Lake was drawn down over the winter of 2002 and 2003. The winter weather was ideal with very cold and dry conditions throughout the majority of winter. A post-drawdown plant survey was conducted in 2003 to assess the success of the drawdown.

Sediment compaction was also measured during the drawdown to assess the affects drying and oxidation had on the sediments. Pipes were driven into the sediments of Montello Lake at ten different locations to assess the amount of compaction that occurs during dewatering. Eight sites were chosen as test sites and two sites were control sites. The test sites were composed of soft sediments (muck and organic matter) and the control sites had sand as the major sediment type. Compaction was measured by recording the distance from the sediment to the tops of the pipes. As the sediment compacted, the distance between the pipe top and sediment increased. The average amount of compaction was approximately 6 inches at test sites and no compaction was recorded at the control sites. The drawdown was considered a success.

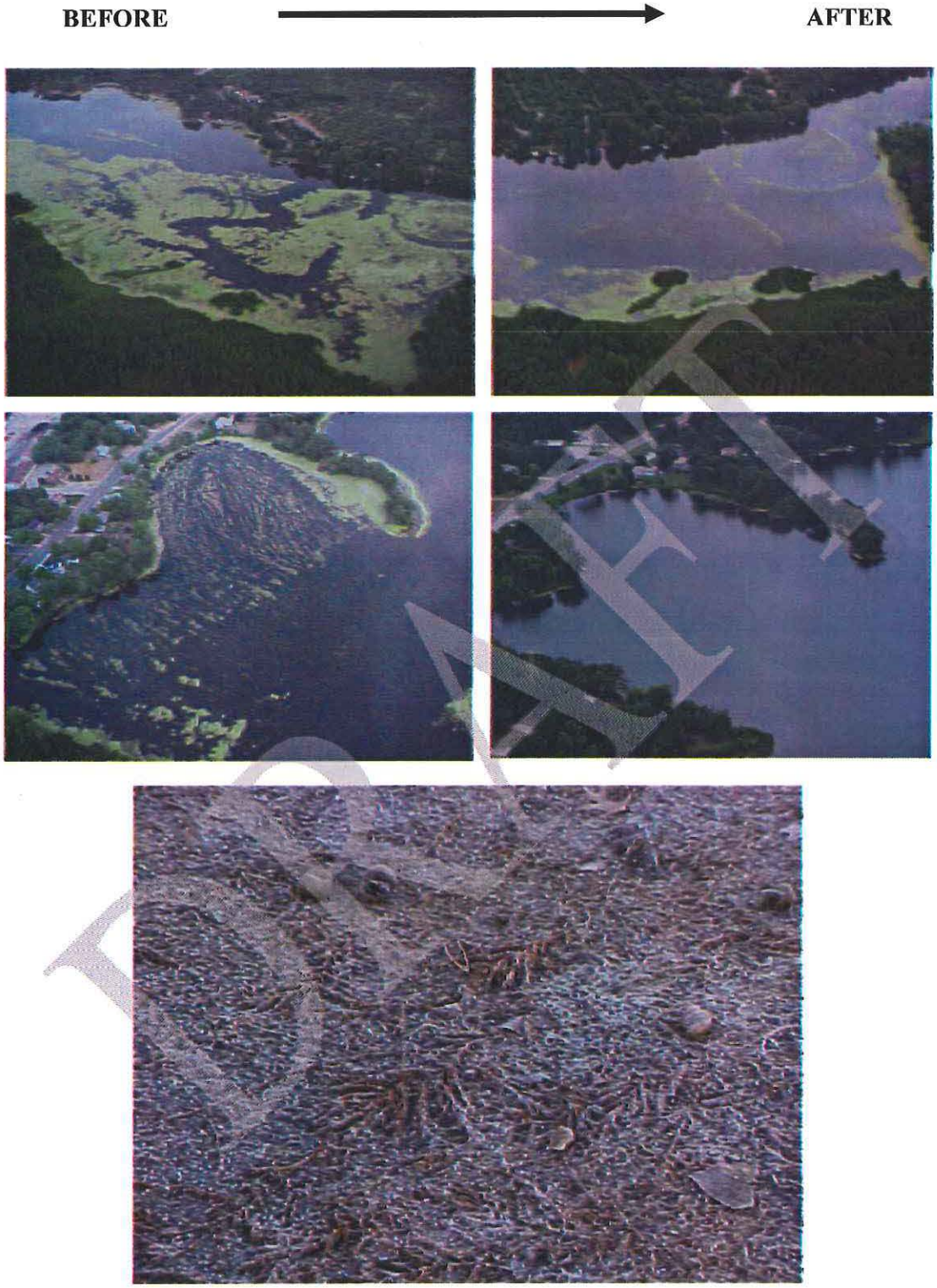

Figure 1. Comparison photographs showing conditions of Montello Lake in 2002 (top left) and in 2003 (top right) at normal water level. Aquatic macrophytes succumb to dry and cold winter conditions during the drawdown from 2002-03 (bottom).

3.5 Whole-lake Aquatic Plant Surveys

Aquatic plant survey conducted in 1993 reported coontail as the most common species present. The 1994 survey helped expand that list to include coontail, EWM, common waterweed and star duckweed. This survey also documented that the entire lake supported aquatic plant growth with the exception of deep areas (river bed). These surveys were conducted using transect and depth zone techniques and are not directly comparable to data collected under the 2002 Lake Management Plan.

The point intercept aquatic plant surveys conducted from 2003 to 2006 show that nearly the entire littoral zone of Montello Lake contains aquatic vegetation. The lake contains several floating leaf and emergent plants but is predominantly occupied by submersed aquatic macrophytes. The most common plant species found include coontail, elodea, EWM and wild celery (Figures 2 through 5). These surveys document that dominant species in 1993 and 1994 continue to dominate the plant community.

The FQI was calculated for the surveys conducted in 1994 and from 2003 through 2006 (Table 1). The results show that the community remains relatively unchanged from 1994. The values are all within the middle 50% of lakes in region and state. Though the data suggest the community has not changed recently, there isn't sufficient data to show long term trends in the aquatic plant community.

Table 1. Comparison of FQI values for Montello Lake (Marquette County, WI).

	1994	**2003**	**2004**	**2005**	**2006**
FQI	18.6	20.6	18.6	22.5	20.0

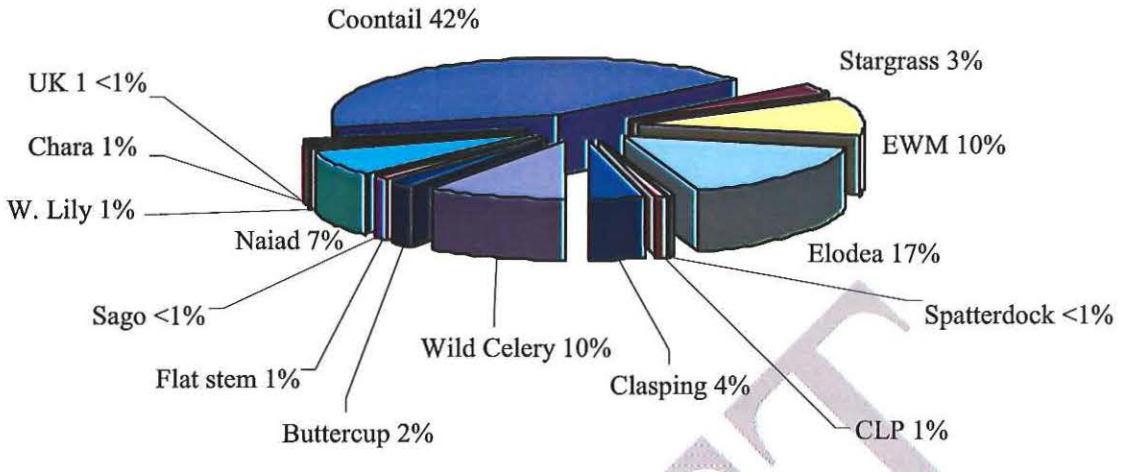

Figure 2. Relative abundance of aquatic plant species from the whole-lake survey, Montello Lake (Marquette County, WI) July 25 and 26, 2006.

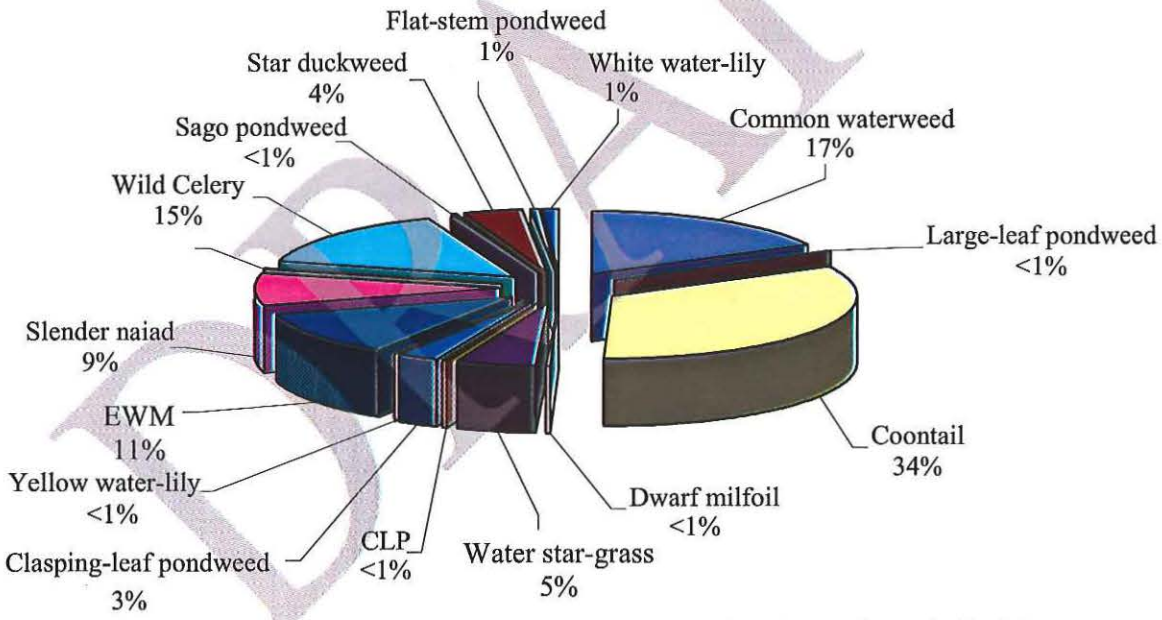

Figure 3. Relative abundance of aquatic plant species from the whole-lake survey, Montello Lake (Marquette County, WI) August 15-17, 2005.

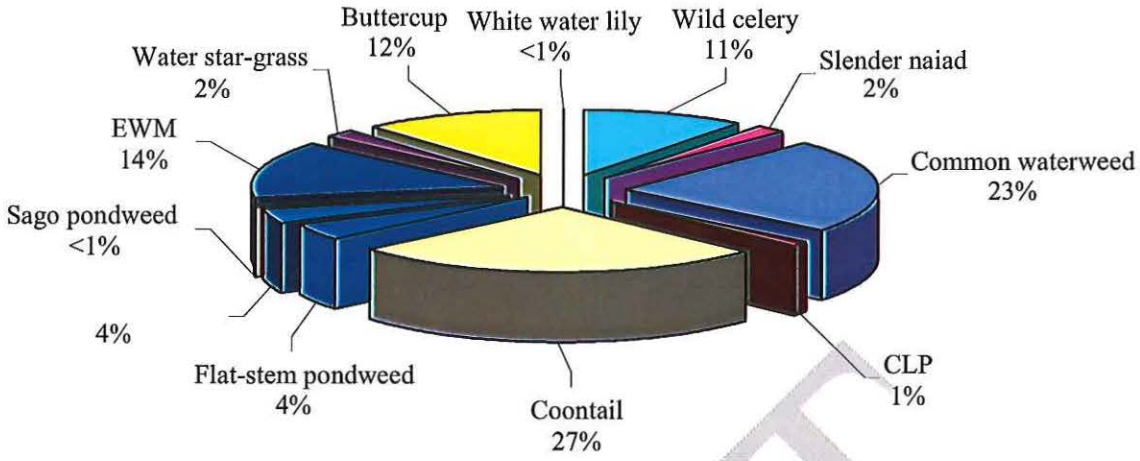

Figure 4. Relative abundance of aquatic plant species from whole-lake survey, Montello Lake (Marquette County, WI) July 20-21, 2004.

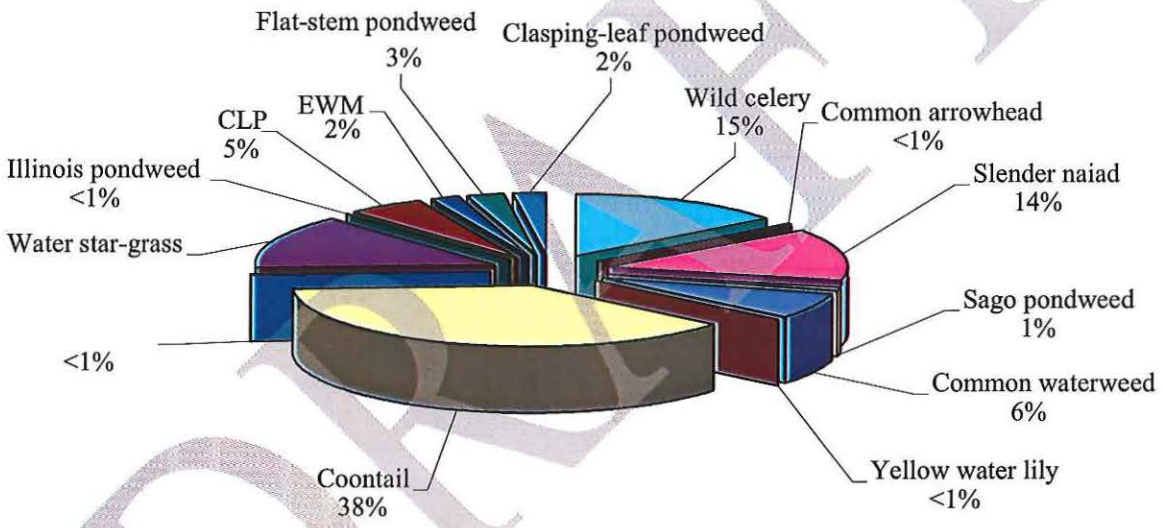

Figure 5. Relative abundance of aquatic plant/algae species from whole-lake survey on Montello Lake (Marquette County, WI) August 12-14, 2003.

3.6 Invasive Species Assessment

Whole lake surveys conducted from 2003 to 2006 show the current EWM distribution has essentially remained the same since 1994 (Figures 6 through 9). The aquatic plant survey conducted in 1994 revealed a widespread EWM infestation. Though the results of that survey are not directly comparable to the surveys performed after 2002, it does provide insight to the history of Montello Lake's EWM infestation.

3.7 Substrate Evaluation

The most common substrate type in Montello Lake is mud. This substrate type is most conducive to growing EWM, CLP, coontail, elodea, cattail, white and yellow water lilies, and various pondweeds. Because Montello Lake has a large, agriculturally dominated watershed, it will continue to fill in with silt and soft sediments. The most practical method for combating sedimentation is through winter drawdown events. As seen in 2002-03, sediments can become compacted as much as 9 inches in one season. Drawdown must be repeated often to maintain sediment compaction results. Other alternatives to managing sedimentation, such as dredging, work well when used to manage small areas as opposed to the whole lake.

3.8 Limited Phosphorus Budget

The 2004 Limited Phosphorus Budget shows that the single largest contributor of phosphorus to Montello Lake is Montello River. This is not surprising given the fact much of the very large watershed is intensively used row crop agriculture.

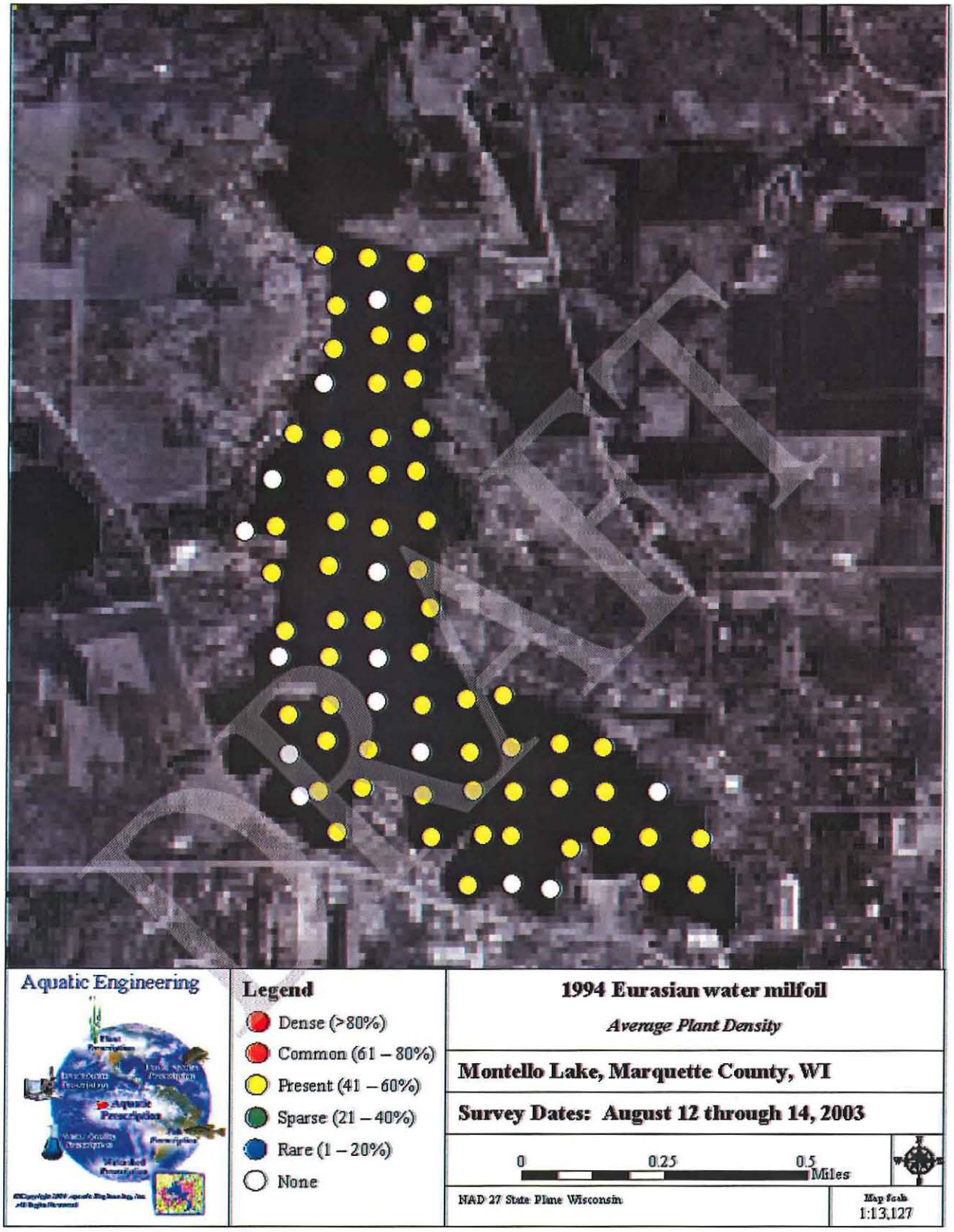

Figure 6. Distribution of EWM in Montello Lake (Marquette County, WI) in 1994.

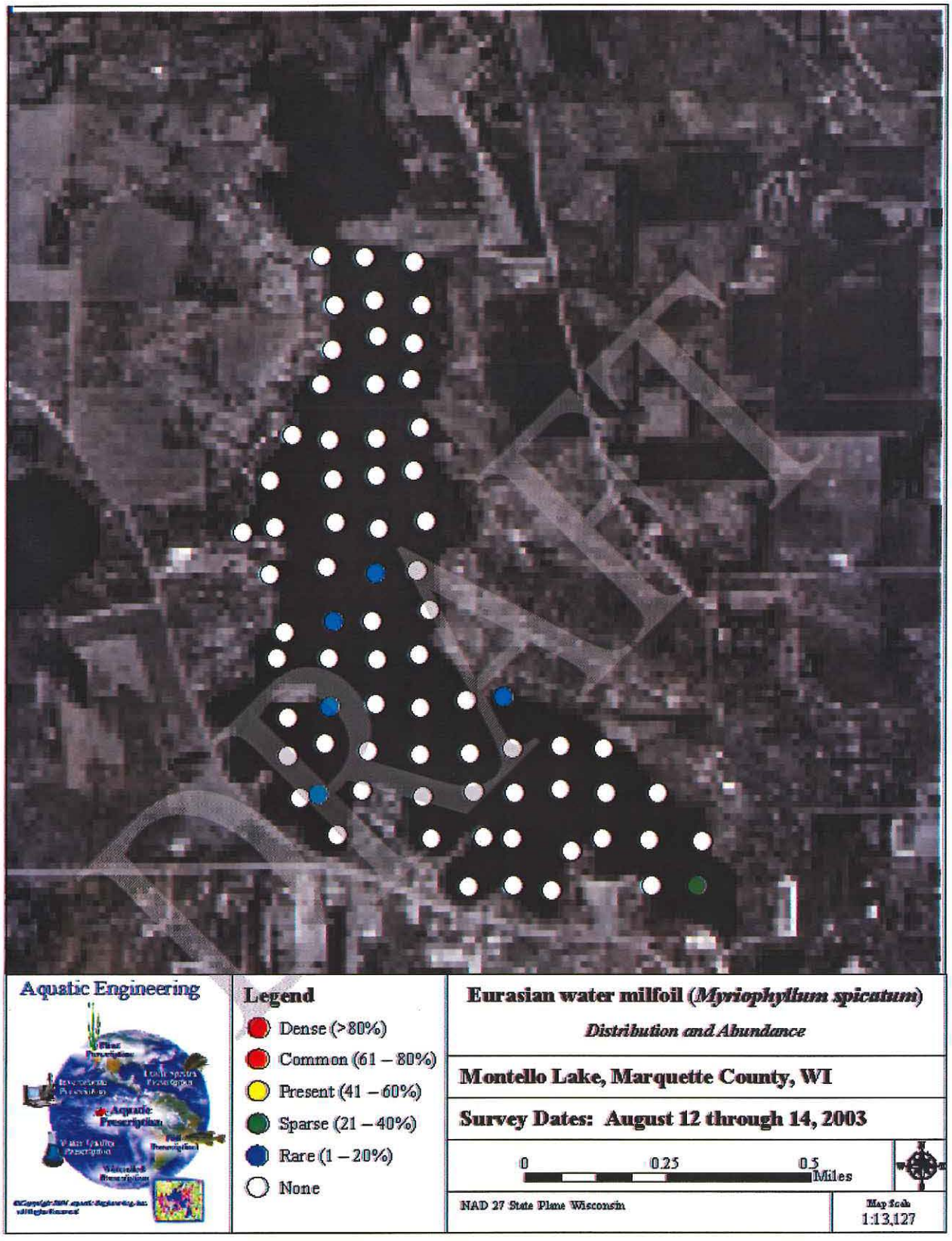

Figure 7. Distribution of EWM in Montello Lake (Marquette County, WI) in 2003.

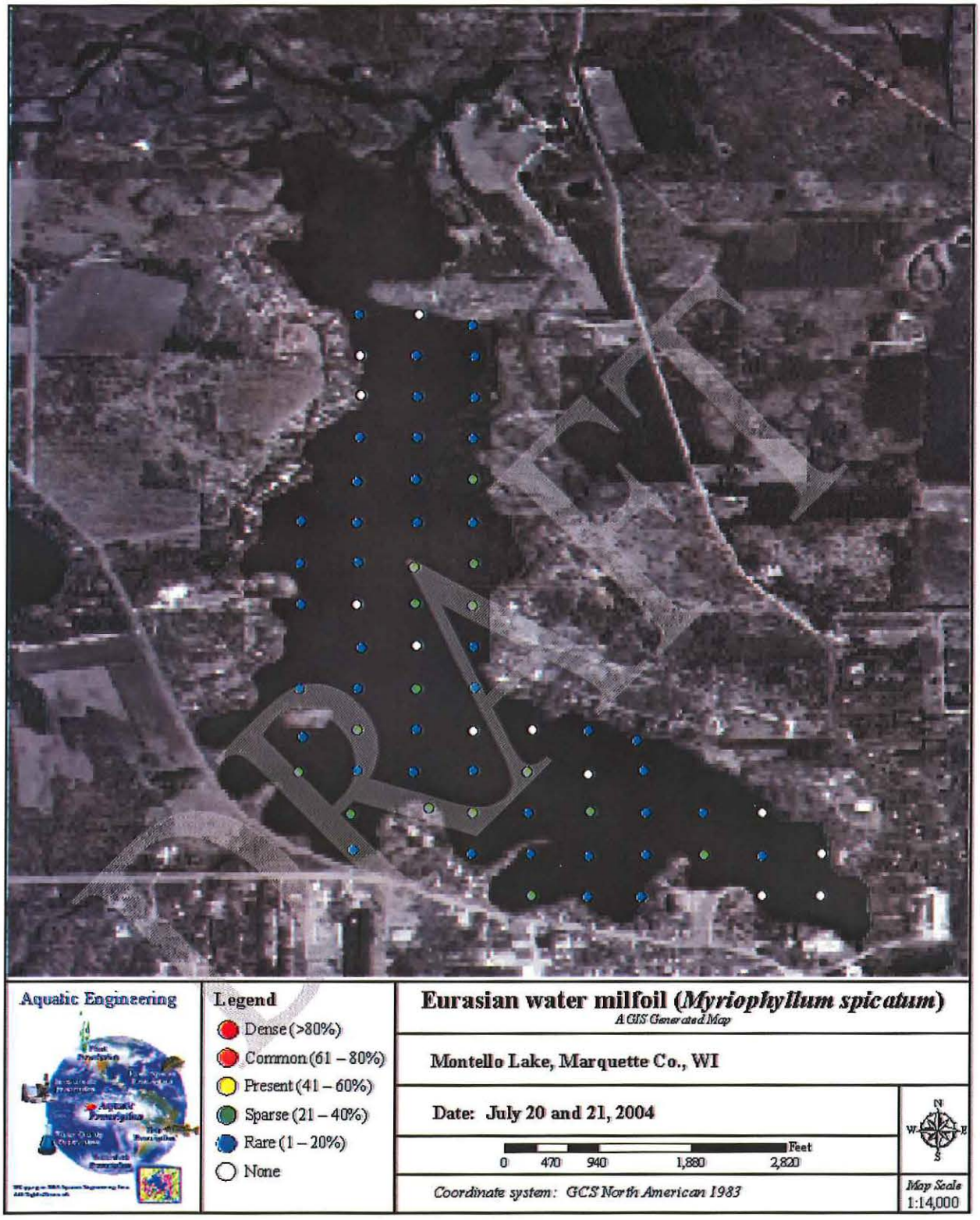

Figure 8. Distribution of EWM in Montello Lake (Marquette County, WI) in 2004.

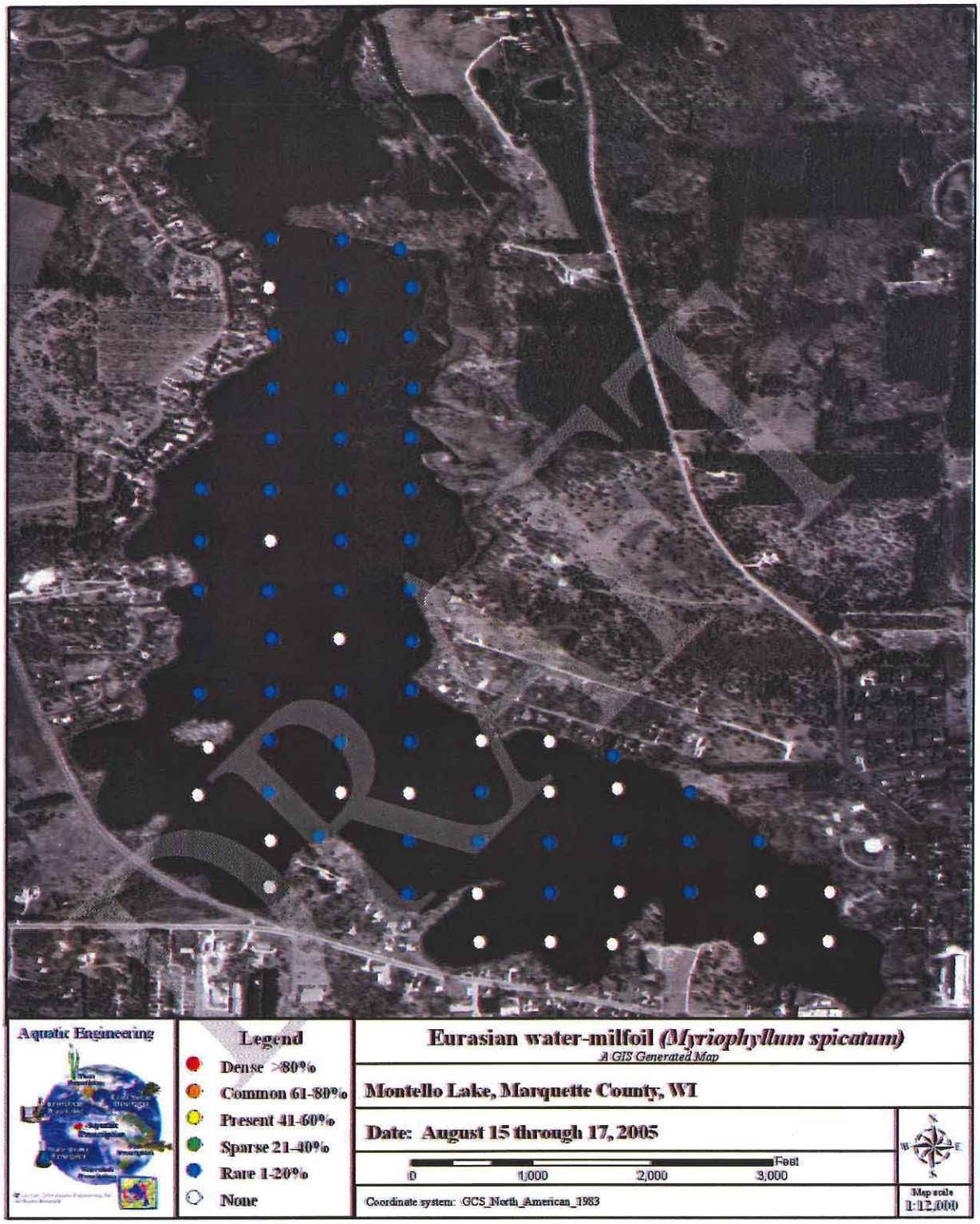

Figure 9. Distribution of EWM in Montello Lake (Marquette County, WI) in 2005.

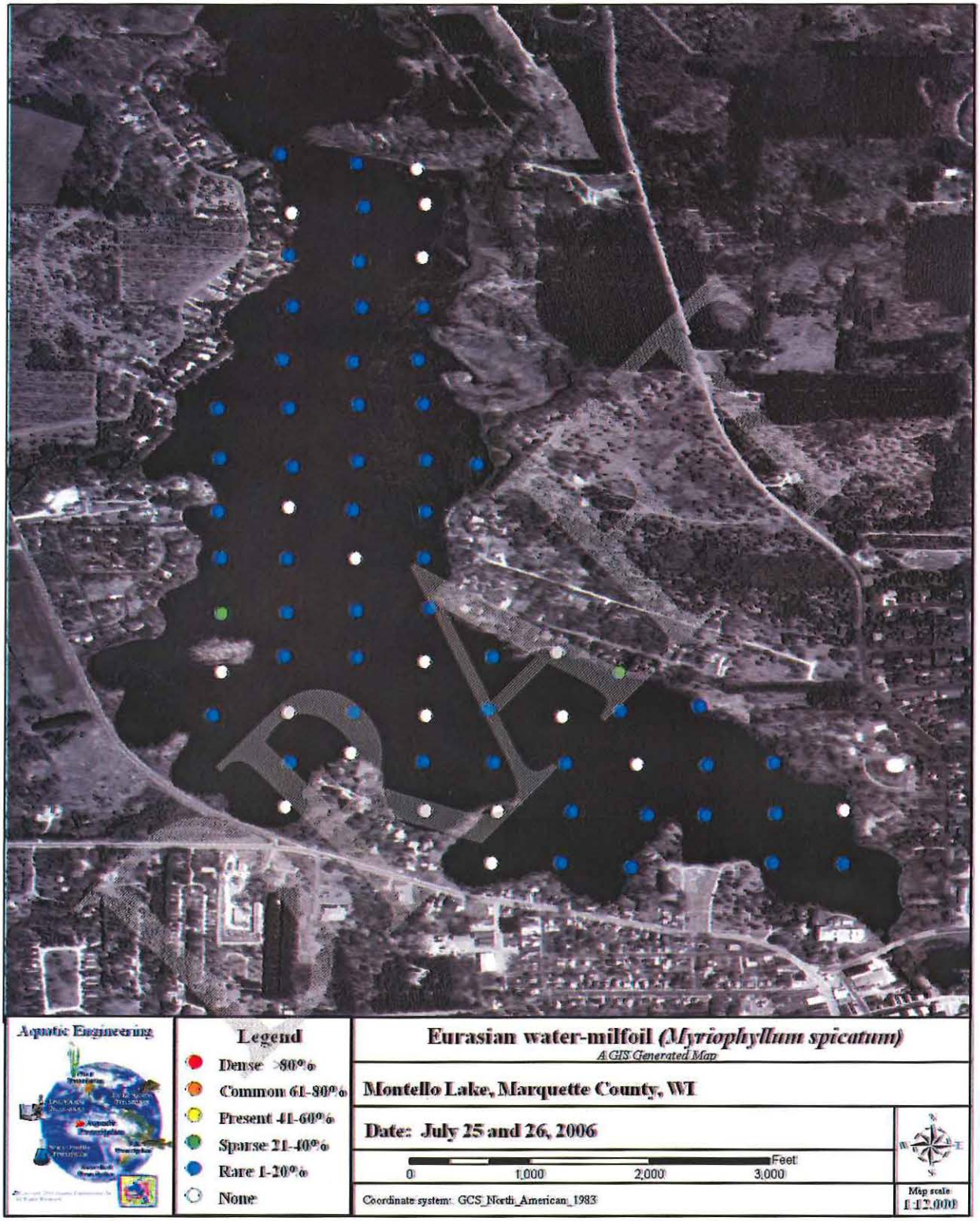

Figure 10. Distribution of EWM in Montello Lake (Marquette County, WI) in 2006.

4.0 Review of Management Options

4.1 Options for Managing Aquatic Macrophytes

The following subsections provide an overview of management strategies that are commonly used to manage eutrophic effects on lakes. The purpose of this section is to provide a general introduction to popular management strategies for future reference and consideration. Methods described are derived from the *Managing Lakes and Reservoirs* manual prepared by the North American Lake Management Society.

Mechanical weed harvesting can be used to remove the upper portion of rooted vegetation. Weed harvesters are low-draft barges that cut and remove vegetation growing at or near the water surface. A harvester can generally operate at a rate of approximately 0.2 to 0.6 acres per hour, depending on the equipment. Once cut, the plants are moved via conveyer to a holding area on the barge itself until they can be unloaded, via a second conveyer, at the shore. Plants are usually transported away from the lake to a compost site or a landfill. The physical removal of plant material means that the nutrients trapped in the plants are also removed from the lake ecosystem.

Harvesting is most effective to remove plants in three to six feet of water growing in dense beds. Harvesting can be used to open navigational channels, remove weedy obstructions from highly used recreational areas, or to produce relief for fish in weed-choked areas of a lake. Harvesting is non-specific and will remove all plants within the harvested area. Sometimes fish become trapped in harvested plants and end up being removed from the lake as well. Problems associated with harvesting include non-selective plant removal in management areas, increased turbidity, and spread of invasive species through fragmentation (Holden, Jones, and Taggert 2001). Harvesting equipment is usually expensive, and operational costs vary depending on the harvesting effort required. Effects of harvesting are immediate, and there is no use restriction during operations. WDNR permits are required for mechanical harvesting. Contact the local APM coordinator for more information regarding permitting requirements.

Manual weed harvesting is a scaled-down method of mechanical harvesting. In manual weed harvesting, weeds can be uprooted completely or simply cut close to the sediment using a variety of equipment from drag lines and garden rakes to specially designed weed cutters. This method is the most species-specific mechanical method of plant removal since an individual can physically see which plants are going to be removed and which will be missed. This method, however, is also the most labor-intensive means of controlling plants, and its feasibility is directly affected by the available labor force. This method is most applicable to individual property owners who wish to maintain clear areas for swimming, fishing, and for boat access to their dock. And since many times plants are not removed from the root, repeated efforts are needed to maintain the benefits. WDNR permits may be required for manual harvesting. Contact the local APM coordinator for more information regarding permitting requirements.

Sediment screens range from fiberglass or plastic mesh screens to simply sand or gravel, and are placed on the existing sediment and plants to block light and suppress growth. While the synthetic barriers make better screens, they are the most difficult to install and maintain. The screens must be installed early in the year and securely anchored to the sediment to prevent them from being disturbed. The screens must be removed and cleaned periodically to prevent sediment from building up on top of them.

Sand and gravel are more natural means of suppressing aquatic vegetation and are less expensive, but they also require maintenance on an annual basis and are less effective. WDNR permits are required for sediment screening. Contact the local APM coordinator for more information regarding permitting requirements.

Water level manipulation, commonly referred to as "draw-down", is a useful way to control nuisance vegetation that occurs in the shallow regions of a lake. This method is typically applied in the fall and over winter. Cold, dry conditions are best for a draw-down event, because frozen sediments will kill most of the seed bank and compress soft sediments. Both of these conditions prevent plant growth in the following spring when the water level is brought back up to normal conditions. This method severely impacts

recreational uses while the water level is lowered and has the potential to trap fish and other wildlife in shallow areas that may not become completely dry but do freeze from top to bottom over the winter.

Drawing the water level down in the summer has the opposite effect on plant growth. Lowering the water level generally increases the wetland area, and the littoral zone of a lake becomes larger. This provides more habitat for plants to become established. This is a low-labor option but can become expensive if power is generated at the dam. The power company may be entitled to compensation for loss of power generated during the draw-down.

Raising the water level in the summer can also suppress aquatic vegetation by limiting the amount of light penetrating to the bottom thereby making the littoral zone smaller. Raising the water level of Montello Lake in the summer will not provide relief because of the lake's relatively clear water.

WDNR permits are required for water-level manipulations. Contact the local APM coordinator for more information regarding permitting requirements.

Dredging sediments and plants is usually only performed when an increase in depth is a required part of the management outcome. If the depth is increased sufficiently, light penetration is limited in the dredged area and plant growth is suppressed. Dredging an entire lake bed is very rarely performed. Dredging small areas for boat access and other recreational uses is a cheaper and more applicable compromise. WDNR permits are required for dredging. Contact the local APM coordinator for more information regarding permitting requirements.

Chemical control of aquatic plants and algae is often used in areas where vegetation has created nuisance conditions. Herbicides and algaecides are used to control a wide variety of plant and algae species. Some herbicides and application methods are very specific for which plants they will control. Others control a wide variety of vegetation. In some

cases, the precision and concentration of herbicide applied will also determine which species are controlled.

Chemical applications are designed to control vegetation which is already present and rarely address the underlying nutrient problem associated with nuisance plants and algae. They are sometimes the only economically feasible method for creating recreational relief. Recent advances in technologies have made chemical control a more favorable tool for managing exotic species selectively while restoring native habitats. WDNR permits are required for aquatic herbicide applications. Contact the local APM coordinator for more information regarding permitting requirements.

Biomanipulation refers to altering a food web in order to obtain a desired end result. In the case of controlling algae, a "top-down" approach is taken. Promoting top-level predator fish like muskellunge, walleye, largemouth bass, and northern pike naturally reduces the panfish population. Panfish graze on zooplankton (algae eaters). When zooplankton reach higher numbers, more algae is consumed and the water clarity is increased. This is generally used only to improve water clarity, however improved water clarity has a significant impact on plant distribution within the lake. WDNR permits are required for biomanipulation. Contact the local APM coordinator for more information regarding permitting requirements.

Biological Control Agents is a term used to describe organisms capable of controlling other organisms within their ecosystem by various methods. For example, loosestrife weevils have been used to control the exotic plant purple loosestrife. The weevils are tiny insects that use the plants for food, shelter and to reproduce. The weevil larvae consume plant material and make growth and reproduction difficult, if not impossible, for the plant. A similar situation is suggested to occur for EWM, an aquatic exotic plant. There are no known biological control agents that would improve conditions within Montello Lake with respect to CLP and nuisance natives.

No management means that the lake resources are not actively managed but are monitored on a regular basis. Monitoring results are tracked and compared from year to year. When conditions that warrant management are discovered, a management tool is selected. In some cases, the plant community will face a natural obstruction and balance is regained naturally.

4.2 Discussion of Aquatic Plant Management Options

Of the listed management options, lake level manipulation, dredging, chemical control, and mechanical harvesting are the most applicable techniques for Montello Lake. Sediment screens and manual removal will not create noticeable improvements because of their size limitations. Biomanipulation will not help the plant community unless grass carp are stocked. Stocking weed-eating fish would disrupt the ecology of the lake, is illegal in Wisconsin, and therefore is not a practical option. Biological control is unproven in Montello Lake and would take a considerable effort with no guaranteed pay-off.

The Montello Lake Protection and Rehabilitation District has been managing their aquatic plant community over the past 5 years under an integrated approach. The District members have a good understanding of the management options available to them and the benefits and drawbacks of each. The following sub-sections cover the most common aquatic plant management techniques and emphasize the tools implemented since 2002. Successes and failures are also mentioned for techniques previously attempted.

Chemical Control in 2003 was geared toward CLP management while treatments in 2004 through 2006 were geared toward EWM management. These treatments provided annual relief for recreationists but will not likely create beneficial long-term changes in the aquatic plant community. The treatments are most important for EWM where harvesting may cause the spread of fragments and in areas too shallow for safe harvesting.

Water level manipulation in 2002-03 was very successful in controlling submersed aquatic vegetation in the affected areas. The duration of the effects is somewhat

subjective but was at minimum 1 year and maximum 3; levels of aquatic vegetation were at or near pre-drawdown levels in the summer of 2005 and fully recovered by 2006. The sediment compaction study also showed a gain in lake depth of approximately 6 inches. It is unclear how long the sediment remained compacted after re-watering. Some residents did express their discontent with a winter fish kill they felt was a direct result of the drawdown.

Mechanical harvesting efforts have provided the expected relief and will continue to play a role in the integrated management approach for Montello Lake. Harvesting provides recreational access and also provides predator fish with lanes for stalking and capturing prey. Harvesting also removes plant biomass which means a reduction in nutrients and decaying organic matter.

Past harvesting efforts have been guided by public input and by following lines marked on paper maps. Future harvesting will be performed using an on-board GPS guidance system which will be acquired through grant funding. Harvesting will be performed based on predefined management channels and each cutting will be digitally recorded. This will help the District better gauge their benefit per unit effort (i.e., they will be able to calculate the acres harvested per hour and plant mass harvested per acre).

In most cases, integrated approaches produce the best results. Regardless of the selected management activities, the goal of the plan should be to rehabilitate the native plant community and protect valuable habitat while limiting non-native growth and distribution.

4.3 Options for Managing Water Quality

The following management options can help improve water quality in lakes:

- Dredging
- Weed harvesting
- Biomanipulation
- Chemical manipulations

- Water circulation/aeration
- Watershed Best Management Practices (BMPs)
- Water level manipulation

There are nearly endless options for improving water quality but some are not feasible due to cost or ecological impact. The most common approaches involve practices that are inexpensive and result in long-term changes. The remainder of this section explores options for managing water quality.

Dredging removes nutrient rich sediments from the lake and typically results in deeper water, less organic and fine sediments, and reduced aquatic plant growth. Depending on the extent of the dredging project, results may also include improved flow and sediment transport and can reduce algal blooms. Dredging is, however, very disruptive to the aquatic ecosystem and can have unforeseen adverse impacts. Dredging is very expensive and requires extensive permitting and monitoring. For these reasons, dredging is not considered a viable option.

Weed harvesting can improve Montello Lake's water quality in three distinct ways. First, removing plant biomass from the lake and immediate watershed will remove nutrients from the lake. However, the amount of plant material removed during harvesting will not be enough to make a noticeable difference on its own.

The second way weed harvesting can improve water quality is that removing biomass in the summer means less decaying organic matter will deposit in the lake in the fall and winter. Like nutrient removal, weed harvesting will not noticeably reduce the amount of organic sediment as plants will still top out and reach their full size prior to dying for the season.

The third way weed harvesting can improve water quality is by reducing seasonal nutrient load caused by decaying CLP each summer. CLP has an annual cycle which starts in late fall and ends in early summer. Decaying CLP can release up to five pounds

of elemental phosphorus per monotypic acre. Timing of CLP decay promotes algae but can also fuel aggressive submersed aquatic plants. Managing CLP each fall or spring can reduce the amount of nutrients released in June and July when it would naturally decay.

Biomanipulation can cause a shift in the fish and plant community which favors water clarity. Stocking/promoting top end predator fish can actually improve water quality. This concept is a "top-down management" practice. Top-down management works under the theory that top end predators ultimately control the direction of lower trophic levels. Picivorus fish remove panfish and baitfish which feed on zooplankton which graze on phytoplankton (planktonic algae). The result is fewer phytoplankton which means clearer water. This method of biomanipulation may also improve the fishery through increased competition and predation of rough fish and panfish.

Top end predators can control rough fish species, like common carp, which have been linked to increased turbidity. Many methods for removing common carp have be successful but few are as benign and long-lasting as promoting predators like northern pike, muskellunge, and certain catfish species. This can be accomplished through education and promotion of catch-and-release for game fish and removal of rough fish and planktivores and improving aquatic plant habitat. Stocking efforts can also be used to supplement the current picivorus fish community. This form of biomanipulation starts at the top of the food chain while other manipulations are implemented at the base.

Removing planktivorus fish, like bluegill, can improve water quality by reducing the pressure on zooplankton which feed on phytoplankton. This, too, can be accomplished through public education and sportsmen involvement. Lakes with few predators tend to have many panfish which never reach great size due to crowding and competition. Since sportsmen don't typically keep as many small fish, the problem persists and can become worse.

Chemical manipulations involve adding foreign substances to change the chemical qualities of a lake. These can include pH/buffer manipulations and nutrient precipitation.

The most common technique for managing water quality in phosphorus limited lakes involves applying a chemical called alum which binds to free phosphorus in the water, forms a precipitate, and settles to the bottom of the lake. This process removes phosphorus from the water column and prevents internal loading of phosphorus by creating a barrier on the sediment. Results typically last several years but since alum treatments don't address the source of nutrient problems, repeat applications will be necessary to maintain desired phosphorus concentrations.

These manipulations work well for small seepage lakes with high water retention times. Treating water in impoundments with short water retention times is not beneficial because the results will literally be washed away.

Water circulation and aeration can help improve water quality by keeping a lake well mixed and maintaining artificially high oxygen levels at the water-sediment interface. This will reduce the amount of nutrients entering the water from internal loading and will reduce algal growth by circulating algae to aphotic zones where they can't grow as rapidly.

Like chemical manipulations, water circulation and aeration work well in "closed" systems of small seepage lakes where the water volume to surface area ratio is greater and thermal stratification occurs. Shallow impoundments don't have an anoxic or aphotic hypolimnion. Some circulators and aerators can actually cause increased sediment disturbance and would therefore contribute to the problem.

Watershed Best Management Practices address the sources and transportation of nutrients and sediments into the lake. Because these techniques influence the way water moves throughout the watershed, lakes with large watersheds stand the most to gain from implementing BMPs.

These techniques can be implemented by residents, farmers, industry, and municipalities or other governmental agencies. Techniques range from ordinary rain gardens

implemented by a home owner to EPA regulations regarding industrial emission standards. Unlike top-down management approaches, watershed management focuses on what goes into the lake and is therefore considered a "bottom-up" approach.

Best Management Practices should focus on what the District can control and should include ways to measure results. Managing the watershed corrects the source of impairment and results tend to last longer than those gained by manipulating conditions within the lake. This is the most highly recommended management method for improving water quality within Montello Lake.

Water level manipulation (drawdown) can improve water quality by compacting sediments in areas exposed during a drawdown. Many areas of Montello Lake are less than 6 feet deep and would be dewatered if the lake level was lowered. These same areas are typically covered with fine organic sediments that would be compacted during the dewatering process. Exposed sediments can also be oxidized and further reduced during dewatering. When the lake level is brought back up, the sediments remain compacted for a period of time. During this time, sediment suspension is reduced and turbidity is decreased. The results, however, don't last indefinitely and repeated drawdowns will be necessary to maintain effects.

4.4 Discussion of Water Quality Management Options

Of the management options listed, watershed BMPs are the most practical for Montello Lake. While mechanical harvesting and drawdown will have water quality impacts, their results alone will not create noticeable changes in water quality. The lake already has good water clarity evidenced by the presence of rooted aquatic vegetation throughout the lake. Fresh water sponges, which are thought to be indicators of good water quality, have been regularly found during quantitative plant surveys in Montello Lake.

Excessive nutrients are the main concern for Montello Lake's water quality. Nutrient inputs can be minimized by implementing watershed BMPs. These practices should focus on the large agricultural portions of the watershed. Since the watershed is fairly

sizable, it should be broken down into sub-watersheds and the pieces can be managed separately. This will allow for flexibility from area to area where different management approaches will be necessary due to variation in land use and farming practices.

5.0 Aquatic Plant Management Overview

A complete aquatic macrophyte management plan follows a series of steps. A plan organizes labor and resources for a clearly defined mission and outlines a way to measure success. The WDNR is currently in the process of creating a "manual" for aquatic plant management in Wisconsin. The manual outlines a seven-step process for managing aquatic plants. The steps to completing a plant management plan are:

- Setting Goals. . .Why are We Doing This?
- Inventory. . .Gather Information
- Analysis. . .Synthesis of the Information
- Alternatives. . .Providing Choices
- Recommendations. . .Completing the Plan for a Formal Decision
- Implementation. . .Taking Action
- Monitor and Modify. . .So How are We Doing?

The purpose of the following sub-sections is to provide the Montello Lake District with an overview of each step, explain what measures the District has already taken towards completing the step, and explain what, if any, additional action the District must take to complete the step.

5.1 Setting Goals

Overview

In order to set goals for aquatic plant management, a lake group must identify problems facing lake users and what endpoint is desired through management efforts. Setting goals involve the following three steps: 1) Develop a goal statement; 2) Create a plan of work; 3) Create a communication and education strategy.

Completed

The first step to improving aquatic plant conditions within Montello Lake is to complete the APM Plan. Public interest in improving conditions is high, and the finished plan will reflect the interests of the property owners while taking into consideration the best action for the resource.

The MLPRD will continue to hold regular meetings throughout the planning and implementation of the APM Plan. Special meetings may be called when certain topics warrant immediate attention. In addition, TLI will provide educational materials and an informal presentation of the preliminary findings of the plant and water quality monitoring activities so that the District may make a well-informed decision regarding future management.

Goal Statement

The goal of this plan is to identify and implement the most successful management techniques for the aquatic plant issues facing the Montello Lake Protection and Rehabilitation District. The District will continue to support public education and participation as well as implementation of the integrated management approach in order to maintain reasonable recreational use of the lake.

Additional Action

There is no additional action required for setting goals.

5.2 Inventory

Overview

In this step of the plan, information regarding several aspects of the lake and surrounding area need to be collected and analyzed. Examples of information that should be gathered include:

- Existing plans and studies
- Data regarding plants, fish, wildlife, and water quality within the lake
- Maps and historical documentation that describes past conditions of the lake
- Aerial photographs of the lake
- State and local regulations and ordinances
- Technical information or research on the topics of concern to the District
- Examples of other lake APM plans

Additional information may have to be reviewed depending on the goals of the District. The WDNR, UW-Extension, and regional resources such as county zoning, town clerk, and planning offices are great places to gather most of this information. Past consulting firms may also be able to provide some information specific to their findings.

Completed

As part of several studies conducted since 1994, historical data regarding the aquatic plant community, fishery and wildlife, and water quality of Montello Lake has been collected and organized. A current plant community inventory was collected in 2006 as part of the current management plan.

Additional Action

The District will store all information regarding their lake management activities with the District President. The District will be keep records of all management activities, meetings, and reports. The information will be kept in hard copy format in a standard file box or cabinet and accompanied by electronic formats when available. The District President will maintain the organization of the file and will create additional files as necessary. The files will be kept at a location agreed upon by the District board members. Access to these records will be provided upon reasonable request. Examples of information the District will keep include:

- Past Management Plans
- Public Surveys
- Contracts/Agreements with Consulting Firms
- Management Activity and Implementation Reports

5.3 Analysis

Overview

The analysis step is the most critical step in the management process. It is during this step that the information gathered in the previous step is thoroughly analyzed and compared to the initial issues voiced. The information should provide an objective view of the perceived problems and be summarized in an "Analysis Report". Individuals

dedicated to completing this step need to approach the analysis with open and objective minds so that decisions are based on fact and not emotion or public pressure. To create an objective Analysis Report, consider these three variables: (1) What is the nature of people's concerns; (2) Where do conflicts occur; and (3) Has the problem changed over time?

(1) Considering the nature of people's concerns involves dissecting public input to decide if opinions genuinely have the health of the resource in mind. People must understand that not all plants are nuisances and that a certain amount of vegetation is necessary to sustain fish and wildlife and that it helps improve water quality and general aesthetics.

(2) Identifying areas where conflicts regarding lake use and proposed management may occur will help create a more detailed management plan. Areas that will have restricted use based on management activities need to be identified and management activities timed according to expected lake use. For example, one would not propose to perform a large scale herbicide treatment prior to the 4th of July when use restrictions may prevent activities such as swimming or fishing over the holiday weekend.

(3) Determining whether the problem has changed over time involves reviewing objective information gathered regarding the problem. A previous study or plan may contain objective findings regarding the problem and can be used to compare past conditions to the current state.

Completed – Analysis Report

Public opinion supports findings of water quality monitoring in that the current conditions are favorable for recreation and meet the needs of District members. The District should focus on water quality monitoring and protection for the time being. Preventative actions are required before conditions worsen and will provide years of results. It is very difficult to manipulate water quality once eutrophic conditions are established.

Plant inventory data suggests that EWM, coontail, and CLP have historically caused the greatest nuisance conditions. EWM and coontail cause nuisance conditions in the summer which generally occur in shallow bays and in near-shore areas. Large areas of EWM exist along some shorelines and should be monitored annually to determine if density or distribution increase. If management actions should be needed to meet the District's goals, they will likely include annual harvesting, herbicide treatments for EWM and periodic drawdowns. Coontail is the most likely plant to replace EWM after management and should also be monitored to determine if it will subsequently require management. Coontail is difficult to manage with herbicides because it does not form well established roots and can float in and out of different areas in the lake. Applying herbicides should only occur if coontail has demonstrated it is not easily moving in and out of the treatment zone.

The nature of people's concerns is genuine and in the best interest of the lake resource. The District is unified in its efforts, but some conflicts are apparent. One conflict is that some residents feel management efforts are contributing to problems on Montello Lake (Montello Lake Management Plan, 2000 survey results). A second conflict exists near the public beach where the City draws water for irrigation of their adjacent baseball fields. This is the only public irrigation or drinking water intake know to exist and care should be taken to avoid irrigating after herbicide applications. If irrigation is unavoidable, the area surrounding the public beach should not be managed with aquatic herbicides that have irrigation restrictions.

Based on the analysis of the inventory data and public feedback from the 2000 survey, Level III management is necessary to manage the plant community within Montello Lake. The remaining elements of this plan are those required of a Level III management plan.

Additional Action

There is no additional action required of the Montello Lake District.

5.4 Alternatives

Overview

It is difficult to conduct an analysis without simultaneously considering alternative management techniques. So, these portions of the plan may become merged into an "Alternatives Analysis". However, it is important that the need for and level of control be established independent of choosing the control method. The amount of discussion on alternatives will correspond with the level of control proposed.

Completed

The District has been presented with alternatives suitable for Montello Lake and is aware of the costs and benefits associated with each. District members have reviewed the table on the following page and have a clear understanding of the problems facing Montello Lake.

Additional Action

There is no additional action required of the Montello Lake District regarding the alternatives step.

Table 2. Comparison of various aquatic plant management options.

	Benefits	Drawbacks	Applicable	Recommended	Costs[1]	Longevity
Mechanical Harvesting	Removes plants and nutrients	Small areas controlled	Yes	Yes	$200,000 equipment and $200-600 per acre	1-3 Weeks
	Immediate relief	Can not reach shallow areas				
	No use restrictions	Not species selective				
	No potentially harmful chemicals	Promotes growth of opportunistic plants				
Manual Harvesting	Species specific	Labor intensive	Yes	Yes	$100-? per acre	1-3 Weeks
	Shallow areas affected	Very small areas controlled				
	No chemicals	Slow				
	Removes plants and nutrients	Correct plant ID required				
Sediment Screens	Little negative impact to whole lake	Harms benthic invertebrates	Yes	No	$20,000-50,000 per acre	Months to Years
	No chemicals	Permit required				
	Site specific control	Difficult to install				
	Reversible	Expensive				
Water Level Manipulation	Controls plants in shallows	Restricts recreational use during	Yes	Yes	$1,000-2,000 per acre	1-2 Years
	Sediment compaction	Perfect weather conditions required				
	2 years of control	Disrupts wildlife				
	Inexpensive (maybe)	Expensive (maybe)				
Dredging	Improves navigation	Increases turbidity	Yes	No	$20,000-80,000 per acre	Depends on sedimentation rate
	Removes plants and nutrients	Releases toxic contaminants				
		Destroys habitat				
		Very expensive				
Chemical Control	Quick relief	Repeat treatments required	Yes	Yes	$1,000-2,000 per acre	Months to Years
	Species specific	Does not remove nutrients				
	2 months of relief	Promotes aggressive species				
	Cost effective	Can increase algal blooms				
Biological control agents	Cost effective over the long term	Oscillating cycle of control	Yes	No	$300 - $3,000 per acre	Years
	Long term relief	Does not address nuisance natives				
	EWM specific	Susceptible to shoreline developments				
Biomanipulation	Long lasting	Hard to start	No	No	Varies	Varies
	Self sustaining	Alters habitat				
	No chemicals	May have negative impacts on habitat				
	Improves water quality	Can be irreversible				
	Improves fishery					

[1] Cost range per acre treated without consideration of longevity of effects (Holdren et al. 2001)

5.5 Recommendations

Overview

In this step of the plan, a preferred management tool(s) is selected. This requires reviewing the goals and objectives set in step one, reviewing existing conditions from step two, reviewing the level of management decided in step three, and reviewing management alternatives from step four. The next step in the recommendations is to evaluate the action plan, organize resources such as volunteer time and District budget, and identify and meet legal obligations prior to implementing the plan. Such legal obligations may be obtaining state permits for managing plants or informing the public of herbicide applications. Many of the requirements are listed in Wisconsin state statutes NR107 and NR109.

Completed

Primary Management Tool Selected[2]

The Montello Lake Protection and Rehabilitation District has chosen to continue their integrated aquatic plant management approach through 2011. The approach utilizes water level drawdown, mechanical harvesting and chemical control. Future considerations will be made for sediment dredging and biological control of EWM.

Additional Action

The District has chosen its preferred primary management techniques based on objective inventory data, comparative analysis of options, public opinion, and historical successes. Further action is not necessary for this step of the planning process.

5.6 Implementation

Overview

Implementation can be broken down into three steps. The first step is to adopt the plan. The plan should be adopted by the District first. The District should then present the adopted plan to local units of government for additional support. In the case of creating

[2] Prepared by the Montello District in 2006

ordinances as part of the plan, government bodies will be essential in creating and enforcing laws.

The second step to implementation is to prioritize and schedule actions. Actions can be immediate, short-range, medium-range, and long-range.

The final step of implementation is to assign roles and responsibilities for the various agencies involved in the management activities. The responsibilities need to be clearly defined and recognized by the individuals and organizations responsible for carrying them out. Formal resolutions and contracts are usually adequate in covering these responsibilities.

Completed

Plan Adoption

The District has arranged for TLI to distribute a draft version of this document to the vested parties for review. The vested parties have the opportunity to make suggestions for revisions to TLI. The document will then be revised and a final draft will be distributed to the District and WDNR. The APM plan is expected to be completed in February 2007, and submitted to the WDNR shortly thereafter. The District will adopt the plan and request support from the WDNR and Marquette County. Once the WDNR approved the plan, the District will proceed with application to the Townships for help in getting implementation grants. If unsuccessful, recommendations will be made to finance future treatments by District budget (see Section 7.0).

Immediate Implementation Actions

Educational campaigns designed to inform property owners about the value of aquatic plants and what they can do to help improve the water quality should start immediately. Information on how property owners and lake patrons can help protect water quality should also be included in the campaign. The District board should have a member responsible for carrying out the educational campaign. Information and resources can be gathered from the WDNR, Marquette County, and local UW-extension office.

Educational materials may be typed and distributed, posted in a public place, or presented as part of regular District meetings. The reason for the campaign is to raise awareness, solicit involvement, and promote action.

Short-term Implementation Actions

Short-term plant management actions will include drawdown, manual harvesting and selective herbicide applications. Integrated management strategies provide the flexibility to manage different areas of the lake in different ways. Manual harvesting can be used to create relief for individual property owners. Herbicide treatments will provide relief for individual property owners as well as entire bays of the lake and high use recreational areas. An integrated approach will include the three management practices and will result in clear navigation, access to private piers and docks, and control of non-native species.

Another short-term goal is to protect valuable aquatic habitat by promoting the growth of high-value native plant species and protect certain areas by minimizing impacts from management practices as well as recreationists. The District will request that the WDNR designate sensitive areas of the lake. The District will then consider those areas when planning their management activities.

An additional short-term action will include improving water quality (gauged by annual average Secchi depth) by implementing certain BMPs throughout the watershed. Protecting water quality is a fundamental aspect of lake improvement projects.

The District plans to address short term actions by the following:

- The District will evaluate the status of the aquatic plant community (ongoing)
- Monitor and protect the water quality at Montello Lake (Self-Help monitoring, weekly Secchi depths, monthly water samples)
- Complete a public use survey (2000)
- Educate members, the general public and local governments about aquatic plant management activities and planning processes (newsletters, meetings, notices, etc.)
- Complete and submit this updated Aquatic Plant Management Plan to Wisconsin Department of Natural Resources for plan approval (Spring 2007)

Intermediate Actions

The District plans to implement the flowing intermediate actions:

- Educate members and the general public in specific plant management techniques and practices
- Implement a Clean Boats, Clean Water education program to prevent additional exotic species infestation problems
- Participate in Self-Help Secchi disk monitoring

Long-term Implementation Actions

Water quality monitoring will be an ongoing process and the plant community will be monitored professionally every three to five years.

The District will address long-term actions as needed. We plan to achieve long-term results by managing nuisance plant growth, promoting growth of high value native plants, monitor and protect water quality, plan and budget for a professional analysis of the lake every three to five years, and find assistance to help fund implementation by applying for grants.

Additional Action

There are no additional actions needed by the District with respect to the implementation step.

Funding Sources and District Budget

The District has set aside approximately $20,000 per year for annual aquatic plant management from 2007 through 2011. The expected budget from 2007 to 2011 is approximately $208,000. Approximately $92,000 may be available through grant funding while the remaining $116,000 is in the District's budget. Future expenditures, including those partially covered by grant funding options, will be discussed and budgeted during the Board of Directors annual budget process.

The Board of Directors is committed to the implementation of the Aquatic Plant Management Plan and will set aside money for implementation during their annual

budgeting process. The District will apply for implementation grants by presenting the approved plan to the City of Montello, Marquette County, and WDNR.

5.7 Monitor and Modify

Overview

Monitoring the plant community with methods outlined by the WDNR ensures that objective values are obtained and that management activities are evaluated without bias. Future decisions concerning the plant community will be based on objective data gathered annually throughout implementation of the plan. It is important for the District to realize that effective monitoring will be the result of clearly defined performance objectives.

The WDNR APM guidelines outline the necessary monitoring and background information needed to perform Level I through III aquatic plant management activities in Wisconsin lakes. This report has been written to satisfy the requirements for the highest level of management described in the WDNR APM guidelines – Level III. The methods for monitoring and tracking management progress occur annually. The guidelines also recommend calculating the FQI annually. The FQI should increase if the frequency of exotic species decreases and/or the frequency of native species, especially those designated as "sensitive species", increases. Calculating the FQI is explained in the WDNR's Aquatic Plant Management in Wisconsin guidelines.

General monitoring methods are also outlined in the WDNR's Aquatic Plant Management in Wisconsin manual. Specific monitoring is required for herbicide applications, draw-downs, and harvesting, while other recommendations exist for monitoring current exotic species and preventing others. The current version of the manual is a draft and is not available for distribution. Once the manual is made available, the District will receive a copy. The District should insist that all management and monitoring activities follow the recommendations within the current draft of the manual.

Completed

Future monitoring will be dependent on the management activities that are performed. The minimum requirements are outlined in section 6 of this report and include plant and water quality monitoring. Additional monitoring may be required by the regional DNR aquatic plant management coordinator as part of the application process for harvesting, drawdown, and chemical control of aquatic plants.

APM Plan updates and revisions will be made throughout the approval and monitor and modify processes. In addition, the District will have a formal plan update at least every five years.

Additional Action

The Montello Lake Aquatic Plant Management Plan will be updated every 3 to 5 years and will include a review of past management including specific tracking of efforts, costs, and benefits. Plan updates will provide the flexibility to change the course of management as public and ecological needs change.

6.0 Recommendations

6.1 Specific Elements of the Montello Lake APM Plan

This section lists the specific recommendations of the WDNR for Level III management. The recommendations have either been satisfied based on information gathered during previous studies and management activities (black items) or still need to be fulfilled (red items).

Goals

- ✓ Purpose Statement (Section 3.1)
- ✓ Goal Statement (Section 5.1)

Management History

- ✓ Summary of past management activities (Section 3.0)

Plant Community

- ✓ Comprehensive species list and review growth cycles of dominant species (2003 through 2006 Implementation Reports)
- ✓ Total surface area covered by aquatic vegetation (2003 through 2006 Implementation Reports)
- ✓ Highlight rare, threatened or endangered species and species of concern (2003 through 2006 Implementation Reports)
- ✓ Highlight invasive and non-native species, map, and compare to native community (2003 through 2006 Implementation Reports)
- ✓ Describe beneficial use of plants as well as nuisance or use conflicts associated with plant community (Section 2.0)
- ✓ Describe vegetative characteristics of near shore or shoreland areas (these have not been surveyed or at least not reported)
- ✓ Collect quantitative data of the lake's aquatic plant community (2003 through 2006 Implementation Reports)
- ✓ Determine the percent frequency of each species present (2003 through 2006 Implementation Reports)
- ✓ Determine the lake's FQI (Section 3.5)
- ✓ Collect three samples of each species for herbarium specimens (this has not occurred in past surveys)
- ✓ Label sites where rare, threatened, endangered, special concern, invasive, and non-native plants were found (2003-2006 Implementation Reports)
- ✓ Map areas to show dominant species type and aquatic invasive species (AIS)(Appendix A&C 2003 through 2006 Implementation Reports)
- ✓ Maintain plant information in database or GIS including species name, location, and date sampled (2003 through 2006 Implementation Reports)
- ✓ Create map depicting proposed management areas and affect of management (Section 6.3.1)
- ✓ Map coordinates to be recorded on GIS map

Lake Map

- ✓ Obtain map with accurate scale (2003 through 2006 Implementation Reports)
- ✓ Determine township, range and section of lake (Section 1.0)
- ✓ Tabulate lake surface area, and maximum and mean depths (Section 1.0)
- ✓ Find Water Body Identification Code (WBIC) assigned by WDNR (Section 1.0)
- ✓ Obtain aerial photos of lake (2003 through 2006 Implementation Reports)
- ✓ Obtain bathymetric map of lake (Not available)
- ✓ Identify sediment characteristics (Section 3.7)
- ✓ Use GPS to record locations of specific sites of interest such as plant sampling locations (2003 through 2006 Implementation Reports)

Fishery & Wildlife

- ✓ Prepare a narrative describing the fish and wildlife community and its relationship to the plant community (Section 2.0)
- ✓ Identify any areas designated as "Sensitive Areas" by the WDNR (None listed)
- ✓ Identify areas where rare, threatened, or endangered species or species of special concern exist (2003-2006 Implementation Reports)
- ✓ Conduct specific surveys as required (NA)

Water Quality

- ✓ Obtain one year of current water quality, including a minimum of five Secchi disk readings from June 1 to August 31
- ✓ Prepare summary of historical data (Section 3.0)
- ✓ Measure the temperature and dissolved oxygen at one-meter intervals at the deepest point of the lake during the summer
- ✓ Measure nutrient levels for TP, TKN, nitrate, ammonium and nitrite throughout the summer and obtain nutrient budget if available
- ✓ Measure chlorophyll-a concentrations, turbidity, alkalinity, and pH throughout the summer

Water Use

- ✓ Note primary human use patterns in the lake and on shore
- ✓ Note areas where use is restricted for any reason
- ✓ Collect public survey to gather opinions and perceptions on plant and water conditions (2002 Montello Lake Management Plan)
- ✓ Note water intakes for public water supply or irrigation (Section 5.3)
- ✓ Include the above information on GIS map

Watershed Description

- ✓ Provide topographical map showing watershed boundaries, inflows and outflows (2002 Montello Lake Management Plan)
- ✓ Determine watershed area (2002 Montello Lake Management Plan)
- ✓ Quantify land use areas within watershed (2002 Montello Lake Management Plan)
- ✓ Calculate nutrient loading by area (2004 Lake Montello Limited Phosphorus Budget)

- ✓ Locate all inputs into lake including streams, drainage ditches, drain tile, etc.
- ✓ Include the above information on GIS map
- ✓ Model the lake and watershed to develop annual nutrient budget (2004 Lake Montello Limited Phosphorus Budget)

Analysis

- ✓ Identify management objectives needed to maintain and restore beneficial uses of the lake (Section 5.3)
- ✓ Create maps and overlays of the information from the inventory and interpret the results (2003 through 2006 Implementation Reports)
- ✓ Identify target levels or intensity of manipulations (Section 5.3)
- ✓ Map areas proposed for management (Section 6.3)
- ✓ Mapping coordinates should be recorded on a GIS map

Alternatives

- ✓ Plans should include measures to protect the valuable elements of the aquatic plant community as well as measures to control nonnative and invasive plants, plants that interfere with beneficial lake uses, and plants that enhance habitat for fish and aquatic life (Section 6.3)
- ✓ Discuss most common plant control techniques, benefits, drawbacks with vested parties (Sections 4.0 and 5.4)
- ✓ Provide sufficient information regarding the feasibility, costs, and duration of control expected of each alternative (Sections 4.0 and 5.4)
- ✓ Discuss the potential adverse impacts of each alternative (Section 4.0 and 5.4)

Recommendations

- ✓ Develop an invasive species prevention program including education and monitoring (Section 6.4)
- ✓ Implement "Clean Boats, Clean Waters" program (Section 6.4)
- ✓ Involve the public in keeping the lake healthy by finding ways to decrease harmful watershed inputs (Section 6.4)
- ✓ List proposed control actions beyond those strictly necessary for aquatic plant management that will be implemented to achieve desired level of control (Section 6.4)
- ✓ Identify specific areas for control on a map and list the level of proposed management (Sections 5.3 and 6.3)

Implementation

- ✓ Describe education or prevention strategies needed to maintain and protect the plant community (Section 6.4)
- ✓ Describe how all the management recommendations will be implemented, the methods and schedules applicable to the operation, including, timing, capital, operational cost estimates, and maintenance schedules if applicable. Describe the roles and responsibilities of the persons and/or organizations involved in the management process (Sections 6.3 and 6.4)
- ✓ Describe how the public will be involved (Section 6.4)

- ✓ Prepare a budget and identify funding sources, including plans for grant application (Section 6.5)
- ✓ Describe the process by which the plan will be adopted, revised, and coordinated, with WDNR approval (Section 6.2)

Monitoring and Evaluation (Lakes with Known Invasive Populations and Following Management Actions)

- ✓ Monitor for invasive aquatic plants in early spring and twice in the summer Perform quantitative plant survey at least once every five years (Section 6.4)
- ✓ Track diversity indices such as FQI for early warning signs of decreasing diversity or water quality (Section 6.4)
- ✓ Contract for a professional survey every 3 to 5 years for the presence of exotic species and for updating the native plant list (Section 6.4)
- ✓ For lakes with known exotics, sample more often, use the rake method, and sample areas of know infestation, major inlets, and boat launches (Section 6.4)
- ✓ Following management activities collect basic water chemistry and physical parameters such as TP, TKN, temperature, pH, dissolved and dissolved oxygen at a mid lake site and within each management zone (Sections6.4)

6.2 Aquatic Plant Management Plan Update

The recommendations for Montello Lake Inland Protection and Rehabilitation District are to continue their integrated management approach including periodic lake level drawdown, selective herbicide applications, and mechanical harvesting supplemented with monitoring of the aquatic plant community. The District has included a budget (Section 7.0) outlining expected costs of each management activity. The District will continue to apply for grant funding for all qualified management activities.

Items from the above list which have not been met will be met while implementing this plan. These items will be met through Advanced Self Help Monitoring in 2007:

- ✓ Obtain one year of current water quality, including a minimum of five Secchi disk readings from June 1 to August 31
- ✓ Measure the temperature and dissolved oxygen at one-meter intervals at the deepest point of the lake during the summer
- ✓ Measure nutrient levels for TP, TKN, nitrate, ammonium and nitrite throughout the summer and obtain nutrient budget if available
- ✓ Measure chlorophyll-a concentrations, turbidity, alkalinity, and pH throughout the summer

These items will be met through annual plant monitoring activities in 2007:

- ✓ Describe vegetative characteristics of near shore or shore-land areas

- ✓ Collect three samples of each species for herbarium specimens

These items will be met through District monitoring and education activities in 2007:

- ✓ Note primary human use patterns in the lake and on shore
- ✓ Note areas where use is restricted for any reason
- ✓ Locate all inputs into lake including streams, drainage ditches, drain tile, etc.

This item applies to more than one specific area but will be implemented by a hired consultant as information becomes available for incorporation (likely 2007-08).

- ✓ Include the above information on GIS map

6.3 Integrated Aquatic Plant Management Strategy

Drawdown, mechanical harvesting and herbicides will all play an important role in future management strategies and need to be used when best suited for particular situations. Harvesting will be performed each spring and summer to control CLP and nuisance native vegetation growing at high densities (>60%). Herbicide applications will control nuisance vegetation *(especially EWM)* when densities are 30% or less or when control is required in areas not safe for harvesting. If harvesting EWM becomes necessary, a winter drawdown will be planned for the winter directly following the summer harvesting. Harvesting EWM in this circumstance is allowed since the drawdown should control any fragmented EWM plants before the next spring; this is the only circumstance harvesting EWM is recommended.

6.3.1 Mechanical Removal

The District will follow a set of guidelines when implementing mechanical harvesting activities. Harvesting will be limited to areas no less than 5' deep to minimize bottom sediment disturbance and protect fish spawning habitat. The harvester will be equipped with a GPS guidance system and navigational channels will be pre-determined by the District prior to harvesting. The GPS guidance system will also have the capability to record and store the path of the harvester while harvesting.

General guidelines are broken down based on the target plant species and are as follows:

CLP

Harvesting CLP will continue from 2007 to 2011. Harvesting efforts for CLP will be focused on harvesting before turion production occurs. The District will monitor the progression of CLP each year and will stop harvesting CLP once turions are present. CLP beds will be mapped in the spring and compared to the Districts pre-determined navigational channel needs. Harvesting will occur in areas where CLP accounts for approximately 60 percent of the plant population and will be recorded via an onboard GPS integrated with GIS. Harvesting sites may be added or removed based on the District's needs and seasonal variation in plant growth.

EWM

Harvesting EWM will be avoided when harvesting other target plants. Harvesting EWM will only occur when over 60 percent of the littoral zone has EWM at relative densities over 60 percent. The rationale is that at this concentration and distribution harvesting will not create any more fragmentation than what would naturally occur. Harvesting EWM must be followed up by a winter drawdown in order to prevent establishment of fragmented EWM. Harvesting zones will be mapped prior to harvesting and loaded onto the on board navigation system. All harvested areas will be mapped and recorded.

Nuisance Natives

Coontail and wild celery posed navigational problems from 2003 to 2006. Each summer these native plants became overgrown and impeded recreation in many areas of the lake. Harvesting nuisance natives within the designated navigational areas will continue through 2011 and will be assessed on an annual basis. As with exotic species harvesting, the effort will be recorded via an onboard GPS integrated with GIS software.

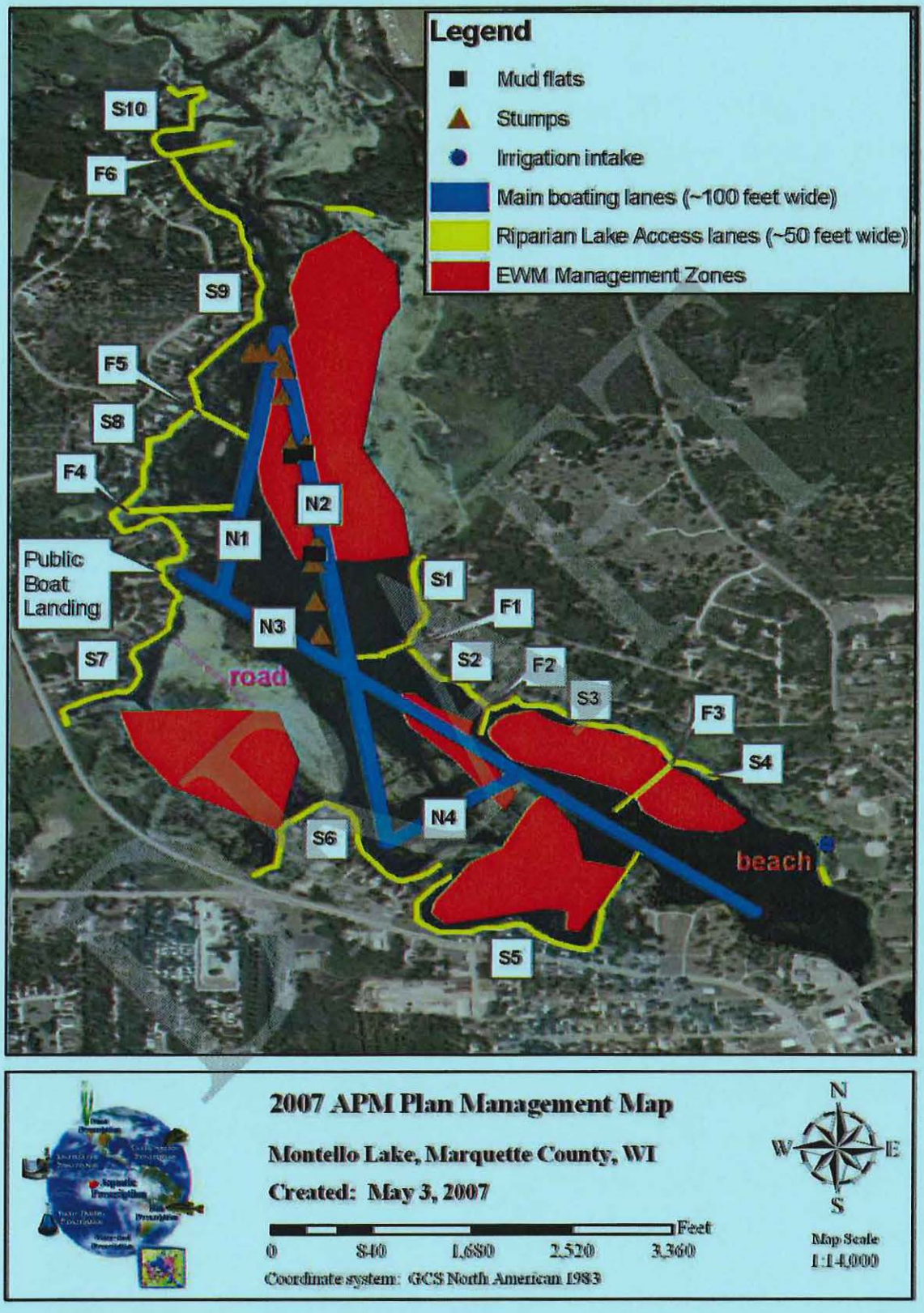

Figure 11. Master harvesting map for 2007 through 2011 for Montello Lake.

6.3.2 Water Level Drawdown

Water level manipulation or drawdown appears to be a very effective means of plant control for Montello Lake based on the 2002 and 2003 aquatic plant surveys. The drawdown should be repeated as necessary to limit vegetation in shallow littoral areas. The duration of control for a drawdown will be anywhere from one to three years depending on winter weather conditions. The frequency of drawdowns for Montello Lake may vary and should be estimated on an annual basis when plants reach nuisance levels. The integrated plan for drawdown implementation will be measured by abundance of EWM and natives plant species. Drawdown will occur when vegetation reaches the threshold of 60 percent coverage and 60 percent relative abundance. Given the level of control achieved in 2003, drawdown should only have to occur once out of every three or four years. Effects of the 2002-2003 drawdown included a reduction in EWM density, increase in abundance of emergent plants in shallow littoral areas, an average 6-inch sediment compaction, and eliminated the need for small scale herbicide treatments. These conditions can be expected when ideal winter conditions are present during drawdown.

6.3.3 Herbicides

The District will continue to implement herbicide applications as part of their integrated approach. The District will solicit bids from professional application firms on an annual basis. The applications will be performed using precision pesticide application methods and technology (GPS/GIS) to ensure accurate application of herbicides within the lake. The District will collect GIS files recorded during herbicide treatments for their records.

Selective **curly-leaf pondweed** *(CLP)* herbicide applications will occur after ice out ideally when the water temperature is between 50 and 58 degrees Fahrenheit, within each of the predetermined management zones. Liquid Aquathol K will be injected into the water at a concentration of 1.0 to 1.5 ppm in management zones less than 5 feet deep. All precautions will be taken to avoid areas of high flow for increased efficacy. In the event flows cannot be avoided granular Aquathol K will be substituted for the liquid

formula. If neither liquid nor granular Aquathol K control plants within the treated areas the areas could be harvested.

Eurasian water-milfoil and **curly-leaf pondweed** can be treated when occupying the same management zones. This option is best deployed when CLP and EWM are both actively growing in mid-spring. If the situation were to arise, the District will have CLP treated with Aquathol K applied at 1-2 ppm which will control CLP and EWM. Some application systems may have the ability to dispense two different herbicides simultaneously and at different rates. If control of both CLP and EWM is required, an alternative to high Aquathol K concentrations will be to apply Aquathol K at 1.5 ppm for CLP and granular 2,4-D at appropriate concentrations for EWM based on water volume and plant densities. This herbicide mixture will control both invasive species.

For selective **Eurasian water-milfoil** *(EWM)* herbicide applications, Triclopyr and Granular 2,4-D products should be applied to the water with precision guided application systems. A detailed area map of the application area*(s)* will be generated during the initial aquatic plant survey*(s)* that will allow accurate calculation of the total product required. Granular 2,4-D will be applied at a rate of 200lbs per surface acre in all areas greater than 6 feet in average depth. Where the average depth is less than 6 feet, an application rate of 150lbs per surface acre will be used. Where the average depth is less than 3 feet an application rate of 100lbs per surface acre will be used. Triclopyr products such as Renovate can be applied sub-surface in dosages of 1.5ppm. Product labels should be carefully monitored as recent changes to the label may require extensive set-back distances from water intakes which are loosely defined by regulatory officials.

For all selective chemical applications the District should have a residual chemical concentration bioassay performed. Pursuant to chemical label restrictions, an approved assay must indicate a concentration for irrigation and for potable water use below label specifications. Samples should be gathered from within the center of each management zone, at any discharge downstream of an application and at a minimum of one non-treated control site. EWM and CLP can be treated when occupying the same

management zones. This option is best deployed when CLP and EWM are both actively growing in mid-spring.

The District may also have the need to treat **nuisance native species**, like coontail, filamentous algae, and elodea, for recreation purposes. This was performed in 2006 in a 50-foot by 50-foot area only at the public beach. The treatments were designed to provide a clear and clean swimming area and have lessened ecological value. These treatments should be limited to high use recreational areas only and evaluated on an annual basis.

6.4 Monitoring and Education Strategy

Monitoring Strategy

Monitoring on Montello Lake will include qualitative *(visual)* lake surveys during each growing season. Scheduled formal plant surveys will document changes in the aquatic plant community. Periodic water quality monitoring and a comprehensive lake-wide fish survey will be conducted as needed. The District will assess the needs for these surveys every 3 years when their plan is updated. Additionally, voucher specimens should be collected (in triplicate) to verify plant identifications and to have a reference for future plant surveyors.

Visual plant surveys will occur in May for CLP and July for EWM each year. Visual surveys will consist of touring the lake in a boat and visually inspecting the littoral zone. Limited rake toss sampling will occur in areas where plants can not be seen from the surface. These surveys will also help document and map monotypic beds of EWM and CLP for that year's management activities. Native plants will also be mapped where they reach nuisance densities and require management.

A whole lake quantitative *(point intercept)* plant survey will be conducted in mid-summer. The survey will help document the lake-wide condition of the aquatic plant community. Data gathered will provide insight into long-term trends in the composition and structure of the plant community. Lake-wide surveys have occurred each year from

2003 to 2006. These surveys helped the District get a good baseline data set for future comparison. These surveys will provide data to qualitatively track the plant community through the use of the Floristic Quality Index.

Whole lake surveys will continue to occur at least once every 3 years though more frequent surveys would be ideal. Frequency of surveys will be based on available funding and District needs. The DNR has published a set of guidelines for aquatic plant management. The recommendations within those guidelines should be followed when applicable. The protocol followed from 2003 to 2006 can continue to be used and will allow direct comparison to previous data. The guidelines suggest slightly different methods and will not allow for direct comparison to previous data. The District will evaluate the possibility of switching their whole lake monitoring activities to the new guidelines.

The District will also have quantitative surveys performed before and after large scale management activities. Point-intercept methods, similar to those used for the whole lake surveys, will be used. Sample points will be located within management areas and in adjacent littoral areas. The DNR guidelines also outline areas of concern that should also be surveyed. These areas include known areas of exotic infestation, major inlets and outlets, and public access points. The data will be used to determine the effectiveness of management and assess impacts to the native plant community. This is especially applicable in the case of drawdowns and large scale herbicide applications. These surveys are not necessary for harvesting since harvesters are not designed to change the composition of the plant community.

The Montello Lake District will re-initiate their Self-Help water quality monitoring program through the Wisconsin Department of Natural Resources. Monthly *(June, July, August, September)* water quality monitoring that includes pH, dissolved oxygen, temperature, total phosphorus, and chlorophyll-a, would be sufficient to detect significant changes. Secchi depth will be collected every two weeks from June through September.

It is necessary to have this data so future management efforts can be more precisely prescribed and planned.

The District will manage the fishery and water quality by focusing on four key methods; (1) education; (2) fisherman and riparian owner cooperation; (3) habitat management; and (4) enhancement of predator populations. The District will accomplish the latter two points by implementing this Aquatic Plant Management Plan. The District will acquire educational materials from the WDNR and UW-Extension offices and distribute those materials at public meetings and at the boat launch in order to meet the first two goals.

Fisherman and riparian land owner cooperation will be important in implementing a voluntary catch-and-release program, voluntary local size and number limitations, voluntary fertilizer minimums, and shoreline restoration (vegetative buffer strips). Voluntary actions will go a long way to maintain and improve the fishery and water quality of Montello Lake.

Adopt-A-Lake/Clean Boats, Clean Waters

Fall – Each year since 1999, the Adopt-A-Lake group has coordinated "Meet the Lake", where students spend the day at the Montello Lake, gaining valuable information from community members, county and state personnel who share information regarding water and land resources. Students learn the importance of being stewards to our precious natural resources. Activities include: water monitoring, visiting the hydroplant, SCUBA, water filtration, energy and values of it, shoreline restoration information, learning about buffer zones, tour of watershed area, pontoon boat rides (provided by lake property owners), angler education, scavenger hunts, and during drawdown years – we walk the shoreline, etc.

Winter – "Under the Ice" – Adopt-A-Lake students and coordinators plan another ½ day event. Such activities in the past have included: learning about changes in habitat, critter identification (through prints, markings, pelts, teeth, etc.), survival skills, safety on the

ice, ice fishing, snow bank dissection, using the Eckman dredge, underwater camera and probes to discover more about the water and what lies below the surface.

Spring – Earth Day and LAKES Week. Activities are coordinated in conjunction with Earth Day, and involve participation throughout grades K-12. Such activities include: litter clean up at park and community, raking neighborhood yards, storm drain stenciling, water monitoring, work at the school forest, trivia for high school and junior high, poster contest, mural contests, and trivia contest for K-6.

Spring – "Celebrate the Lake Day". Annual event since 1999, we do similar activities such as those conducted in the fall, revisiting key and important concepts. Additional activities include canoeing the lake and up to the Montello River as it forms the lake, critter and plant identification, water monitoring, Secchi disk readings, planting at the local greenhouse (O'Malley and Foss) for plants around the ball diamond and beach area at Montello City Park (located on Montello Lake), etc.

Spring (May) – Clean Boats, Clean Waters; "Day at the Landing". Held on the opening weekend of fishing (or the following), this event is sponsored by CBCW, and two lake property owners and lake stewards who take great pride in our lake, and our youth. Youth clean litter and rake leaves and other debris around the landing. They distribute education materials about exotic aquatics to fishermen, and rinse off boats, motors and trailers. A cookout is also held, where fishermen and nearby residents can come enjoy a bite to eat, while learning what the kids have to share!

6.5 Montello Lake District 2007-11 Budget

Five year Montello Lake management estimates

Description		Year estimated costs 2007	2008	2009	2010	2011
January - March						
30 acre treatment permit		$770.00	$770.00	$770.00	$770.00	$770.00
public notices about treatments		$63.25	$63.25	$63.25	$63.25	$63.25
mailings addressing treatments		$230.00	$230.00	$230.00	$230.00	$230.00
Spring annual educational meeting	*	$1,150.00	$1,150.00	$1,150.00	$1,150.00	$1,150.00
March - September						
Volunteer Self-Help Monitoring						
Lake Leaders Institute (2 people estimated for first year and 1 person thereafter)	*	$1,200.00	$600.00	$600.00	$600.00	$600.00
Provided by State at $75 per participant	*	$300.00	$300.00	$300.00	$300.00	$300.00
Additional training provided to others at $20 per person with 20 people involved	*	$400.00	$400.00	$400.00	$400.00	$400.00
Montello Lake volunteer time for water quality monitoring ($8 per hour) (8 months with one inspector for two hours) (credit)	*	$128.00	$128.00	$128.00	$128.00	$128.00
Treatment regime						
Professional pre-treatment monitoring	*	$1,782.50	$1,818.15	$1,853.80	$1,889.45	$1,925.10
Professional Exotic Species Herbicide Treatment	*	$18,543.75	$18,914.63	$19,285.50	$19,656.38	$20,027.25
Professional post-treatment monitoring (50-60 pt plant survey in treatment area and an additional 70-80 pt plant survey on entire lake)	*	$7,733.75	$7,888.43	$8,043.10	$8,197.78	$8,352.45
Harvesting						
Professional harvesting	*					
GPS guided computer system (first year only)		$17,250.00				
Material disposal						
September - December						

Winter drawdown						
Dam re-imbursement	*				$13,800.00	
Annual implementation report	*	$1,983.75	$2,023.43	$2,063.10	$2,102.78	$2,142.45
APM update						$2,500.00
Total		$51,535.00	$34,285.88	$34,886.75	$49,287.63	$38,588.50
Grant funds at 50% of eligible costs		$16,610.88	$16,611.31	$16,911.75	$24,112.19	$17,512.63
Total remaining after 50% cost share						
Total grant eligible for 50% cost share						$91,758.75
Total remaining after 50% cost share						$116,825.00
5 year estimated total						$208,583.75

* Denotes 50% grant eligible

7.0 APM Plan Responsibilities and Deadlines

Task	Item	Responsible Party	Deadline
Mechanical Harvesting	Appoint Harvesting Coordinator	District Board	March 31
	Spring maintenance	Harvester operators/coordinator	April 15
	Begin harvesting	Harvesting coordinator	May 15
	End harvesting	Harvesting coordinator	August 31
Aquatic Herbicide Applications	Collect bids for service	District Board	December 31
	Select application firm	District Board	February 28
	Acquire DNR approval	District Board	April 1
	Provide public notice/meeting	District Board	April 1
	Provide riparian notice	District Board	April 15
	Begin pre-treatment monitoring	District Board/Application Firm	April 15
	Begin herbicide applications	Management Firm	May 1
	End herbicide applications	Management Firm	July 1
	Post-treatment monitoring	Management Firm	July 15
Winter Drawdown	Assess need for drawdown	District Board	August 1
	Coordinate with stakeholders	District Board	September 1
	Begin drawdown	District Board/Dam operator	Fall
	Dam reimbursement	District Board	December 31
	Begin refilling	District Board/Dam operator	Spring
	Post-drawdown assessment	District Board	June
Whole Lake AP survey	Perform AP survey	Management Firm	July 15

Task	Item	Responsible Party	Deadline
Public Education/Involvement	Lake Leader Institute training	2 appointed/volunteers	March 1
	Begin volunteer water quality monitoring	District volunteers	March 1
	Maintain signage at public launch	District Board	April 1
	Earth Day and LAKES week	Cindy Neeb	Spring
	"Celebrate the Lake Day"	Cindy Neeb	Spring
	CBCW "Day at the Landing"	Cindy Neeb and volunteers	May
	End volunteer water quality monitoring	District volunteers	October 31
	Adopt-A-Lake participation	Cindy Neeb	School year
	"Meet the Lake"	Cindy Neeb	Fall
	"Under the Ice"	Cindy Neeb	Winter
Create Annual Reports	Harvesting	District Board/Management Firm	December 1
	Herbicide applications	Management Firm	
	Drawdown evaluation	District Board/Management Firm	
	Whole-lake AP survey	Management Firm	
	Public education and involvement	Cindy Neeb/Management Firm	
Update APMP	Update APM Plan	District Board	Every 5 years

8.0 References

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