AMENDMENT 2
Aquatic Plant Management Plan, Lake Mendota, Lower Rock River Basin, Dane County Wisconsin

Approved by the Dane County Lakes and Watershed Commission on December 21, 2017 and by the Wisconsin Department of Natural Resources on April 13, 2018

Prepared by Dane County Land and Water Resources Department (LWRD) staff Sue Jones, Pete Jopke, Andrew Karleigh, John Reimer, and Michelle Richardson, with assistance from Susan Sandford.

Plant surveys were conducted by Dane County staff Pete Jopke and Andrew Karleigh. The Wisconsin Department of Natural Resources provided funding to LWRD to support this plan amendment.

Introduction

This is a second amendment to the Aquatic Plant Management Plan, Lake Mendota, Lower Rock River Basin, Dane County Wisconsin, published in January 2007 by the Dane County Office of Lakes and Watersheds. The Wisconsin Department of Natural Resources approved the 2007 plan on March 17, 2007 and the Dane County Lakes and Watershed Commission approved the plan on April 12, 2007. The first amendment to the 2007 plan was approved by the Wisconsin Department of Natural Resources on March 27, 2014 and by the Dane County Lakes and Watershed Commission on April 10, 2014. Aquatic Plant Management Plans are required under NR 109.04(d), Wisconsin Administrative Code, to guide mechanical harvesting activities and the effective management of aquatic plants in water bodies.

This plan is prepared in support of Dane County's permit for its mechanical aquatic plant harvesting program, operated in accordance with NR 109 Wisconsin Administrative Code. Individuals and groups that propose herbicide treatments of aquatic plants in Dane County waters would need to go through a separate planning and permitting process with the Wisconsin Department of Natural Resources.

Recent Plant Survey Methods and Results

Dane County LWRD staff conducted the aquatic plant survey of Lake Mendota on July, 25, 26, 27, 28, Aug 1, and Aug 2, 2017, using current Wisconsin DNR approved protocols and the point intercept method. Refer to the point intercept maps in the 2007 plan for the sampling locations for the Mendota surveys.

Table 1 below indicates species present during the 2017 survey for Lake Mendota, and Figure 1 indicates species richness from 1989-2017 for Lake Mendota.

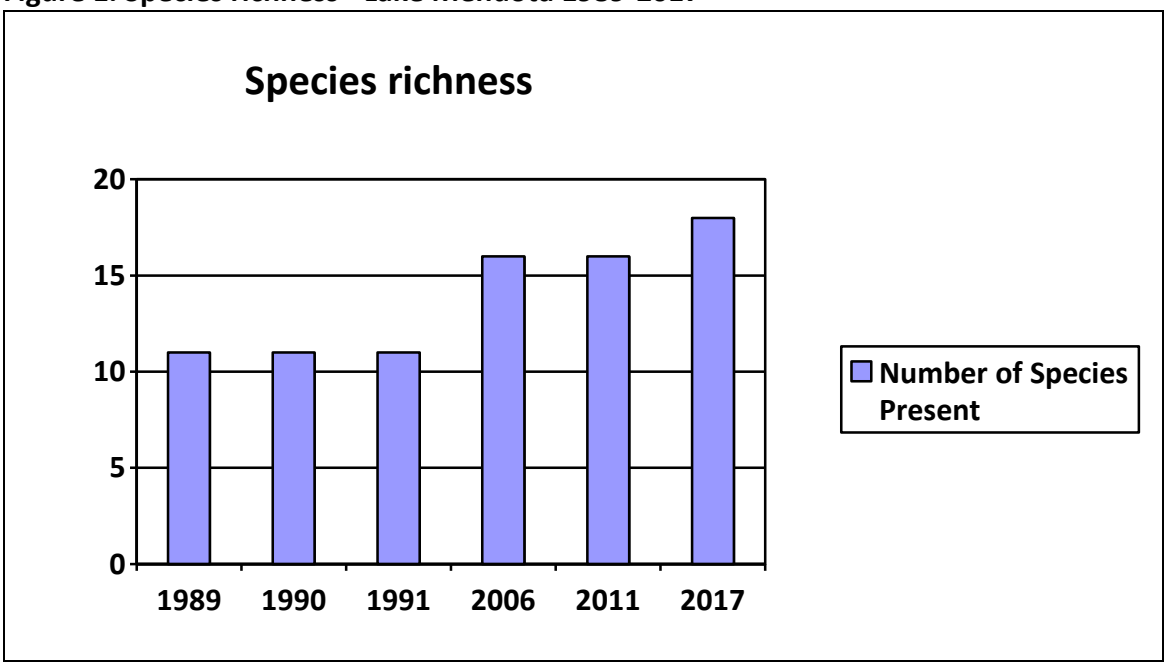
Species richness is a count of the total number of different plant species found in a lake. Generally, the better the water quality the higher the species richness count.

Appendix A includes Lake Mendota plant statistics from the 2017 plant survey. Appendix C includes maps of aquatic plant distributions for Lake Mendota in 2017.

Table 1. Species present during 2017 aquatic plant survey – Lake Mendota

Genus	Species	Common Name	Category
Algae	*sp.*	Filamentous algae	Submersed
Ceratophyllum	*demersum*	Coontail	Submersed
Chara	*sp.*	Muskgrass	Submersed
Elodea	*canadensis*	Common waterweed	Submersed
Heteranthera	*dubia*	Water star-grass	Submersed
Lemna	*minor*	Small duckweed	Free floating
Myriophyllum	*spicatum*	Eurasian water-milfoil	Submersed - Invasive
Myriophyllum	*sibiricum*	Northern water-milfoil	Submersed
Najas	*flexilis*	Slender Naiad	Submersed
Nelumbo	*lutea*	American lotus	Emergent
Nymphaea	*odorata*	White water lily	Floating-leaf
Potamogeton	*foliosus*	Leafy pondweed	Submersed
Potamogeton	*richardsonii*	Clasping-leaf pondweed	Submersed
Potamogeton	*zosteriformis*	Flat-stem pondweed	Submersed
Potamogeton	*nodosus*	Long-leaf pondweed	Submersed
Spirodela	*polyrhiza*	Large duckweed	Free floating
Stuckenia	*pectinata*	Sago pondweed	Submersed
Vallisnera	*americana*	Wild celery	Submersed

Figure 1. Species richness - Lake Mendota 1989-2017



Discussion of historical plant community changes

Definition of terms used in this section

Maximum depth of plant growth is the deepest depth at which plants were found in the lake. This is a function of water clarity. The clearer the water, the better the light penetration and presumably the deeper plants are able to grow. Not all plants grow in deep water. Some may prefer the shallower parts of the lake, but with clearer water the opportunity to grow deeper is available. Oligotrophic lakes (very clear water lakes) will have some plants growing in waters deeper than 20 feet. Hypereutrophic lakes (the opposite of oligotrophic) are characterized by excessive algal blooms and turbid poor water quality and clarity. Rooted plants are few and restricted to either unusual weather conditions or very shallow water where light can penetrate. Plant diversity is usually restricted to species that can tolerate poor water clarities.

Frequency of occurrence is calculated by taking the total number of times a species is sampled divided by the total number of points at which depth was less than or equal to the maximum depth of plant growth.

The photic zone is the area where light penetrates enough to support plant growth.

The Floristic Quality Index (FQI) is a metric that evaluates the closeness of the flora in a lake to that of an undisturbed condition. The higher a FQI value, the closer that plant community is to an undisturbed ecosystem. Just for reference, compare a lake's numbers to the statewide average (24) or ecoregion average (20) (lakes also within the Southeast Glacial Plans ecoregion -

see map here http://dnr.wi.gov/topic/landscapes/documents/StateMaps/Map_S1_ELs.pdf), calculated from a subset of approximately 250 lakes across Wisconsin.

Coefficients of conservatism (C) range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition (see the end of Table 4 in Appendix A). The lower numbers indicate more of a disturbed ecosystem, while the higher numbers indicate a community more like one that would have been found before human settlement.

Lake Mendota

Prior survey results

The 2006 survey showed plant depth to 16 feet and diversity to 16 total species. Coontail and EWM were the dominant species in 2006. The 2011 survey showed similar, overall community statistics mirroring the species richness and maximum depth of plants found in 2006. However, the most prevalent species found in 2011 was wild celery, with abundant coontail and EWM. Over these sampling periods, the FQI and average coefficient of conservatism (C) both increased. From 1989-1991, the FQI and average C were stable at 15 and 5, respectively. In 2006, these rose to 19.14 and 5.31 and then rose in again after the 2011 survey to 20.58 and 5.5. These values can be used to gauge the health of the lake and potentially show an increasingly healthy aquatic plant community on the lake.

In the previous two surveys, 16 species were identified during both. Though maximum depth remained the same at 16 feet, the total frequency of occurrence of plants in the photic zone decreased from 67.04% to 51.36%. Wild celery saw the biggest increase in abundance from 9.0% relative frequency to 29.6% while EWM also increased. Slender naiad, Illinois pondweed, and common watermeal were new species found during the 2011 survey while curly-leaf pondweed (invasive species), leafy pondweed, and sago pondweed were not found in 2011 but were found in 2006.

2017 survey results

In the 2017 survey, an increase in the community diversity and makeup was observed compared to the 2011 survey. The total number of species present was 18 to a maximum depth of 15 feet. The FQI rose to 21.5, and C declined slightly to 5.38.

The 2017 survey was dominated by wild celery, coontail and Eurasian water-milfoil. The total frequency of occurrence of plants in the photic zone increased to 68.29% and wild celery increased to a relative frequency of 47.36%. The new species during the 2017 survey were Northern water-milfoil, long leaf pondweed, and large duckweed. Curly-leaf pondweed, common watermeal, and Illinois pondweed were not found during the 2017 survey. Comparing the 2017 vegetation survey to previous ones conducted on Lake Mendota, in 2017 the number of species present increased. This led to a slight increase in the mean C and more significant

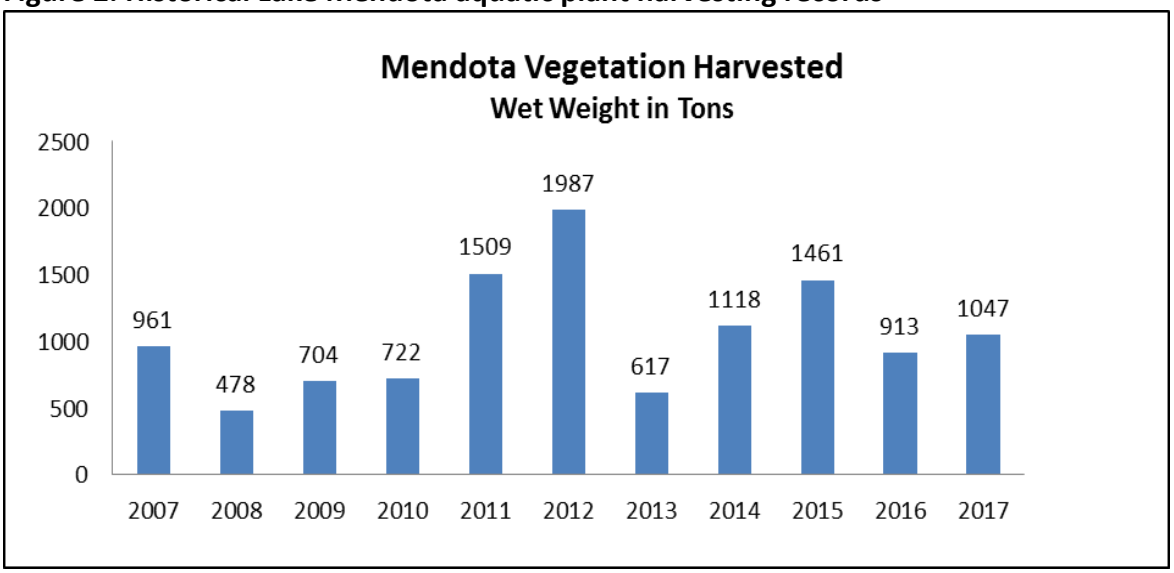
increase in the FQI. Table 5 in appendix A shows that the 2017 frequency of occurrence of Eurasian water milfoil, coontail and water star-grass are lower than prior years. Increases were noted in flat-stem pondweed, clasping leaf pondweed, and slender naiad.

The presence or absence of these species should not be a cause for concern, but should be monitored on future surveys.

Harvesting Aquatic Plant Management Records

Figure 2 summarizes Dane County's mechanical harvesting operations in Lake Mendota since 2007. According to Wisconsin DNR, the last permit granted for herbicide use on Lake Mendota was in 2007.

Figure 2: Historical Lake Mendota aquatic plant harvesting records



Public input opportunities

Dane County Land and Water Resources Department (LWRD) staff developed an aquatic plant management online survey hosted on the Office of Lakes and Watersheds web page from May through August 2017. Staff promoted the survey via email, press release, social media, and through business – card-sized prompts handed out by harvester operators, Clean Boats Clean Waters staff, and other LWRD staff over the summer.

There were 165 responses to the online survey, and almost 80% of the respondents did not recommend any changes to the harvesting program priority goals and maps for each waterbody. More than 50% of the respondents reported areas that are difficult to navigate through related to aquatic plant growth, and identified specific locations where these difficulties have occurred from time to time.

Dane County Land and Water Resources Department staff held two public information meetings on October 2 (held at Dane County offices in southeast Madison) and 9 (held in Middleton), 2017. Although these meetings were well publicized through press releases, email, and social media, and were promoted by one television station, only a few people attended.

The complete draft plans were posted on the Office of Lakes and Watersheds web page in mid-November, with public comment solicited until December 8. No public comment was received on the Lake Mendota plan. LWRD staff have made several clarifications to plan text based on DNR comments.

Dane County staff does not recommend any changes to the current harvesting priority maps as a result of the online survey responses, public information meeting comments, and draft plan public comment period. Dane County staff have noted the areas identified by survey

respondents as difficult to navigate through, and the Plant Scout will monitor those locations during upcoming seasons, and will evaluate whether additional harvesting in those locations is appropriate.

Aquatic Plant Management in Dane County

The overall goal of Dane County's mechanical harvesting program is to cut and harvest Eurasian water-milfoil and other nuisance vegetation to help provide for reasonable use of the lakes for boating, fishing and swimming, while preserving the health and balance of the lake ecosystem. During periods of high water, harvesting of plants in the Yahara River between lakes Waubesa and Kegonsa becomes the highest priority to reduce the extent and duration of flooding.

Aquatic plant growth varies from lake to lake and year to year. Dane County employs a Plant Scout to evaluate plant growth conditions and recommend appropriate harvesting in response, within the limits of the plan harvesting priority areas and DNR permit. In times of heavy plant growth, local residents often advocate for additional harvesting in their areas, harvesting longer into the season (into the fall), or dedicating a harvester for a particular waterbody. County managers balance staff and harvesting equipment resources and priorities with needs and ecological conditions countywide. Local groups or individuals have the option of contracting with the county for additional harvesting and special event harvesting, within the boundaries of the permit and pending staff and equipment availability. Additional information about contract harvesting is available here: https://wred-lwrd.countyofdane.com/documents/APM/Dane%20County%20Aquatic%20Plant%20Harvest%20Contract%20.pdf.

Dane County holds annual training sessions for new and returning harvester operators before the harvesting season begins. In that training, permanent and seasonal staff receive instruction on many topics including aquatic invasive species prevention protocols, plant identification, and communications. The Lakes Management Supervisor directs the day-to-day operations of the staff, guided by the Stormwater Engineer who is informed of plant conditions and harvesting needs by the Plant Scout. Particular concerns with a water body; deep versus shallow harvesting; collection of plant fragments from harvesters, plant self-fragmentation, and boat propellers etc. are all addressed in the supervision.

Working closely with the Wisconsin Department of Natural Resources, the Dane County Land and Water Resources Department has developed harvesting priority maps that are included in many of the aquatic plant management plans and referred to in DNR harvesting permits issued to Dane County. Not every area that is identified for potential harvesting on the map will be harvested in any given harvesting season if there is little to no plant growth, because attention to higher priority areas does not permit it, or due to budget constraints. Harvester operators are instructed not to cut and remove plants outside of harvesting priority areas identified on these maps, unless authorized by their Supervisor in consultation with the Wisconsin Department of Natural Resources.

Harvesting machines are designed to cut, collect and remove plant fragments. Machine operators do not cut and harvest aquatic plants in water less than three feet in depth except where it's permitted by the Wisconsin Department of Natural Resources in the Yahara River.

Limits of the equipment, staff, and budget mean that plant harvesting for aesthetics, collection of wind-blown plant fragments due to boat propeller action, and the removal of plants that release from the sediment and float free in the fall cannot generally be accomplished. However, Dane County helps clean up plant materials at beaches and other public access points, even when the plant material is not associated with harvesting operations. Program managers also do their best to accommodate special requests for collection of naturally-occurring windblown and boat motor chopped plant fragments near private shorelines, as time and budget permit, and in consultation with Wisconsin DNR. Occasionally this collection of plant fragments occurs in waters less than three feet deep. The Dane County Lake Management Operations Manual provides instructions to harvesting machine operators about plant fragment collection.

There is a common misperception that excessive external nutrients carried into lakes in runoff from the watershed causes macrophyte (large aquatic plant) problems. In fact, external nutrient loading usually produces algal blooms that shade and reduce macrophyte biomass. Attempts to control biomass by controlling nutrients in the water column are unproductive, according to G. Dennis Cooke and others in the third edition of Restoration and Management of Lakes and Reservoirs (2005). This is because rooted macrophytes, such as the nuisance Eurasian water-milfoil, usually get their phosphorus and nitrogen directly from sediments. In the short-term, reduced phosphorus in the water column resulting from watershed controls may actually result in more macrophyte growth, because clearer water permits more light penetration that fosters plant growth.

It could take many years to reduce the historical nutrient additions to lake sediments, especially in agricultural areas. Much important work is underway in the Yahara River watershed to reduce watershed phosphorus loadings. In the long-term, scientists and managers hope that community efforts can reduce sediment phosphorus, thereby more directly affecting plant growth.

Fisheries

Anglers sometimes raise concerns over harvesting vegetation in late spring and early summer during the fish spawning period. Harvesting aquatic vegetation during this critical time impacts a small fraction of the available spawning habitat for any given species and we continue to monitor the fish populations closely for any impacts aquatic plant harvesting may have. Dane County works closely with WDNR Fisheries and there appears to be no negative impact on the fishery as a whole. The Yahara Chain of Lakes continue to provide excellent fishing opportunities of all sorts including panfish, walleye, northern pike, largemouth bass, and musky.

Invasive Species

Much of the focus of Dane County's mechanical harvesting program is to cut and harvest Eurasian water-milfoil and other invasive and nuisance vegetation to help provide for reasonable use of the lakes for boating, fishing and swimming.

Dane County staff will continue to take steps to ensure that its plant harvesting equipment is cleaned and disinfected before moving it to other waterbodies, and follow all other Wisconsin invasive species laws (see Appendix B) to prevent transport of invasive plants to other waterbodies.

The invasive species below are more recent arrivals to the Yahara chain of lakes. Dane County staff, along with recreational users, following cleaning and disinfecting protocols will help prevent the spread of these and other invasive plants and animals.

Spiny Waterfleas

In 2009 populations of spiny waterfleas (SWF) were verified by the Wisconsin DNR to be present in the Yahara chain of lakes. Spiny waterfleas are zooplankton that are native to Europe and Asia. Introduction of SWF into the Great Lakes by ballast water discharged from ocean going ships most likely occurred in the 1980's, and since then the spread to inland waters has continued.

The most likely method of introduction of SWF into the Yahara chain of lakes was by a boat, bilge water, or live well that had not be decontaminated. Research suggests that the SPF were introduced into Lake Mendota in the mid 1990's based upon sediment core samples where spines are present. By 2009 SWF were found in Lake Mendota at densities that are higher than any other waterbody in its native or invaded range. (Walsh 2016)

The SWF are carnivorous predators eating native herbivorous zooplankton. This loss of native zooplankton can have negative impacts on the lake ecology, impacting the zooplankton structure and distribution. This loss of native zooplankton can also affect fish populations that rely on the zooplankton as a food source. Small fish try to prey upon SWF but their spines make them difficult to swallow. The loss of zooplankton can also increase the amount of phytoplankton, leading to greater turbidity, degraded plant health and reduced maximum depth where plants grow. As a result we see greater algal blooms and more impacts on people using the water.

One of the impacts to anglers is that SWF clog fishing rod eyelets and accumulate on fishing lines.

Zebra Mussels

In 2015 in Lake Mendota a population of zebra mussels was found by the UW Center for Limnology and verified by the Wisconsin DNR. Additionally in 2016 a population of zebra mussels was verified by the Wisconsin DNR in Lake Monona. Zebra mussels are native to Europe and Asia. The zebra mussel is a small bottom dwelling clam that spread through microscopic larvae called veligers. The zebra mussels were introduced into the Great Lakes in the 1980's most likely through the ballast water from ocean going ships, and since then zebra mussels have been spread to other inland waters.

The most likely method of introduction of zebra mussels into the Yahara chain of lakes was by a boat, bilge water, or live well that had not been decontaminated. The first observation of zebra mussels in the Yahara was in Lake Monona in 2001 when a few adult specimens were found.

The zebra mussels are the only freshwater mollusk that can attach themselves to solid objects. They become prolific in many lakes altering the food web. There may be increased plant abundance, as well as bluegreen algae blooms. Zebra mussels affect shoreline residents, boat owners and swimmers when their shells accumulate on hard surfaces making them a hazard to grab or stand on. They also encrust piers and boats, potentially damaging boat motors unless people take preventative steps. Adult females can produce one million eggs per year.

Chinese Mystery Snails

In 2012 these invasive snails were found in Lake Waubesa. In 2015 they were found in Stewart Lake, and in 2017 they were found in Lake Monona. These snails are native to eastern Asia and have been transported to the area for aquarium trade and possibly by in mud on boats or trailers. With a hard operculum (trap door that seals the shell) these snails can survive out of water for four weeks (*Unstad, K.M. and others. Management of Biological Invasions (2013) Volume 4, Issue 2: 123–127*), making their transport to a new waterbody likely. The impacts of these snails are not very well-studied.

Recommended management

Dane County staff have reviewed the plant survey data and public input, and recommends the management elements found in this section, which are largely unchanged from 2013.

Lake Mendota Goals

Because Eurasian water-milfoil has dominated the littoral zone for several decades, the goals for managing Lake Mendota aquatic plants are to: (1) improve recreational access in the lake, (2) protect areas of unique natural value and historical significance, and (3) restore documented losses and declines of high value species [NR 107.08(4)] in the lake including large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*Potamogeton illinoensis*), clasping-leaf pondweed (*Potamogeton richardsonii*), horned pondweed (*Zannichelia palustris*), wild celery (*Vallisneria Americana*), sago pondweed (*Struckenia pectinatus*), bulrush (*Scirpus*), and wild rice (*Zizania*). Other important native plants that have declined in Lake Mendota and

also require protection include flat-stem pondweed (*P. zosteriformis*) yellow water lily (*Nuphar*), white water lily (*Nymphaea tuberosa*), American lotus (*Nelumbo lutea*), *Chara*, slender naiad (*Najas flexilis*), leafy pondweed (*Potamogeton foliosus*), and water stargrass (*Heteranthera dubia*).

These overarching aquatic plant management goals are coupled with the more specific goals of Dane County's mechanical harvesting program: to cut and harvest Eurasian water-milfoil and other nuisance vegetation to help provide for reasonable use of the lakes for boating, fishing and swimming, while preserving the health and balance of the lake ecosystem.

Lake Mendota Recommendations

1. Conduct large-scale mechanical harvesting in areas where Eurasian water-milfoil inhibits boating access and recreation. Avoid designated or proposed Critical Habitat Areas under Wisconsin Administrative Codes. (Designation of Critical Habitat Areas is a DNR decision.)
2. Consider options for reducing motorboat impacts to floating-leaf plants (American lotus and white water lily) in University Bay and Governor's Island sheltered coves.
3. Consider expanding floating-leaf plant beds and introducing high value species (historically found in the lake) within proposed Critical Habitat Areas, University Bay and Governor's Island sheltered coves.
4. The Dane County Plant Scout should document occurrences of high value native plants in regular scouting reports, including shoreline reference and GPS location. Dane County staff should make an annual summary report of these occurrences available to the public.
5. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes and streams. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment (see Appendix B).

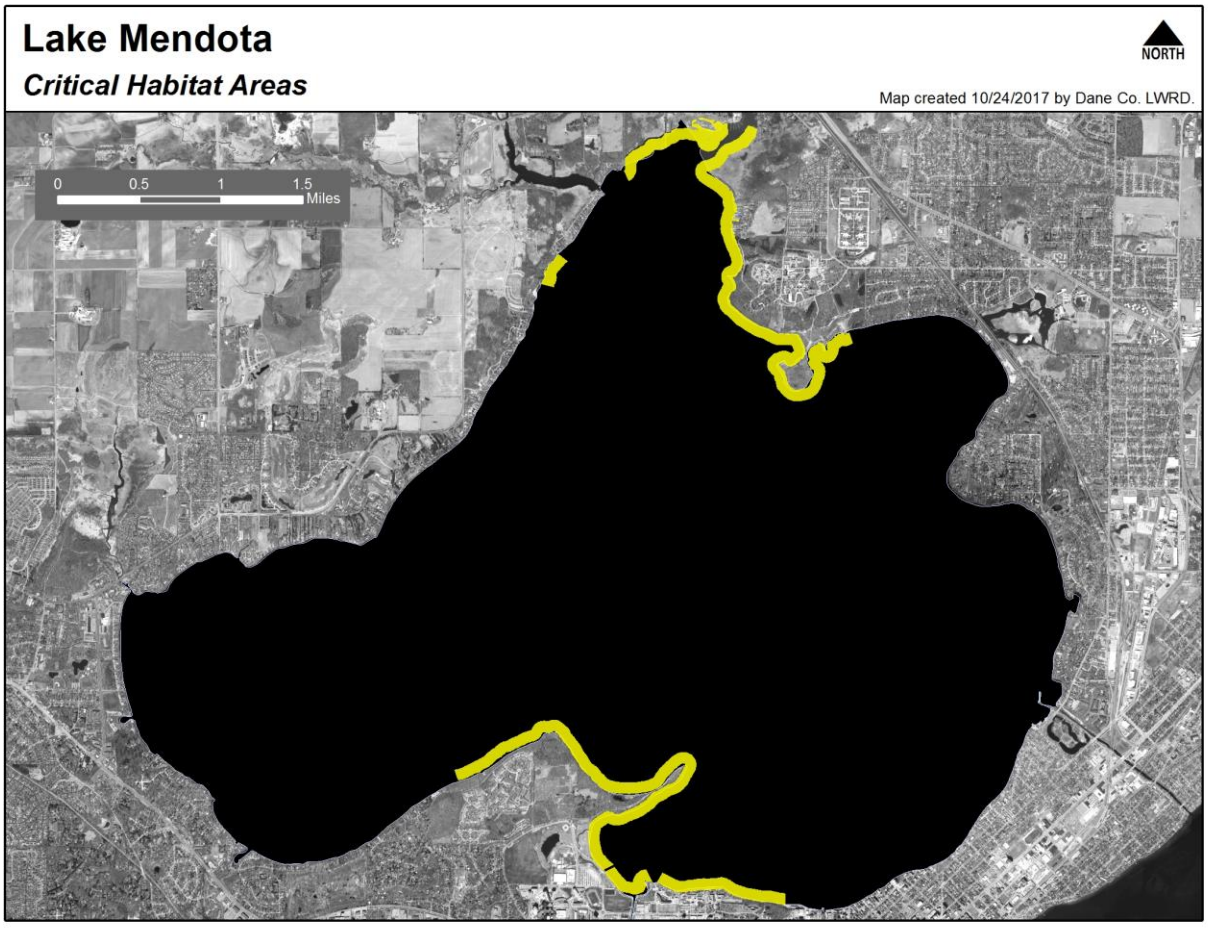
Proposed Critical Habitat Areas

Wisconsin DNR's website describes the importance of the DNR's designation of Critical Habitat Areas as follows: "Every waterbody has critical habitat - those areas that are most important to the overall health of the aquatic plants and animals. Remarkably, eighty percent of the plants and animals on the state's endangered and threatened species list spend all or part of their life cycle within the near shore zone. …….. Wisconsin law mandates special protections for these critical habitats. Critical Habitat Designation is a program that recognizes those areas and maps them so that everyone knows which areas are most vulnerable to impacts from human activity. A critical habitat designation assists waterfront owners by identifying these areas up front, so they can design their waterfront projects to protect habitat and ensure the long-term health of the lake they where they live."

Lake Mendota

Figure 4 is the Critical Habitat Area map for Lake Mendota. The only change to this map since the 2013 plan amendment was to delete an area southwest of Tenney Lock that was mistakenly identified as critical habitat, when in fact it is a machinery hazard area.

Figure 4. Proposed Critical Habitat Areas for Lake Mendota



Harvesting Priorities

The harvesting priorities map for Lake Mendota (Figure 5) shows areas that may be harvested. Wisconsin Department of Natural Resources staff approved Figure 5 in April 2017, and its addition of a harvesting area for row boating off shore of UW's Porter Boathouse. Additional background on harvesting priorities is found in the Lake Management Operations Manual and posted on the LWRD website (https://wred-lwrd.countyofdane.com/Aquatic-Plant-Management/Aquatic-Plant-Harvesting-Program). Annual training and daily supervision of harvester operators reinforce that plants should be harvested only from these planned areas, unless a variance from the plan has been approved by Wisconsin DNR. Actual effort is dictated based on plant conditions, as evaluated and reported by Dane County's Plant Scout.

Figure 5. Lake Mendota harvesting priorities