AQUATIC PLANT MANAGEMENT PLAN

FOR

LAKE WAUBESA
Lower Rock River Basin

DANE COUNTY, WISCONSIN

Lake Waubesa from Lake Farm County Park

December 2011

OFFICE OF LAKES AND WATERSHEDS
DANE COUNTY LAND AND WATER RESOURCES DEPARTMENT
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Summary

An aquatic plant survey was performed during the summer of 2008 on Lake Waubesa. A total of 520 sites were sampled across the lake but only 225 sites supported aquatic vegetation of one type or another. Filamentous algae and/or duckweed were the only plant forms found at some of the 225 sites. The relative dearth of plants in Lake Waubesa reflected a major decline in Eurasian watermilfoil (EWM). Milfoils including EWM, northern watermilfoil or hybrid were only collected at 44 sites while coontail was the most abundant rooted plant and it was collected at 144 sites. A similar pronounced EWM decline had occurred in Monona Bay in 2008 but not within the larger Lake Monona basin. Sensitive Areas that are recommended under Wisconsin Administrative Code NR 107.05(3-i) include public shorelines along the north end of the lake, south end and various public parks. These areas were also recommended in 1993 as part of the previous aquatic plant management plan for Lake Waubesa.

Public comment on the draft plan was solicited on the Dane County Office of Lakes and Watersheds website, and publicized using various forms of electronic communication.

Recommendations

1. Conduct large-scale mechanical harvesting in areas where EWM grows in dense monotypic stands. Goals for managing EWM are to improve boating access and fish habitat, and to expand native rooted plant species.
2. Prohibit chemical herbicide treatments within Sensitive Areas (see Figure 8) except in areas where monotypic stands of EWM occur and goals should include improving fish habitat and expanding native rooted plants. Sensitive Areas are relatively undeveloped areas supporting coarse woody debris; floating-leaf plants including spatterdock (*Nuphar variegata*) and white water lily (*Nymphaea odorata*); and submersed native plant species including clasping-leaf pondweed (*Potamogeton richardsonii*), sago pondweed (*Struckenia pectinatus*), leafy

pondweed (*Potamogeton foliosus*), water stargrass (*Heteranthera dubia*), muskgrass (*Chara*) and wild celery (*Vallisneria Americana*).

3. Chemical herbicide treatments should focus on the selective control of Eurasian watermilfoil – EWM (*Myriophyllum spicatum*).
4. Adopt the “Natural Shorelines” identified in the 1993 (Winkelman and Lathrop) aquatic plant management plan as Sensitive Areas.
5. Dane County’s mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. The fact sheet in Appendix A is included in the harvesting crews’ operations manual.

Introduction

As required in Wisconsin Administrative Code NR 109.04(d), the purpose of this plan is to guide mechanical harvesting activities and the effective management of aquatic plants in Lake Waubesa. This plan also updates a previous aquatic plant management plan prepared in 1993 (Winkelman and Lathrop). Dane County operates mechanical harvesters in Lake Waubesa to reduce dense beds of exotic EWM and occasionally exotic curly-leaf pondweed – CLP (*Potamogeton crispus*). Native coontail (*Ceratophyllum demersum*) beds are targeted when densities undermine recreational uses. Dense stands of these “weedy” plants have undermined boating access and other recreational uses in the lake. Harvesting efforts have been designed to enhance important lake management functions.

Aquatic plant beds in Lake Waubesa have changed significantly since the nineteenth century. The combination of declining water quality, invasions of non-native carp (*Cyprinus carpio*) and weedy plants (EWM and CLP), shoreline development, herbicide treatments and heavy motorboat traffic have altered the plant communities in the lake (Nichols and Lathrop 1994). As a result, several high value native species had not been collected in decades while other native species have declined substantially from the lake. Lake Waubesa has supported relatively low species richness, a likely symptom of urbanization within the watershed and historic wastewater discharges. More detailed discussions on the trends and environmental impacts on aquatic plants in Lake Waubesa and other Yahara Chain of Lakes can be found in *Cultural Impacts on Macrophytes in the Yahara Lakes Since the Late 1800s (*Nichols and Lathrop 1994) and *Aquatic Plants in Lake Waubesa: Their Status and Implications for Management* (1993).

The primary goals in preparing this plan were to establish long-term realistic objectives for managing nuisance exotic plant species while protecting valuable native species and their important habitat functions. While the goal was not to create a comprehensive lake management plan, aquatic plant community relationships with other aspects of lake and watershed management cannot be ignored.

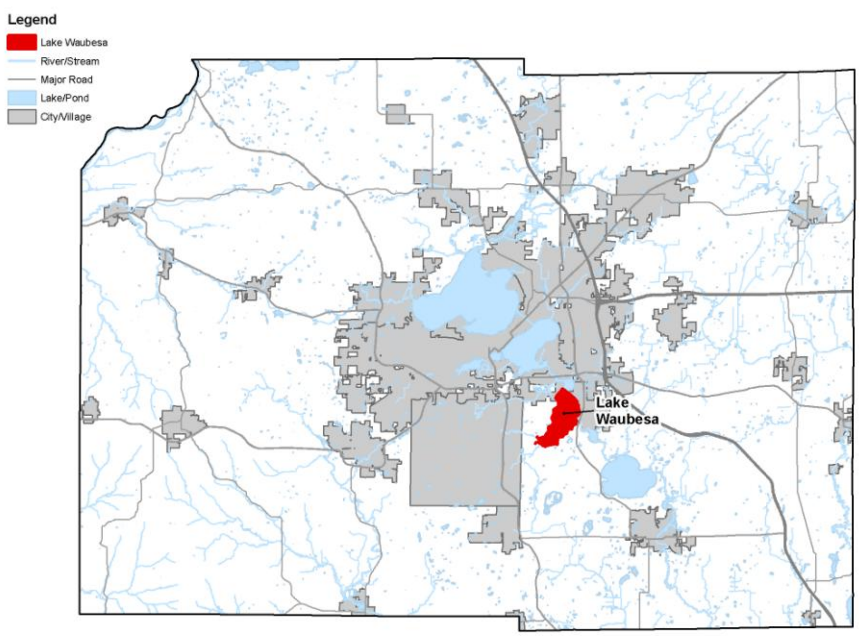
Goals

Because Eurasian watermilfoil has dominated the littoral zone for several decades, the goals for managing Lake Waubesa aquatic plants are to (1) improve recreational access in the lake, (2) protect Sensitive Areas defined under Wisconsin Administration NR 107.05(3-i) and (3) restore documented declines and possible of high value species [NR 107.08(4)] in the lake including clasping-leaf pondweed (*Potamogeton richardsonii*), horned pondweed (*Zannichelia palustris*), wild celery (*Vallisneria Americana*) and sago pondweed (*Struckenia pectinatus*). Other important native plants that have declined in Lake Waubesa and also require protection include flat-stem pondweed (*P. zosteriformis*), spatterdock (*Nuphar variegata*), white water lily (*Nymphaea tuberosa*), muskgrass (*Chara*), slender naiad (*Najas flexilis*), leafy pondweed (*Potamogeton foliosus*), and water stargrass (*Heteranthera dubia*).

Background Information

Lake Waubesa (2,080 acres) lies downstream of Lake Monona and upstream of Lake Kegonsa (Figure 1). The lake has a maximum depth of 38 feet and shoreline length of 9.4 miles. It is third in a series of lakes that were formed as morainic damming of pre-glacial Yahara River (Day et al. 1985). Excluding the land area that drains into the upper Yahara Lakes, the direct watershed area surrounding Lake Waubesa is 47.1 square miles of mixed agriculture and urban landscapes. Lake Waubesa typically displays advanced eutrophic conditions (primarily algal blooms and reduced water clarity), reflecting a number of factors including historic wastewater discharges, polluted runoff and a shallow basin that enables internal loading from lack of sustained thermal stratification (Dane County Regional Planning Commission 1979).

Figure 1: Lake Waubesa location within Dane County



The northern and southern portions of the lake are the only natural shorelines that remain today. Development has modified most of the lakeshore and nearshore littoral zone habitats.

The cumulative long-term effects of eutrophication and habitat destruction have been altering aquatic plant communities in the lake for decades. While species accounts of aquatic plants in Lake Waubesa are sketchy, areas of dense aquatic plants were described long before the introduction of EWM and wild celery was very abundant until the mid-1930's (Lathrop et al 1992). Following the discharge of poorly treated wastewater into

Lake Waubesa during the 1930's, the maximum depth of aquatic plant growth was only five feet and continued to decline to only three feet by 1951 (Nichols and Lathrop 1994). More recently, rooting depths for aquatic plants have increased to at least 11 feet, reflecting improved water clarity since the 1970's.

In addition to declining water quality and extensive chemical treatments, other factors that lead to native plant declines include exotic invasions of common carp, EWM and to a much lesser extent CLP. Carp were introduced into the Yahara Lakes between 1897 and 1893. Direct impacts of carp include uprooting and roiling the bottom sediments during feeding and spawning. EWM appeared to have a pronounced impact as native plant declines coincided with rapid expansion of the exotic plant by 1966 (Nichols and Lathrop 1994). Because they begin their growth early in the year, both EWM and CLP can create dense canopies before native species emerge from winter dormancy. For approximately a decade after its introduction, EWM became well established in Lake Waubesa and remained very abundant until the first noted decline in 1976. Since then, periodic declines and resurgence of EWM have occurred in Lake Waubesa and in the other Yahara lakes, a typical sequence found for EWM and other exotic plant invasions (Nichols 1994, Smith and Barko 1992). Compared with EWM, CLP growth trends have been insignificant and have had minor impacts on native plants in Lake Waubesa.

EWM has undermined boating, fishing, water skiing, and swimming in Lake Waubesa. This is a common pattern found throughout the United States when EWM enters a lake (Nichols 1994, Smith and Barko 1990). In addition to human use impairments, the ecological side effects of dense stands of EWM and other weedy plants on fisheries have been extensively evaluated (Engel 1987, Dibble et al. 1996, Olson et al. 1998, Savino and Stein 1982, Trebitz et al. 1997). Dense EWM beds have been linked with slow fish growth rates in some lakes. However the effects of EWM on panfish and predator growth rates in Lake Monona are not significant. Growth rates and production of a variety of sportfishes in Lake Waubesa have been considered excellent for decades. In Lake Mendota, EWM in may have contributed to the disappearance of nongame fishes including banded killifish (*Fundulus diaphanus*), blackstripe topminnow (*Fundulus* *notatus*) blackchin shiner (*Notropis heterodon*), blacknose shiner (*Notropis heterolepis*), pugnose shiner (*Notropis anogenus*), and tadpole madtom (*Noturus gyrinis*) (Lyons 1996). Other factors such as shoreline development and piers may have also affected these species due to their strong affinity for nearshore aquatic plant habitat (Garrison et al. 2005, Bryan and Scarnecchia 1992, Becker 1983, Gaumitz 2005, Marshall and Lyons 2008). Heavy motorboat traffic has also been linked to declining aquatic plant habitat in lakes (Asplund and Cook 1997).

While nongame fish declines likely occurred, Lake Waubesa supports diverse warmwater fisheries including longnose gar (*Lepisosteus osseus*), bowfin (*Amia calva*), northern pike (*Esox lucius*), common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), spottail shiner (*Notropis hudsonius*), bluntnose minnow (*Pimephales notatus*), fathead minnow (*Pimephales promelas*), white sucker (*Catostomus commersoni*), black bullhead (*Ameiurus melas*), yellow bullhead (*Ameiurus melas*), brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*) brook silverside (*Labedesthes sicculus*), white bass (*Morone chrysops*), rock bass (*Ambloplites rupestris*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), logperch (*Percina caprodes*), Iowa darter (*Etheostoma exile*), walleye (*Stizostediun vitreum*) and freshwater drum (*Aplodinotus grunniens*) – (Day et al. 1985).

High mercury in lake sediments from historic wastewater discharges is a concern due to bioaccumulation of methyl-mercury in fish and the fish consumption advisory. While mercury in sediments are at higher levels most lakes in the state, mercury levels in fish have consistently been lower than those found in many other lakes with lower alkalinities and higher rates of anaerobic bacterial conversion of inorganic mercury to methyl-mercury. Lakes with lower alkalinities (closer to neutral or below 7 on the pH scale) are typically found in northern Wisconsin. They are often referred to as northern shield lakes. These lakes are found in soils that have low amounts of calcium and magnesium, which results in lower alkalinities. Most mercury found in these northern lakes is a result of mercury contribution from rain and snow. Anaerobic (low or no oxygen) conditions then facilitate the process of methylation of mercury, or changing its form to one that can readily enter the food chain.

Recent Chemical and Harvesting Aquatic Plant Management Records

Dane County's mechanical harvesting program typically runs from mid-May to mid-August each summer. Harvesting is not conducted in water less than three feet deep. Harvesting staff at times will operate the machines in waters shallower than three feet, but only to scoop up floating plants. The cutting head of the harvesters are lifted up so as to avoid disturbing sediment during these floating plant collection times. Priority harvesting includes emergency flood relief, boat navigation and public access areas such as beaches and boat landings. Harvested plants are removed to a local composting site. Figure 2 contains the annual tonnage of aquatic plants harvested from Lake Waubesa from 1989 to 2008.   Figure 3 is a map of priority harvesting areas within Lake Waubesa. Background on establishment of harvesting priorities is found at www.countyofdane.com/lwrd/parks/aquatic_plant_harvesting.aspx .

Figure 2 Lake Waubesa mechanical harvesting summary

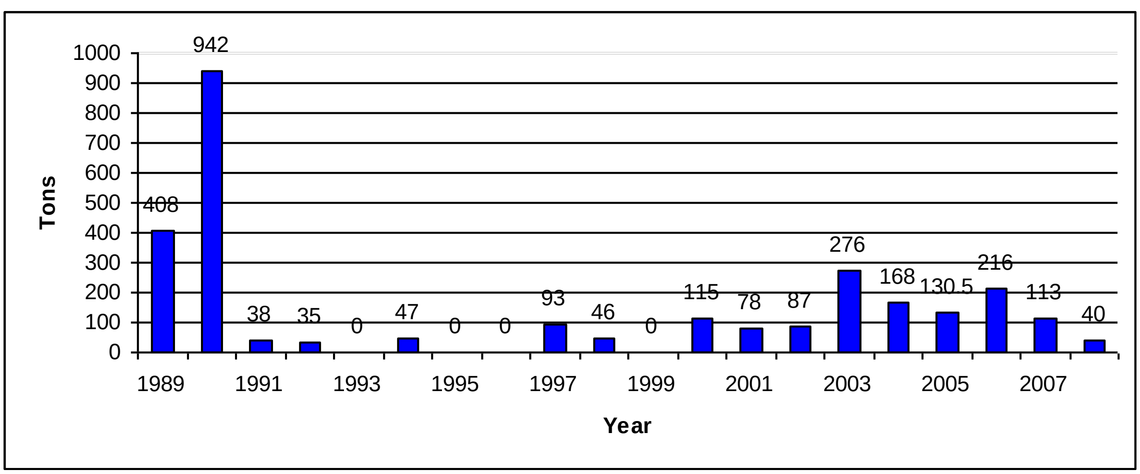
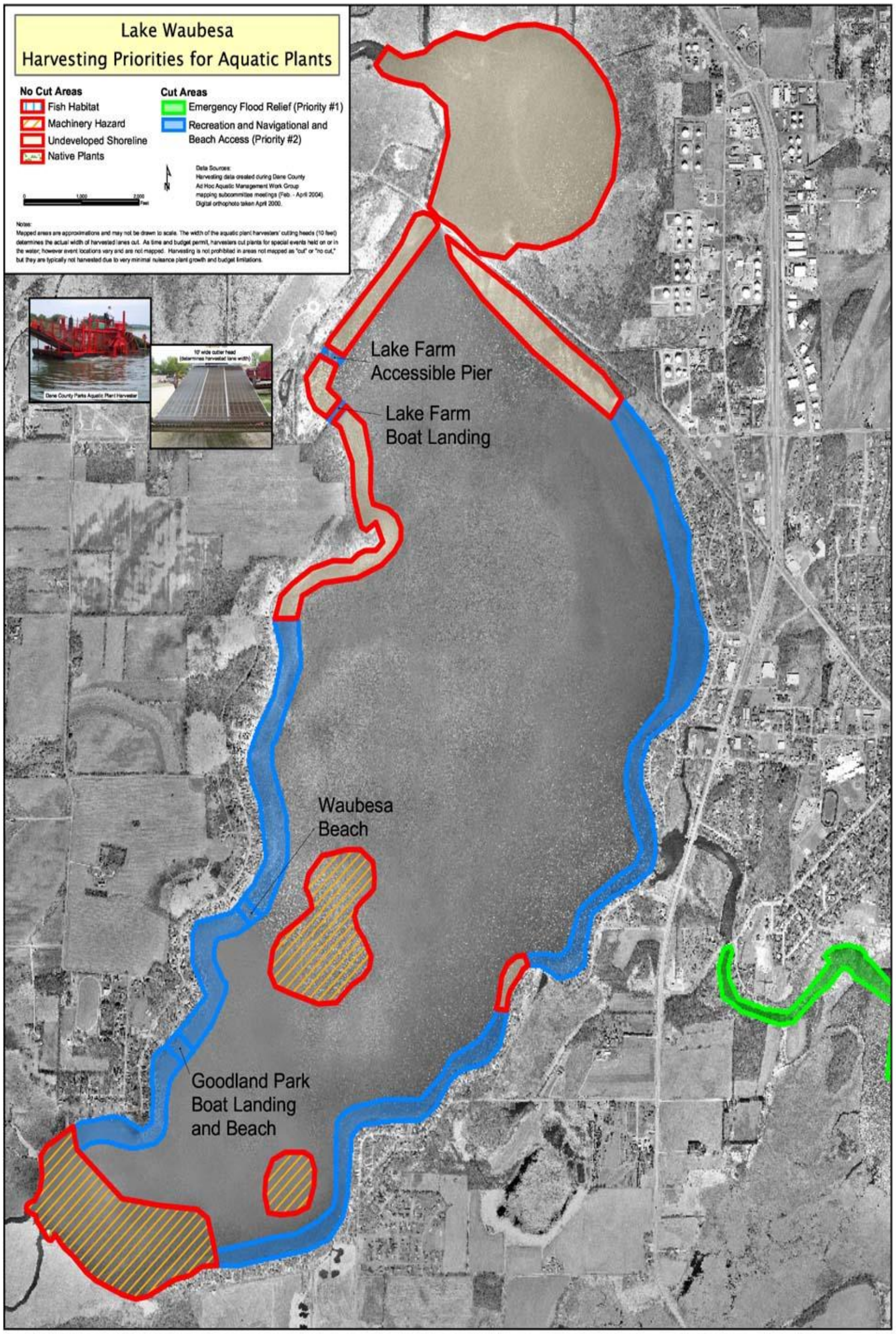
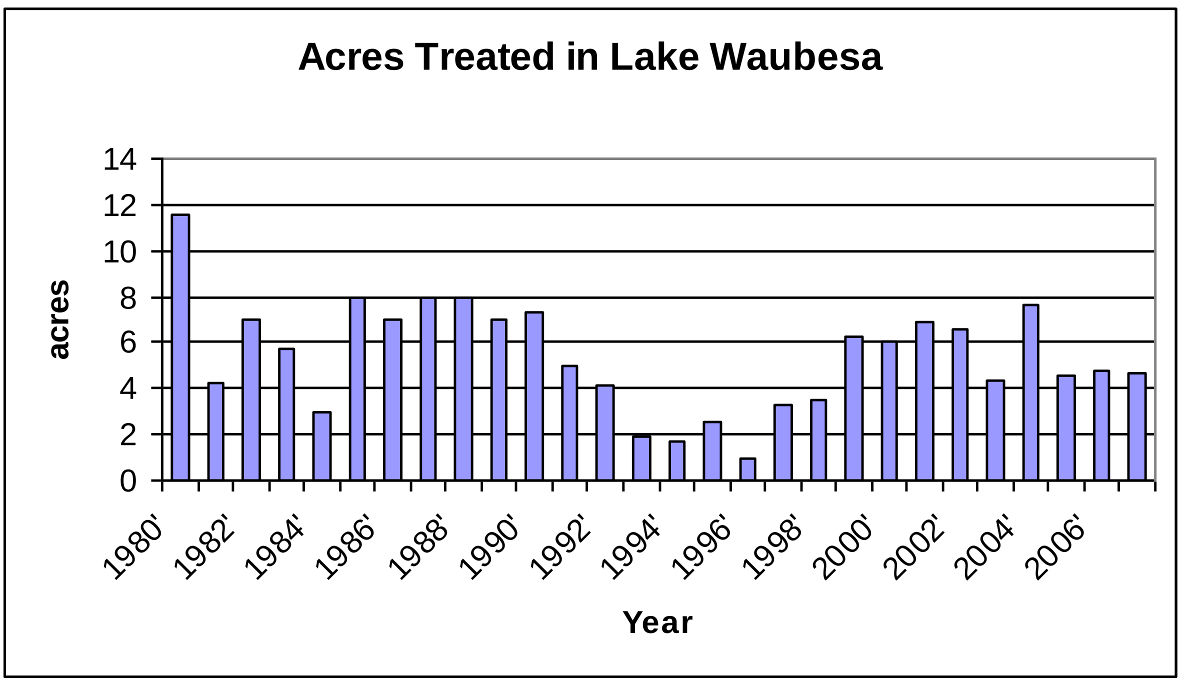


Figure 3: Lake Waubesa Mechanical Harvesting Priority Areas



While Dane County operates mechanical harvesting equipment in water deeper than three feet, a number of the private riparian property owners collectively hire one or more certified chemical applicators each year for nuisance plant control in shallower waters. These chemical herbicide applications are for individual property owners and include areas adjacent to their docks. Chemical applications have been a controversial issue for managing aquatic plants in the Yahara lakes since the 1970s, primarily due to concerns over potential unknown ecological and health effects. Potential adverse impacts of chemical applications include damage to non-target organisms and change to ecosystem functions. In general, chemical applications have been fairly consistent over the last few decades and treatment areas have been relatively modest in relation to the total littoral zone in the lake. One concern has been that herbicide treatments focus on near shore plant communities where most of the native plants occur. Figure 4 lists total littoral zone acres treated annually for EWM and filamentous algae from 1980 to 2007.

Figure 4: Acres chemically treated in Lake Waubesa by private entities



2008 Aquatic Plant Survey Update

Methods

Jen Hauxwell, a research scientist with the Wisconsin Department of Natural Resources (WDNR) Bureau of Integrated Science Services, developed the point intercept sampling protocol. The point intercept method involves a large number of sampling sites that are distributed equidistantly across a lake. In each lake, sampling determines the maximum depth of rooted plant growth and greater depths are ultimately ignored. GPS units were used to locate the sites and double-headed rakes were used to collect aquatic plants. Two forms of sampling rakes were used. The pole rake was used for sampling aquatic plants up to 15 ft (4.6 m) and rope rake was used to sample deeper areas. Density ratings from 1-3 were determined by the amount of plant material in the two-headed rake. Plants that were observed near the boat but were not collected in the rake were also noted. Samples of each species found in a lake were collected, pressed and submitted as voucher specimens to the UW Madison Herbarium. Secchi measurements were collected during each sampling day and these were transformed to Trophic State Index values (TSI). The TSI is a lake water quality index ranging from 0 to 100. Values greater than 50 indicate eutrophic or high fertility.

Statistical analysis included the following:

- Frequency of occurrence within vegetated sites (number of times a species was found divided by the total number of vegetated sites.
- Relative frequency of plant species collected (describes each species contributing a certain percentage of the whole aquatic plant community).
- The Simpson Diversity Index is a nonparametric estimator of community heterogeneity. The Simpson Diversity Index range is from 0 to 1 with lower diversity reflected in scores closer to 1.

Detailed statistical results appear in Appendix B. Appendix E contains detailed plant survey results.

WDNR provided the sampling grids and Excel spreadsheet software for data entry and analysis. A more detailed sampling description can be found in Baseline Monitoring of Aquatic Macrophytes (Hauxwell 2006).

Results and Discussion

The point intercept survey was conducted on July 8, 11, 15 and 18, 2008. Secchi depths ranged from 3.6 feet (TSI = 59) and 5.5 feet (TSI = 53) and reflected moderate Cyanobacteria blooms. Aquatic plants were sampled at a total of 520 GPS points across the lake. The maps in Appendix C display aquatic plant distributions in Lake Waubesa, and Appendix D summarizes fish and waterfowl values of native plants in the lake. Results of the 2008 plant survey included that a few plants were found at a maximum depth of 13 feet but most plant collections were less than 10 feet, more consistent with previous surveys. The 2008 survey maximum rooting depth is compared with previous reports for Lake Waubesa in Figure 5 (adapted from Winkelman and Lathrop 1993). Total species richness was similar during the two major sampling periods, the early 1990's and 2008. However, coontail comprised a much larger percentage of the aquatic plant community in 2008 (relative frequency of 35% compared to just 9% for EWM) and likely reflects the decline in EWM that year. Simpson Diversity Index was moderately low at 0.78. Values closer to 1 indicate greater aquatic plant community diversity.

Table 1 lists aquatic plant species collected 1990-92 and 2008. Adapted from Winkelman and Lathrop (1993), Figure 6 compares relative frequencies for EWM, coontail, CLP and sago pondweed. These four species were dominant during the 1990's but in 2008 other species appeared to become more common including water stargrass, leafy pondweed flatstem pondweed and northern watermilfoil. EWM was the dominant rooted plant in most years except 1990 when coontail was collected at about the same frequency and in 2008 when it clearly dominated in the wake of the EWM decline. Relative frequency data for all species collected in 2008 are displayed in Figure 7, including filamentous algae and duckweed. Previous surveys excluded these two plant groups but filamentous algae were frequently collected in 1992 rake-head samples.

Figure 8 displays proposed Sensitive Areas (Wisconsin Administrative Code NR 107.05(3-I)) in Lake Waubesa.

Figure 5: Depth of maximum rooted plant growth in Lake Waubesa.

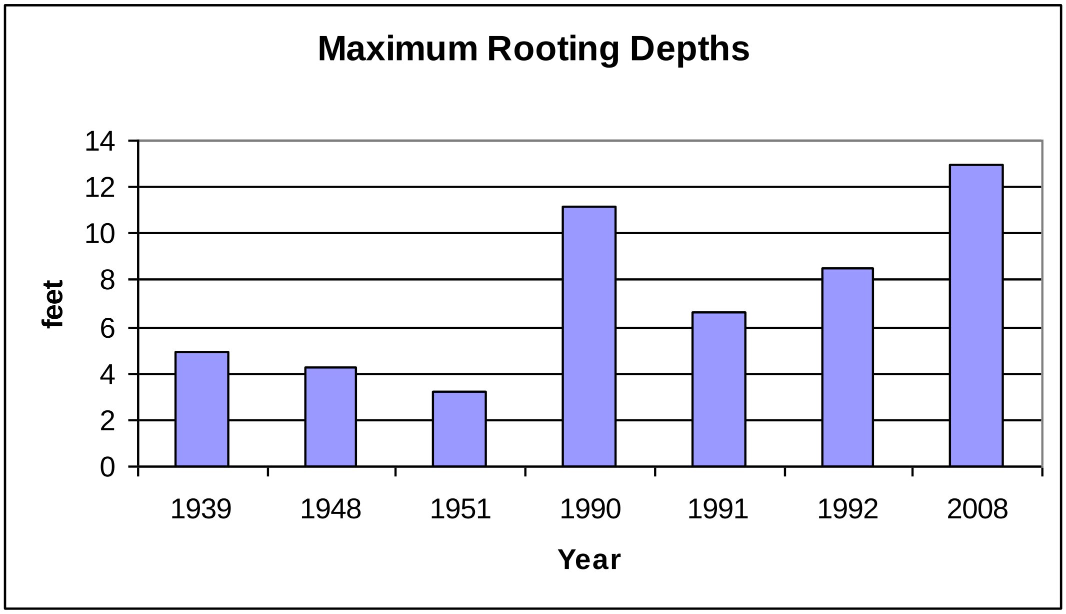


Table 1: Lake Waubesa Aquatic Plant Species List, 1990-92 and 2008 (Adopted from Winkelman and Lathrop 1993).

Species	**1990-92**	**2008**
Coontail	x	x
Elodea	x	x
CLP	x	x
Flatstem pondweed	x	
Leafy pondweed	x	x
Clasping-leaf pondweed	x	x
Sago pondweed	x	x
Wild celery	x	x**
N. water milfoil		x
EWM	x	x
Water stargrass	x	x
Muskgrass	x	
Horned pondweed	x	x
White water lily		x*
Spatterdock	x	

*White water lilies were observed but not sampled near Lake Farm Park.
** Visual only.

Figure 6: Relative frequencies for EWM, coontail, CLP and sago pondweed in Lake Waubesa (adopted from Winkelman and Lathrop 1993). Filamentous algae and duckweed are not represented in the analysis since they were not accounted for in the previous surveys. Other native species are represented in areas where the bars do not reach 100%.

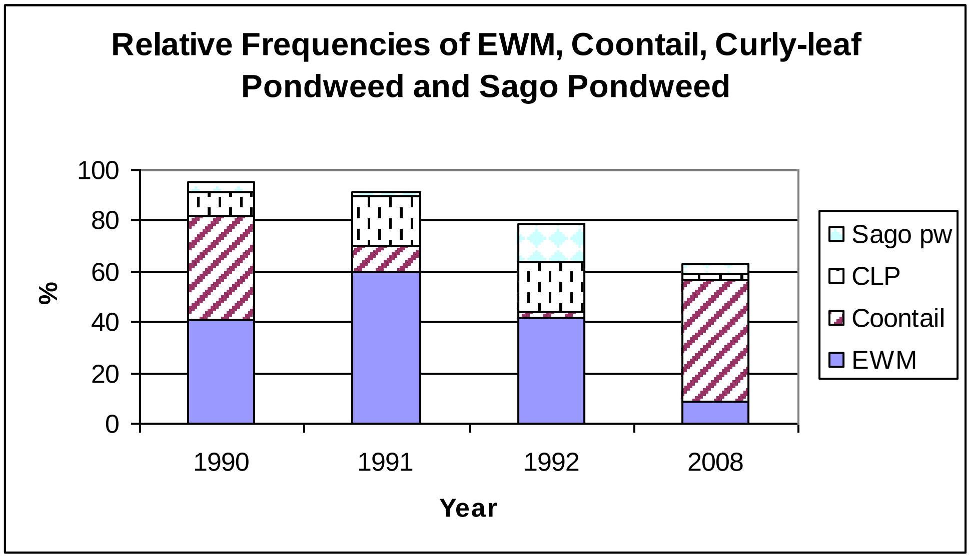


Figure 7: Relative frequencies for all plants sampled in 2008

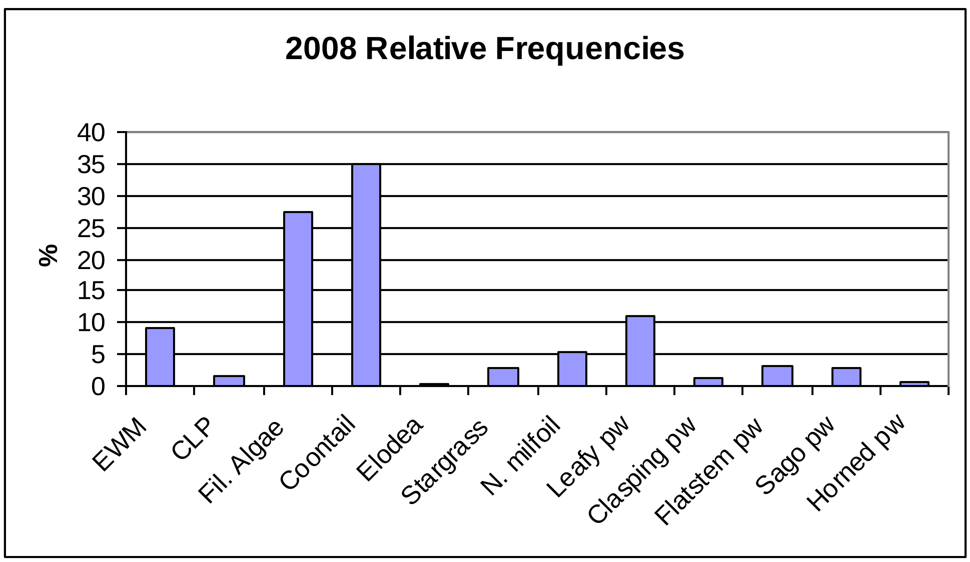
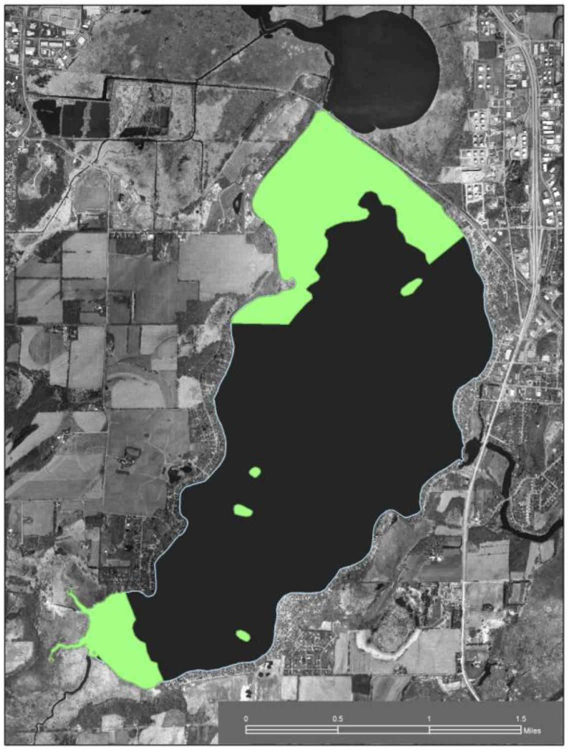


Figure 8: Proposed Lake Waubesa sensitive areas



Aquatic Plant Management Alternatives

While the primary emphasis of this plan is to protect important aquatic plant habitats and control nuisance EWM growths with mechanical harvesting equipment, additional management tools are available to individual property owners. Chemical treatments are regulated under Wisconsin Administrative Code NR 107. Figure 4 demonstrates the recent trends in herbicide applications.

Under NR 109.06 (a-1), a riparian owner is not required to obtain a permit for manual plant harvesting from WDNR if the removal involves invasive species or removal of native species is limited to a single area with a maximum width of no more than 30 feet measured along the shoreline.

Dredging is generally not considered to be a practical option due to high costs. Limited dredging efforts have been publicly-funded for selected boat ramps and river channel access. Dredging as a form of aquatic plant management would require a Chapter 30 permit from WDNR. Historic dredging has already resulted in significant losses and modifications of littoral areas.

Another alternative is the use of aquatic weevils. Weevils have been demonstrated to control EWM in laboratory and enclosure studies (Mazzei et al. 1999, Sheldon and Creed 1995). A EWM decline in Fish Lake occurred in 1994, coinciding with evidence of weevil damage (Lillie 2000), however EWM rebounded a few years later and high densities continue in the presence of the insect. More detailed discussions on aquatic plant management alternatives can be found in Cooke et al. (2005) and Petty (2005).

Specific Alternatives for Lake Waubesa

1) **No treatment**: Rejecting all types of aquatic plant management does not appear realistic, given the extent of EWM coverage and heavy recreational needs across the lake.
2) **Biological control**: This method does not appear realistic at this time. Research findings suggest that weevils are difficult and expensive to establish in a lake and effectiveness has been mixed. Research will no doubt continue to assess biological controls. If a method proves viable as a possible control method, it will be evaluated as a potential control method for Lake Monona or other Yahara Lakes.
3) **Chemical control:** Herbicide use should be restricted to agents selective at controlling EWM. 2, 4-D is the likely agent given the partial selectivity for controlling EWM. However, several valuable native plants including water lilies can be damaged from 2, 4-D so WDNR permit applications should be carefully screened to avoid loss of already declining native plants. Whole-lake chemical applications in Lake Waubesa are not feasible given its enormous size and discharge. The U.S. Army Corps of Engineers (COE) is working on using herbicides to control exotic plants while not adversely impacting and/or

enhancing native plants. Dane County is coordinating research efforts to assess early season chemical treatments in parts of Turville Bay of Lake Monona.

4) **Manual - hand removal**: Manually removing plants around piers and swimming areas is a viable option. However, property owners should be educated about the importance of high value native species so that their efforts should focus on weedy exotics such as EWM. Sensitive Areas should be avoided and all plants that are cut should be removed.
5) **Mechanical harvesting**: Given the extent of EWM throughout the Yahara Lakes, mechanical harvesting provides effective temporary access through the dense monotypic beds as well as providing habitat improvements. Sensitive Areas should be avoided to prevent loss of floating-leaf plants and other high value species along the north and south ends of the lake and other publicly owned shorelines.
6) **Physical controls**: Hydraulic dredging can be an option for removing the nutrient rich sediments within designated navigation channels. This method has the greatest potential for long-term control but can be initially expensive. Whole lake dredging is unrealistic given the vast littoral areas affected by EWM. Fabrics are another physical control method but rarely used by property owners because of the labor of installation and maintenance. During local demonstrations at Tenney Locks, problems arose due to gas collection under the fabric and attached filamentous algae growth. Drawdown is infrequently used in Wisconsin for aquatic plant management and would not likely affect the weedy stands of EWM and coontail beyond the nearshore areas. Nearshore valuable native plants could be negatively affected by a drawdown and water replacement may be an issue during a drought cycle.
7) **WDNR management options for Wisconsin lakes can be found at this website**: www.danewaters.com/pdf/2006/management_options_aq_plants.pdf

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GLOSSARY

Alleopathy Chemical suppression of a plant on another plant species.

Biomanipulation A technique involving using predatory fish to reduce the number of fish that feed on zooplankton.

Chlorophyll a The photosynthetic pigment in plant life. Concentrations in lake water are related to the planktonic algal growth and fertility.

Columnaris Bacterial infection of fish that especially occurs when they are stressed. The disease is highly contagious to fish and typically enters through gills, mouth or small skin wounds.

Cyanobacteria Blue-green algae: a group of algae that are often associated with nuisance lake blooms. Certain species can produce toxins that can cause illness and even death in animals and humans. Blue-green algae can fix nitrogen from the atmosphere and thus are often found when phosphorus levels in water are high.

Emergent plants Species with leaves that extend above the water surface and are usually found in shallow water.

Eutrophication The process of increasing lake fertility, often accelerated by humans (cultural eutrophication).

Eutrophic Description for a very productive and fertile lake.

Floating-leaf plants Rooted plants with leaves that float on the water surface such as water lilies and native several pondweeds.

Filamentous algae	Algae that forms filaments or mats which attach to the bottom sediments, rooted plants, piers, etc.
Hectare	A unit of measure which is equivalent to 2.47 acres.
Herptiles	A broad group of cold blooded animals including turtles and amphibians.
Hypereutrophic	A very nutrient enriched lake characterized by severe and dominant algal blooms and very poor water quality.
Hypolimnion	The deeper stratified layer in a lake that typically remains cold and isolated from the atmosphere.
Hypolimnetic	See hypolimnion.
Intolerant	Species sensitive to degraded habitat and water quality.
Limnologist	A specialist in the study of freshwater ponds and lakes.
Littoral Zone	Shallow areas of a lake where most of the rooted aquatic plants are found.
Macrophytes	Rooted plants typically found growing the littoral zone of lakes. They produce oxygen and provide food and cover for lake organisms.
Mesotrophic	Intermediate description for lake fertility between Eutrophic (very fertile) and Oligotrophic (infertile) waters.
Monotypic	Dominance of a single plant species.
Oligotrophic	Lakes that are relatively infertile with low levels of plankton and rooted plants.
Pelagic	The open water zone of a lake outside of the littoral zone.
Phytoplankton	Free-floating algae that form the base of lake food webs.
Planktivores	Fish that typically feed on zooplankton.
Point Source	Wastewater or source of pollution with a defined discharge point such as a discharge pipe.

Secchi disc	An eight-inch diameter disc with four alternating quadrants of black and white. It is lowered into a lake on a rope and used to measure light penetration. Lakes are infertile (oligotrophic) if the depth you can see the disc are great. Lakes are fertile (eutrophic) if the disc disappears quickly.
Species Richness	An indicator of species diversity.
Thermocline	Metalimnion or transitional zone between the epilimnion (upper part) and the hypolimnion (bottom). This portion of a lake is where the temperature changes most rapidly and in most waters is found around 20 feet or deeper.
Trophic State Index	An empirical water quality scale for lakes based on total phosphorus, secchi and chlorophyll-a.
Turions	The over-wintering bud produced by aquatic plants.

Appendix A

BOAT AND HARVESTER DISINFECTION AND VEGETATION REMOVAL LAWS
Dane County Lake Management Guidelines

We already have many exotic species in our waters, and while it may seem somewhat ridiculous to remove plants that are already a problem, and found in most if not all the county waters, the future most likely will find new problems being identified. Frequently, exotics become established because you do not realize that you even have one of these “new visitors” on your boat. It is now State Law to remove plant materials and water from watercrafts and equipment.

We follow the State Law Guidelines developed by the Wisconsin Department of Natural Resources (DNR). Their guidelines are consistent with nationally accepted set of prevention steps.

Following these guidelines is important for three reasons. It sets a good example to the public, it insures that we are not responsible for, or contributing to, the spread of aquatic exotics and due to recent legislative changes may also be against the law to transport or spread invasive species.

The following steps shall be taken every time a boat, equipment or gear is moved between waters to avoid transporting invasive species and/or pathogens.

- **Inspec**t and **remove** aquatic plants, animals, and mud from your boat, trailer, equipment and gear.
- **Drain** all water, if applicable, from your boat, motor, live well, bilge, transom wells, as well as from your equipment and gear, including but not limited to tracked vehicles, barges, silt or turbidity curtain, hoses, sheet pile and pumps.
- **Dispose** of unwanted aquatic plants and animals in an appropriate way. Try and place them where normal clean-up activities can occur or so as to not contribute to an unsightly condition.
- **Disinfect** – We will disinfect all harvesters and equipment whenever equipment leaves or enters the Yahara River Chain of Lakes or when moving from one waterbody to another waterbody outside the Yahara River Chain of Lakes. Disinfecting: Pressure wash and treat all surfaces with a bleach solution - using 0.5 oz of household bleach per gallon of water. At least a 10-minute contact time is recommended. Bleach contains chlorine and the following precautions should be taken.

****** Wear eye protection, rain gear and gloves if spraying.
****** Stay upwind of the spray.

Chlorine is corrosive to metal and rubber and toxic to fish at these concentrations so it needs to be well rinsed after the 10 minute contact time (sodium thiosulfate can also be used to neutralize chlorine – at three grams per gallon of water). Rinsing should be done so as to prevent runoff to a surface water.

The following guidance is directly from the DNR Manual Code (9183.1).

Boats, trailers and live wells
Remove organic material from boats, trailers, and live wells. Drain water from live wells, bilges and pumps. The outside and inside of the boat, trailer, live wells, bilges and pumps should be sprayed with the disinfection solution and left wet for the appropriate contact time. The inside of the live wells, bilges and pumps should be made to contact the solution for the appropriate contact time as well. Run pumps so they take in the disinfection solution and make sure that the solution comes in contact with all parts of the pump and hose. The boat, trailer, bilges, live well, and pumps should be rinsed with clean water or water from the next waterbody after the appropriate contact time. *Every effort should be made to keep the disinfection solution and rinse water out of surface waters.* Pull the boat and trailer off the ramp and onto a fairly level area and away from street drains to minimize potential runoff into surface waters.

Appendix B

2008 Summary Statistics for Lake Waubesa

SUMMARY STATS:	
Total number of points sampled	520
Total number of sites with vegetation	225
Total number of sites shallower than maximum depth of plants	415
Frequency of occurrence at sites shallower than maximum depth of plants	54.22
Simpson Diversity Index	0.78
Maximum depth of plants (ft)	13.00
Number of sites sampled using rake on Rope (R)	15
Number of sites sampled using rake on Pole (P)	402
Average number of all species per site (shallower than max depth)	0.99
Average number of all species per site (veg. sites only)	1.83
Average number of native species per site (shallower than max depth)	0.61
Average number of native species per site (veg. sites only)	1.67
Species Richness	12
Species Richness (including visuals)	16

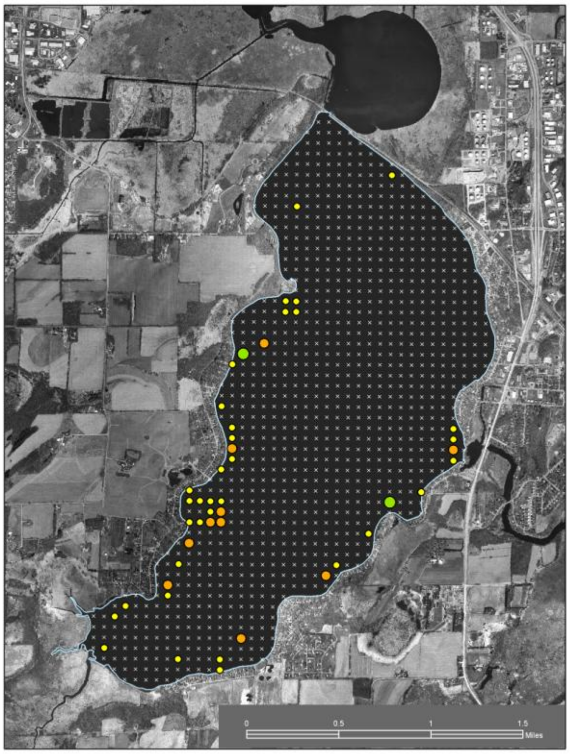
Appendix C. 2008 Lake Waubesa Aquatic Plant Distributions

Individual Plant Species Amounts

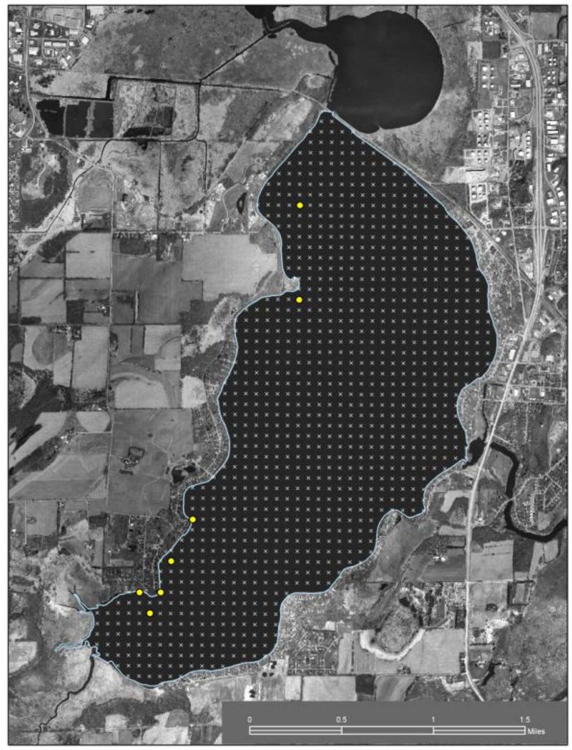
Amount Found / Rake
- overflowing, can't see top of rake head
- rake head ~1/2 full, between 1 & 2
- few plants on rake head
- × nothing found

perimeter of sampling points (provided by WDNR)

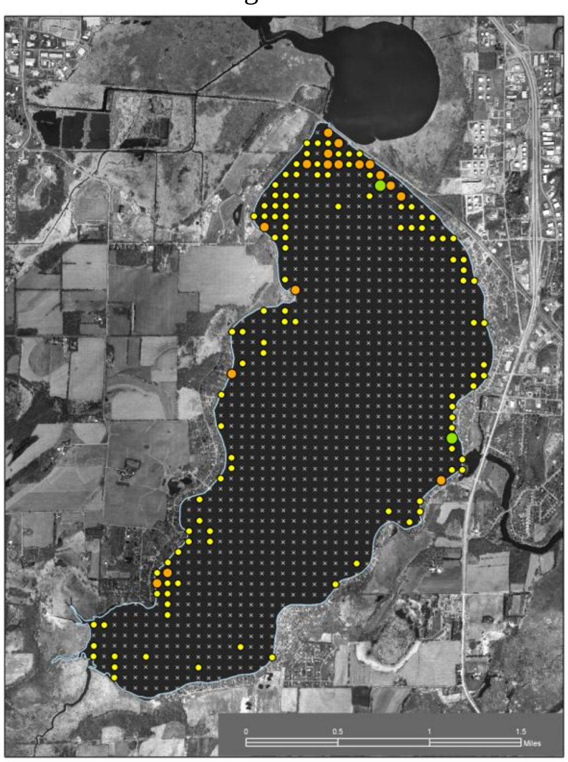
C1. Eurasian Water-milfoil



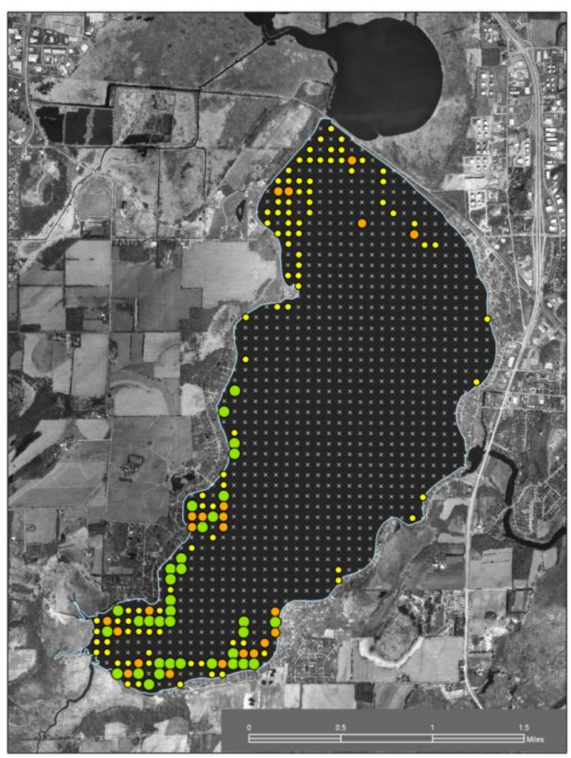
C2. Curly-leaf Pondweed



C3. Filamentous Algae



C4. Coontail



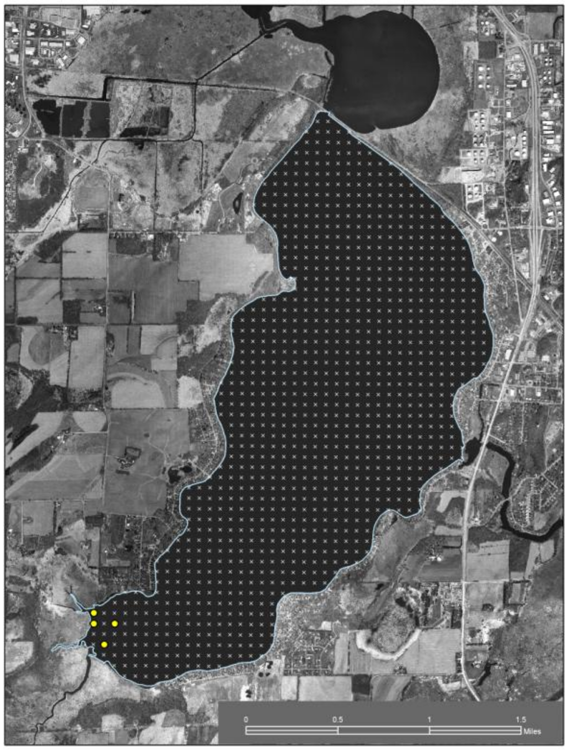
Appendix C. 2008 Lake Waubesa Aquatic Plant Distributions (cont.)

Individual Plant Species Amounts

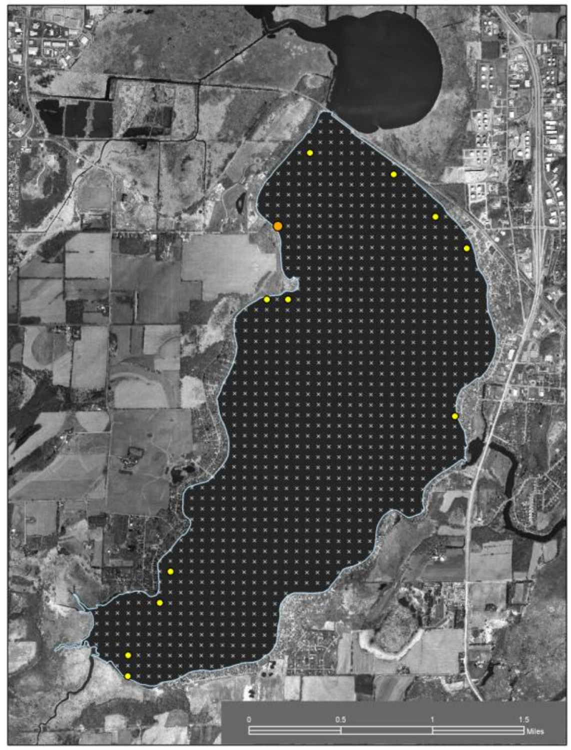
Amount Found / Rake
- overflowing, can’t see top of rake head
- rake head ~1/2 full, between 1 & 2
- few plants on rake head
- × nothing found

perimeter of sampling points (provided by WDNR)

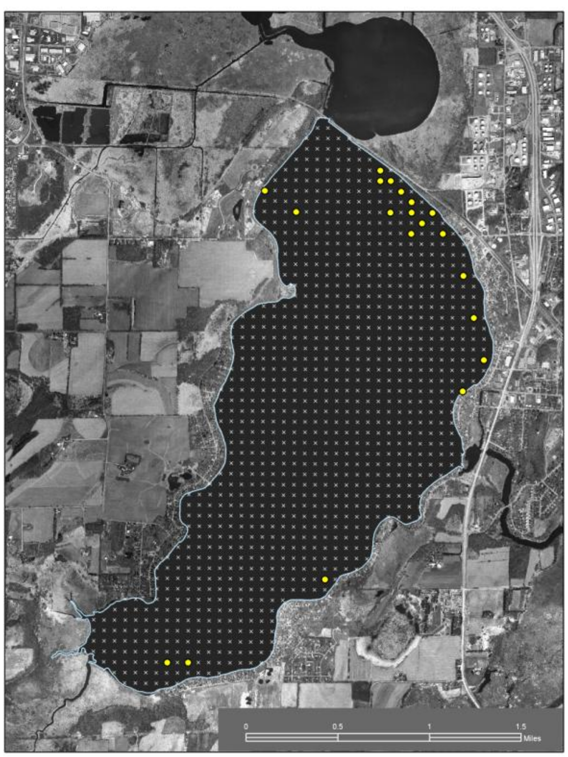
C5. Common Waterweed



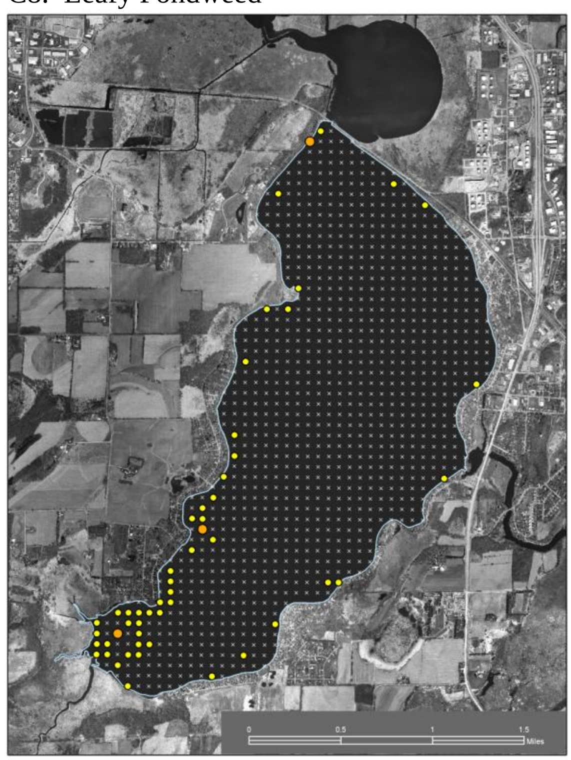
C6. Water Star-grass



C7. Northern Water-milfoil



C8. Leafy Pondweed



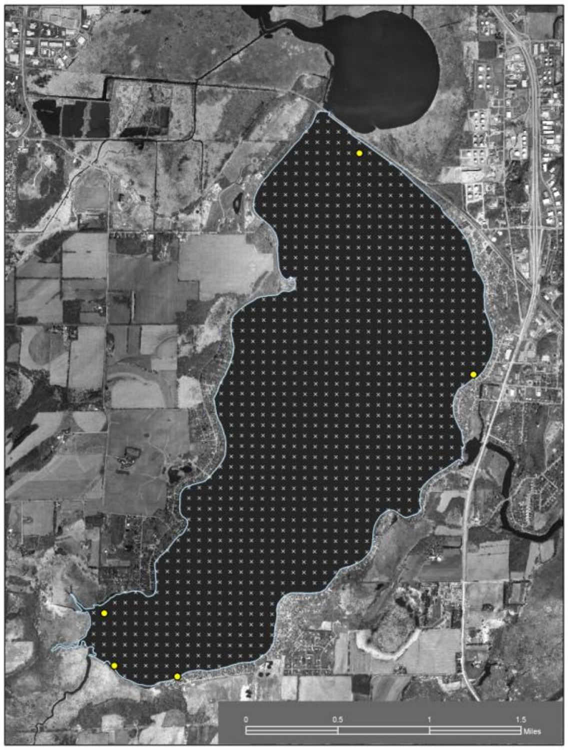
Appendix C. 2008 Lake Waubesa Aquatic Plant Distributions (cont.)

Individual Plant Species Amounts

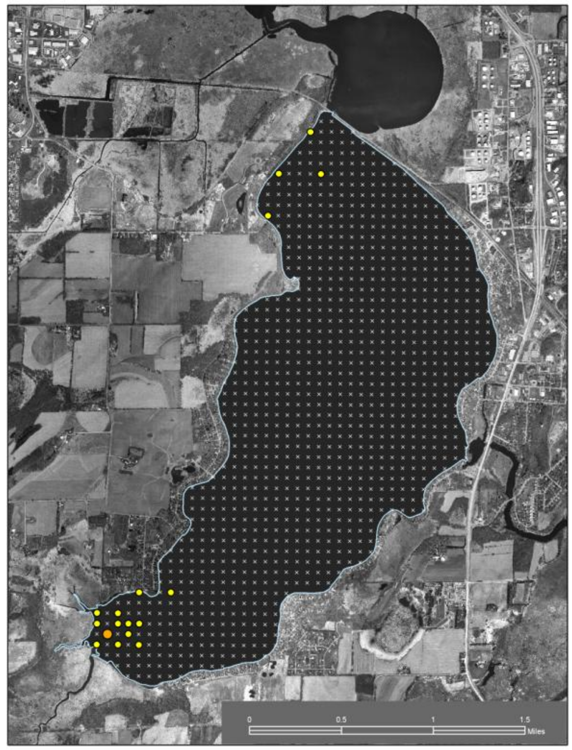
Amount Found / Rake
- overflowing, can't see top of rake head
- rake head ~1/2 full, between 1 & 2
- few plants on rake head
- × nothing found

perimeter of sampling points (provided by WDNR)

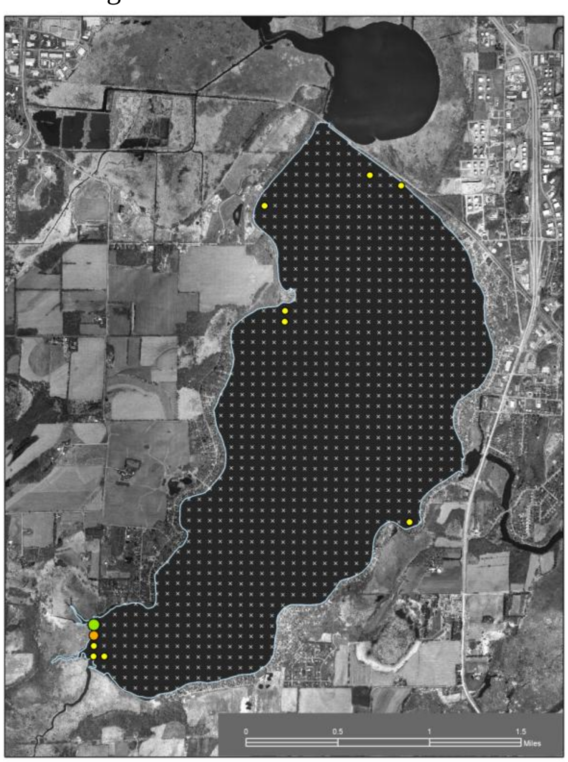
C9. Clasping-leaf Pondweed



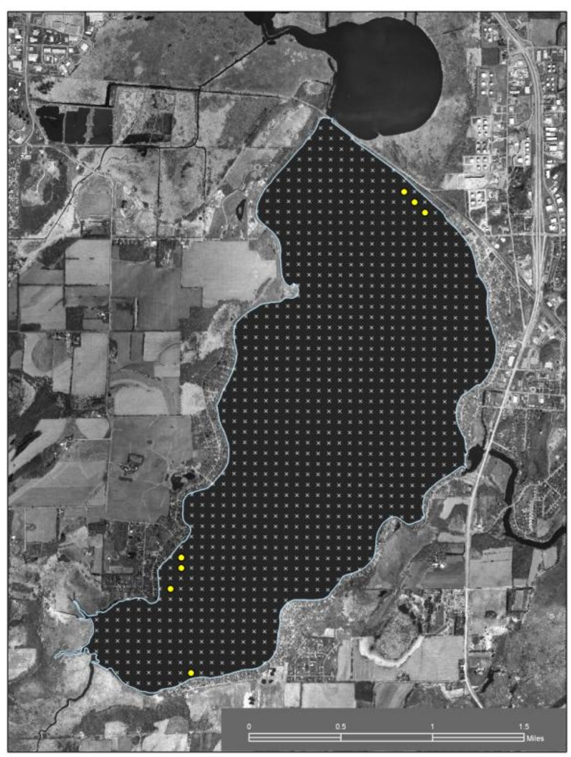
C10. Flat-stem Pondweed



C11. Sago Pondweed



C12. Horned Pondweed



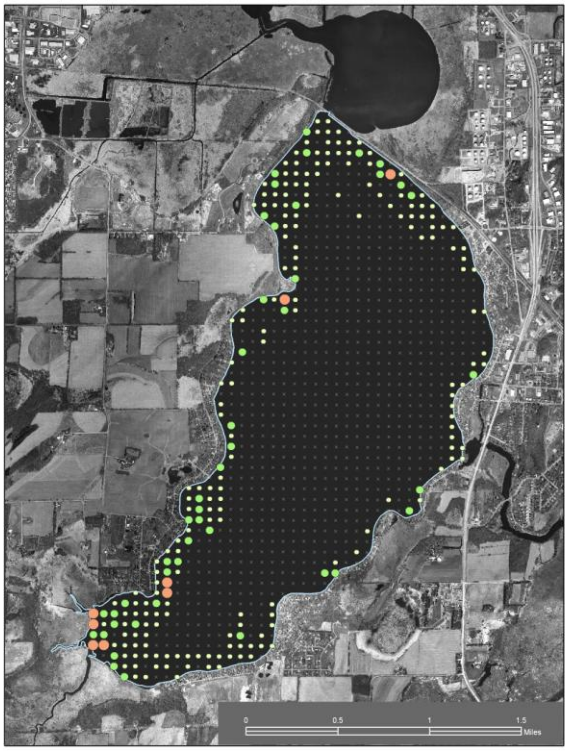
Appendix C. 2008 Lake Waubesa Aquatic Plant Distributions (cont.)

Total Number of Plant Species

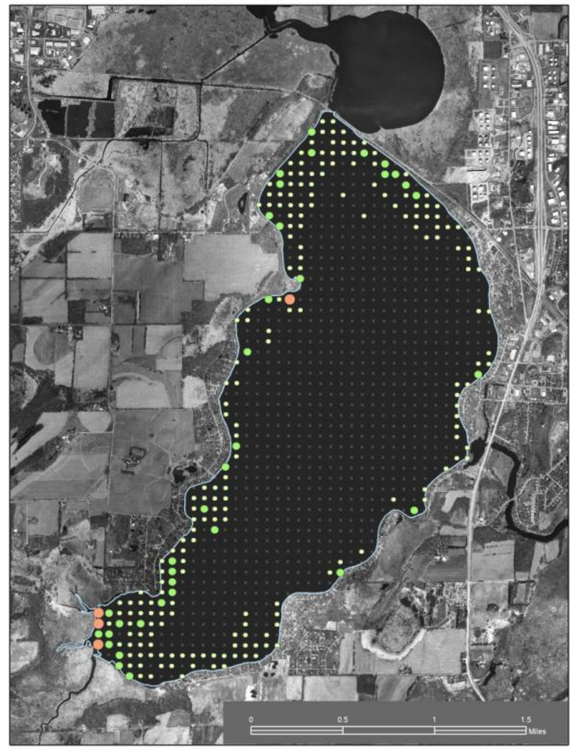
Number of Species

- 5
- 3-4
- 1-2
- × 0

C13. Total Number of Species (includes exotics)



C14. Total Number of Species (no exotics)



Appendix D

Fish and Waterfowl Values of Desirable Native Plants in Lake Waubesa

Scientific Name	Common Name	Fish	Wildlife
Ceratophyllum demersum	Coontail	Food and cover	Food
Elodea canadensis	Elodea	Food and cover	Food
Heteranthera dubia	Water stargrass	Food and cover	Food
Lemna minor	Lesser Duckweed	Food and cover	Food
Myriophyllum sibiricum	Northern Watermilfoil	Food and cover	Food
Zannichellia palustris	Horned pondweed	Food and cover	Food
Nymphaea odorata	White Water Lily	Food and cover	Food
Nuphar variegatum	Spatterdock	Food and cover	Food
Potamogetan foliosus	Leafy Pondweed	Food and cover	Food
Potamogetan richardsonii	Clasping-leaf Pondweed	Food and cover	Food
Potamogetan zosteriformes	Flat-stem Pondweed	Food and cover	Food
Struckenia pectinatus	Sago Pondweed	Food and cover	Food
Vallisneria americana	Wild celery	Food and cover	Food

Fish and Wildlife Values based on Borman et al. 1997, Nichols and Vennie 1991 and Janecek 1988.

Appendix E

Detailed 2008 APM Survey Results for Lake Waubesa

Species	Freq. veg. sites (%)	Freq. shallower – max. root depth (%)	Rel. freq. (%)	Sites found	Ave. rake fullness	Visual sites
EWM	16.44	2.67	9	37	1	1
CLP	2.67	1.45	1.5	6	1	
Fil. algae	50.22	27.23	27.5	113	1	
Coontail	64	34.7	35	144	2	5
Elodea	0.44	0.24	0.2	1	1	
W. stargrass	4.89	2.65	2.7	11	1	
Small d.w.						18
Leafy p.w.	20	10.84	10.9	45	1	
Horned p.w.	1.33	0.72	0.7	3	1	
Flatstem p.w.	5.78	3.13	3.2	13	1	
Clasping leaf p.w.	2.22	1.2	1.2	5	1	
Sago p.w.	4.89	2.65	2.7	11	1	
Large d.w.						17
W. celery						1