Aquatic Plant Management Plan

Minong Flowage

Washburn and Douglas Counties, Wisconsin

WBIC: 2692900
SEH No. A-MINFA0702.00

July 2011

July 20, 2011

RE: Minong Flowage
Aquatic Plant Management Plan
Washburn and Douglas Counties, Wisconsin
WBIC: 2692900
SEH No. A-MINFA0702.00

Ms. Doris Youngquist
Minong Flowage Association
4542 Evergreen Drive
Vadnais Height, MN 55127

Dear Doris:

Short Elliott Hendrickson Inc. (SEH®) is pleased to present this Aquatic Plant Management Plan for the Minong Flowage to the Minong Flowage Association, the Wisconsin Department of Natural Resources (WDNR), and other stakeholders for review. This document should be considered a draft until the WDNR offers its final approval. The Minong Flowage Association may now pursue the application and project description for an Aquatic Invasive Species Established Infestation Control grant. The activities described in this aquatic plant management plan cover three years. At the end of said time the entire plan should be revised and updated to reflect the success or failure of said activities.

Should the Minong Flowage Association or the WDNR require modifications to this plan before granting approval, SEH in good faith, will complete them. Our role in this current project does not end until the WDNR approves the aquatic plant management plan for the Minong Flowage. Please review this document. I hope you find it satisfactory.

Sincerely,

Dave Blumer
Scientist

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Aquatic Plant Management Plan

Minong Flowage
Washburn and Douglas Counties, Wisconsin

Prepared for:
Minong Flowage Association and Wisconsin Department of Natural Resources

Prepared by:
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Prepared for Minong Flowage Association

1.0 Introduction

In 2002, Eurasian water milfoil (EWM), an aquatic invasive plant species, was found in the Minong Flowage in Washburn and Douglas Counties. A subsequent plant survey and a sediment survey determined that it was likely present in the Flowage several years before being detected. Some predictions were made at that time that EWM would only grow to nuisance levels in about 100 acres in any given year. A committee was formed by the Minong Flowage Association to watch the EWM and begin the process of determining how best to manage the unwanted plant species in the Flowage. Bouys were placed in the Flowage each year to inform boaters where EWM beds were located so that boaters could avoid it. It was hoped that if boaters avoided these areas, EWM would not spread throughout the Flowage quite as rapidly. A Wisconsin Department of Natural Resources (WDNR) grant funded project was started by the Association in August 2007. SEH was contracted to redo the plant survey completed in 2003, compare changes from 2003 to 2008, and to make best management recommendations for the Flowage. In July of 2008 a User Survey was added to the project to get a better understanding of the feelings and attitudes landowners and lake users had related to the Flowage and management of plants in it. This report seeks to develop local best management practices specifically to deal with EWM in the Minong Flowage that are approved by the WDNR and the Minong Flowage Association.

2.0 Lake Characteristics

The Minong Flowage is a 1564 acre impoundment located in the Town of Minong in Washburn County and the Town of Wascott in Douglas County. It has a maximum depth of 21 ft. and a mean depth of 9 ft. 14.5% of the Flowage is less than 3 ft. deep. The Flowage was created in 1937 when a dam with an 18 ft. head was installed on the Totagatic River. The dam is currently operated by North American Hydro and generates hydroelectric power for the region. The dam has a structural height of 29 ft. and was designed to hold a maximum of 23,000 acre feet. It has an estimated normal flow at the outlet of 110 cu. ft../sec (Sather and Busch 1976). It is considered a large dam by state code and has a hazard rating of “significant” (SWIMS 2008).

The Flowage has approximately 24 miles of shoreline, is 2.25 miles long, and 1.08 miles wide at its widest point. There are 16 islands in the Flowage with a total area of 45.6 acres. The largest island is 16.2 acres in size. It is fed by the Totagatic River from the west and Cranberry Lake in Douglas County to the north via the Cranberry Flowage. The Flowage has a mostly sandy bottom with some muck, gravel, and rock. Total volume of the lake is approximately 13,326.5 acre/ft. (Lake Survey Map, Wisconsin Conservation Division, 1966 Appendix A).

The Minong Flowage is currently listed on the Wisconsin 303d impairment list for mercury contamination. Atmospheric deposition is the main contributor, and it has a low priority listing. The Minong Flowage is known to have Eurasian water milfoil, curly-leaf pondweed, and rusty crayfish. Purple loosestrife may also be present on the Flowage but has not been officially documented.

The lake has approximately 300 property owners. It is home to the Totagatic County Park which is open to the public for camping, swimming, fishing, and boating. This is a 75 site campground with a designated swimming area, pavilion, numerous picnic areas, children’s play area, fishing pier, fish cleaning house, nature trail, and public boat launch. There is a shower house, toilets, dump station, and electric water stations located throughout the park for drinking water. The lake is also home to the Swift Nature Camp which is a summer camp for boys and girls ages 6-15 to learn about nature and the environment. There are two resorts on the lake, one seasonal with a bar area and one that is open annually with a restaurant/bar. There is one restaurant/bar with a campground, and one bar that also supplies lake users with bait, ice, and convenience items. Approximately 85% of the shoreline around the Flowage slopes steeply to the lake, and is well developed in those areas open to development. Shoreland erosion is occurring around the Flowage, particularly on some of the larger islands that are used for summer recreational purposes.

The Minong Flowage can be accessed through several public and private boat landings. The WDNR owns a landing on the east side of the Flowage, and there is a county landing on the west side of the lake at the Totagatic County Park. There are two other public access points, one at Smiths Bridge over the Totagatic River on the east side, and on the south end of Cranberry Lake in Douglas County. Boats can travel between Cranberry Lake and the Minong Flowage via the Cranberry Flowage which flows under the Hwy T bridge near Wascott. Pogo’s Inn also maintains a private access point just south of the Hwy T bridge. There are numerous other unregulated, private access points at people’s homes or cottages.

3.0 Watershed Characteristics

The Minong Flowage watershed has a direct drainage basin of approximately 8.3 square miles. The total drainage area is approximately 233.62 square miles and is part of the Totagatic River Watershed (Appendix B). The Totagatic River Watershed is part of the Namekagon River Watershed, which in turn is part the larger St. Croix Basin watershed (Clemens 2005). The Totagatic River flows through the Flowage and then empties into the

Namekagon River and then into the St. Croix River. In 1966, 100% of the watershed was considered in a natural state with various forested cover, and a little grassland (Sather and Busch1976). Other than some additional shoreline development, the watershed is in a similar state today. Only 52 acres of wetland are adjacent to the Flowage. Soils in this part of Washburn and Douglas County are primarily upland and outwash types from glacial drift. Soils along the various river watersheds including the Totogatic are mostly sand, and the uplands soils are of loam and silty materials (NRCS 2008, Appendix C).

4.0 Fisheries and Wildlife

The Minong Flowage has primarily a warm water fishery. Walleye, northern pike, large-mouth (and some small-mouth) bass, panfish, bullheads, white suckers, and redhorse are common. Rock bass, carp, and various forage minnow species are also present. In 1994, the WDNR conducted a species-presence survey which identified 33 different species of fish. In the 1940's the Minong Flowage was stocked with walleye fingerlings or fry on a yearly basis. No stocking has occurred since. The walleye population is naturally producing and abundant. The most recent WDNR Game Fish Survey and Analysis for walleye, northern pike and large-mouth bass was conducted in 2005 (Bass, 2006). Results form this survey were compared to a similar study done in 1989. The estimated walleye population in 2005 was 25% higher than in 1989. There are abundant numbers of smaller walleyes, but the report noted a decline in the number of fish greater than or equal to 20 inches in length. The same report suggests walleye growth rates have decreased dramatically. It takes more than five full seasons for walleyes to reach 15 inches and 10 seasons to reach 20 inches. There are still a lot of old fish, but they are not growing as rapidly as they used to. Northern pike and large-mouth bass populations in the Flowage appear to be stable but also reflect slower than average growth for fish greater than five years old. This report mentions the discovery of EWM in the Flowage in 2002, but does not comment on the impact the EWM could be having on the fish population.

The level of macrophyte growth in a body of water does affect the fish population of that lake, and the size and growth patterns of the fishery. A paper published in the American Fisheries Society Symposium (Dibble et al. 1996) reviewed many fish-plant interaction papers. Most of these papers conclude that intermediate levels of plant growth in water bodies promote high species richness and are optimal for growth and survival of fishes. Vegetated habitats supported higher fish densities than unvegetated areas, aquatic plants led to reduced risk of predation and structurally oriented fish exploited aquatic plant beds. However, the same report concluded that pelagic fish species and benthic omnivores often declined in abundance with increased plant cover. When plants occupied an entire water body, fish growth became stunted due to depletion of food resources. Both limited and excessive aquatic plant growth may decrease fish growth rates.

Because of its size and diverse habitat, the Minong Flowage is teaming with wildlife. Waterfowl use it all season long and migrating ducks pass through it in the spring and fall. Wild rice is abundant in the Flowage, particularly in the eastern most bay where the Totagatic River enters the Flowage, providing food and cover for many waterfowl and other wildlife, as well as being an important cultural icon. Wild rice in Wisconsin is highly prized and protected. Any management activity that could impact wild rice in the Flowage will be and should be closely scrutinized. At least one pair of loons nest and have young every year on the Flowage. Eagles can be seen just about any time and there is at least one nesting pair. Muskrats and beaver are common.

The Wisconsin Natural Heritage Inventory (NHI), established in Wisconsin by the Nature Conservancy, is part of an international network of NHI programs and is coordinated by an international non-profit organization. NHI programs focus on locating and documenting occurrences of rare species and natural communities, including state and federal endangered and threatened species. All NHI programs use a standard methodology for collecting, characterizing, and managing data, making it possible to combine data at various scales to address local, state, regional, and national issues.

In the area of the Minong Flowage this inventory lists several animal species including bald eagles, osprey, Blandings and wood turtles, least darters (a minnow), and banded killifish. Redhorse, a rough fish, are also present in the Flowage but not any of the three species that are listed as endangered or threatened in Wisconsin. Several plant species are listed including northern bur-reed, Torry’s bulrush, and northeastern bladderwort. Aquatic plant surveys in 2003 and 2008 identified two additional plant species of special concern in Wisconsin, Vasey’s pondweed, and small white water lily. Several ecosystem communities are also mentioned including emergent marsh, northern dry forest, northern dry-mesic forest, and northern sedge-meadow (NHI data portal 2008). Special concern should be given to accommodate these species of special concern in and around the Minong Flowage.

To date, no critical habitat or sensitive areas surveys have been completed on the Flowage. However, there are many areas that likely are critical habitat including the east bay where the Totagatic River enters the Flowage, areas in the north central basin, areas near the WDNR public access on the east side, and areas in the Cranberry Flowage between Hwy T and Cranberry Lake.

5.0 Water Quality

Water clarity and water chemistry are important indicators of water quality. Secchi disk readings of water clarity and chemistry parameters including total phosphorus, chlorophyll a, and temperature and oxygen profiles have been collected by Wisconsin Citizen Lake Monitoring Network (CLMN), formerly the Self-help Lake Monitoring Program, volunteers since 1994. A Secchi reading of 4 ft. was recorded in September1966, probably at the deepest site near the dam. At this time pH was listed at 6.8. Methyl purple alkalinity (MPA), a test used to determine fertility as related to the amount of available carbonates, bicarbonates, and hydroxides in parts per million (ppm) of water, was listed at 48 ppm. At this time water bodies with values between 41 and 80 ppm were considered to be moderately fertile. These values, collected in 1966, indicate that the Minong Flowage is a soft-water drainage lake or impoundment. Water color was classified as medium brown indicating a somewhat stained water lake (Sather & Busch 1976).

A water quality survey requested by the Minong Flowage Association and conducted by undergraduate students from the University of Wisconsin-Superior Department of Biology and Earth Science was completed in 1999 following three years of water quality data collection (Appendix D). This study included data collected from 5 sites in the Flowage. Data was collected on 4 dates in 1997, 6 dates in 1998, and 2 dates in 1999, but not at all sites each time. Data was collected in August, September, October, January, February, April, May, and July. Water depth, Secchi disk transparency, water temperature, conductivity, and dissolved oxygen profiles were measured. Water samples were collected and preserved for additional lab analysis including pH, alkalinity, water hardness, phosphates, and ammonia. Plankton and benthic invertebrates were also sampled.

Secchi disk transparency showed seasonal changes from depths of 1.0 to 2.3 meters. It was higher in the winter and lowest in August during the peak of the algae blooms. Water temperature was normal for lakes in northern Wisconsin. Turnover occurred in the early spring, thermal stratification occurred at Site 1 in the deep hole near the dam in late spring and early summer. Summer water temperatures were fairly consistent surface to bottom indicating some surface mixing was again occurring. In the fall, as waters cooled down, full water column mixing again occurred. Reverse stratification occurred under the ice. Reduced mixing in the early summer and late winter led to the development of anoxic or oxygen depleted waters at Site 1. Conductivity was low, pH values ranged from 6.3 to 7.9, and alkalinity and hardness were fairly consistent throughout the Flowage. Ammonia was low, and nitrates and phosphates were mostly below detection levels.

This study concluded that the Flowage was indeed a soft water system with moderate buffering capacity to withstand current levels of acid deposition. It was classified as mesotrophic in nature. Although phosphates and nitrates were low, there was abundant phytoplankton (algae) present in the summer months possibly indicating immediate utilization of available nutrients. Oxygen depletion and nutrient release is likely occurring in deep water areas of the Flowage due to organic matter decomposition. The benthic invertebrate community is similar to most mesotrophic water bodies in northern Wisconsin.

Two lake sites have been consistently monitored by CLMN volunteers. All Citizen Lake Monitoring data is available on the SWIMS webpage. Appendix E contains summary information for both CLMN sites. Secchi disk readings for the Deep Hole 1/3 mile above the dam have been collected since 2001, and since 1994 in the Central Basin NW of the youth camp. Surface water samples tested for Total Phosphorus and Chlorophyll a have been collected since 2001 at the Deep Hole, and from 1994 through 2001 at the Central Basin. Temperature and dissolved oxygen profiles were also collected. Summer (July and August) Secchi readings for the Deep Hole averaged 4.3 ft. For the Central Basin they averaged 4.15 ft. Only the Central

Basin site has enough data to compare water clarity pre and post discovery of EWM in the Flowage, but it does appear that EWM has impacted water clarity. From 1994 to 2001 the average summer Secchi reading in the Central Basin was 4.5 ft. (based on 15 readings), and from 2002 to 2008 it was 3.8 ft. (based on 13 readings). These values indicate that the Flowage is slightly eutrophic or nutrient rich with Trophic State Index (TSI) values in the 55-58 range. However, because the water in the Flowage is considered to be moderately stained these Secchi values may be artificially low.

Phosphorus values averaged 0.040 mg/l (0.024-0.094) in the Central Basin from 1994 to 2003. By the dam, phosphorus values averaged 0.033 mg/l (0.019-0.047) from 2001 to 2008. These values indicate that the Minong Flowage is slightly eutrophic or nutrient rich with TSI values in the 55-57 range.

In the Central Basin, Chlorophyll A values averaged 17.94 µg/l with a range of 1.2 µg/l to 61.6 µg/l. By the dam, Chlorophyll A values averaged 12.89 µg/l with a range of 4.04 µg/l to 37.4 µg/l. These values indicate that the Minong Flowage is slightly eutrophic or nutrient rich with TSI values in the 54-57 range.

Both sites experience decreased dissolved oxygen (DO) values in the bottom 3 to 6 ft. of water in late June and July. Data collected to date does not indicate that complete depletion of oxygen occurs in the bottom waters. However, in late July 2007 DO values did drop to around 1 mg/l. Volunteers on the Flowage currently use the Chemets Colormetric Dissolved Oxygen kit for determining DO levels. This kit is not considered accurate by the EPA. Future DO monitoring should occur at both sites using a WDNR approved method. At the current time this includes the use of an approved digital DO meter or a titration method for determining DO concentration.

Anecdotally, water clarity in the north central basin and in the channel leading to Cranberry Lake is very good in late August and in September even when water clarity in the southern 2/3 of the Flowage is not very good. There could be several reasons for this. One, there is a lot of fresh water entering the Minong Flowage in the northern third of the Flowage from the Totagatic River and from Cranberry Lake. Both of these water bodies have decent water clarity however the river water is relatively stained. Another reason for the improved water clarity in the northern third of the Flowage could be that this is where the majority of EWM is located. Beds of EWM approximately 97 and 134 acres in size are both located in this area. Growing plants use up available nutrients often limiting the amount of nutrients available for algal growth. Once water passes this area in the Flowage, it slows down and limited plant growth due to substrates, deeper water, and limited light penetration make more nutrients available for algal growth. Dead and dying plants are also being deposited in the deeper areas of the southern two thirds of the Flowage. When they decompose nutrients are released back in to the water. Dissolved oxygen depletion may also be occurring as a result of anaerobic decay. If oxygen values reach zero ppm, a reaction occurs that releases nutrients (primarily phosphorus) from the sediments back into the water column.

Additional water testing sites could be established in the Flowage, particularly for Secchi disk readings. Both existing sites should have a minimum of Secchi, total phosphorus, chlorophyll a, dissolved oxygen, and temperature monitoring completed on them. Changes in water quality will be important to document as treatment of the EWM goes forward. “Green water” was the third ranked lake issue behind “introduction of undesirable invasive species” and “too much plant growth” by lake residents in a recent Lake User Survey. All three issues are linked together. What happens in one of these areas will likely impact the others.

6.0 Lake User Survey

A Lake User Survey was constructed by the Minong Flowage Association and SEH with help from the WDNR in late August and early September 2008. On September 17, 2008, more than 300 copies of it were mailed to residents of the Minong Flowage by the Minong Flowage Association. Respondents to the survey were instructed to send the surveys directly to SEH to eliminate any question there may be related to the Association “changing” or “fixing” the results. As of this writing 158 surveys had been returned (greater than 50%) and responses evaluated. The purpose of this Survey was to determine how the Flowage is currently being used, lake issues and concerns held by lake residents, resident views related to the status of aquatic plants in the Flowage, familiarity with aquatic invasive species, what aquatic plant management strategies residents would support, and what results they would like to see. The following is a brief synopsis of the survey results. The entire survey and summary of results can be viewed in Appendices F and G.

6.1 Section 1 – Residency

In order to determine which area of the Minong Flowage survey respondents came from the Flowage was divided into 5 sub-regions: North, Northeast, Northwest, Central, and South. In addition, residents not on the Flowage were also given the opportunity to respond to the survey. The responses were well distributed across these sub-regions (see map attached to the survey). Respondents were asked what type of residence they kept, permanent or seasonal, rented or owned. No respondents were renters. Seasonal residents made up 51% of the respondents, with permanent residents second at 38%. Cabin ownership came in at 6%, with undeveloped land, business owners or others making up less than 2% each. 80% of all respondents spend more than 6 months time (at least on weekends) at the Flowage. 67% of respondents have been on the Flowage more than 10 years. 90% of respondents use the Flowage more 2-4 times a month or more.

6.2 Section 2 – Working with the Cranberry Lake Association

Minong Flowage residents overwhelmingly supported the notion that the Cranberry Lake Association and the Minong Flowage Association should work together to manage the aquatic plant issues in both waters.

6.3 Section 3 – Lake Use and Lake Issues

From this survey, it is clear that the Flowage is used in many different ways. Fishing, pontoon and recreational boating, swimming, water skiing and/or tubing, canoe/kayaking, rest and relaxation, and wildlife viewing were all very common responses. Of these, pontoon boating, fishing, skiing/tubing, and rest/relaxation were the top responses. As would be expected, most lake residents responding to this survey owned watercraft. In many cases, more than one type of watercraft was owned. More residents have pontoon boats then any other watercraft. Fishing boats with motors less than 50 horsepower, canoes or kayaks, and paddle boats were also very abundant. 87% of survey respondents do not use the public access points on the lake or only use them to put in or take out their boats in the spring or fall. For those that do use the public access points it is pretty evenly split between the WDNR landing on the east side of the Flowage and the County landing on the west side. In general, survey respondents had very little problem with any of the access points on the Flowage. It will be important to maintain the Flowage in a condition that supports a wide variety of uses.

Many possible lake issues were presented to survey respondents in this survey. Respondents were asked to mark five issues that concerned them, and then to pick the one of these five that was of most concern to them. Three issues clearly stood out: the introduction of undesirable plants and animals, too much weed growth, and green water. Excessive or uncontrolled waterskiing, floating vegetation, poor fishing, too much public use, and overdevelopment of the shore line were also concerns.

6.4 Section 4 – Aquatic Plant Growth

Ninety-five percent of respondents believe that plant growth in the Flowage has increased since they have been using it. Ninety-two percent consider plant growth to be a moderate or large problem. The majority of respondents consider plant growth to be at its worst in the summer months interfering most with swimming, fishing from boat or shore, and recreational boating. Fifty-seven percent of respondents say they have made attempts to remove vegetation by their lake frontage. Eighty-five percent of respondents felt some form of aquatic plant management in the Flowage should occur. When asked who should be responsible for controlling problem plants by their property or in general, the WDNR, the Lake Association, and the landowner were the top three choices. A distinction was made between managing plants by the landowner’s property or in the Flowage as a whole, but the responses were similar.

Respondents were asked if green water or algae growth in the Flowage ever prevented them from enjoying the Flowage. Sixty-one percent felt it sometimes or often did.

6.5 Section 5 – Aquatic Invasive Species in the Minong Flowage

In this section of the survey more information was gathered related to the presence and management of Eurasian water milfoil (EWM) and curly-leaf pondweed (CLP) in the Flowage. Almost all respondents (90%) thought they would recognize EWM if they saw it. 90% felt EWM growth was a moderate to large problem in the Flowage, and 92% thought it should be managed in some way. Not as many respondents were familiar with CLP. Only 34% thought they would recognize it if they saw it. More than 55% were unsure when asked if CLP growth was a problem, and only 56% thought some form of management was necessary. Forty percent were unsure. When asked if they could identify non-native plant species in general, 31% were unsure. Another 30% thought they probably could. When asked if they were willing to be trained in the identification of native and non-native plant species only 32% said they would be.

Preventing the spread of new aquatic invasive species (AIS) into the Flowage is an important management strategy. More than 80% of the survey respondents said they were somewhat or very familiar with the prevention techniques necessary to protect the Flowage from future AIS introductions. Ninety-three percent had heard the Inspect, Remove, and Drain message before. Almost all respondents said they did take steps themselves to clean off their boats before using them on the Flowage, though a lot commented that they never take their watercraft anywhere else.

6.6 Section 6 – Aquatic Plant Management Methods and Expectations

In this section, survey respondents were asked to pick their number one and number two choices when presented with aquatic plant management options. While great detail for each of the methods presented was not given in the survey, enough information was given to enable the respondent to distinguish between the management options. Each management method was weighted based on the number of times it was chosen as first and second. Under common management methods, large-scale chemical herbicide use was the overwhelming choice of respondents, distantly followed by respondents who were unsure, small-scale chemical control, and the use of biological control.

Uncommon management methods included those alternatives that often cause the greatest disturbance to the ecosystem, are not allowed except in extreme cases, are usually too costly, or are still being researched. Even larger-scale chemical use on a lake-wide basis was the top choice of survey respondents followed closely by a large-scale drawdown or lowering of the lake level, and then by respondents who were unsure about any of the methods presented.

When asked what management outcomes respondents would accept, reducing excessive AIS growth over time was the clear choice. Many respondents were unsure about what they should expect and whole lake restoration and seasonal only AIS relief also received some support. No management received almost no support from survey respondents.

6.7 Section 7 – Community Support

Several questions were asked in this section to determine what level of financial and volunteer support the respondents were willing to give. 64% said they would be willing to give at least few hours a year to support management efforts on the Flowage. Many of the management option presented in this survey are expensive propositions. Survey respondents were asked how they would be willing to financially support management recommendations. Cash donations, increased annual lake association dues, and fundraisers were the top three choices. Many respondents commented that there should be required launch fees for all users of the Flowage. While this is certainly one way to collect funds, it ma be difficult on the Flowage. Only one of the four landings on the Flowage is private, the rest are publicly owned by the WDNR, Washburn County, and the Town of Minong. Many hurdles would need to be cleared if launch fees were going to be assessed. Respondents were asked if they would support the formation of a Lake District, which has taxing authority over all property on the Flowage. While this may be a viable funding alternative in the future, it requires a majority vote of all residents on the Flowage to even begin the process. Currently support for this option is only at 32%.

6.8 Survey Summary

Overall, the survey indicates that residents on the Flowage are overwhelmingly in favor of managing EWM growth in the Flowage. Most residents believe that EWM is interfering with use of the Flowage and feel the problem has gotten worse in the last couple of years. Large-scale herbicide application seems to be the management strategy of choice. Familiarity with EWM among lake residents is relatively high, but more education is likely necessary for other invasive species and in the management expectations and outcomes for the Flowage.

6.8.1 2003-2008 Plant Survey Comparisons

The purpose of this report is to determine if treatment of the EWM in the Minong Flowage is necessary. If it is, then analyzing all possible alternatives to do so is necessary. Based on this analysis then, best management recommendations would be made. Responses to the User Survey overwhelmingly indicated that some form of management was needed and desired by residents living on the Flowage. This by itself does not constitute adequate justification to begin management. An evaluation of the current status of aquatic vegetation is not only required, but makes perfect sense. In many cases one plant survey is all that exists to determine the need for management. The Minong Flowage has the added benefit of two comprehensive aquatic plant surveys completed within five years of each other to determine the need for aquatic plant management.

In 2003, one year after EWM was discovered in the Flowage the WDNR instigated a whole-lake plant survey using the point-intercept method of sampling (Appendix H). In 2003, point-intercept surveys were still being evaluated as a tool for aquatic plant management. In 2005, a switch was made in the WDNR Aquatic Plant Management Program requiring all plant surveys be done in this format, instead of in the transect method previously supported by the WDNR. Another whole-lake point-intercept survey was completed in 2008 by Endangered Resource Services, an SEH sub-consultant (Appendix I). Data from both of these surveys can be used to determine the necessity of aquatic plant management on the Flowage. To date, no formal EWM management has occurred other than to mark existing EWM beds with buoys.

In 2003, a grid system consisting of 952 survey points was created for the main body of the Minong Flowage. The complete survey covered more than 1200 points but included Cranberry Lake and did not include that area of the Flowage east of the Smiths Bridge landing where the Totagatic River enters the Flowage and wild rice is abundant. This area is estimated at 109 acres. Each point in this survey covered approximately 1.58 acres. Craig Roesler, a WDNR water quality biologist, spearheaded the survey with assistance from several Minong Flowage Association volunteers. The grid was uploaded into hand-held GPS units, and actual sites were marked by anchoring or by marker buoys when GPS units indicated at least a10 ft. accuracy. At each point, aquatic plants were assessed within a 5-ft. radius of the site marker. Two rake drags across a 4-ft. length of the lake bottom were also made to collect any additional plant species present. Plants collected by volunteers were placed in plastic bags and identified at the end of the day. Plants collected by WDNR personnel were identified in the field. If EWM was present at a site a visual estimate of density was made based on the number of plants in a 10-ft. diameter area (low 1-5 plants, medium 6-10 plants, high >10 plants). Density was not recorded for other plant species. Water depth and substrate type were also recorded. The survey was conducted from August 4-15, 2003.

The 2008 survey used a grid system created by a WDNR Research team specifically set up for this purpose. It consisted of 879 points similar in position to the 2003 survey, but not exactly. This grid system did not include Cranberry Lake or the County Park Pond. It did however include the area east of the Smith bridge landing. Each point in this survey covered approximately 1.78 acres. Matt Berg, from Endangered Resource Services, completed the survey. His report includes an early season cold water rapid assessment survey in June specifically looking for CLP, and a late July warm water full-lake point intercept survey. In the late July survey, all visually identified plants within 6-ft. of the sample point were recorded, and a rake was dragged one time across a 2.5 ft. section of the bottom. Density for all plants identified was based on rake-head fullness; 1 for a few plants, 2 for a rake half full of plants, and 3 for a rake head reaching or exceeding 100% rake fullness. Depth and substrate type was also recorded.

Table 1 compares many parameters from both surveys. EWM was identified in approximately 103 acres of the Flowage in 2003. In 2008 this figure jumped to 335 acres. Average EWM density rating per sampling point also increased from 1.38 in 2003 to 1.93 in 2008 on a 1-3 Scale. While the designated littoral zone was slightly different in the two surveys both concurred that EWM grew best in depths ranging from 3.5 to 7 ft. of water particularly in those areas with a muck bottom (Tables 2 and 3). Approximately 561 acres of the littoral zone in the Minong Flowage is less than 7.1-ft. deep. Most of this area also has a muck bottom (Figure 1). While EWM is already present in this area (somewhere around 300acres of it), it still has ample ground to expand (another 250 to 300 acres), particularly in the area known as the Cranberry Flowage, the area just north of the WDNR public Access on the east side, and into the area east of the Smiths Bridge landing where currently there is a lot of wild rice. It is also possible, that as more vegetation (primarily EWM) grows and dies areas of the Flowage with sandy bottoms could get more organic material build up, thus creating new areas for future EWM growth.

Table 1
2003/2008 Plant Survey Comparison

Survey Parameter	2003	2008
Total Acreage	1585	1564
# of Survey Points	952	879
Acres/point	1.58	1.78
# of plant and algae species found	53	63
Floristic Quality Index	44.5	52.4
Max Littoral Zone	Approx. 8 ft.	9.5 ft.
Points in the Littoral Zone	409*	519
Total Littoral Zone Acreage	646 acres*	924 acres
% of Littoral Zone w/plants present	58%**	73.75%
Muck in the littoral zone (% of sites)	44%	59%***
Sand in the littoral zone (% of sites)	40%	25%***
Detritus in the littoral zone (% of sites)	16%	NA
Points w/ EWM	65	188****
Total EWM acreage	103	335
EWM Density Rating (1-3 Scale)	1.38*****	1.93******
Points w/ CLP (July/August)	4	3
Points w/CLP (June)	NA	17
Depth Range of EWM	1 to 8-ft.	0.5 to 8.5-ft.
Depth of Highest EWM Frequency and Density	4 to 6.5-ft.	3.5 to 7.0-ft.
Points less than 7.1 ft.	241*	315
Total Acreage less than 7.1 ft.	381*	561

Notes:
*does not include area east of Smiths Bridge Landing (estimated at 109 acres)
**based only on the area of the Minong Flowage south of Hwy T
*** These percentages are based on 519 points in the littoral zone, only 435 of the 519 points had substrate recorded. The remaining points were in areas where the sampler could not get his rake to the bottom due to stumps or other obstructions.
****Includes 22 visual sites
*****Based on an in-lake visual 1-3 rating
******Based on a rakehead sample 1-3 rating

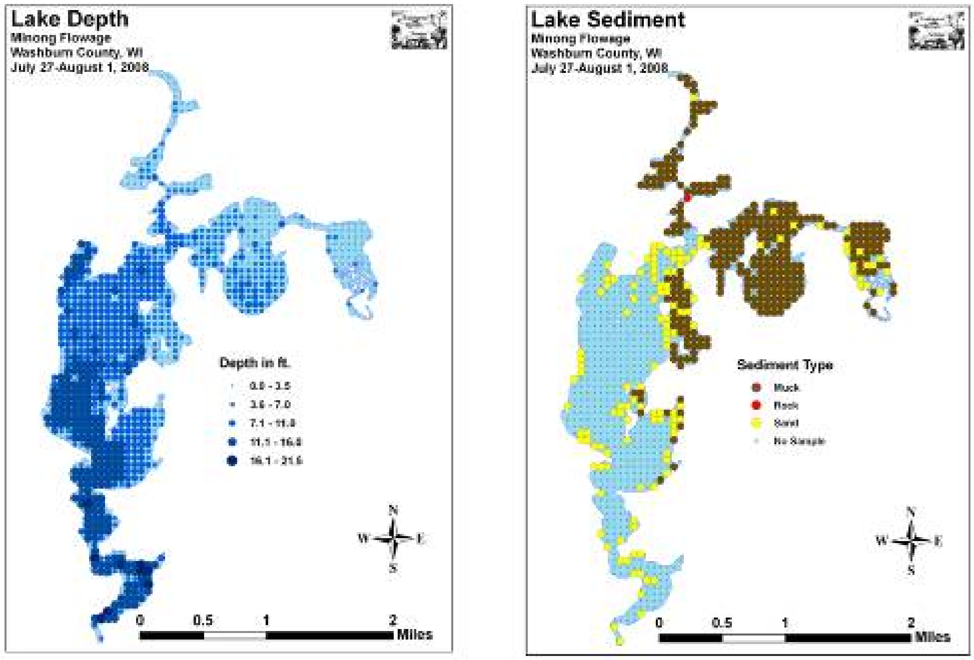
Table 2
2003 Survey Results (based on 65 Sites w/EWM)

Substrate Type	# of sites w/EWM	% sites w/EWM	Visual Only	Low Density	Med. Density	High Density
Muck	42	64%	NA	29 (69%)	8 (19%)	5 (12%)
Sand	17	27%	NA	13 (76%)	3 (18%)	1 (6%)
Detritus	6	9%	NA	5 (83%)	0 (0%)	1 (17%)

Table 3
2008 Survey Results (Based on 188 sites w/EWM)

Substrate Type	# of sites w/EWM	% sites w/EWM	Visual Only	Low Density	Med. Density	High Density
Muck	148	79%	18 (12%)	45 (30%)	45 (30%)	40 (27%)
Sand	40	21%	4 (10%)	16 (40%)	10 (25%)	10 (25%)
Detritus	NA	NA	NA	NA	NA	NA

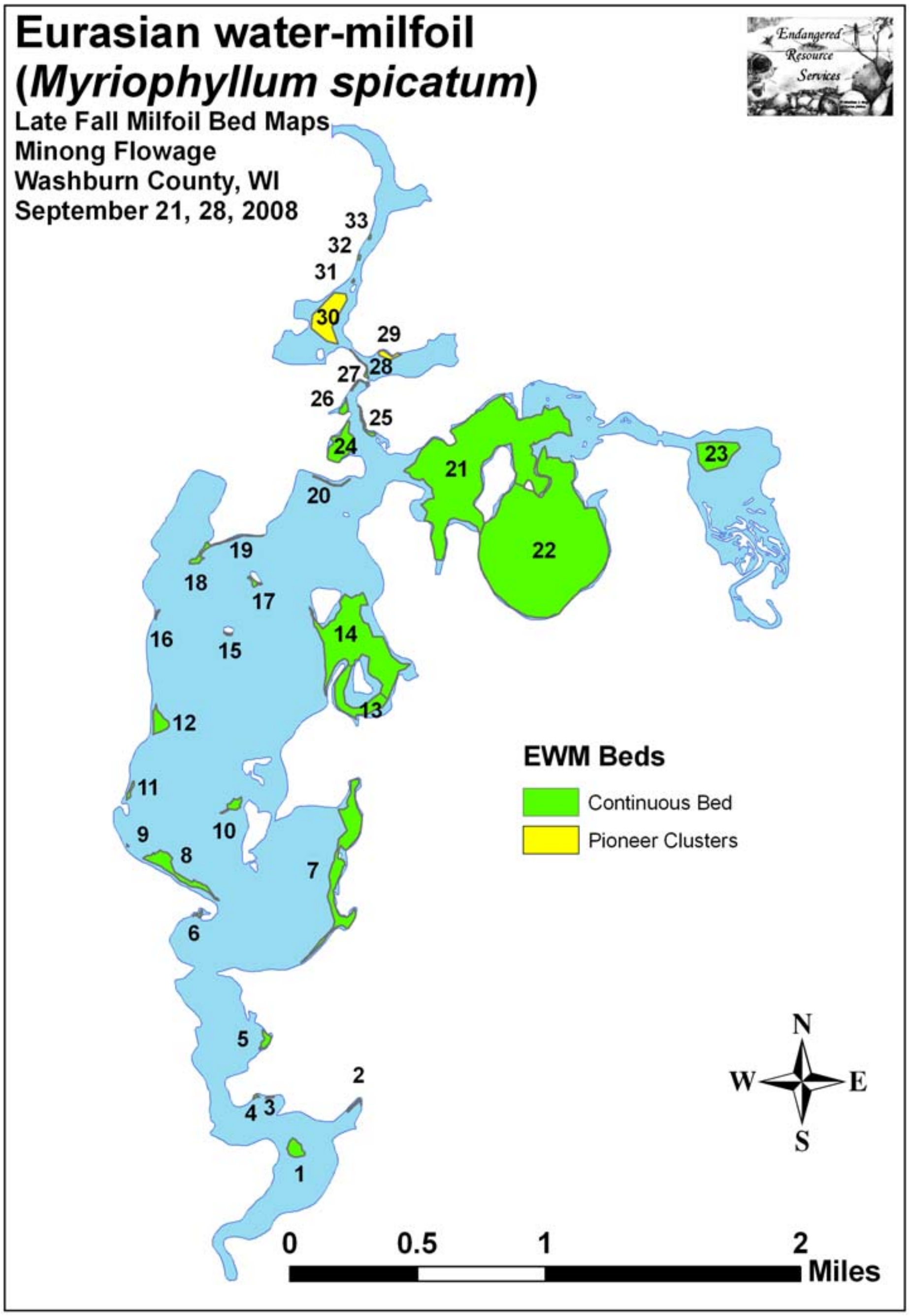
Figure 1 – Minong Flowage Lake Depth and Bottom Substrate



It should be noted that at the time of the 2003 Plant Survey, a lake sediment fertility project was completed (McComas, 2004). Results from this study were used to predict the potential for nuisance EWM growth in the Flowage based on sediment characteristics. The report concluded that once EWM had reached its full extent of distribution, nuisance coverage would be no more than 120 acres and likely less due to water clarity influences. Nuisance EWM growth (rakehead density rating of 3) in 2008 was estimated at more than 240 acres, primarily in the northeastern bays. The largest bed of nuisance growth EWM by itself covered more than 130 acres (Figure 2). While the general areas of nuisance EWM growth in the Flowage were predicted accurately in this study, the extent to which EWM would become a nuisance was grossly underestimated.

In the 2003 Plant Survey 53 different plant and algae species were identified. In 2008, 63 were identified. The 2008 report speculates that the difference in plant species identified is not likely due to increased diversity, but rather from the 2003 surveyor identifying several plant species to genus rather than species. This could account for at least nine species being excluded from the 2003 survey (Berg, 2008). The top four plants in terms of abundance in 2003 south of Hwy T were coontail, water celery, common waterweed, and Eurasian water milfoil. In 2008 the top four most abundant plants were coontail, EWM, common waterweed, and water celery. The top four species are the same in both surveys except EWM became the second most common plant in 2008, switching places with water celery.

Figure 2 – Minong Flowage Fall 2008 EWM Beds



It appears that native plants, except for water celery, are at least able to survive in the face of the EWM expansion in the Flowage. Water celery is abundant in other areas of the Flowage where EWM is not as prevalent. Coontail, water lilies, and wild rice seem to be the only plants that are holding there own against the expansion. Results from the 2008 survey indicated a slight trend toward a reduction in species richness, however, it was deemed insignificant at this time. It may not be in the future. While most documents published about EWM indicate that it can out-compete native plant species, and it often does, this is not always the case. When it does it is usually the result of early and fast growth which then shades out less dominant plants (Smith & Barko 1990). Many native plants, not very abundant in the Flowage, are located in the worst areas of EWM growth (Beds 21 & 22). In these areas, EWM growth is rapid, early and dense enough to create a canopy capable of shading out other plants. Watershield, water star-grass, several species of duckweed, water marigold, water crowfoot, and floating-leaf bur-reed are all found exclusively in this area. Northern water milfoil, common bladderwort and a majority of the pondweeds present in the Flowage including bushy, large-leaf, ribbon-leaf, small, clasping-leaf, fern-leaf, and flat-stem pondweeds are found in this area. Vasey's pondweed, a species of special concern in Wisconsin, is also found in this area.

Many more somewhat rare species of aquatic plants in the Flowage are found in the area known as the Cranberry Flowage, north of Hwy T. Northern water naiad, flat-leaf and creeping bladderwort, small, narrow-leaf, and short-stemmed bur-reed, water bulrush, Vasey's pondweed, white-stem pondweed, floating-leaf pondweed, variable pondweed, whorled water milfoil, waterwort, and muskgrass are all found in the Cranberry Flowage area, along with substantial populations of watershield, northern water milfoil, large-leaf pondweed, fern-leaf pondweed, bushy pondweed, and common bladderwort. The Cranberry Flowage is one of the areas where EWM has the most opportunity to expand due to water depth and a primarily mucky bottom. As EWM becomes denser in this area, many of these native plants will likely be reduced or eliminated.

There is some question as to who will take on the responsibility to manage this area of the Flowage. A general consensus seems to be that it will be managed by the Cranberry Lake Association. This area has a diverse population of plants, perhaps one of the most diverse in the Flowage. It is an important area to keep EWM at bay, if for no other reason than to protect the native plant diversity. It should not be forgotten or disregarded.

Curly-leaf pondweed, another aquatic invasive species, is also located in the area where EWM growth is the heaviest. This may be the reason that at the present time CLP presents little in the way of necessary management. Growth of CLP should however be monitored as it could do better once the EWM has been controlled in this area.

7.0 Establishing the Need for EWM Management

Results from both the User Survey and the 2008 Plant Survey indicate that some form of EWM management should be attempted in the Minong Flowage. Lake residents overwhelmingly believe that EWM is interfering with many lake uses, including swimming, boating, and fishing. Certain parts of the Flowage are almost entirely "sacked" in with EWM. Navigation in these areas is difficult at best, impossible at worst.

A comparison of the survey results from 2003 and from 2008 supports these conceptions, and shows that EWM growth has more than tripled in that time. While the fishery and the native plant community do not show obvious signs of stress due to the over-abundance of EWM, recent trends including a slight reduction in plant species diversity, and a decline in size structure of the fishes indicates something is going on. EWM beds with an overall rakehead density of 3 on a 1-3 scale covered more than 240 acres or 15% of the 1564 acre water body. EWM was present in more than 335 acres or 21.4% of the water body. If just the littoral zone is looked at than dense EWM covered nearly 26%, it was present in almost 36% of the littoral zone. It is estimated that EWM can still expand its current distribution and/or invade at least another 225 acres classified as suitable for growth based on water depth and substrate type. It is possible for EWM to be present in more than 60% of the littoral zone or 35% of the entire surface water area.

Normal lake use and the native plant community are already being negatively impacted by the current levels of EWM growth. It is possible that the fishery is as well. If EWM growth nearly doubles in the next few years major negative impacts will be the result. Efforts should be taken now to reduce the levels of EWM in the Flowage to manageable levels and to protect existing native plants.

8.0 Alternative Management Strategies

8.1 No Management

The first management strategy that should be considered is the possibility of doing nothing. In some cases, no management is the best alternative. Certain conditions such as EWM in areas that do not impact lake uses, areas where the benefit of management is far out-weighed by the cost of management, where water quality or other lake characteristics that would limit nuisance growth conditions exist, areas where highly valued native plants like wild rice would be negatively impacted by treatment, and in situations where hand-pulling and other forms of control with minimal impact can be done without permits by concerned lake residents, all would suggest no management to be the best alternative.

While there are areas in the Flowage where EWM growth meets some of these characteristics, much of the EWM growth does not. The majority of the population on the Flowage does not support this alternative. Nor do the plant survey results from 2003 to 2008. It is hoped that after an initial management plan has been implemented, those areas of the Flowage where no management may be the best course of action will be more clearly defined and reflected in future management plans.

8.2 Hand-pulling/Manual Removal

Manual removal of aquatic plants by means of a hand-held rake or by pulling the plants from the lake bottom by hand is allowed by the WDNR without a permit provided the area of removal does not exceed 30 shoreland feet and all raked or pulled plant material is taken completely out of the lake. If an aquatic invasive species like EWM or curly-leaf pondweed is the target species than removal by this means is unlimited. Manual removal can be effective at controlling individual plants or small areas of plant growth. It limits disturbance to the lake bottom, is inexpensive, and can be practiced by many lake residents. In shallow, hard bottom areas of a lake, or where impacts to fish spawning habitat need to be minimized, this may be the best form of control. Pulling aquatic invasive species while snorkeling or diving in deeper water is also allowable without a permit and can be effective at slowing the spread of a new aquatic invasive species infestation in a waterbody when done properly.

In the Flowage, 57% of the residents say they already do this. It should work well in shallow areas of the Flowage with mostly sand bottoms. EWM in the Flowage has shown that it can grow in sandy areas of the Flowage, but most of the really problematic growth is in areas with mucky bottoms. If landowners, particularly in the southern two-thirds of the Flowage, actively participate in this form of control, much will be accomplished towards limiting the spread of new plants in this area. Hiring divers to come in and remove EWM from deeper water is likely not a sound management strategy. However, if there are divers on the Flowage willing to do this, it never hurts.

8.3 Mechanical Removal

Mechanical removal involves the use of devices not solely powered by human means. This includes gas and electric motors, ATV’s, boats, tractors, etc. Using these instruments to pull, cut, grind, suction harvest, or rotovate aquatic plants is mostly illegal in Wisconsin without a permit. Large-scale mechanical harvesting can and is used effectively to remove unwanted plant species but this method will be discussed later. Using repeated mechanical disturbance such as bottom rollers or sweepers can be effective at control in small areas, but again, in Wisconsin these devices are illegal without a permit. These devices disturb and disrupt habitat for fish, invertebrates, benthic or bottom dwelling organisms and native plants.

Suction harvesting of unwanted aquatic plants is gaining popularity as a treatment method. Suction harvesting involves using an underwater vacuum system to suck up plants and their root systems that are pulled by divers and fed into the suction tube to be taken to the surface. It can have negative impacts to other nearby native plants, particularly those that are perennials and expand their populations by sub-sediment runners, by inadvertently harvesting one plant which was then attached to several others (Eichler et al. 1993). In Wisconsin, there is concern that these devices may actually be classified as dredging devices and have negative impacts to benthic organisms in the sediment. The cost of this endeavor back in 1993 was estimated at $15,800.00 per hectare based on an 8-hr man-day at $160.00 per man-day, and did not include equipment, transportation, survey, and evaluation costs. One hectare equals 2.47 acres. To use this method in the Flowage to control just the densest areas (approximately 240 acres) would cost over $1.5 million.

8.4 Large-scale Mechanical Harvesting

Large-scale mechanical harvesting can be an effective way to reduce EWM biomass in a water body. It is typically used to open up channels through existing beds of EWM to improve access for both human related activities like boating, and natural activities like fish distribution and mobility. Several published reports summarized by Painter, 1988 suggested that long-term effects of harvesting on EWM were variable. Plant biomass, shoot weight, and plant density was reduced, however plant height continued to reach the surface even after four years of harvesting. A paper published ten years later by Unmuth et al, 1998, evaluated the affects of close-cut mechanical harvesting on EWM. Close-cut harvesting used a modified cutting bar that allowed plants to be cut near the sediment surface in depths ranging from 1 to several meters. Channels 1.8 meters wide and totaling 36,200 meters in length were cut in a dense bed of EWM as a part of a whole-lake, fish management-research experiment designed to measure the effects of increasing the amount of plant bed, edge habitat on fish growth (Unmuth et al, 1998). Success of the cuts was measured relative to a predetermined objective cutting height and the persistence of the one-time cuts after 3 years. An average of 46% of the original channel cuts persisted after 3 yrs in water between 3 and 4.5 meters deep. Only 4% of the original cuts remained in shallower areas. Affect on fish species in the littoral zone was measured by the number and size distribution of fish removed. Fish mortality was low with only 35 fish per hectare removed. Most of these fish were small bluegills less than 30 mm in length (Unmuth et al, 1998).

Using mechanical harvesting to open up areas of the Flowage currently impacted by EWM would be a viable alternative except for one problem. The nature of a shallow flowage in Wisconsin is to have many snags and tree stumps submerged all over the system. This is the case in the Minong Flowage. The plant surveyor anecdotally noted tree stumps all over the Flowage, both visible and below the surface. In those areas most impacted by EWM, damage to expensive harvesting equipment would most certainly be substantial almost on a daily basis. The initial cost of purchasing one or more harvesters for the lake and the continuous repairs bills that would likely accompany use of the harvesters would make the costs for this alternative prohibitive based on the benefits that would likely be gained. However, the indication that harvesting at the sediment level left channels that persisted for up to three years is a positive thing when considering other management methods.

8.5 Bottom Barriers and Shading

Physical barriers, fabric or other, placed on the bottom of the lake to reduce EWM growth eliminate all plants, inhibit fish spawning, affect benthic invertebrates, and can cause anaerobic conditions which may release excess nutrients from the sediment. Gas build-up beneath these barriers can cause them to dislodge from the bottom and sediment can build up on them allowing EWM to re-establish. Bottom barriers are typically used for very small areas and provide only limited relief. Currently the WDNR does not permit this type of control.

Creating conditions in a lake that may serve to shade out EWM growth has also been tried with mixed success. The general intention is to reduce light penetration in the water which in turns limits the depth at which plants can grow. Typically dyes have been added to a small water body to darken the water. Shading occurs naturally in many water bodies including the Minong Flowage. Stained water as a result of tannins in the Flowage creates a medium brown colored water which does limit light penetration to some degree. Plant growth substantially declines once water depth exceeds 7 ft. Water quality in the Flowage also serves to reduce light penetration in the Flowage, particularly in the late summer when algal blooms are common. Green water mostly limits EWM growth in the southern two-thirds of the Flowage.

Bottom barriers and attempts to further reduce light penetration in the Flowage are not recommended.

8.6 Dredging

Dredging is the removal of bottom sediment from a lake. Its success is based on altering the target plant’s environment. It is not usually performed solely for aquatic plant management but rather to restore lakes that have been filled in with sediment, have excess nutrients, inadequate pelagic and hypolimnetic zones, needs deepening, or require removal of toxic substances (Peterson, 1982). In shallow lakes with excess plant growth, dredging can make areas of the lake to deep for plant growth. It can also remove significant plant root structures, seeds turions, rhizomes, tubers, etc. In Collins Lake, New York the biomass of curly-leaf pondweed remained significantly lower than pre-dredging levels 10-yrs after dredging (Tobiessen et al. 1992). Dredging is very expensive, requires disposal of sediments, and has major environmental impacts. It is not a selective procedure so can not be used to target any one particular species with great success except under extenuating circumstances. Dredging at any level must be permitted by the WDNR. It should not be performed for aquatic plant management alone. It is best used as a multipurpose lake remediation technique (Madsen, 2000).

Dredging alone is not a viable alternative for the Minong Flowage. EWM is too widespread for it to be a cost-effective and beneficial strategy.

8.7 Drawdown

Drawdown, like dredging, alters the plant environment by removing all water in a water body to a certain depth. It can be a rather inexpensive, effective control technique, but only if the water is lowered to such a point that includes the entire range of the target plant (Madsen, 2000). Areas of the lake bottom must be exposed for a long enough time period to impact the target plant. In northern WI this means a fall drawdown to expose bottom sediments to freezing temperatures for a long enough time period to kill the target species. Drawdown has been shown to be an affective control measure for EWM, but typically only provides 2-3 years of relief before EWM levels return to pre-drawdown levels. A drawdown at the level that would be needed on the Minong Flowage requires that an Environmental Impact Statement be completed. This assessment has to be open for public comment and would weigh the benefits gained by the costs associated with it. In the Minong Flowage these costs would be tremendous.

Drawdown can have severe environmental and recreational impacts. In the Minong Flowage the water level would have to be lowered by more than 6 to 7 ft. to be effective as the range of the greatest EWM growth in the Flowage is 3.5 to 7ft. A drawdown of less than this would only serve to kill a small percentage of the EWM present. The average depth of the Flowage is only 9ft. If 7 ft. of water was removed, greater than 560 acres or almost 36% of the Flowage would be without water. Another 489 acres or 31% would be 3 ft. or less in depth. Essentially 67% of the Flowage would not have enough water in it to sustain a fish population. The Minong Flowage has a high quality fishery that would be highly impacted by a drawdown of this magnitude. Area wetlands and riparian wells would also be severely impacted. A past drawdown of only 3-ft. (according to the WDNR) for dam maintenance resulted in several riparian wells going dry. Many more would be impacted by a drawdown of this level. Native plants in the lake and in the adjacent wetlands would also be impacted, as a drawdown is not selective. Any EWM not killed by the drawdown would have even less competition from native plants once water levels were restored. CLP turions in the sediment might generate new growth that would be more successful without competition from EWM or native plants. Winter recreational use of the Flowage would also be severely impacted. Ice fishing, snowmobiling, and trapping would probably not be permitted during the time of drawdown.

A drawdown would have to be started in the early fall to achieve the kind of depth reduction necessary to have an effect on EWM and to minimize increased water flow impacts downstream. More than 5600 acre/ft. of water would have to be removed. The Totagatic, the Namekagon, and the St. Croix Rivers would all be affected by a drawdown of this magnitude. While it is likely that EWM fragments are currently washing over the dam, a drawdown in the early fall would increase the number of fragments going over the dam significantly. How long it would take to refill the Flowage in the spring is unpredictable. Normal flow on the Totagatic could not be interrupted further increasing the amount of time it takes to refill the Flowage. Winters of late have not provided the level of spring runoff to bring even smaller lakes impacted by two to three years of drought conditions back to normal levels. Loss of power generation at the dam would also be expected to be great. An estimate back in 2003 predicted revenue losses to be around $17,000.00 for a winter drawdown. It is still unclear if North American Hydro would be eligible for compensation as a result of a drawdown.

Unless a drawdown is required for other purposes, it is not a viable alternative for the Minong Flowage. The human and environmental impacts would be too great. Furthermore, a letter sent to the Minong Flowage Association in June 2007 by the WDNR stated that as an organization, they would not support the use of a drawdown to control EWM on the Flowage (Appendix J). Nothing in this report indicates that a drawdown should be considered on its own merits. If however, a drawdown is required in the future, some benefits could be gained in controlling EWM. Discussion at that time could involve when the drawdown is to occur, and the depth to which the Flowage is drawn down to. At this time as well, the issue of dredging could be discussed. There may be areas of the Flowage that would benefit from some dredging activity.

8.8 Biological Control

Biological control involves using one plant, animal, or pathogen as a means to control a target species in the same environment. The goal of biological control is to weaken, reduce the spread, or eliminate the unwanted population so that native or more desirable populations can make a comeback. Care must be taken however, to insure that the control species does not become as big a problem as the one that is being controlled. A special permit is required in Wisconsin before any biological control measure can be introduced into a new area.

8.9 EWM Weevils

While many biological controls have been studied, only one has proven to be effective at controlling EWM under the right circumstances. Euhrychiopsis lecontei are an aquatic weevil native to Wisconsin that feed on aquatic milfoils. Their host plant is typically northern watermilfoil (Myriophyllum sibiricum), however they seem to prefer EWM when it is available. Milfoil weevils are typically present in low numbers wherever northern or Eurasian water milfoil is found. They often produce several generation is a given year and over winter in undisturbed shorelines around the lake. All aspects of the weevil's life cycle can affect the plant. Adults feed on the plant and lay their eggs. The eggs hatch and the larva feed on the plant. As the larva mature they eventually burrow into the stem of the plant. When they emerge as adults later, the hole left in the stem reduces buoyancy often causing the stem to collapse. The resulting interruption in the flow of carbohydrates to the root crowns, reduce the plants ability to store carbohydrates for over wintering reducing the health and vigor (Newman et al. 1996). One company, EnviroScience, has taken a patent out on rearing and distributing the weevil. They call the program Middfoil, and it involves surveying, stocking, and monitoring of the success of the weevil. Recent PR information claims they have successfully introduced weevils to more than 100 lakes in the United States and Canada in the last 10-yrs. Costs for using the Middfoil program run about $1.50/weevil purchased, but includes the costs of mapping, stocking, and monitoring of effects (EnviroScience 2008).

The weevil is not a silver bullet however. They do not work in all situations. The extent to which weevils exist naturally in a lake, adequate shore land over wintering habitat, the population of bluegills and sunfish in a system, and water quality characteristics are all factors that have been shown to affect the success rate of the weevil. A study out of Washington State, suggests that weevils will do the best in water that has a total alkalinity of around 132.4, a water temperature around 21.5 C, a pH around 8.7, a EWM frequency of occurrence around 77.3, and in water around 1.5 meters deep (Tamayo et al. 2000).

Jester et al, 2000, found in-lake weevil densities in Wisconsin were positively correlated with percent natural shoreline and negatively correlated to percent sandy shoreline. Newman and Biesboer, 2000 suggest that undisturbed grasses may be more important than forested areas for providing good over wintering habitat. Having dry sites available as opposed to areas that are affected by rising fall or winter lake levels are likely important for weevil habitat as well. While smaller populations of weevils in a lake may not be impacted by the amount of over wintering habitat, at a larger scale, such as would be created by artificial stocking, over wintering habitat could be a limiting factor.

Sutter and Newman 1997 suggest that bluegill and sunfish populations can impact the success of E. lecontei weevils in a lake through predation. If there is an over-abundant population of these fish species in a water body it is possible that introduced weevils could become fodder before ever having an impact on the EWM.

It is possible for E. lecontei weevils to be used in the Minong Flowage to control EWM. There are large areas of milfoil that could potentially benefit from the introduction of weevils, particularly since other forms of control in these areas are questionable. Anecdotally, there is an existing population of naturalized weevils in the Flowage. However, before spending tens of thousands of dollars to artificially beef up this population more data should be collected, including a more quantifiable estimation of current weevil densities, a better assessment of the bluegill and sunfish population, and a formal analysis of the over wintering habitat available. Should all these variables prove to be in line with apparent conditions that warrant success, then EWM control with weevils should be attempted. The cost when compared to the use of large-scale herbicide application could be comparable or potentially less expensive. Since the bulk of EWM biomass can be found in just a few areas, weevil introduction and monitoring would not be that difficult.

There are other forms of biological control being used or researched. It was thought at one time that the introduction of plant eating carp could be successful. It has since been shown that these carp have a preference list for certain aquatic plants. Unfortunately, EWM is very low on this preference list (Pine and Anderson, 1991). Use of “grass carp” in Wisconsin is illegal as there are many other environmental concerns including what happens once the target species is destroyed, removal of the carp from the system, impacts to other fish and aquatic plants, and preventing escapees into other lakes and rivers.

8.10 Pathogens or Fungi

Several pathogens or fungi are currently being researched that when introduced by themselves or in combination with herbicide application can effectively control EWM and lower the concentration of chemical used or the time of exposure necessary to kill the plant (Sorsa et al. 1988, Nelson and Shearer 2002). None of these have currently been approved for use in Wisconsin.

8.11 Biomanipulation

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

The presence of a particular form of algae may cause a decline in EWM vigor and vitality. In the July survey of the Minong Flowage, the plant surveyor found that most of the EWM present was covered with a form of algae known as "nostoc." In the surveyors opinion the EWM was substantially less vigorous than expected due primarily to the presence of this algae on the EWM plants. In the fall survey, nostoc had all but disappeared from the water column and the EWM had made a substantial come back. It is not known if the presence of this algal species is a regular occurrence or an isolated incident in 2008. Steps should be taken to document the presence of this algal species in future years to see if it continues to have a negative impact on the EWM.

8.12 Native Plant Restoration

Finally, a healthy population of native plants might slow invasion or reinvasion of non-native aquatic plants. It should be the goal of every management plan to protect existing native plants and restore native plants after the invasive species has been controlled. In many cases, a propagule bank probably exists that will help restore native plant communities after the invasive species is controlled (Getsinger et al. 1997). This is certainly the case in the Minong Flowage. If EWM can be controlled, enough native plants currently still exist to begin repopulating treatment areas. It is the goal of this plan to protect and enhance native plant populations while controlling EWM.

8.13 Chemical Control

Chemical control involves application of an herbicide approved for use in aquatic systems. Currently there are only six chemicals approved for aquatic plant control. They are 2,4-D, Diquat, Endothall, Triclopyr, Fluridone, and Glysophate. These chemicals can be classified as either a systemic herbicide or a contact herbicide. Contact herbicides act immediately on the tissues contacted, typically causing extensive cellular damage at the point of uptake but not affecting areas untouched by the herbicide. Systemic herbicides are taken in by the plant from the water or sediment and trans-located throughout the plant. Contact herbicides are faster but do not have sustained effects and may not kill roots, root crowns, or rhizomes. Systemic herbicides take longer to act but often result in the mortality of the entire plant (Madsen 2000). Glysophate is a contact herbicide that is used only for emergent vegetation and not effective on submersed plants (Madsen 2000). There is one compound, complexed copper that is approved for algae control. There are several enzyme specific chemicals being tested at the present time including Carfentrazone, Penoxsulam, and Imazamox but it is likely that the five herbicides listed above (excluding glysophate) will be the main products used for control of submersed invasive plants like EWM and CLP (Netherland 2008).

While aquatic herbicides typically provide relief from the nuisance plant, applications can elicit concerns regarding potential for non-target plant impacts, off-target plant impacts, and impacts to fisheries. Identifying lake hydrology and site characteristics are important for determining which chemical at what concentration is necessary to achieve a control goal, usually predetermined by the stakeholders involved. Aquatic herbicides are not generally applied to the target plant itself, but rather to the water around the target plant to get to a designated concentration. The target plant typically only takes in 1-5% of the available herbicide. The rate and time of exposure that is experienced by the target plant is essential in determining the effectiveness of the treatment. Many processes in the lake will affect the concentration and exposure time a submersed aquatic plant will experience. Size of treatment area, dilution and dispersion, density of target species, water flow, and even thermal patterns can impact herbicide application. The key is to make the herbicide stay in place long enough at a high enough concentration to negatively affect or kill the target plant, be that several hours to several months (Netherland 2008).

Several of the chemicals used in aquatic setting can be considered to be "selective" herbicides based on the chemical make up of the herbicide. Selectivity can be improved by determining application times, such as early spring, that have minimal impacts on non-target plants. 2,4-D is a selective herbicide that only affects plants like EWM classified as dicots. Many pondweeds including CLP are considered monocots, so are not affected by 2,4-D. Since EWM and CLP are both early season plants, often beginning their growth before many native plants get started, early season application can improve selectivity.

The following paragraphs provide more detail about each of the potential chemicals used for aquatic plant control. It is important to note that all of these chemicals are only "safe" when used at concentrations and in settings indicated on the label. More is not better, and trying the herbicide on something new is illegal.

8.13.1 Diquat

Diquat is a non-selective, contact herbicide that will kill or injure a wide variety of plants by damaging cell tissues when absorbed by the foliage. It will not kill parts of the plant it does not come into direct contact with. Its common trade name is Reward. Diquat is not effective in lakes or ponds with muddy water or plants covered with silt because it is strongly attracted to clay particles in the water. Bottom sediments must not be disturbed when this herbicide is used. At approved application rates Diquat does not appear to have any long or short term effects on most aquatic organisms.

8.13.2 Endothall

Endothall is also a contact herbicide that works by blocking the plants ability to produce certain proteins it needs to survive. Its common trade name is Aquathall K or Hydrothall. Endothall is a broad spectrum herbicide most commonly used to kill pondweeds like curly-leaf. It is also used to kill EWM, coontail, wild celery, and some species of algae. At recommended rates, it does not appear to have any long or short term effects on fish or aquatic invertebrates. Both Endothall and Diquat kill the plant material they come in contact with, but do not necessarily kill root crowns or stems not contacted by the herbicide.

8.13.3 Fluridone

Fluridone is a non-selective systemic herbicide. It requires very long exposure times often 3 months or more, but may be effective at very low concentrations. Its common trade name is SONAR. Fluridone is gaining acceptance for control of EWM. It was just recently approved for use in Wisconsin lakes. It works best where the entire lake or flowage system can be managed, but not in spot treatments or high water exchange areas. Fluridone does not appear to have any long or short term adverse effects on fish or other aquatic invertebrates if label directions are followed. EPA tolerance for fluridone residues in fish is 0.5 ppm.

8.13.4 Triclopyr

Triclopyr is a systemic herbicide, similar to 2,4-D used for control of aquatic dicots. It common trade name is Garlon 3A or Renovate. Triclopyr degrades quickly in an aquatic environment making its use most effective in systems with low water-exchange where contact with target plants can be maintained for longer periods of time, though not as long as Fluridone. Low concentrations of this herbicide can be effective for EWM control when exposure time reaches 48 to 72 hours (Netherland and Getsinger 1992). It does not appear to significantly affect pondweeds and coontail (Clayton & Clayton 2001). As of 2005, Triclopyr was not a registered herbicide and can only be used under an experimental use permit in the United States (Cooke et al. 2005).

8.13.5 2,4-D

2,4-D is one of the most common systemic herbicides in use today. There are at least 1500 different products containing 2,4-D registered with the EPA. 2,4-D is a relatively selective herbicide commonly used for treatment of EWM. A few of its most common trade names for use in an aquatic environment are Aqua-kleen, Aquacide or Navigate. It is available in several different forms. Granular or pellet forms are most commonly used to kill EWM. It effectively controls broadleaf plants with a relatively short contact time (5-7 days), but does not generally harm pondweeds or water celery (Madsen 2000). In water 2,4-D has a half life or 7-48 days and quickly degrades through photolysis and microbial action. It does not have any long or short term effects on other aquatic organisms if applied at rates specified on the label. 2,4-D does impact younger stages of wild rice growth, reducing tiller and seedhead production (Nelson et al. 2003), therefore it should not be used in the early season in areas where wild rice growth occurs.

The biggest disadvantage for using 2,4-D, or for that matter any chemical, is public perception (Madsen 2000). Full exclosure of any negative impacts, good education, and making sure application is done properly by experienced people will help to reduce negative public opinion. While there is some concern that target plants may develop a resistance to some herbicides, and that chemical residues may remain in the aquatic environment longer than is reported, there is little evidence of any build-up of herbicide residues or chronic toxicity in natural aquatic systems and fish populations appear not to be adversely affected (Murphy and Barrett 1990).

One unconfirmed study by Lovato et al. 1996 from the Michigan Department of Environmental Quality, Drinking Water, and Radiological Protection Division, Ground Water Supply Section suggests that 2,4-D can migrate from surface water application to groundwater under certain hydrogeologic conditions. Once in groundwater, a lack of oxygen may allow the compounds that make up 2,4-D to persist for longer periods of time. The authors conclude that shallow, near shore wells are at greatest risk for contamination. They also conclude that further study is needed.

It is important to keep in mind that "no product can be registered (by the EPA) for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources and, in addition it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Madsen 2000).

9.0 Discussion

Based on the information presented in the previous pages some form of management for EWM in the Minong Flowage is necessary. The surface area of the Flowage with EWM has more than tripled in the last five years now present in at least 336 acres. Surface area with a rakehead density rating of 2 or more on a 1-3 scale is more than 240 acres, interfering with many lake uses including swimming, fishing, and recreational boating. Water quality, native plant species, and the fishery all seem to be holding their own at the current time but are showing signs of stress. There is still room for EWM in the Flowage to expand its current range and to become more dense in areas it is already present. More than 560 acres of the Flowage appear to contain good habitat for EWM growth. It can be expected that EWM will expand into these areas if little or no management is done. As the frequency of occurrence for EWM increases it is likely that water quality will continue to degrade as the plant dies and decays in the sediments adding more nutrients to the system. The density and distribution of native plants will likely also decline. The fishery is experiencing a slowing in the growth rate of its fishes. This may or may not be attributed to greater EWM growth, but it can not be ruled out. The majority of residents feel that some form of control work on the Flowage is necessary and are prepared for the potential cost of treatment. It is the goal of the majority of lake residents to reduce the levels of EWM growth in the Flowage to a manageable level over time. A management plan that helps accomplish this goal in necessary.

Several management activities should be included in a management plan for the Minong Flowage. Lake residents should continue to physically remove new and pioneering sites with EWM from areas that are easily accessible. The potential for biological controls, specifically the EWM weevil needs to be evaluated. While drawdown and dredging could potentially provide some control of EWM in the Flowage, unless it is done for some other reason like dam maintenance, it is not a viable alternative for the Flowage at this time. Mechanical harvesting is not a viable management alternative due to the nature and characteristics of the Flowage. Herbicide use is a viable alternative for the Flowage, and is supported by the majority of respondents to the Lake User Survey. Small-scale treatment (<10 acres) could be used to control new or pioneering sites, but it is likely that the total treatment area would exceed the 10 acre minimum very quickly. Large-scale herbicide application up to 160 acres is the most likely management alternative for the Minong Flowage. If chemical treatment exceeds 160 acres or 50% of the littoral zone, it is considered whole-lake and a formal Environmental Assessment is required by the WDNR (Appendix K).

Two scenarios for large-scale herbicide use (< 160 acres) have been proposed for the Minong Flowage. Each was set up for a 3-yr period and would treat about the same acreage of EWM in the Flowage over that time period. Both are designed to reduce dense growth of EWM in the areas most affected by it. In the first year approximately 125 acres would be treated with some additional acreage coming from individual landowners who may need more immediate local relief. In the second year a similar amount of EWM would be treated, again with the potential for some additional acreage coming from individual landowners needing local relief. Year three would be a follow-up year to retreat patches of EWM that appear to have been missed or where herbicide application was perhaps inadequate in the previous years. It is expected that the total acreage of EWM treated in the third year would be substantially lower than in the two previous years. At the end of year three, the treatment plan would be reevaluated to determine if it was effective and if changes could be made to substantially reduce the total acreage of the Flowage chemically treated, and/or if other forms of management including biological control by weevils should be introduced. Native plants would again be evaluated to determine if they were negatively or positively impacted by the previous large-scale herbicide application. It is the goal of such a plan to reduce levels of EWM in the Flowage to a much more manageable and affordable level so that more targeted treatment could occur in smaller areas.

Scenario One is based on a “hot spots and navigation” approach. Herbicide use would be more widely spread throughout the Flowage to open areas currently experiencing navigational problems as a result of EWM growth, and to treat smaller areas that are causing landowner issues. Year One would concentrate on opening navigation channels through beds 14, 21, and 22 (Appendix L, Map 1). It would also treat hot spots in beds 7, 8, 12, and 24. Treatment in Year Two would expand treatment areas in beds 7, 14, 21, and

22. Additional hot spots would be included in beds 1, 10, and 18 (Appendix L, Map 2). Year Three would include follow-up treatment in these areas and in other areas not previously designated if necessary. This approach also could mimic results found by Unmuth et al. (1998) when discussing the benefits of cutting channels through dense EWM beds very near the sediment level. There was some level of channel persistence even a couple of years after treatment and large amounts of vegetative "edge" habitat was created for the fishery.

Scenario Two is based on a "lake restoration" approach. Large-scale herbicide use would be more concentrated in large areas currently affected by EWM. Individual landowner relief would be limited as the goal would be to "restore" large areas of the Flowage, giving native plants the best chance to re-colonize. Year One would concentrate on treating large areas of EWM in beds 14, 21, and 22 (Appendix L, Map 3). Smaller areas of EWM would not be treated. In Year Two, additional acreage in beds 14, 21, & 22 would be treated largely making these areas free from dense EWM growth. Additional acreage would be treated in beds 7 and 8 (Appendix L, Map 4). Year Three would include follow-up in previously treated areas and include limited treatment in other areas of the Flowage.

There are benefits and drawbacks to both of these scenarios. Benefits from a "hot spots and navigation" approach include improving access to areas most affected by EWM growth to fishing and boating, providing more near shore relief which may limit the number of individual landowner permits that are issued, and that areas designated for treatment are more easily changed under short notice as conditions warrant. Drawbacks include not opening as large an area to fishing and boating or to native plant re-colonization, the necessity for a more accurately defined treatment area, and more difficult pre, post, and fall monitoring.

Benefits from a "lake restoration" approach include opening larger areas of the Flowage to fishing, boating, and native plant re-colonization, less fine-tuning of the treatment area, and easier pre, post, and fall monitoring. Drawbacks include not providing landowners with immediate local relief which may increase the number of individual landowner permits requested, limited fishing and boating relief in other areas of the Flowage, treatment areas are not as easily changed under short notice, and herbicide use is more concentrated in just a few areas of the Flowage.

While both approaches could successfully be implemented on the Flowage, the "hot spots and navigation" approach is more widely supported by lake residents, is the better of the two scenarios in this consultant's opinion, and seems to have the most support from the WDNR (Craig Roesler, personal communication Oct. 2008).

At this time 2,4-D is the preferred herbicide to use for this application. This herbicide has been widely used for both small-scale and large-scale EWM control. It is also the most cost-effective herbicide for use at this level at no more than 0.5 gallons per acre for a maximum concentration of 2.0 mg/l (Madsen 2000). The actual amount of herbicide needed to obtain a concentration level and exposure time necessary for effective EWM control is dependant on treatment area characteristics within the Minong Flowage. Triclopyr could also be considered if it ever is approved for general use in aquatic systems.

All 2,4-D applications should follow early season guidelines accept in areas where wild rice is present. In general, it appears that wild rice is most abundant in areas previously designated as no treatment areas (waters less than 3 ft. deep). Currently, wild rice appears to be holding its own against the advance of EWM in the area where the Totagatic River enters the Minong Flowage. There is a small bed of EWM just upstream of the Smiths Bridge landing. This area should be closely monitored to determine if EWM starts to have an impact on the wild rice in the area. If it does, then future management of the EWM should be considered. This would not involve the use of 2,4-D in the early season, but could involve late season application of 2,4-D or another approved herbicide when mature wild rice plants are most resistant (Nelson et al. 2003).

Curly-leaf pondweed is present in the Flowage and could become more successful with the control of EWM. A curly-leaf monitoring program should be included in any management plan. This could be completed by a consultant or by Minong Flowage residents as a part of the Citizen Lake Monitoring Network (CLMN) (Appendix M).

The WDNR has required guidelines for pre- and post-treatment monitoring, and late season monitoring for impacts on native aquatic plants and to determine proposed treatment areas for the following year. Three years of monitoring followed by a lake wide assessment of the native plants would have to be completed (Appendix N).

A watercraft inspection program would have to be completed at each of the main access points on the Flowage. This would involve either volunteer or paid time at the landings by lake residents or a hired inspector. Official “Clean Boats, Clean Waters” water craft inspection guidelines would have to be followed.

Continued and likely increased volunteer water quality monitoring would be advised to better assess EWM treatment effects on the lake. This could be done by volunteers, but it is likely that the additional lab costs would not be covered by the Citizen Lake Monitoring Network, as the current lake monitoring program is.

Should a concern arise over the large-scale use of the herbicide 2,4-D and the presumption that it could possibly contaminate groundwater, several area shallow wells could be tested on a regular basis during the 3-yr treatment period.

A EWM weevil survey should be completed to assess the potential for biological control, perhaps over a couple of years. This could be done by a consultant, or volunteers on the Flowage could be trained to be weevil surveyors as a part of the CLMN (Appendix O).

9.1 Cranberry Flowage

This management plan does not include any EWM control work in the area known as the Cranberry Flowage between Hwy T and Cranberry Lake. This is one area where EWM has the potential to really increase its presence. Some discussion has led this consultant to believe that this area would likely be managed by the Cranberry Lake Association, even though it is officially recognized as part of the Minong Flowage. Further discussion is needed to iron out the details of treatment in this area.

The following is the suggested Aquatic Plant Management Plan (APMP) for the Minong Flowage. The APMP is based on a 3-yr large-scale herbicide application program to substantially reduce EWM acreage to a level that is more manageable and affordable in the long run.

10.0 Aquatic Plant Management (APM) Recommendations

Each of the recommendations put forth in this aquatic plant management plan strives to meet one or more of the following goals:

1. To respond to concerns expressed by lake residents and users.
2. To substantially reduce nuisance level growth of EWM in order to establish a more affordable, sustainable, and manageable infestation.
3. To promote protection, restoration, and expansion of native aquatic plant, fisheries, and invertebrate communities in the lake.
4. To take steps to prevent the introduction and establishment of other aquatic invasive species.
5. To inform, educate, and involve lake residents and the general public in all present and future aquatic plant management activities on the lake including planning.

All stakeholders will be given the opportunity to evaluate and provide feedback on this plan before it is implemented.

Recommendation 1: All residents and users of the Minong Flowage should be informed and educated as to what their role is and will be in implementing this aquatic plant management plan.

Elements:

- Learn and promote the value of all aquatic plants.
- Learn to identify aquatic invasive species present and monitor their expansion or decline.
- Support continued water quality monitoring.
- Support aquatic invasive species monitoring and watercraft inspection programs designed to protect the lake from further damage due to unwanted invasive species.
- Provide stakeholder feedback related to current and future recommendations presented in this APM Plan.
- Be good stewards of the lake and surrounding area.

Recommendation 2: Seek outside funding to support the recommendations in this plan.

Elements:

- Aquatic Invasive Species Established Infestation Control Grant. Deadline: February 1st, 2009
- Recreational Boating Facilities Management Grant
- Look into sources of tribal funding (protection of wild rice)

Recommendation 3: Use early season large-scale chemical application to control EWM in the Minong Flowage, based on a "hot spots and navigation" approach, except in areas where wild rice is present.

Elements:

- Follow all WDNR guidelines for proposed, pre, and post chemical herbicide treatment monitoring (Appendix N).
- Limit treatment to only areas where in-lake rake head EWM density ratings are 2 or 3 on a 1-3 scale.
- Small or large-scale chemical application should only be applied to designated areas according to early season guidelines, except in areas where wild rice is present.
- Apply chemicals in a manner that will not unduly effect native plant species or compromise fish spawning habitat in water 3-ft. or less, or wild rice growing zones.
- Large-scale chemical application may not always be the best alternative. Assess the need for a large-scale chemical application each time one is proposed.
- Individual landowner permits for herbicide application may be issued but the Minong Flowage Association must be informed to ensure total treatment area does not exceed 160 acres.

Recommendation 4: Do not treat any native aquatic plants.

Elements:

- Native plants are abundant in the Minong Flowage, but at this time they do not present nuisance conditions warranting any kind of treatment.
- Follow current WDNR APM Strategy for establishing the need to treat native aquatic plants in the future (Appendix P).
- Repeat point-intercept survey of the entire lake at least every five years to determine the extent of native plant growth vs. EWM growth in the lake.
- Re-evaluate this recommendation if native plants become a nuisance before the next aquatic plant survey.

Recommendation 5: Encourage lake residents to use raking and hand-pulling to control EWM in shallow areas near shore.

Elements:

- Provide training for EWM identification.
- Provide guidance on the best ways to physically remove EWM from the lake.

Recommendation 6: Consider the milfoil weevil a potential, viable EWM control option for the future.

Elements:

- Monitor for the presence and abundance of the milfoil weevil according to guidelines provided by the CLMN (Appendix O).

Recommendation 7: Implement a curly-leaf pondweed monitoring program possibly as a part of the CLMN Aquatic Invasive Species "Watch" program.

- Train lake residents and users how to identify CLP.
- Map the presence of CLP each year to determine the extent of spread.

Recommendation 8: Establish and maintain an effective watercraft inspection program at the landing to prevent aquatic invasive species from entering and exiting the Minong Flowage.

Elements:

- Follow guidelines established by the Wisconsin Clean Boats, Clean Waters Program.
- Such a program is required by the state to receive AIS Established Infestation Control grant funding.

Recommendation 9: Continue and expand water quality monitoring on the Flowage.

- Continue with the Citizen Lake Monitoring Network (CLMN) on both existing lake sites. Parameters on both sites should include total phosphorus, chlorophyll a, Secchi, dissolved oxygen, and temperature profiles.
- Add an additional CLMN site in the north basin with the same parameters as the original two lake sites.

Recommendation 10: Offer to include the Cranberry Lake Association in all discussion related to this management plan, including EWM treatment in the area known as the Cranberry Flowage, watercraft inspection, weevil monitoring, and future invasive species work.

Elements:

- Share this aquatic plant management plan with the Cranberry Lake Association.
- Determine a EWM management strategy for that area known as the Cranberry Flowage.

Recommendation 11: Protect and enhance areas of wild rice growth.

Elements:

- Do not allow early season treatment of EWM with the herbicide 2,4-D in wild rice areas.
- Monitor the impact of expanding EWM on existing wild rice beds.
- Seek involvement and support from the Voight Task Force in protecting wild rice beds.

11.0 Management Success

Management success would be based on an overall long-term goal of reducing treatment in any given year to less than 10% of the total littoral zone. Since 10% would be approximately 90 acres, the expected goal would actually be around 5% or 45 acres or less of nuisance or dense growth EWM treatment in any given year. A revised management plan after the three years accounted for in this plan would reflect this goal. An additional goal is to reduce the size and density of large beds of EWM to much smaller areas with only scattered plants having a density of 1 or less on a 1-3 rakehead density scale.

Acceptable native plant response would be no net loss in native plant diversity or FQI, and ideally some gain.

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Appendix A

1966 Lake Survey Map

Appendix B

Minong Flowage Watershed Map

Appendix C

Land Cover, Soils, and Wetlands Maps

Appendix D

UW-Superior Limnological Assessment

Appendix E

Citizen Lake Monitoring Network Water Quality Reports

Appendix F

Lake User Survey

Appendix G

Lake User Survey Results

Appendix H

2003 WDNR Plant Survey Report

Appendix I

2008 SEH Plant Survey Report

Appendix J

2007 WDNR Letter Opposing a Minong Flowage Drawdown

Appendix K

Large-scale Treatment WDNR Guidelines

Appendix L

Lake Treatment Maps (incomplete)

Appendix M

Citizen Lake Monitoring Curly-leaf Pondweed Watch Guidelines

Appendix N

WDNR Pre/Post Treatment Monitoring Guidelines

Appendix O

Citizen Lake Monitoring EWM Weevil Monitoring Guidelines

Appendix P

2007 WDNR Northern Region Aquatic Plant Management Strategy