LAKE CLASSIFICATION REPORT
MASON LAKE, ADAMS COUNTY

Presented by Reesa Evans, CLM, Lake Specialist
Adams County Land & Water Conservation Department
P.O. Box 287, Friendship, WI 53934

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Background Information about Mason Lake

Mason Lake is located in the Town of New Haven, Adams County, WI, in the Town of Douglas, Marquette County, and in the Town of Lewiston, Columbia County, in the south central part of Wisconsin. The largest part of the impoundment lies in Adams County. The impoundment (man-made lake) has 855 surface acres, maximum depth of 9', with a surface watershed covering 28 square miles. The Town of Douglas owns the dam forming Mason Lake. A dam was first installed in 1852-1853 to operate a sawmill.

The primary soil types are loamy sand, sand and silt loam away from the lake. Loam and muck are more common around the lake itself. Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Sandy soil tends to be excessively drained, no matter what the slope. Water, air and nutrients move through sandy soils at a rapid rate, so that little runoff occurs unless the soil becomes saturated. Getting vegetation started in sandy soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Silt Loam soils are usually well-drained, with water and air moving through them at a moderately slow or slow rate. Runoff tends to be rapid. Available water capacity, natural fertility and amount of organic matter are moderate. There are difficulties with waste disposal and vegetation establishment because of slope and seepage.

Land Use in Mason Lake Watershed

The surface watershed for Mason Lake is large. The bulk of the watershed (57.8%) is in agricultural use; second largest land use is woodlands (31.7%). Residential use tends to be scattered, except for around the lake itself. The largest land use in the surface watershed for Mason Lake is non-irrigated agriculture. Woodlands are the second largest land use category in Mason Lake's surface watershed.

Mason Lake has a total shoreline of 7.53 miles (39,758.4 feet). The lakeshore tends to be heavily developed over most of the shoreline. Briggsville is located on the southeast part of the lake, with several businesses located along the shore. Some people have claimed that Mason Lake is the oldest impoundment in Wisconsin. Records show that a dam was first built in 1852, so it is clear that the lake has been in use a long time. Many of the buildings are not set back much from the shore, since they were built before shoreline regulations were implemented. Runoff from impervious structure is likely to be aggravated at Mason Lake, due to the nature of the settlement around the lakeshore & the buildings near the shoreline.

A 2004 survey showed that 52.4% of Mason Lake's shoreline was vegetated with native vegetation. The rest of the shoreline contained a combination of traditional cultivated lawn, rock riprap, seawalls, and sand. The 2004 inventory included classifying areas of the Mason Lake shorelines as having "adequate" or "inadequate" buffers. An "adequate" buffer was defined as one having the first 35 feet landward covered by native vegetation. An "inadequate" buffer was anything that didn't meet the definition of "adequate buffer", including native vegetation strips less than 35 feet landward. Using these definitions, about 62%% of Mason Lake's shoreline had an "adequate buffer" in 2004, leaving 38% as "inadequate." Most of the "inadequate" buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

Adequate buffers on Mason Lake in some places could be easily installed on the inadequate areas by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or by planting native seedlings sufficient to fill in the first 35 feet or using biologs to protect the shore that are vegetated. In some instances, hard structure like sea walls would have to be removed first. Where areas are deeply eroded, shaping, revegetating and protecting the shores will be necessary to prevent further erosion.

Water Testing Results

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information on Mason Lake. Overall, Mason Lake was determined to be a hyper-eutrophic lake with poor water quality and poor water clarity.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For an impoundment lake like Mason Lake, a total phosphorus concentration below 30 micrograms/liter tends to prevent nuisance algal blooms. Mason Lake's growing season (June-September) surface average total phosphorus level of 73.25 micrograms/liter is more than double the level at which nuisance algal blooms can be expected. During most summers, Mason Lake has frequent lake-wide nuisance-level algal blooms.

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Mason Lake in 2004-2006 was 2.5 feet. This is low water clarity, putting Mason Lake into the "poor" category for water clarity.

Chlorophyll-a concentration provides a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. The 2004-2006 growing season (June-September) average chlorophyll-a concentration in Mason Lake was 31.91 micrograms/liter, above the level recommended to avoid algal blooms.

Mason Lake water testing results showed "very hard" water with an average of 192.5 milligrams/liter $CaCO3$. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water.

A lake with a neutral or slightly alkaline pH like Mason Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Mason Lake, since its surface water alkalinity averages 166 milliequivalents/liter. The pH levels from the bottom of the lake to the surface hovered between 7 and 8, alkaline enough to buffer acid rain.

Most of the other water quality testing at Mason Lake showed no areas of concern. The average calcium level in Mason Lake's water during the testing period was 31.31 milligrams/liter. The average Magnesium level was 21.96 milligrams/liter. Both of these are low-level readings. Both sodium and potassium levels in Mason Lake are very low: the average sodium level was 2.5 milligrams/liter; the average potassium reading was 1.28 milligrams/liter.

To prevent the formation of hydrogen sulfate gas, levels of 10 milligrams/liter are best. A health advisory kicks in at 30 milligrams/liter. Sulfate levels in Mason Lake are 2.2 milligrams/liter, far below the level for formation of hydrogen sulfate, but below the health advisory level. Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Very turbid waters may not only smell and mask bacteria & other pollutants, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Mason Lake were at low levels between 2004 and 2006.

Some water testing results indicated a need to continue monitoring the nutrients to make sure no problems are developing. The presence of a significant amount of chloride over a period of time may indicate that there are negative human impacts on the water quality present from septic system failure, the presence of fertilizer and/or waste, deposition of road-salt, and other nutrients. Chloride levels found in Mason Lake during the testing period averaged 3.7 milligrams/liter, just above the natural level of 3 milligrams/liter for this region of Wisconsin.

Nitrogen levels can affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 milligrams/liter in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Mason Lake's combination spring levels from 2004 to 2006 average 0.58 milligrams/liter, slightly above the .3 milligrams/liter predictive level. This could be a problem because the growth level of Eurasian watermilfoil, the main invasive aquatic plant species in Mason Lake, has been correlated with fertilization of lake sediments by nitrogen-rich runoff.

Phosphorus

Like most lakes in Wisconsin, Mason Lake is a phosphorus-limited lake: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other water quality aspects.

The total phosphorus (TP) concentration in a lake is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For a man-made lake like Mason Lake, a total phosphorus concentration below 30 micrograms/liter tends to result in few nuisance algal blooms. Mason Lake's growing season (June-September) surface average total phosphorus level of 73.25 micrograms/liter is over that limit, suggesting that phosphorus-related nuisance algal blooms may occur frequently.

Land use plays a major role in phosphorus loading. The land use around Mason Lake that contributes the most phosphorus is non-irrigated agriculture. Some phosphorus deposition cannot be controlled by humans. However, some phosphorus (and other nutrient) input can be decreased or increased by changes in human land use patterns. Practices such as shoreland buffer restoration along waterways; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake. Such practices need to be implemented in all of the Mason Lake Watershed in order for a significant impact on phosphorus reduction to occur.

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under the modeling predictions, reducing phosphorus inputs from human-based activities even 10% would improve Mason Lake water quality by 1.8 to 17.2. A 25% reduction would save 4.5 to 43 micrograms/liter. Lowering the total phosphorus level these amounts might result in less frequent and less coverage by algal blooms. These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Mason Lake's health for future generations.

<u>Aquatic Plant Community</u>

The aquatic plant community is characterized by below average quality for Wisconsin lakes, good species diversity and impacted by high levels of disturbance. Mason Lake is within the 25% of lakes in the state most tolerant of disturbance and furthest from an undisturbed condition.

Ceratophyllum demersum (coontail) was the dominant species in 2005, especially in the shallowest and deepest depth zone. The frequency and density of *Ceratophyllum demersum* increased with increasing depth. *Myriophyllum spicatum* (Eurasian watermilfoil), an aggressive non-native species, was the sub-dominant species. The frequency and density of this species also increases with increasing depth and may be due to the impact of winter drawdown.

Myriophyllum spicatum (Eurasian watermilfoil) had the highest mean density in 1992. When the density of *Myriophyllum spicatum* declined in 1998, *Potamogeton crispus* (curly-leaf pondweed) had the highest mean density. Density of *Myriophyllum. spicatum* increased again by 2001 to its highest level. In 2005, *Myriophyllum spicatum* declined again, and *Ceratophyllum demersum* was the species with the highest mean density.

Value indicates how dominant a species is in the community. *Myriophyllum spicatum* (Eurasian watermilfoil) was the dominant species in 1992 with *Ceratophyllum demersum* as sub-dominant. In 1998, *Potamogeton crispus* was co-dominant with *Ceratophyllum demersum*. In 2001, *Myriophyllum spicatum* (Eurasian watermilfoil) again became the dominant with *Potamogeton. crispus* as sub-dominant. In 2005, *Ceratophyllum. demersum* was again the dominant species with *Myriophyllum. spicatum* the sub-dominant.

Major disturbances in Mason Lake likely include past broad-spectrum chemical treatments, boat traffic in the shallow basin, introduction of two exotic invasive aquatic plant species, winter drawdowns, shoreline development and very poor water clarity. Changes in the plant community are seen when there have been changes in the individual species within the community. Many species have changed in frequency and density in Mason Lake during the study years.

The Coefficient of Community Similarity indicates the percent similarity between two communities; values less than 0.75 indicate the two communities are less than 75% and therefore significantly different. The Coefficients for Mason Lake indicate that the aquatic plant community in Mason Lake has changed significantly between some years. For example, the 1992 and 1998 aquatic plant communities were significantly different. However, the 1998 and 2001 communities were not significantly different. But then the plant community changed significantly again between 2001 and 2005. The accumulated change over the years of the various aquatic plant surveys have resulted in the present (2005) community being only 58% similar to the plant community in 1992. This means that only 58% of the community in 1992 has been retained in the 2005 community.

Mason Lake has three known invasive aquatic plant species: Reed Canarygrass (emergent); Curly-Leaf Pondweed (submergent) and Eurasian Watermilfoil (submergent).Two species of aquatic invasive animals were also found: Rusty crayfish and carp. The lake gets a significant amount of transient boat traffic due to its location (right off a main highway) and several public boat ramps. Fishing pressure is heavy.

Critical Habitat Areas

Wisconsin Rule 107.05(3)(i)(I) defines a "critical habitat areas" as: "areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes. Five areas on Mason Lake were determined by a team of lake professionals to be appropriate for critical habitat designation.

ML1 extends along approximately 4000 feet of shore in Burn's Cove and up into the stream, up to the ordinary high water mark. 9 emergent aquatic plant species were found here. Two species of free-floating plants were also found. At least 10 species of submergents were found, including the exotic invasives Eurasian watermilfoil and

Curly-Leaf pondweed. *Chara* spp., a macrophytic alga, was also present at this site. Filamentous algae were present, as well as rusty crayfish and carp.

ML2a extends along 800 feet of shore and supports near-shore terrestrial habitat. The shoreline is wooded, with both tree and shrub growth sandwiched between cottage developments. Large woody debris is abundant in the shallows. No emergents were found here. Two species of free-floating aquatic plants were present, as well as five species of native submergent plants. Also found were the invasive aquatic plants, Eurasian watermilfoil and Curly-leaf pondweed, and the invasive aquatic animals, rusty crayfish and carp. Filamentous algae were abundant. The area provides spawning, nursery, and feeding sites for fish, as well as cover.

ML2b covers 800 feet of shore at the mouth of the Big Spring tributary, averaging 2 feet in depth. The area provides both visual and audio buffers and is a unique area of scenic beauty for lake residents and visitors. Several species of emergent aquatic plant growth were found, as well as one species of floating-leaf rooted plant and two species of free-floating aquatic plants. At least 8 submergent aquatic plants were present. Exotic invasive noted were Eurasian watermilfoil, Curly-leaf pondweed, Reed canarygrass, rusty crayfish and carp. Filamentous algae were abundant.

Sensitive Area ML3 covers 2000 feet of shore along the west side of Mason Lake, averaging 2 feet in depth. The area serves as a visual and audio buffer, as well as an area of scenic beauty. At least 8 species of aquatic emergent plants were noted, as well as 3 species of free-floating aquatic plants. 9 native submergent aquatic plants were present. The macrophytic algae *Chara* spp (muskgrass) was also found here. Aquatic invasives present included Reed canarygrass, Eurasian watermilfoil, Curly-Leaf Pondweed, rusty crayfish and carp. Filamentous algae were common. The area provides spawning, nursery, and feeding sites for fish, as well as cover.

ML4 covers Amey's Pond, an approximately 60-acre wetland south of Highway 23, averaging 3 feet in depth, with near-shore terrestrial, shoreline and shallow water habitat. This area is jointly managed by the Wisconsin Department of Natural Resources and Ducks Unlimited as a waterfowl preserve. 3 species of emergent aquatic plants were found, as well as one floating-leaf rooted plant and 3 free-floating plants. At least 6 native species of submergents were present. Aquatic invasives present were Eurasian watermilfoil, Curly-leaf pondweed, rusty crayfish and carp. Filamentous algae were abundant.

ML5 extends along 1000 feet of shoreline and supports important spawning habitat. Only one species of emergent aquatic plants was present. At least 7 species of submergent plants were noted. Exotic invasive aquatic plants found were Eurasian watermilfoil and Curly-leaf pondweed.

Fish/Wildlife/Endangered Resources

WDNR stocking records for Mason Lake date back to the 1950's, when northern pike, walleye, bluegills, black crappie, white crappie and largemouth bass were stocked. There were large restockings of the lake in 1971 and 1972 after a chemical kill of fish in 1970 to rid the lake of carp. Rough fish removal in the tons started in the 1930s. The most recent fish inventory revealed that bluegills were abundant; black crappie, largemouth bass and yellow perch were common; but northern pike and green sunfish were scarce. Pumpkinseeds have also been found in Mason Lake.

The Mason Lake surface watershed is reported to contain several endangered resources. Special natural communities in this watershed include northern sedge meadow, spring & pond runs (hard) and spring pond. Threatened wildlife include *Fundulus diaphanous* (banded killifish), *Tyto alba* (barn owl), and *Notropis texanus* (weed shiner fish). Two plant species, *Gentianopsis virgata* (lesser fringed gentian) and *Deschampsis caepitosa* (tufted hairgrass) have also been reported. Wild rice beds used to be found in Mason Lake as well.

Conclusion

Mason Lake is an impoundment impacted substantially by its large surface watershed, as well as significant disturbances. The Mason Lake District will need to regularly review and update its lake management plan in order to address the management issues in a logical, cohesive manner. Implementation of the lake management plan is essential if the lake is to recover sufficiently to be removed from the impaired waterways list.

RECOMMENDATIONS

Lake Management Plan

- The Mason Lake District will need to regularly review and update its lake management plan in order to address the management issues needed. The plan will need to always address the following: aquatic plant management; control/management of invasive species; wildlife and fishery management; watershed management; shoreland protection; critical habitat protection; water quality protection; inventory & management of the larger watershed.

- Having a plan is not enough. The Mason Lake District will need to make a concerted, long-term effort to implement the lake management plan and to manage the lake and its watershed as an integrated unit for any meaningful changes to occur.

Watershed Recommendations

With such a large surface watershed and large point nutrient source of the very large upper watershed, results of the modeling certainly suggest that input of nutrients, especially phosphorus, are factors that need to be explored for Mason Lake. This is not news—but no concerted efforts appear to have been carried out, despite many prior recommendations.

It is recommended that the surface watershed be inventoried as soon as possible, documenting any of the following: runoff from any livestock operations that may be entering the surface water; soil erosion sites; agricultural producers not complying with nutrient management plans and/or irrigation water management plans. If such sites are documented, steps for dealing with these issues can be incorporated into the lake management plan as needed.

Shoreland Recommendations

- All lake residents should practice best management on their lake properties, including keeping septic systems cleaned and in proper condition, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.

- The Mason Lake District should invest in installing several shoreland protection/restoration demonstration sites to encourage waterfront owners to improve the Mason Lake shoreline to a less developed, less urbanized area.

Aquatic Plant Management Recommendations

- Continue winter drawdowns on a decreased frequency of drawdown. This method has been shown to reduce the two exotic plant species in the zone impacted by drawdown and reduce overall plant density to some extent. When compared with selective chemical treatments, winter drawdown had a less severe impact on species diversity and was more successful in controlling both exotic species and opening up areas in the dense vegetation beds. However, winter drawdowns could not have an impact on vegetation in the deeper portions of the lake. Eurasian watermilfoil and curly-leaf pondweed show a lower frequency and density in the shallow water that is impacted by winter drawdown.

- Decrease frequency of winter drawdowns to once every 3 to 5 years. Some species that tolerate winter drawdowns appear to be increased and may be favored by the annual drawdowns. Less frequent drawdowns can control Eurasian water milfoil without encouraging increased abundance of drawdown tolerant species.

- Limit broad spectrum chemical treatments. The earlier chemical treatments were not selective for the exotic nuisance-causing species. Ironically, this promoted the spread of these nuisance-causing, exotic plant species. Future chemical treatments should be conducted to target the two main non-native aquatic plant species: Eurasian watermilfoil and curly-leaf pondweed.

- Start a mechanical harvesting program. This program should target the exotic species. Harvesting the exotic species will have short-term and long-term benefits.
    a. Harvesting curly-leaf pondweed in May has the potential to prevent the formation of the curly-leaf pondweed's turions (the source of the next year's curly leaf problem).
    b. May and June harvesting of curly-leaf will reduce the amount of curly-leaf decomposing in the lake, thus reducing nutrients released that feed summer algae blooms.
    c. Harvesting Eurasian watermilfoil just before it reaches the surface in May and June will reduce the vigor of this species and remove more nutrients.
    d. Harvesting through the summer will remove more nutrients in the plant biomass and keep navigation channels open for boat use and fishing.
    e. Cutting channels can modify the habitat by creating openings in the dense plant beds and increase the success of predatory fish, promoting a more balanced fish community.
    f. Harvesting Eurasian watermilfoil in the late summer/fall will remove biomass before it autofragments to further its spread in the lake.
    g. Harvesting removes plant material from the lake, unlike chemical treatments that allow the vegetation to decompose in place, consuming dissolved oxygen, releasing nutrients and further enriching the sediments.

- Establish a natural buffer zone of native vegetation around Mason Lake. There is too much cultivated lawn, rip-rap and hard surfaces at the shoreline and not enough natural area to absorb nutrients, pesticides or toxics. Protecting the shoreline will improve water quality and increase wildlife habitat. Comparisons of the aquatic plant communities at natural and disturbed shoreline show that disturbed shoreline has impacted the habitat in the lake.

a. Disturbed shore communities support a less diverse plant community that will support a less diverse fish and wildlife community.
b. Disturbed shoreline supports much less emergent plant growth, an important component for wildilfe and fish habitat.
c. Disturbed shore supported a higher frequency and density of Eurasian watermilfoil, providing a more ideal condition for its growth.
d. Unmowed native vegetation reduces shoreline erosion and run-off into the lake and filters the run-off that does enter the lake thus reducing nutrient inputs.
e. Shoreline restoration could be as simple as leaving a band of natural vegetation around the shore by discontinuing mowing.
f. Restoration could be as ambitious as extensive plantings of attractive native wetland species in the water and native grasses, flowers, shrubs and trees on the near shore area.

- Preserve and enhance wetlands in the around Mason Lake and in the watershed. The wetlands are acting as filters that clean the water before it enters the lake. They also regulate the water flow so that there are not drastic changes in the water level of the lake.

- Cooperate with educational and other efforts in the watershed to reduce nutrient and toxic run-off.

- The Lake District and its citizens should get reinvolved in water quality monitoring and invasive species monitoring through the Citizen Volunteer Lake Monitoring Program**.** The Lake District should also have volunteers actively involved in the Clean Boats, Clean Waters program to assist in preventing the introduction of other invasives into the lake and assist in boater education.

- Eliminate the use of lawn fertilizers, both organic and inorganic, and other chemicals, on properties around the lake. Fertilizers used close to waterways can add phosphorus to the water. Chemicals used close to waterways can also contaminate the water.

Critical Habitat Recommendations

(1) Maintain current habitat for fish and wildlife.
(2) Maintain snag, cavity and fallen trees along the shore for nesting & habitat.
(3) No alteration of littoral zone unless to improve spawning habitat.

(4) Seasonal protection of spawning habitat.
(5) Maintain any snag/cavity trees for nesting.
(6) Install nest boxes.
(7) Maintain corridor and restore natural shoreline vegetations where cleared to increase wildlife corridor.
(8) Designate critical habitat areas as no-wake lake areas.
(9) Protect emergent vegetation with no removal of emergent vegetation.
(10) No removal of submergent and floating-leaf aquatic vegetation. Minimize aquatic plant and shore plant removal to maximum 30' wide viewing/access corridor and navigation purposes. Leave as much vegetation as possible to protect water quality and habitat.
(11) Seasonal control of Eurasian Watermilfoil and other invasives with methods selective for control of exotics.
(12) Use winter drawdown for EWM control no more frequently than every 3 to 5 years, with drawdown occurring before October 1.
(13) Continue mechanical harvesting, thus removing some of the phosphorus from the lake.
(14) Use best management practices.
(15) No use of lawn products, including fertilizers, herbicides & other chemicals.
(16) No bank grading or grading of adjacent land.
(17) No pier placement, boat landings, development or other shoreline disturbance in the shore area of the wetland corridor.
(18) No pier construction or other activity except by permit using a case-by-case evaluation and only using light-penetrating materials.
(19) No installation of pea gravel or sand blankets.
(20) Install bank restoration in highly eroded areas. Otherwise, permit no bank restoration unless the erosion index scores moderate or high. Use bioengineering practices only, but not rock riprap, retaining walls or other hard armoring.
(21) No placement of swimming rafts or other recreational floating devices.
(22) Maintain aquatic vegetation buffer in undisturbed condition for wildlife habitat, fish use and water quality protection.
(23) Post exotic species information at public boat landing.
(24) Permit no dredging except for a single channel for navigation.
(25) Investigate making the far east end of the lake a conservancy or purchasing an easement to maintain its mostly undisturbed state.

LAKE CLASSIFICATION REPORT FOR MASON LAKE, ADAMS COUNTY

INTRODUCTION

In 2003, The Adams County Land & Water Conservation Department (Adams County LWCD) determined that a significant amount of natural resource data needed to be collected on the lakes with public access in order to provide it and the public with information necessary to manage the lakes in a manner that would preserve or improve water quality and keep it appropriate for public use. In some instances, there was significant historical data about a particular lake; in that instance, the study activities concentrated on combining and updating information. In other instances, there was no information on a lake, so study activities concentrating on gathering data about that lake. Further, it was discovered that information was scattered among various citizens, so often what information was actually available regarding a particular lake was unknown. To assist in updating some information and gathering baseline information, plus centralize the data collected, so the public may access it. The Adams County LWCD received a series of grants from the Wisconsin Department of Natural Resources (WDNR) from the Lake Classification Grant Program.

Objectives of the study were:

- collect physical data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- collect chemical and biological data on the named lakes to assist in assessing the health of Adams County lake ecosystems and in classifying the water quality of the lakes.
- develop a library of lake information that is centrally located and accessible to the public and to City, County, State and Federal agencies.
- make specific recommendations for actions and strategies for the protection, preservation and management of the lakes and their watersheds.
- create a baseline for future lake water quality monitoring.
- Provide technical information for the development of comprehensive lake management plans for each lake
- provide a basis for the water quality component of the Adams County Land and Water Resource Management Plan. Components of the plan will be incorporated into Adams County's "Smart Growth Plan".
- develop and implement educational programs and materials to inform and education lake area property owners and lake users in Adams County.

METHODS OF DATA COLLECTION

To collect the physical data, the following methods were used:

- delineation & mapping of ground & surface watersheds using topographic maps, ground truthing and computer modeling;
- identification of flow patterns for both the surface & ground watersheds using known flow maps and topographic maps;
- inventory & mapping of current land use with orthographic photos and collected county information;
- inventory & mapping of shoreline erosion and buffers using county parcel maps and visual observation;
- inventory & mapping for historical and cultural sites using information from the local historical society and the Wisconsin Historical Society;
- identification & mapping of critical habitat areas with WDNR and Adams County LWCD staff;
- identification & mapping of endangered or threatened natural resources (including natural communities, plant & animal species) using information from the Natural Heritage Inventory of Wisconsin;
- identification & mapping of wetland areas using WDNR and Natural Resource Conservation Service wetland maps;
- preparation of soil maps for each of the lake watersheds using soil survey data from the Natural Resource Conservation Service.

To collect water quality information, different methods were used:

- for three years, lakes were sampled during late winter, at spring and fall turnover, and several times during the summer for various parameters of water quality, including dissolved oxygen, relevant to fish survival and total phosphorus, related to aquatic plant and algae growth;
- random samples from wells in each lake watershed were taken in two years and tested for several factors;
- aquatic plant surveys were done on all 20 lakes and reports prepared, including identification of exotics, identifying existing aquatic plant community, evaluation of community measures, mapping of plant distribution, and recommendations;
- all lakes were evaluated for critical habitat areas, with reports and recommendations being made to the respective lakes and the WDNR;
- lake water quality modeling was done using data collected, as well as historical data where it was available.

WATER QUALITY COMPUTER MODELING

Wisconsin developed a computer modeling program called WiLMS (Wisconsin Lake Modeling Suite) to assist in determining the amount of phosphorus being loaded annually into a lake, as well as the probable source of that phosphorus. This suite has many models, including Lake Total Phosphorus Prediction, Lake Eutrophic Analysis Procedure, Expanded Trophic Response, Summary Trophic Response, Internal Load Estimator, Prediction & Uncertainty Analysis, and Water & Nutrient Outflow. The models that various types of data inputs: known water chemistry; surface area of lake; mean depth of lake; volume of lake; land use types & acreage. This information is then used in the various models to determine the hydrologic budget, estimated residence time, flushing rate, and other parameters.

Using the data collected over the course of the studies, various models were run under the WiLMS Suite. These water quality models are computer-based mathematical models that simulate lake water quality and watershed runoff conditions. They are meant to be a tool to assist in predicting changes in water quality when watershed management activities are simulated. For example, a model might estimate how much water quality improvement would occur if watershed sources of phosphorus inputs were reduced. However, it should be understood that these models predict only a relative response, not an exact response. Modeling results will be incorporated into topic discussions as appropriate.

DISSEMINATION OF PROJECT DELIVERABLES

The results of this study will be distributed various agencies, organizations and the public as previously described. Based on the classification information, the Adams County Land and Water Conservation Department will identify assistance requests and determine the appropriate future activities, based on the classification determinations. To provide the requested assistance, Adams County Land and Water Conservation Department will incorporate the lake management plans goals, priorities and action items into its Annual Plan of Operations. Goals, priorities and action items may include educational programs, formation of lake districts, further development of lake management plans and implementation of lake management plans.

ADAMS COUNTY INFORMATION

Adams County lies in south central Wisconsin, shaped roughly like the outline of Illinois. Adams County is a small rural county with a full-time population of about 20,000. Between 1980 and 2000, Adams County's population grew by more than 20%, with most of the population increase being located upon the lakes and streams. The population increase has resulted in a greater need for facilitation, technical assistance and education, including information on the lakes and streams.

Figure 1: Adams County Location in Wisconsin

MASON LAKE BACKGROUND INFORMATION

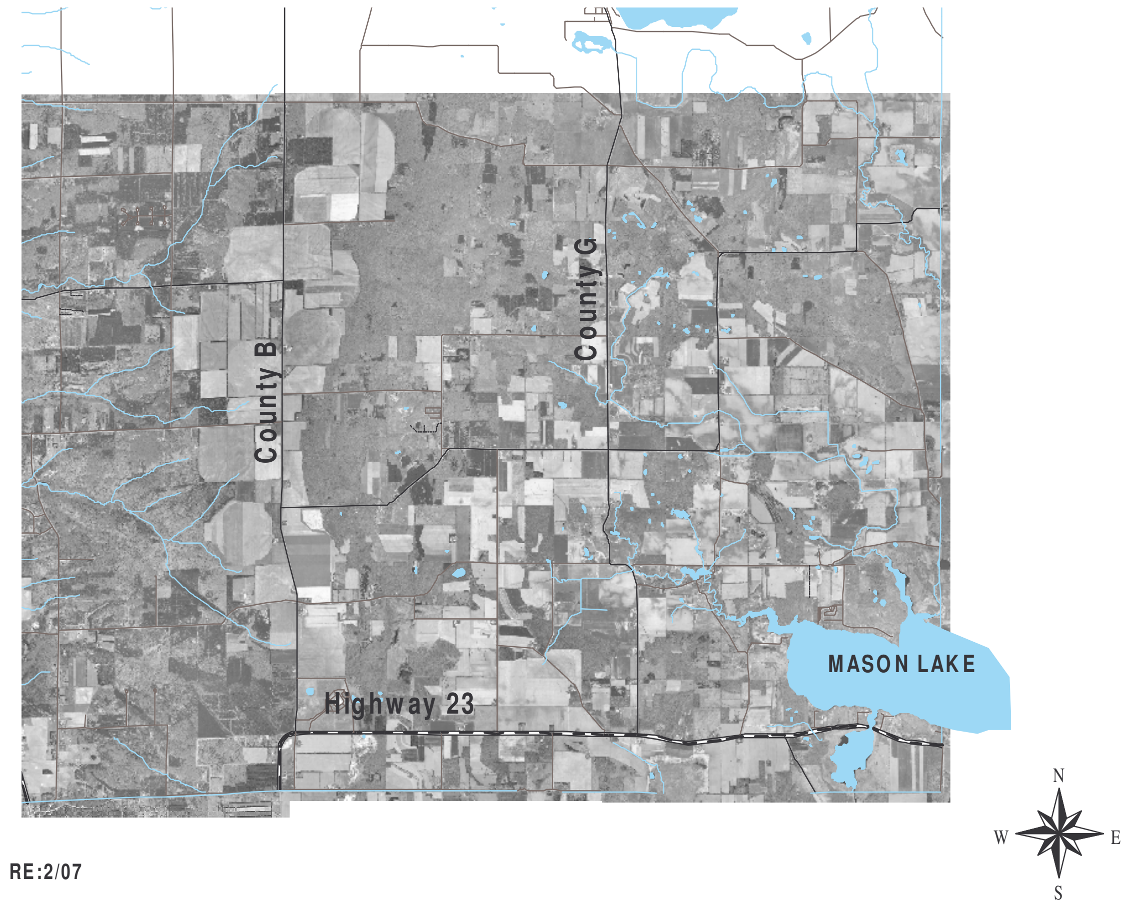
Mason Lake is located in the Town of New Haven, Adams County, WI, in the Town of Douglas, Marquette County, and in the Town of Lewiston, Columbia County, in the south central part of Wisconsin. The largest part of the impoundment lies in Adams County. The impoundment (man-made lake) has 855 surface acres, maximum depth of 9', with a surface watershed covering 28 square miles. The Town of Douglas owns the dam forming Mason Lake. A dam was first installed in 1852-1853 to operate a sawmill.

Attached to Mason Lake by a channel is Amey Pond. Amey Pond is operated jointly as a waterfowl refuge by the Wisconsin Department of Natural Resources and Duck Unlimited. There are several public boat ramps: two are located on the north and south shores are owned by Adams County Parks Department; the third is located in the Town of Briggsville in Marquette County.

In 2002, Mason Lake was placed on the federal impaired waterways list (commonly called the "303(d)" list). The reasons for this placement included highly-elevated phosphorus level, eutrophication, high turbidity, pH problems, NPS contamination and degraded habitat. Two streams that feed Mason Lake are also on the impaired waterways list. Mason Lake is one of the WDNR's "trend lakes", meaning that the WDNR regularly examines the lake for water quality and related issues. The Mason Lake District, formed in 1955, manages Mason Lake.

The Central Sand Hills, which contain Mason Lake, are found at the eastern edge of what was Glacial Lake Wisconsin. Landforms here tend to be glacial moraines partly covered by glacial outwash. The glacial moraines are mixed with areas of pitted outwash containing extensive wetland areas. Streams tend be cold, originating in the glacial moraines. Small kettle lakes are also present.

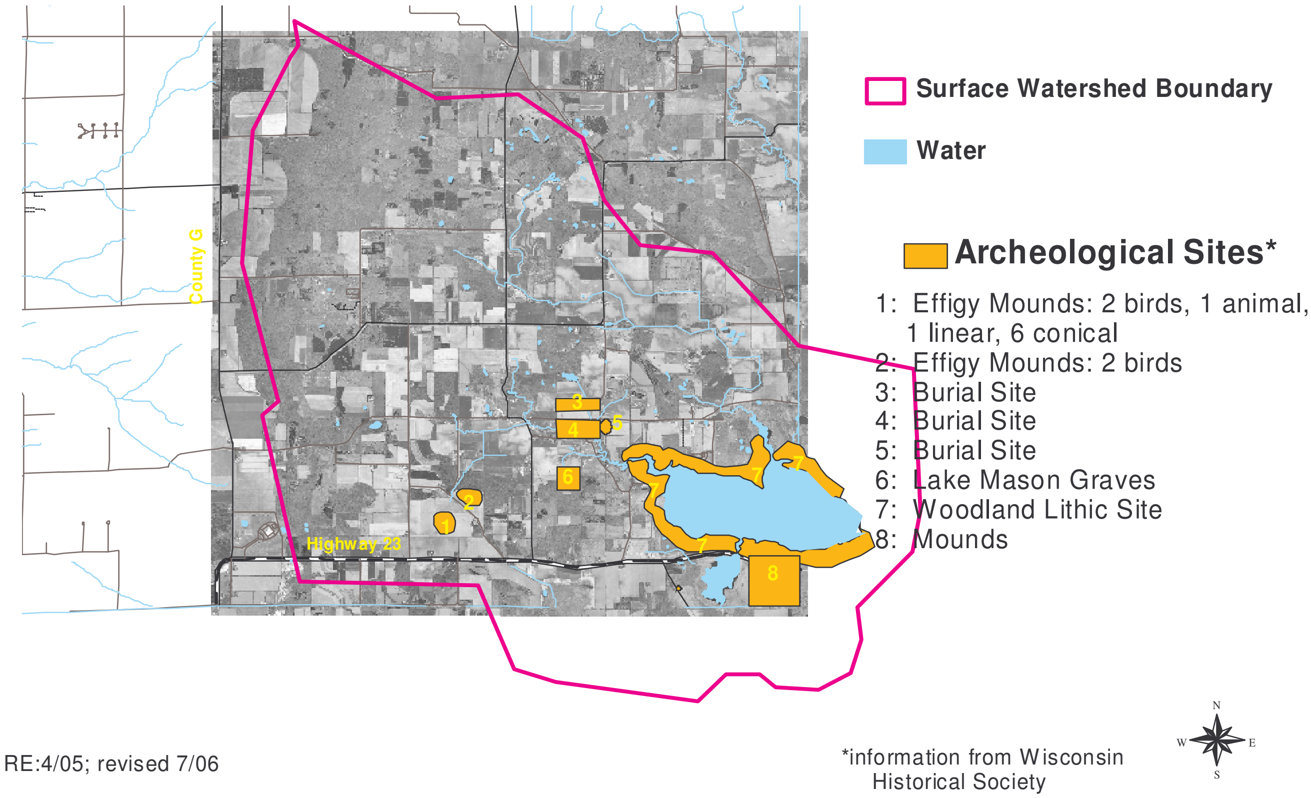
Figure 2: Location of Mason Lake in Town of New Haven



Archeological Sites

There are many Native American archeological and American historical sites in Adams County, with some located in the Mason Lake surface watershed. Under the federal act on Native American burials, the burial sites cannot be further disturbed without permission of the federal government and input from the local tribes.

Figure 3: Mason Lake Archeological Sites



Bedrock and Historical Vegetation

Bedrock around Mason Lake is mostly sandstone, both weak and resistant, formed in the Cambrian Period of Geology (542 to 488 millions years ago). Bedrock may be 50 to 100 more feet below the land surface. Geomorphology includes undulating and hummocky areas, with outwash plains, glacial meltwater deposition and till deposition.

Original upland vegetation of the area included oak-forest, oak savanna and tallgrass prairie. Fens are also common, as well as wet-mesic prairie, wet prairie and marshes.

Soils in the Mason Lake Watersheds

The primary soil types are loamy sand, sand and silt loam. Loam and muck are common around the lake itself.

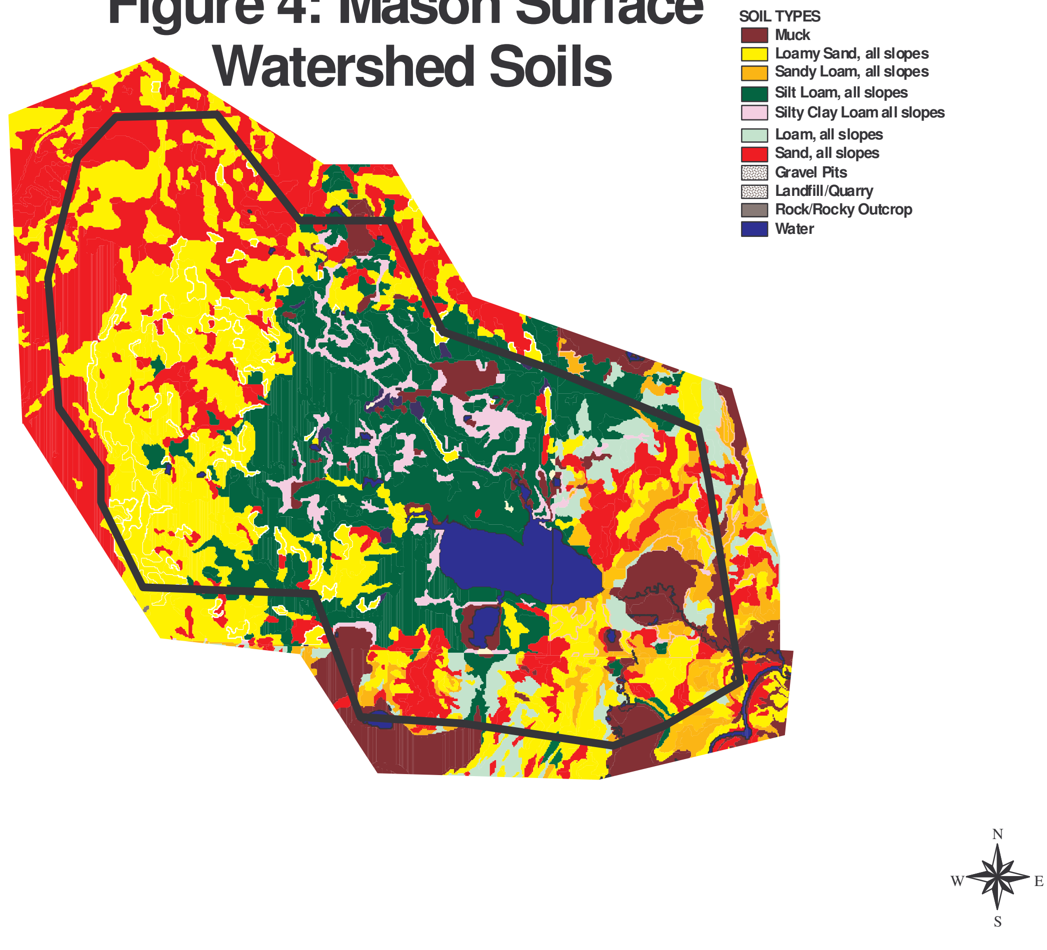
Loamy sands tend to be well-drained, with water, air and nutrients moving through them at a rapid rate. Runoff, when it occurs, tends to be slow. Loamy sands have little water-holding capacity and low natural fertility, although they usually have more organic matter present than do sandy soils. Both wind and water erosion are potential hazards with loamy sands, as is drought. There are difficulties with waste disposal and vegetation establishment because of slope and seepage.

Sandy soil tends to be excessively drained, no matter what the slope. Water, air and nutrients move through sandy soils at a rapid rate, so that little runoff occurs unless the soil becomes saturated. Although water erosion can be a problem, wind erosion may be more of a hazard with sandy soils, especially since these soils dry out so quickly. There are also draught hazards with sandy soils. Getting vegetation started in sandy soils is often difficult due to the low available water capacity, as well as low natural fertility and organic material. Onsite waste disposal in sandy soils is also a problem because of slope and seepage; mound systems are usually required.

Silt Loam soils are usually well-drained, with water and air moving through them at a moderately slow or slow rate. Runoff tends to be rapid. Available water capacity, natural fertility and amount of organic matter are moderate. These soils may puddle when they get too wet. Plant roots may be restricted by compacted silty clay soils. If these soils are cultivated, there is a severe erosion hazard. In general, these soils are poor for uses such as building sites, development and septic tank absorption fields.

The soil and soil slopes around lakes and streams are very important to water quality. They affect amount of infiltration of surface precipitation into the ground and the amount of contaminants that may reach the groundwater, as well as the amount of surface stormwater runoff. In addition, these two factors affect the amount and content of pollutants and particles (including soil) that may wash into a water body, affecting its water quality, its aquatic plant community and its fishery. Further, soil types and soil slopes help determine the appropriate private sewage system and other engineering practices for a particular site, since they affect absorption, filtration and infiltration of contamination from engineering practices.

Figure 4: Mason Surface Watershed Soils



PRIOR STUDIES OF MASON LAKE AREA

The Mason Lake surface watershed was part of the Neenah Creek Priority Watershed program that expired in 2002. Among the projects that program contemplated were several types of shore protection, installation of shore buffers (both lake and stream), wetland restorations, installation of streambank fencing, critical habitat planting and buffer strips to trap animal waste runoff. Not all the planned projects were completed, so a Targeted Runoff Management Grant was applied for in 2003 to continue with the areas of concern. That project has now also expired.

The Mason Lake Management District conducted an owner survey in 2002-2003. At that time, it was determined that 38.5% of the respondents were year-around residents, with another 19.8% using their property year-around on the weekends. Top uses for the lake were boating, fishing, peace/quiet and entertaining. Pontoon boats, fishing boats, paddle boats and canoes were all common, with many respondents owning more than one type of boat. 78.8% of the respondents called the fishing excellent to good. However, over half of the respondents felt that both water quality and fishing quality in the lake had declined. The four major causes the respondents identified were use of chemicals (pesticides, fertilizers, herbicides); agricultural waste; invasion by exotic invasive species; and aging septic systems.

In 1992, Aquatic Resources of Wausau, a private consulting firm, prepared a report on its investigation of the lake and recommendations for management. The objectives were to assess the water quality and land resources, to identify water quality problems, and to develop a conservation/management plan to address the identified problems. The report noted that most of the sands in the Mason Lake area were not suitable for building sites, development or onsite waste disposal. It cited a 1973 Sewer & Water Planning Report from Adams County that recommended that the Mason Lake District, in cooperation with the Town of Briggsville, install a municipal sewage system to prevent the problems with contamination likely to develop from the many individual sewage systems, their age and the soil types.

This study included a survey of the banks of the two main streams feeding into Mason Lake at Morris Cove and Burn's Cove. Along the 83,400 feet of the stream ending into Morris Cove, 3 spring ponds were found. According to this survey, the upper 63,600 feet (76.3%) had been ditched, tiled and straightened. The lower 18,800 feet (23.7%) had been left to its natural meandering. Most of the ditched area did have grass filter strips adjacent to the stream banks. However, the survey did reveal several areas of clay banks collapsing into the ditches or into the stream and some cutting at the banks from high water events. High steep banks with severe erosion were found along the meandering lower stream, as well as heavy unfenced pasturing with signs that cattle had trampled the banks. The stream feeding into Burn's Cove was 57,000 feet, with at least 6 spring ponds. 50% of that length had been ditched and straightened; the remaining 50% was in either meanders or pond shores. The report noted that several of the banks had more than a 12% slope, with significant erosion and evidence of heavy pasturing at the shores.

This report contains a long discussion of the long history of abundant aquatic plant growth, high algal growth and overall water quality problems for Mason Lake. As early as 1935, the water was called "green" with "thick weeds." In 1945, a survey also noted "green" water, with lots of floating and emergent aquatic vegetation, and a water clarity reading of only 1 foot. Intense algal blooms, dense aquatic plant growth and frequent winterkills continued over the years until the early 1950s, when the large number of carp in the lake had nearly denuded the lake bottom of aquatic plants. After a drawdown of the lake and a poisoning to remove carp in 1955, the aquatic vegetation came back, and water clarity readings continued to be generally low: in July 1956, the water clarity was 17 inches; in August 1956, it was 10 inches. Remarks such as "film of algae over most of the lake" and "water always dirty" continued to be noted. Problems with heavy algal blooms, thick aquatic plant growth and fishkills continue through this day.

The report expressed concern that the high fertility in the water caused nuisance levels of aquatic plants and algal blooms that negatively impacted the lake's fishery. It expressed the opinion that unless there were actions taken "in the near future" to reduce nutrients in the lake, continued fish kills, loss of game fish and species shift to those that tolerate heavy algal blooms was likely to occur.

As part of this study, another survey was taken of shoreline owners around Mason Lake. The percentage of owners using their lake property year around was similar to the one gained in the later survey by the Mason Lake District in the early 2000s—this survey found that 60% of the respondents used their lake property year around; the percentage in the early 2000s was 58.3%. The top uses at that time were admiring the scenic beauty, swimming, fishing and boating. Problems identified by respondents at the time included excess weed growth and nutrients, reducing fishing quality, reduced navigational access, and recreational use conflicts. The number one identified problem was the overabundance of weeds. Several respondents also reported problems with their private sewage systems during high water times.

The report went on to recommend that the Mason Lake District write a lake management plan that allowed for long-term watershed and shore protection, as well as management of the flow. The specific recommendations included:

- A "green belt" should be installed around the lake shore of native vegetation that would trap and filter nutrients from runoff and erosion.

- Ditches upstream of the lake should be modified to increase their cross-section to allow them to carry more water and reduce in-ditch erosion. Although agricultural nutrient input had decreased since the 1960s due to the installation of conservation practices, nutrient runoff from frozen ground and heavy rains was expected to continue, so these practices would be necessary.
- Vegetated strips adjacent to the stream banks should be installed where they were not already present to keep nitrogen and phosphorus from animal waste from the ditches, streams and lakes.

- Groundwater entering the streams should be splashed and exposed to the air to drive nitrogen and carbon dioxide from the entering water.
- Riffle areas should be created in parts of the streams where no ditching had occurred.
- Stream headwaters should be protected and/or rehabilitated by installing fences to keep livestock out of these waters, stabilizing banks to reduce nutrient loading & runoff into the stream, and installing control structures to provide cold spring water to the stream & ditch sections.
- Stream meanders should be restored and protected by practices including bank erosion protection, buffers strips adjacent to the banks and fencing.
- Use of fertilizer in the watershed should be reduced.
- Rough fish should be harvested.
- Aquatic plants should be harvested and removed from the lake.
- Wetland areas should be restored.
- The wild rice and wild celery beds that historically occurred at Burn's Cove and Morris Cove should be restored and reseeded. These beds would store nutrients and keep some of the phosphorus unavailable for aquatic plants and algae.
- There should be fall pumping and replacement of septic systems.
- A wildlife control plan should be developed, especially one that would reduce the goose feces entering the Mason Lake system.

CURRENT LAND USE

The surface watershed for Mason Lake is large. The bulk of the watershed (57.8%) is in agricultural use; second largest land use is woodlands (31.7%). Residential use tends to be scattered, except for around the lake itself. Studies have shown that a lake is the product of its watersheds, with land use around a lake having a great impact on the water quality of that lake, especially in the amount and content of stormwater runoff from the surface. Stormwater runoff volume is affected by the amount of impervious surface, the soil type and the slope of the area. Natural landscapes tend to have low runoff rates.

Land use by acreage and percent of total is listed on the graph below:

Figure 5: Mason Lake Surface Watershed Land Use in Acres and Percent of Total

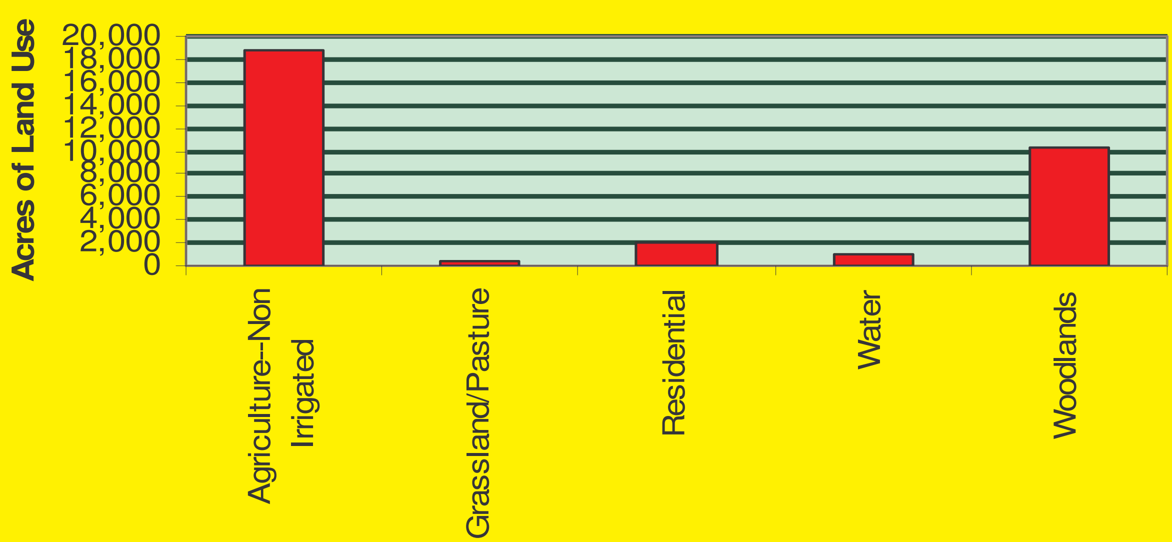
Mason Lake	Acres	% Total
Agriculture--Non Irrigated	18,748.79	57.80%
Grassland/Pasture	356.81	1.10%
Residential	1946.24	6.00%
Water	1102.87	3.40%
Woodlands	10,282.64	31.70%
total	32,437.35	100.00%

The largest land use in the surface watershed for Mason Lake is non-irrigated agriculture. Traditionally, agriculture may contribute significantly to the amount of nutrients in water. Woodlands are the second largest land use category in Mason Lake's surface watershed, but contribute only about 5.3% of nutrients to Mason Lake waters. Since forest floors are often full of leaves, needles and other duff, runoff from forested lands may be more filtered than that from agricultural or residential lands. Residential land use is the third most common land use in Mason Lake's surface watershed, especially around the lake itself, where residential land use is most concentrated. This land use category, in some instances, may also contribute a significant amount of nutrients to the water from stormwater runoff, manicured lawns, and impervious surfaces.

Studies have shown that land use around a lake has a great impact on the water quality of that lake, especially in the amount and content of surface runoff. (James, T., 1992, I-10; Kibler, D.F., ed. 1982. 271) For example, while natural woodland may (on the average) absorb 3.5" out of a 4" rainfall, leaving only .5" as runoff, a residential area with quarter-acre lots may absorb only 2.3" of the 4", leaving 1.7" to run off the land into the lake—the same amount as may be expected to run off from a corn or soybean field. 1.7" of runoff translates into 46,200 gallons per acre ending up in the lake! Percentage of impervious surface, the soil type, vegetation present and slope of the site can all affect runoff volume. (Frankenberger, J, ID-230). The changes in the Mason watershed land use are therefore likely to significantly increase the runoff in volume and content unless protection steps are taken.

When water runs over a surface, it picks up whatever loose pollutants—sediment, chemicals, metals, exhaust gas, etc—are present on that surface and takes those items with it into the lake. Increased development around a lake tends to increase the amount of pollutants being carried into the lake, thus negatively affecting water quality. Residential development areas with lots of one-quarter acre or less may deliver as much as 2.5 pounds of phosphorus per year to the lake for each acre of development.

Figure 6: Mason Lake Land Use



LAND USE IN MASON LAKE SURFACE WATERSHED

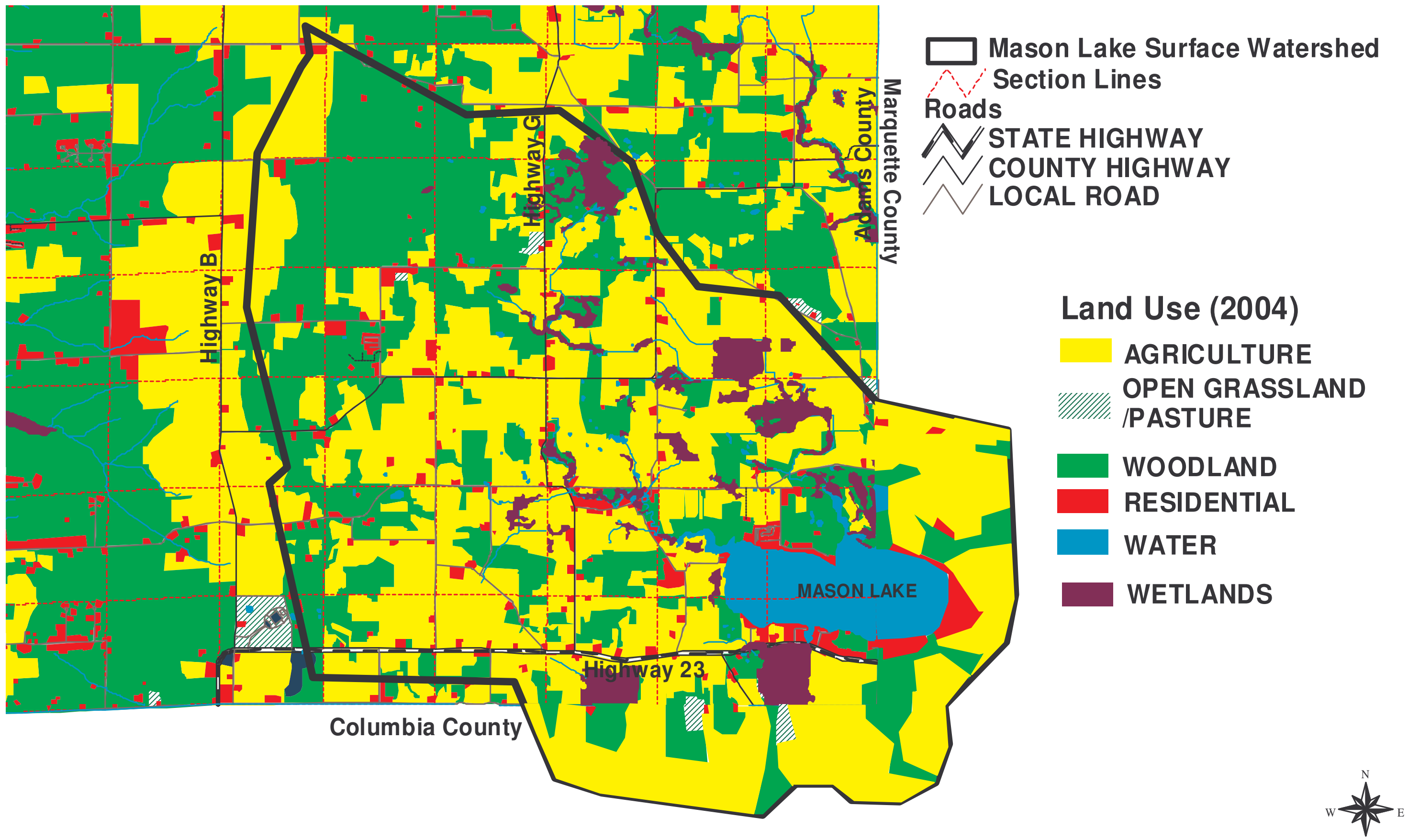


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Figure 7: Land Use in Mason Lake Surface Watershed

There are two specific kinds of land use—wetlands and shorelands--that are so important to water quality that they will be separately discussed.

WETLANDS

A number of wetlands are located in the Mason Lake surface watershed, including several around the lake. In the past, wetlands were seen as "wasted land" that only encouraged disease-transmitting insects. Many wetlands were drained and filled in for cropping, pasturing, or even residential development. In the last few decades, however, the importance of wetlands has become evident, even as wetlands continue to decline in acreage.

Wetlands play an important role in maintaining water quality by trapping many pollutants in runoff and flood waters, thus often helping keep clean the water they connect to. They serve as buffers to catch and control what would otherwise be uncontrolled water and pollutants. Wetlands also play an essential role in the aquatic food chain (thus affecting fishery and water recreation), as well as serving as spaces for wildlife habitat, wildlife reproduction and nesting, and wildlife food.

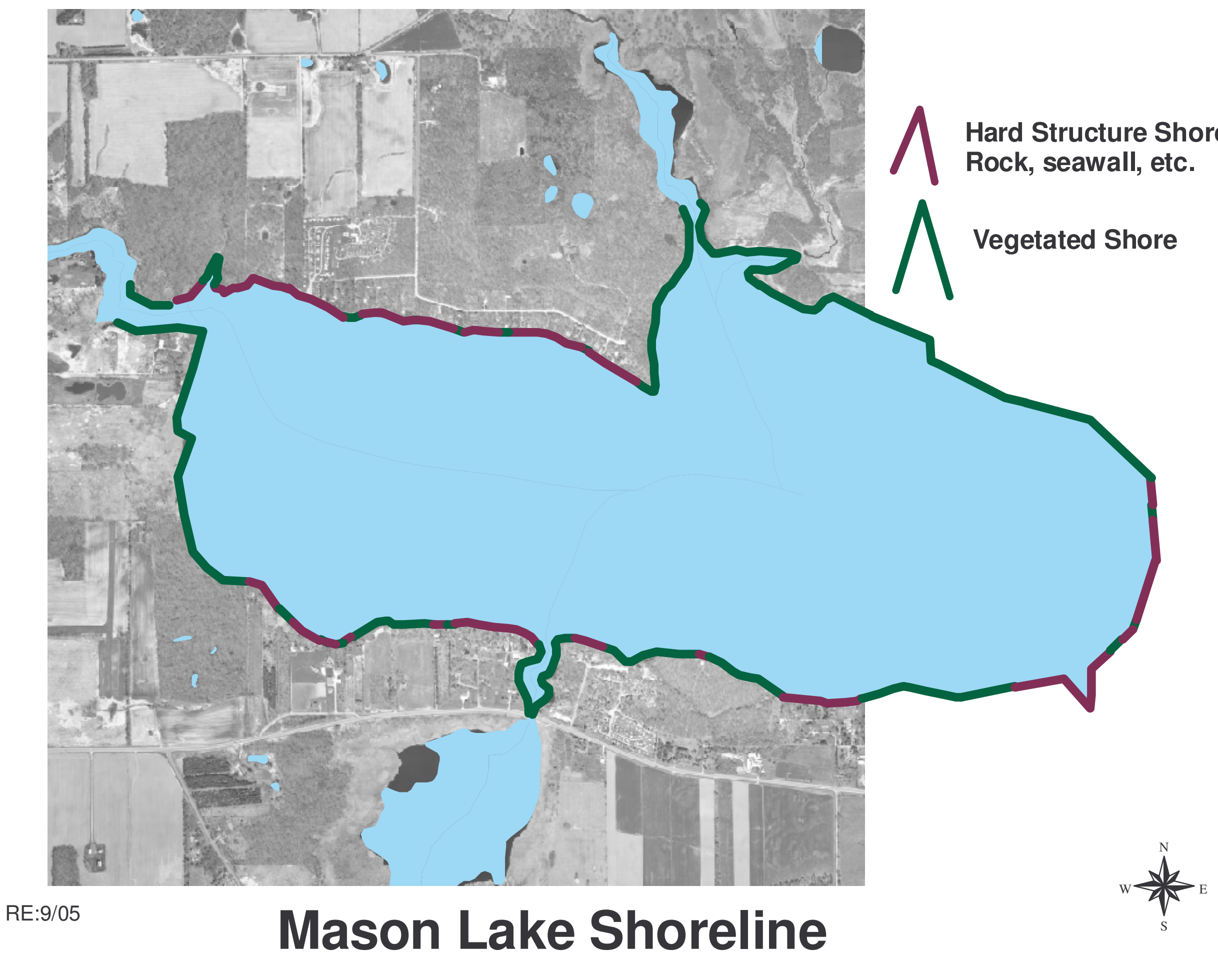
The wetlands around Mason Lake serve as filters and traps that help keep some of the nutrients out of the lake. It is essential to preserve these wetlands for any improvement Mason Lake's water quality.

SHORELANDS

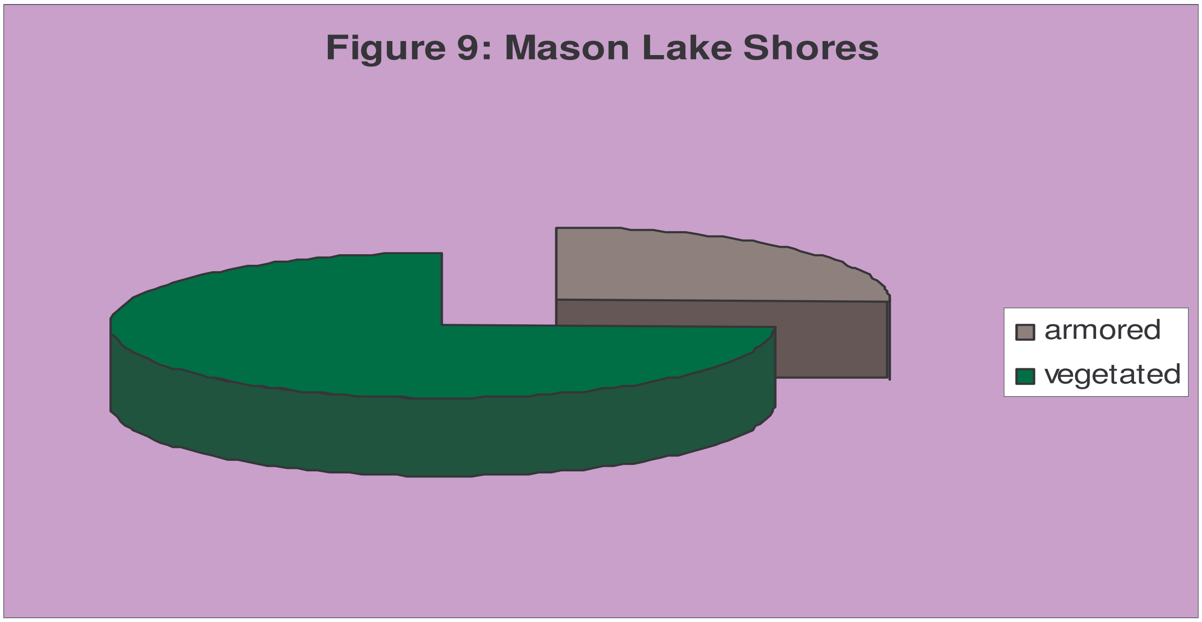
Mason Lake has a total shoreline of 7.53 miles (39,758.4 feet). The lakeshore tends to be heavily developed over most of the shoreline. Briggsville is located on the southeast part of the lake, with several businesses located along the shore. Some people have claimed that Mason Lake is the oldest impoundment in Wisconsin. Records show that a dam was first built in 1852, so it is clear that the lake has been in use a long time. Many of the buildings are not set back much from the shore, since they were built before shoreline regulations were implemented. Runoff from impervious structure is likely to be aggravated at Mason Lake, due to the nature of the settlement around the lakeshore & the buildings near the shoreline.

A 2004 survey showed that 52.4% of Mason Lake's shoreline was vegetated with native vegetation. The rest of the shoreline contained a combination of traditional cultivated lawn, rock riprap, seawalls, and sand.

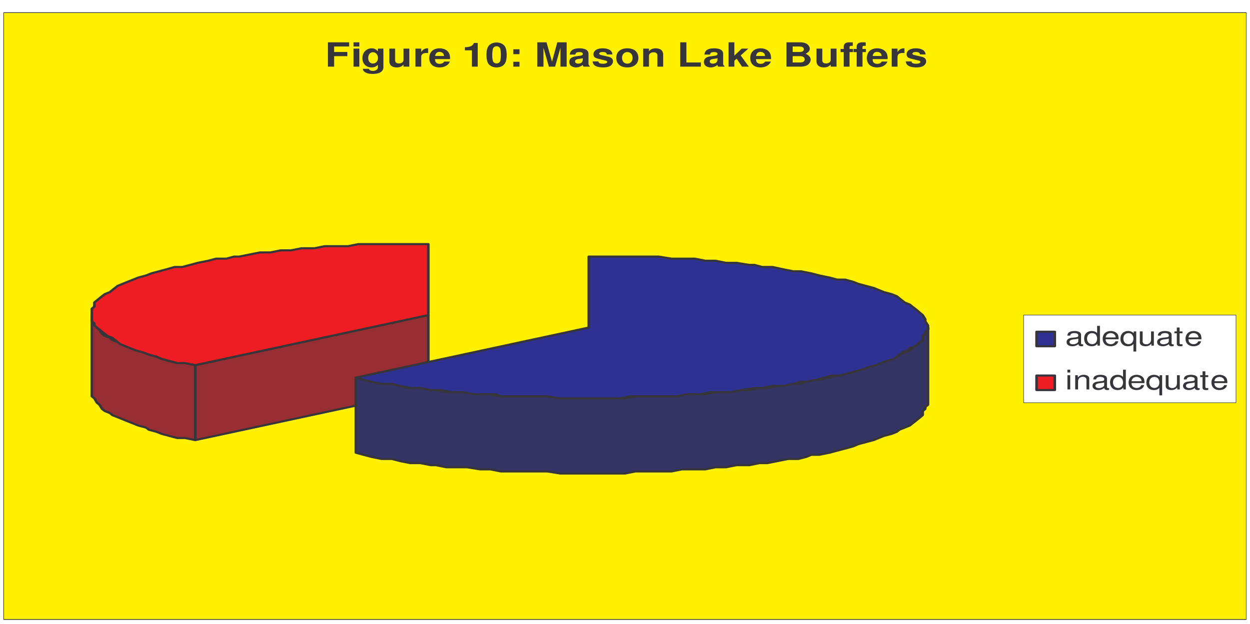
Figure 8: Mason Lake Shoreline Map



The Adams County Shoreline Ordinance defines 1000’ landward from the ordinary high water mark as “shoreland”. Under the ordinance, the first 35 feet landward from the water is a “buffer.” Shoreland buffers are an important part of lake protection and restoration. These buffers are simply a wide border of native plants, grasses, shrubs and trees that filter and trap soil & similar sediments, fertilizer, grass clippings, stormwater runoff and other potential pollutants, keeping them out of the lake. A 1990 study of Wisconsin shorelines revealed that a buffer of native vegetation traps 5 to 18 times more volume of potential pollutants than does a developed, traditional lawn or hard-armored shore.

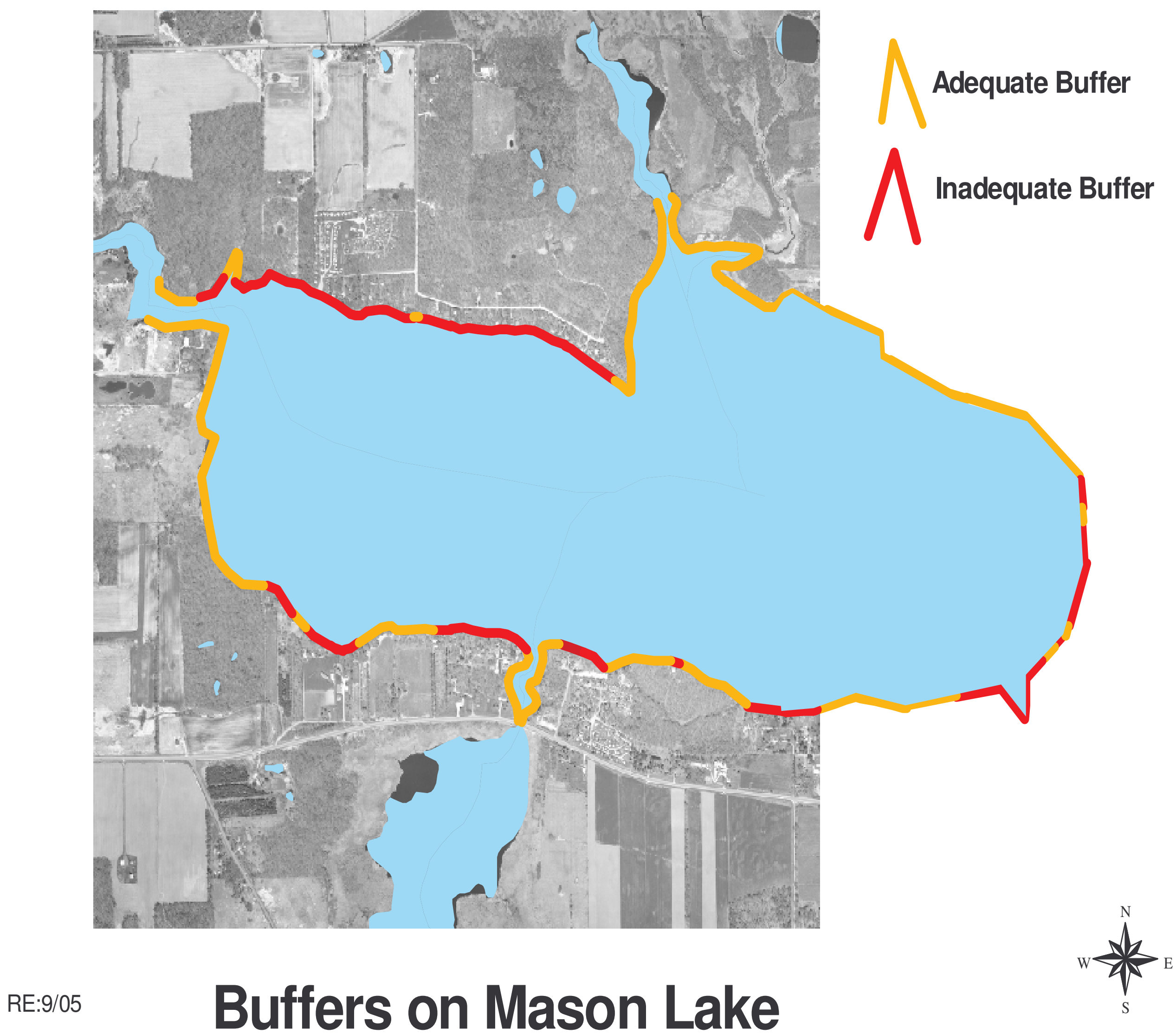


The 2004 inventory included classifying areas of the Mason Lake shorelines as having "adequate" or "inadequate" buffers. An "adequate" buffer was defined as one having the first 35 feet landward covered by native vegetation. An "inadequate" buffer was anything that didn't meet the definition of "adequate buffer", including native vegetation strips less than 35 feet landward. Using these definitions, about 62% of Mason Lake's shoreline had an "adequate buffer" in 2004, leaving 38% as "inadequate." Most of the "inadequate" buffer areas were found with mowed lawns and/or insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.



Vegetated shoreland buffers help stabilize shoreline banks, thus reducing bank erosion. The plant roots give structure to the bank and also increase water infiltration and decrease runoff. Figure 11 maps the adequate and inadequate buffers on Mason Lake.

Figure 11: Mason Buffer Map (2004)



Lakeside buffers also serve as important habitat. Lake edges usually contain aquatic and wetland plants, grading into drier groundcover, then shrubs and trees as one moves inland towards drier land. Buffers provide habitat for many species of water-dependent wildlife, including furbearers, reptiles, birds and insects. Many wildlife species, including birds, small mammals, fish & turtles breed, nest, forage and/or perch in shore buffer areas. Further, 80% of the endangered and threatened species listed spend part of their life in this near-lake buffer area. (Wagner et al, 2006)

When the natural shoreline is replaced by traditional mowed turf-grass lawns, rock, wooden walls or similar installments, bird and animal life, land-based insects, and aquatic insects that hatch or winter on natural shore are negatively impacted. For example, on many Adams County lakes, the non-native aquatic plant, Eurasian Watermilfoil has invaded. There is a weevil native to Wisconsin that weakens Eurasian Watermilfoil by burrowing into and developing within its stems, but that weevil depends on a native-plant shore to overwinter. If the shore is instead covered by rock, seawall or traditional lawn, these weevils will be unavailable for the lake to use as Eurasian Watermilfoil control.

The filtering process and bank stabilization that buffers provide help improve a lake's water quality, including water clarity. Studies in Minnesota, Maine and Michigan have shown that waterfront property value increases for every foot the water clarity of a lake increases. (Krysel et al, 2003).

Figure 12: Example of Inadequate Vegetative Buffer

Figure 13: Example of Adequate Buffer

Natural shoreland buffers serve important cultural functions. They enhance the lake's aesthetics. Studies have shown that aesthetics rank high as one of the reasons people visit or live on lakes. Shore buffers can provide visual & audio privacy screens for homeowners from other neighbors and/or lake users.

Adequate buffers on Mason Lake in some places could be easily installed on the inadequate areas by either letting the first 35 feet landward from the water just grow without mowing it, except for a path to the water, or by planting native seedlings sufficient to fill in the first 35 feet or using biologs to protect the shore that are vegetated. Where areas are deeply eroded, shaping, revegetating and protecting the shores will be necessary to prevent further erosion.

WATER QUALITY

Between 2004 and 2006, Adams County Land & Water Conservation Department gathered water chemistry and other water quality information Mason Lake. Part of the information was gained from periodic water sampling done by Adams County LWCD. Historic information about water testing on Mason Lake was also obtained from the WDNR in a series of tests between 1988 and 2004, and from Self-Help Monitoring records from 1993 to 2002.

Phosphorus

Most lakes in Wisconsin, including Mason Lake, are phosphorus-limited lakes: of the pollutants that end up in the lake, the one that most affects the overall quality of the lake water is phosphorus. The amount of phosphorus especially affects the frequency and density of aquatic vegetation and the frequency and density of various kinds of algae, as well as water clarity and other quality aspects. One pound of phosphorus can produce as much as 500 pounds of algae.

Phosphorus is not an element that occurs in high concentration naturally, so any lake that has significant phosphorus readings must have gotten that phosphorus from outside the lake or from internal loading. Some phosphorus is deposited onto the lake from atmospheric deposition, especially from soil or other particles in the air carrying phosphorus. A lake that includes a flooded wetland area may have a significant amount of phosphorus being released during the flushing of the wetland area. Phosphorus may accumulate in sediments from dying animals, dying aquatic plants and dying algae. If the bottom of the lake becomes anoxic (oxygen-depleted), chemical reactions may cause phosphorus to be released to the water column.

Although there are several forms of phosphorus in water, the total phosphorus (TP) concentration is considered a good indicator of a lake's nutrient status, since the TP concentration tends to be more stable than other types of phosphorus concentration. For an impoundment lake like Mason Lake, a total phosphorus concentration below 30 micrograms/liter tends to prevent nuisance algal blooms. Mason Lake's growing season (June-September) surface average total phosphorus level of 73.25 micrograms/liter is more than double the level at which nuisance algal blooms can be expected. During most summers, Mason Lake has frequent lake-wide nuisance-level algal blooms.

Since phosphorus is usually the limited factor, measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth.

The 2004-2006 summer average phosphorus concentration in Mason Lake places Mason Lake in the "poor" water quality section for impoundments, and in the "poor" level for phosphorus. The total epilimnetic phosphorus levels have varied substantially in Mason Lake over the years. However, except in a few instances, the total phosphorus levels during the growing season have been substantially above the 30 micrograms/liter recommended to avoid phosphorus-related algal blooms. In all instances, the growing season average was over 30 micrograms/liter. Phosphorus should be monitored and steps should be taken to reduce the phosphorus levels in the lake.

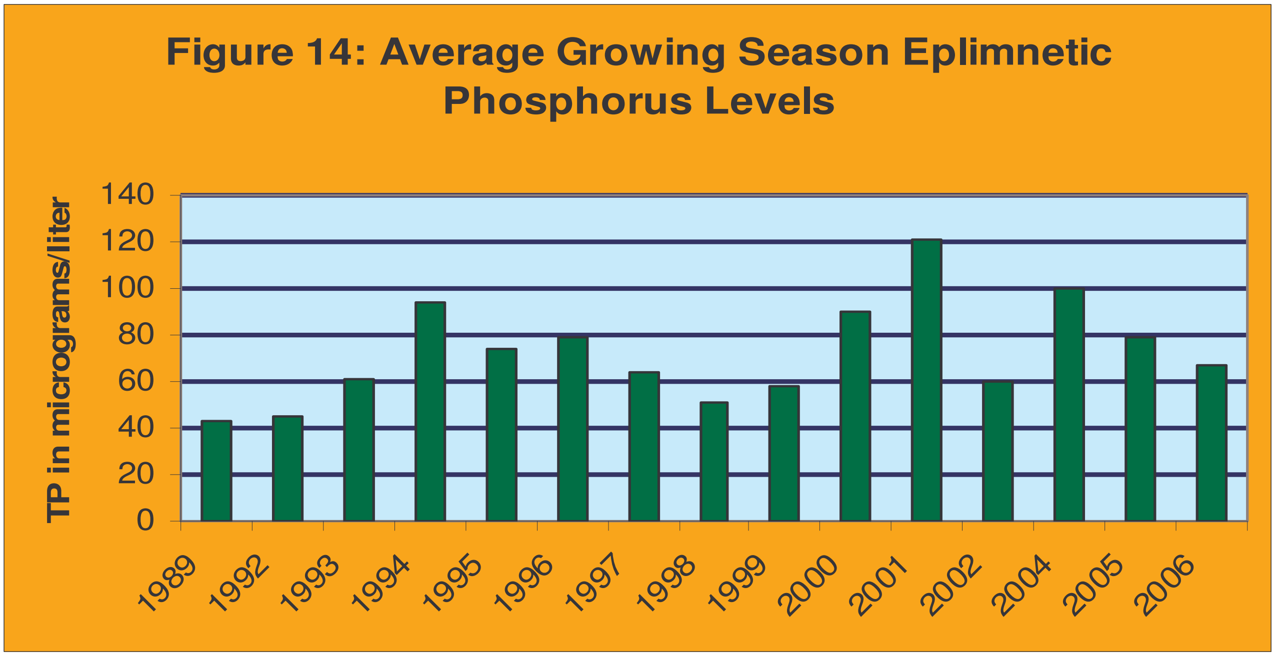


Figure 14: Average Growing Season Eplimnetic Phosphorus Levels
TP in micrograms/liter
0
20
40
60
80
100
120
140
1989
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2004
2005
2006

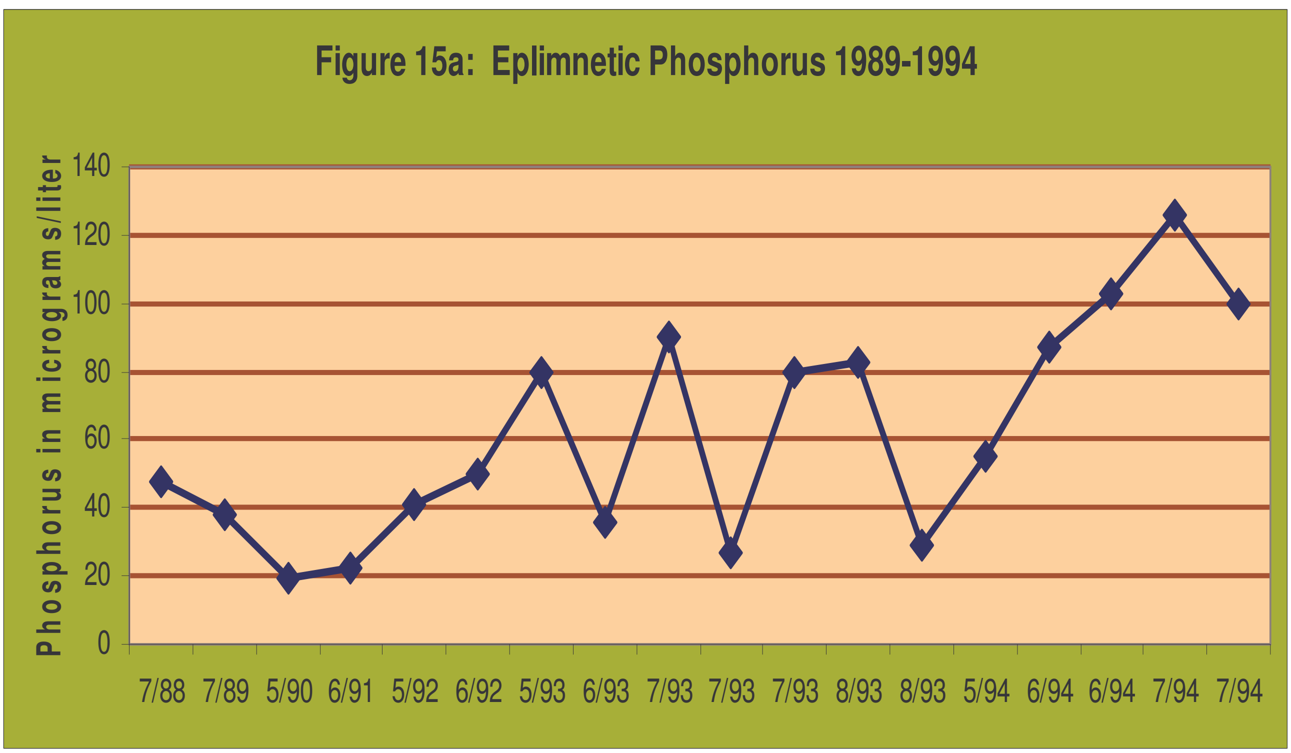


Figure 15a: Eplimnetic Phosphorus 1989-1994
Phosphorus in micrograms/liter
0
20
40
60
80
100
120
140
7/88
7/89
5/90
6/91
5/92
6/92
5/93
6/93
7/93
7/93
7/93
8/93
8/93
5/94
6/94
6/94
7/94
7/94

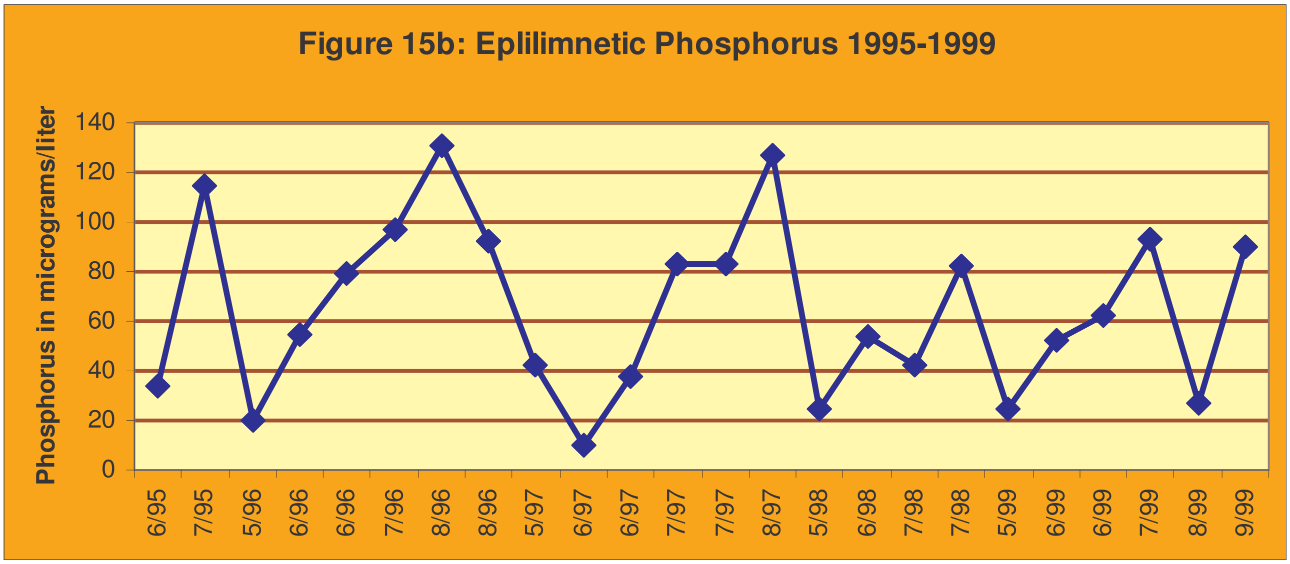


Figure 15b: Eplilimnetic Phosphorus 1995-1999
Phosphorus in micrograms/liter
0
20
40
60
80
100
120
140
6/95 7/95 5/96 6/96 6/96 7/96 8/96 8/96 5/97 6/97 6/97 7/97 7/97 8/97 5/98 6/98 7/98 7/98 5/99 6/99 6/99 7/99 8/99 9/99

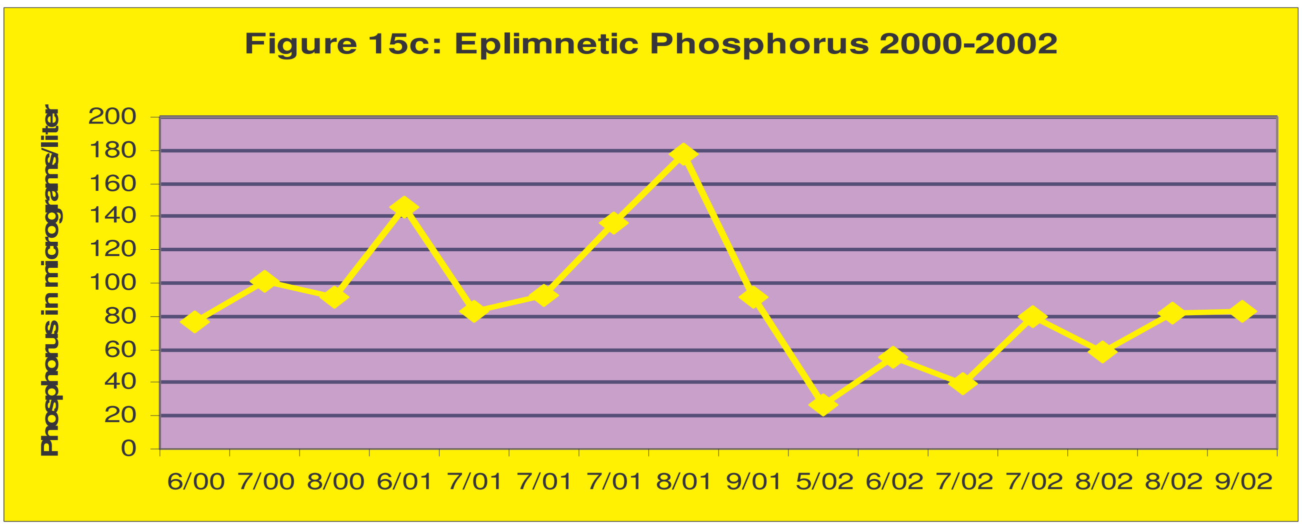


Figure 15c: Eplimnetic Phosphorus 2000-2002
Phosphorus in micrograms/liter
0
20
40
60
80
100
120
140
160
180
200
6/00 7/00 8/00 6/01 7/01 7/01 7/01 8/01 9/01 5/02 6/02 7/02 7/02 8/02 8/02 9/02

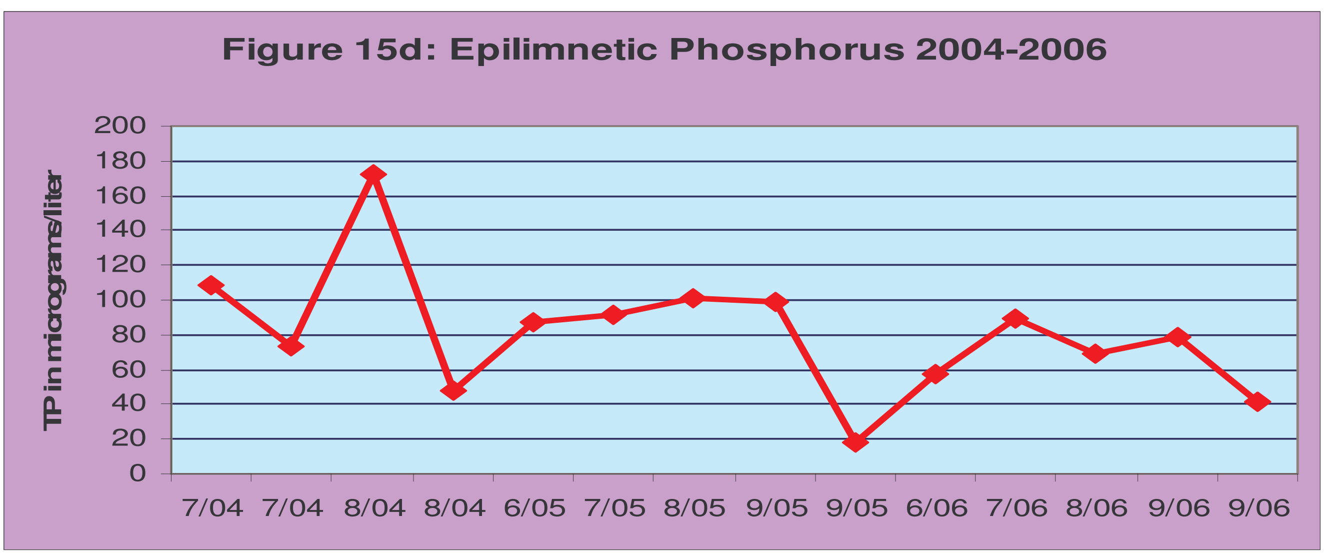


Figure 15d: Epilimnetic Phosphorus 2004-2006
TP in micrograms/liter
0
20
40
60
80
100
120
140
160
180
200
7/04 7/04 8/04 8/04 6/05 7/05 8/05 9/05 9/05 6/06 7/06 8/06 9/06 9/06

Groundwater testing of various wells around Mason Lake was done by Adams County LWCD and included a test one year for total phosphorus levels in the groundwater coming into the lake. The average TP level in the all but one of the wells tested an average of 25.67 micrograms/liter, substantially lower than the lake surface water results. Considering this level, even if some of this phosphorus from the wells enters the lake from groundwater, it is unlikely to contribute significantly to the in-lake phosphorus levels.

Land use plays a major role in phosphorus loading. A key component of the computer models used is the phosphorus budget, that is, the estimated amount of phosphorus delivered to the lake from each land use type annually. The land use that contributes the most phosphorus is non-irrigated agriculture near the lake. Using the current land use data, as well as phosphorus readings from 2004 through 2006 water sampling, a phosphorus loading prediction model was run for Mason Lake. The current results are shown in Figure 19a. Further, although the ground watershed for Mason Lake was not mapped, it is likely that it too contributes a substantial amount of phosphorus to the lake, considering the land uses just outside the surface watershed.

Figure 16: Current Phosphorus Loading by Land Use

MOST LIKELY PHOSPHORUS LOADING		
BY LAND USE	%	current
Non-Irrigated Agriculture	87.70%	9013.40
Grassland/Pasture	0.60%	44.00
Residential	3.60%	371.80
Woodlands	5.30%	550.00
Other Water	0.40%	44.00
Lake Surface	1.50%	151.80
Septics	0.90%	88.00
total in pounds/year	100.00%	10263.00

Although phosphorus deposits such as that from flooded wetlands or from atmospheric deposition cannot be controlled by humans, phosphorus loads from human activities such as agriculture, residential development and septic systems can be partly controlled by changes in human land use patterns. Practices such as agricultural buffers, nutrient management, shoreland buffer restoration; infiltrating stormwater runoff from roof tops, driveways and other impervious surfaces; using no phosphorus lawn fertilizers; and reducing phosphorus input to and properly managing septic systems will minimize phosphorus inputs into the lake. Circumstances such as increased impervious surface, lawns mowed to water's edge, disturbance of shore areas, improperly-functioning septic systems and removal of native vegetation can greatly increase the volume and content of runoff—and thus increase the volume of phosphorus entering the lake. Many of these practices can also increase the concentration of phosphorus entering the lake, by runoff or other methods of entry.

The models were run using not only the current known phosphorus readings in the lake, but also representing decreases or increases of human-controlled phosphorus input by 10%, 25%, and 50%. Just a 10% reduction of the human-impacted phosphorus would reduce the overall load by 947.32 pounds/year. This figure may not seem like much---until you calculate that one pound of phosphorus can result in up to 500 pounds of algae. A 10% reduction in these three areas could result in up to 473,660 pounds less of algae per year!

Figure 17: Impact of Phosphorus Reduction

	current	-10%	-25%	-50%
Non-Irrigated Agriculture	9013.40	8112.06	6760.05	4506.70
Grassland/Pasture	44.00	44.00	44.00	44.00
Residential	371.80	334.62	278.85	185.90
Woodlands	550.00	550.00	550.00	550.00
Other Water	44.00	44.00	44.00	44.00
Lake Surface	151.80	151.80	151.80	151.80
Septics	88.00	79.20	66.00	44.00
total in pounds/year	10263.00	9315.68	7894.70	5526.40

Reducing the amount of input from the surface and ground watersheds results in less nutrient loading into the lake itself. Under the modeling predictions, reducing phosphorus inputs from human-based activities even 10% could improve Mason Lake water quality by up to 17.2 micrograms. A 25% reduction could save up to 43 micrograms/liter. These predictions make it clear that reducing current phosphorus inputs to the lake are essential to improve, maintain and protect Mason Lake's health for future generations.

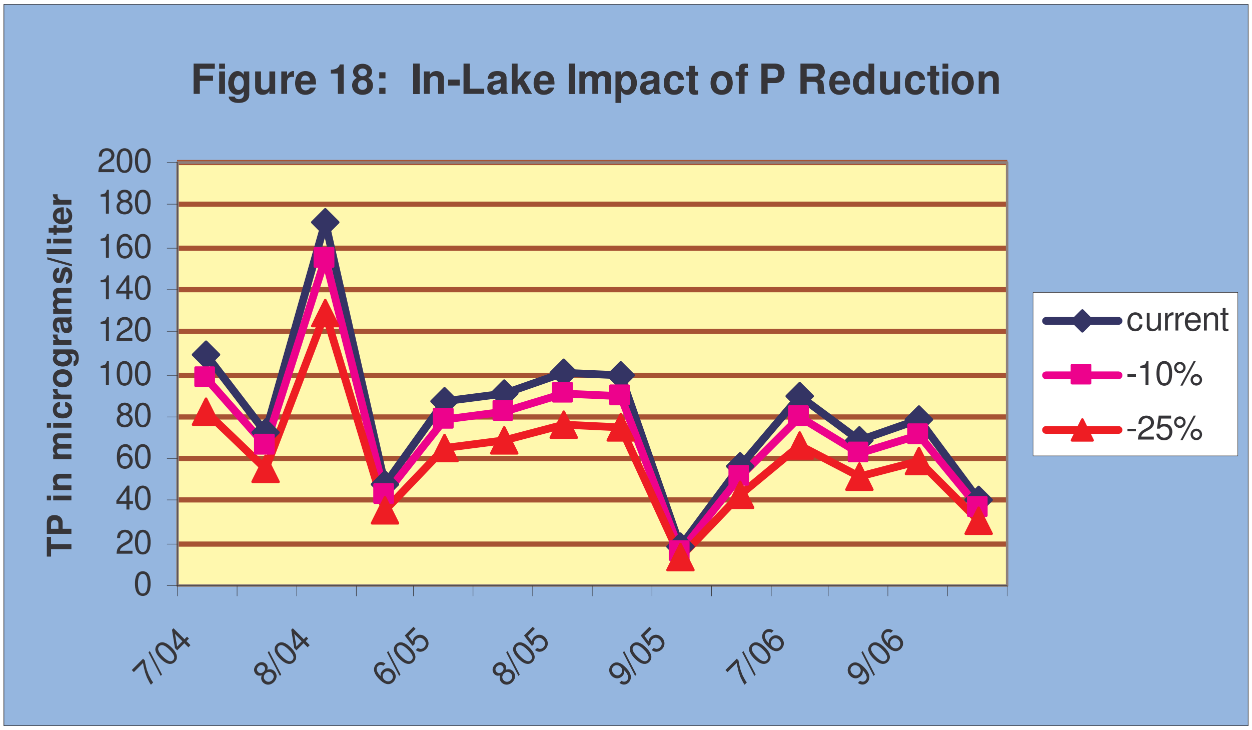
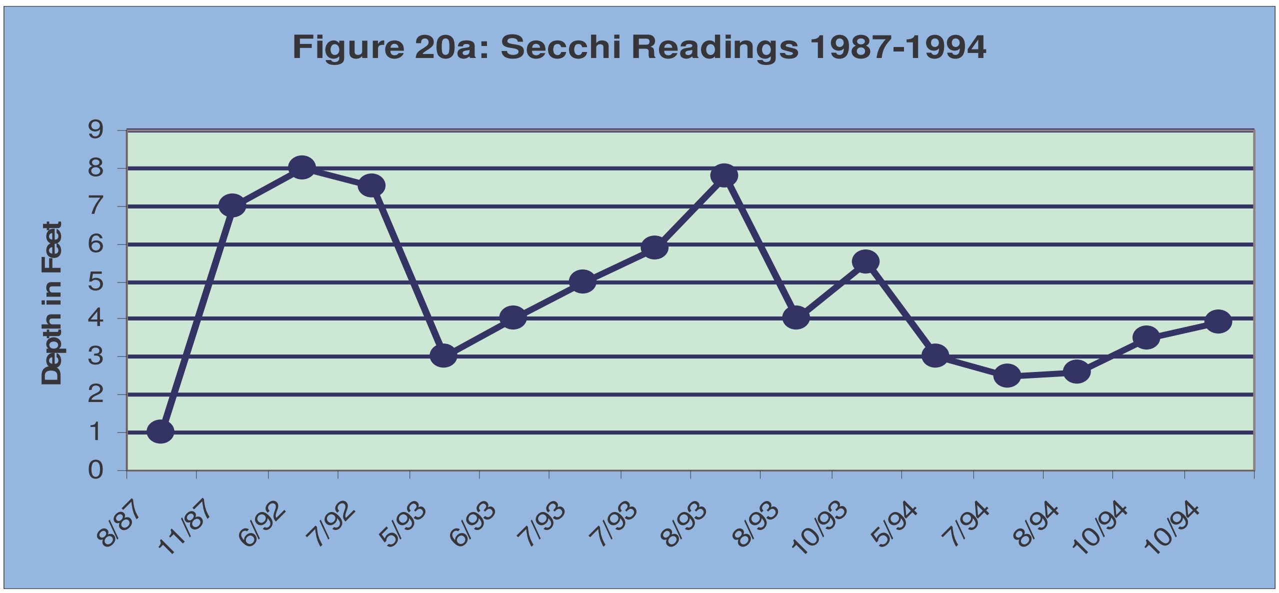
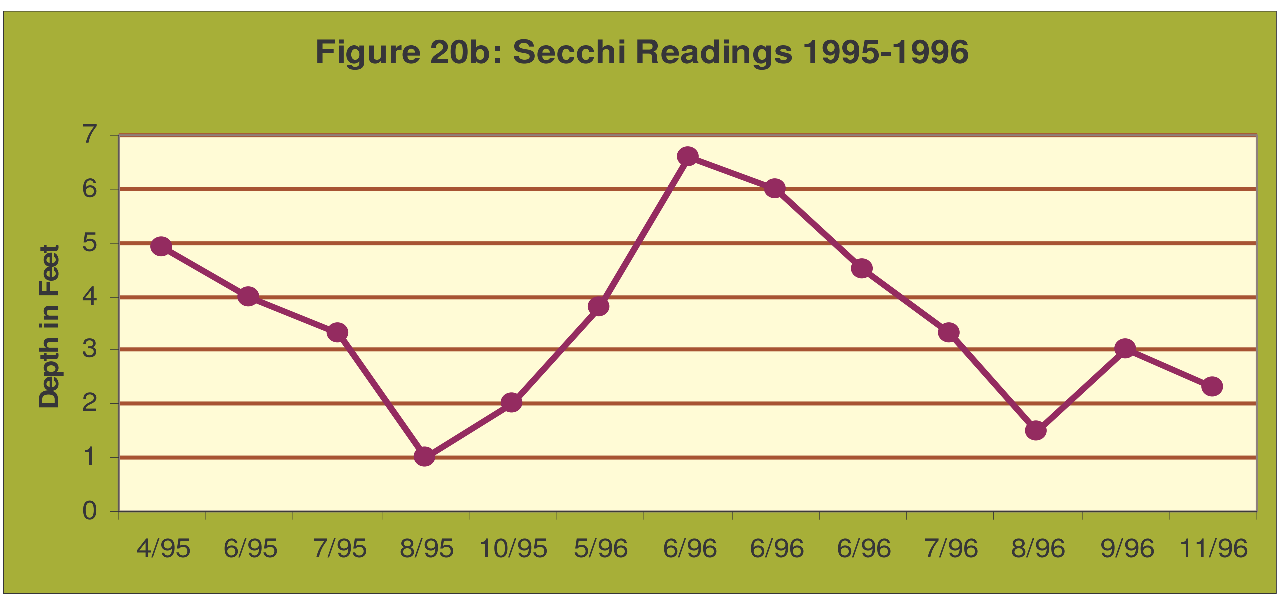


Figure 19: Photo of a Lake in Algal Bloom

Water Clarity

Water clarity is a critical factor for plants. If plants don't get more than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. Average summer Secchi disk clarity in Mason Lake in 2004-2006 was 2.5 feet. This is low water clarity, putting Mason Lake into the "poor" category for water clarity.





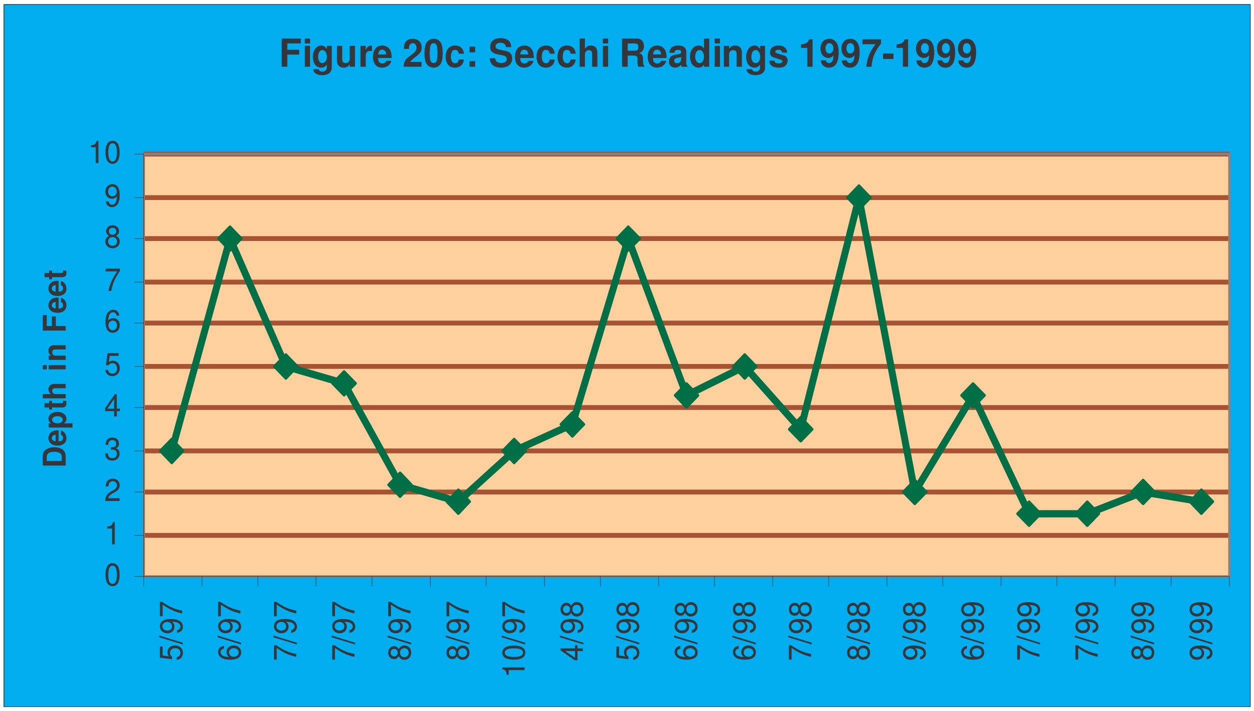


Figure 20c: Secchi Readings 1997-1999
Depth in Feet
0
1
2
3
4
5
6
7
8
9
10
5/97
6/97
7/97
7/97
8/97
8/97
10/97
4/98
5/98
6/98
6/98
7/98
8/98
9/98
6/99
7/99
7/99
8/99
9/99

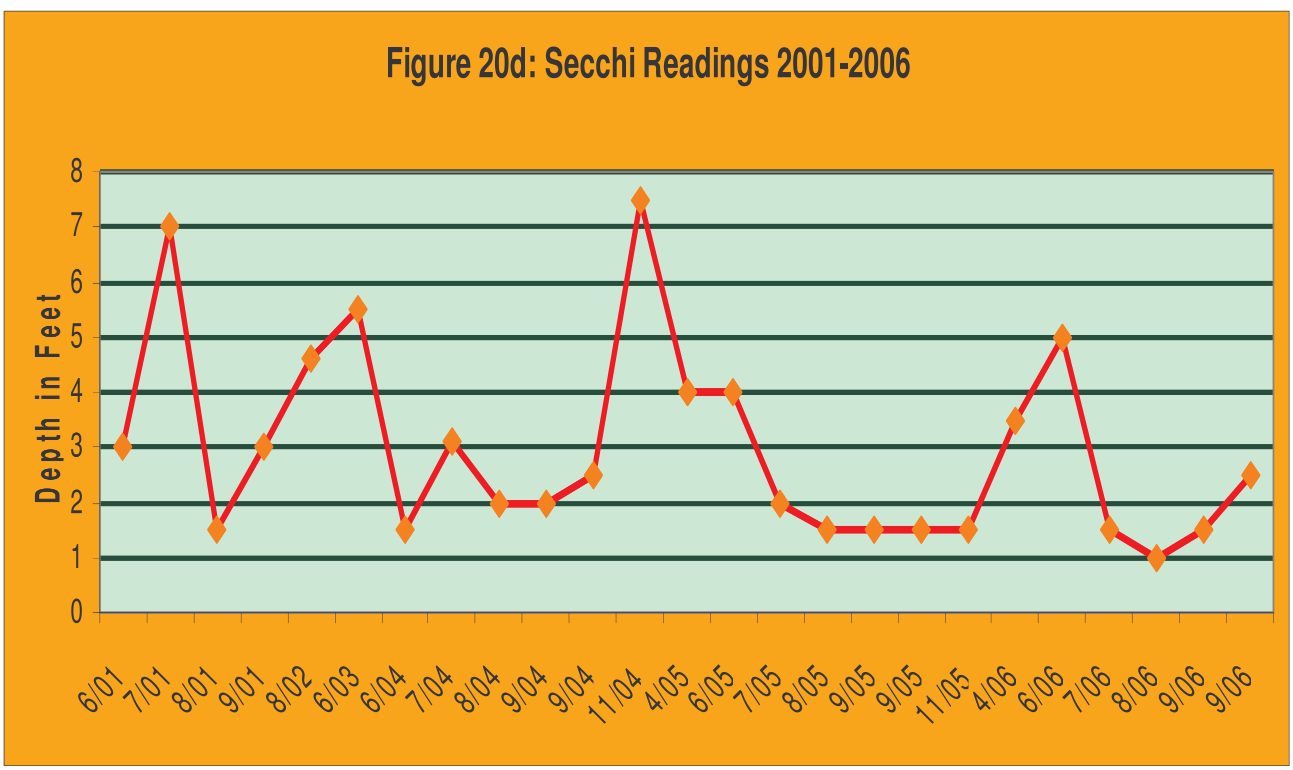


Figure 20d: Secchi Readings 2001-2006
Depth in Feet
0
1
2
3
4
5
6
7
8
6/01
7/01
8/01
9/01
8/02
6/03
6/04
7/04
8/04
9/04
9/04
11/04
4/05
6/05
7/05
8/05
9/05
9/05
11/05
4/06
6/06
7/06
8/06
9/06
9/06

Mason Lake has a considerable history of Secchi disk readings in a number of years. A look at the average Secchi depth for the growing season in each year since 1988 reveals that of the thirteen years for which there were growing season Secchi disk records, ten of them were 4 feet or less, i.e., for 10 of the 13 years, Mason Lake's growing season water clarity average was in the "poor" range.

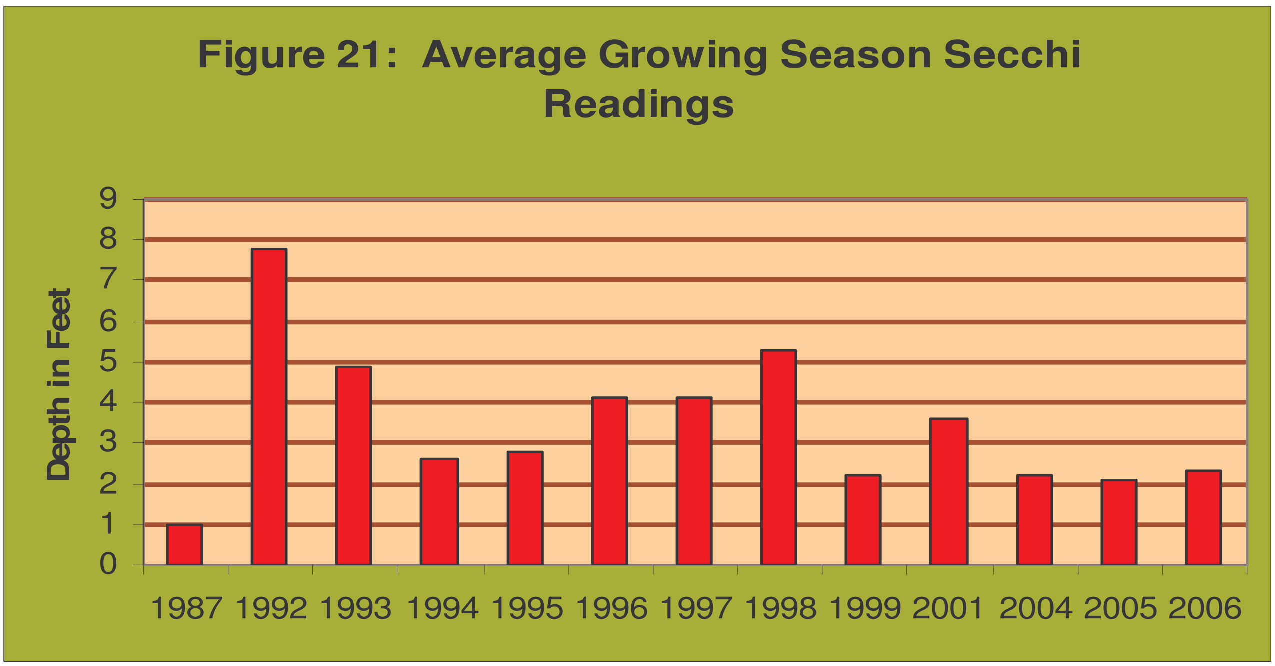
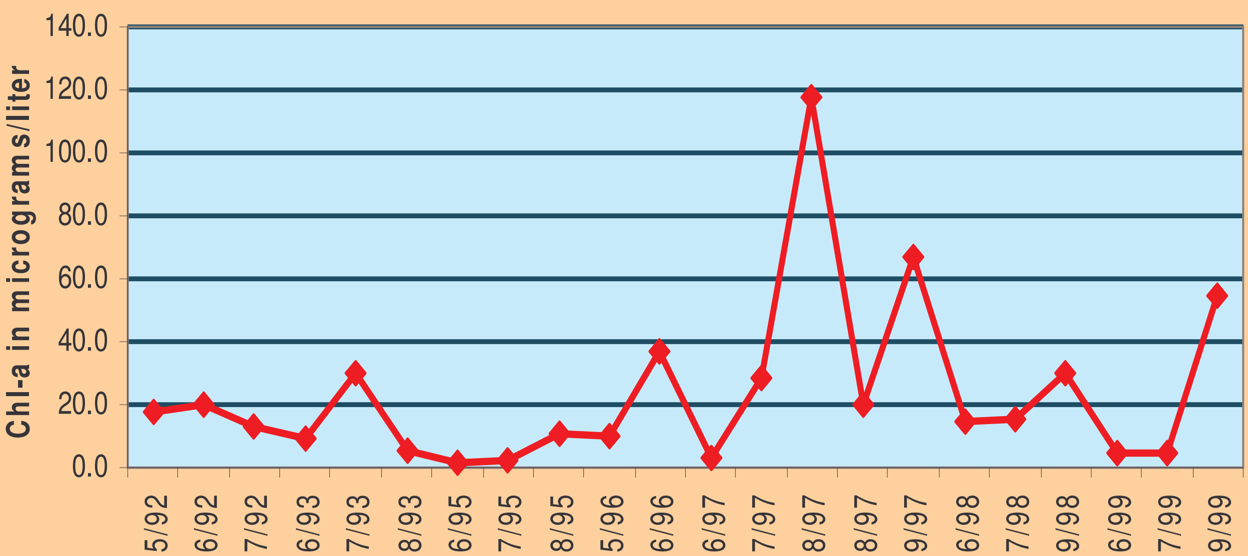


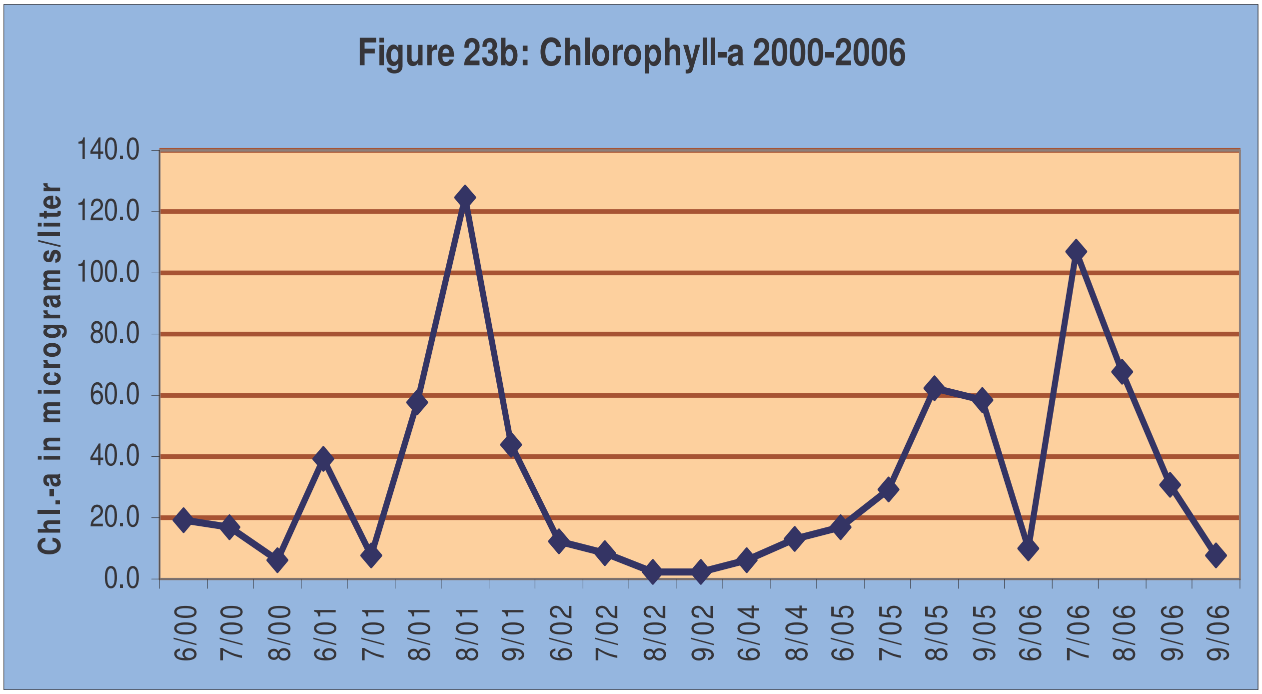
Figure 22: Photo of Testing Water Clarity with Secchi Disk

Chlorophyll a

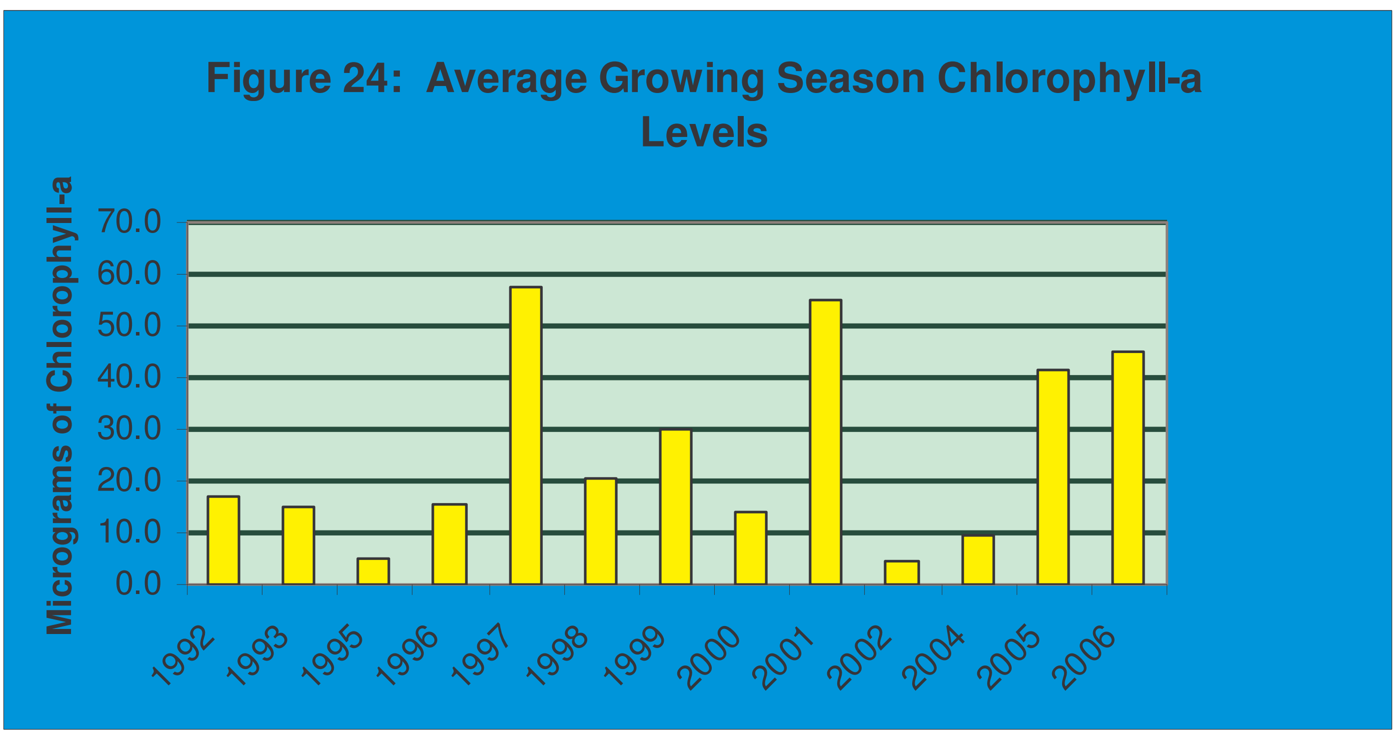
Chlorophyll-a concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth, as well as result in unpleasing odor and appearance. Studies have shown that the amount of chlorophyll-a in lake water depends greatly on the amount of algae present; therefore, chlorophyll-a levels are commonly used as a water quality indicator. The 2004-2006 growing season (June-September) average chlorophyll concentration in Mason Lake was 31.91 micrograms/liter. Such an algae concentration places Mason Lake at the "poor" level for chlorophyll-a results and places it (as do the Secchi disk and total phosphorus averages) in the "eutrophic" category of lakes.

Figure 23a: Chlorophyll-a 1992-1999





Of the thirteen years for which there are chlorophyll-a records for the growing season, 8 of them had elevated chlorophyll-a levels that placed Mason Lake's chlorophyll-a parameter at "poor".



Dissolved Oxygen

Oxygen dissolved in the water is essential to all aerobic aquatic organisms. The oxygen in a lake comes from the atmosphere and from the process of photosynthesis. Aquatic plants and algae consume carbon dioxide and respirate oxygen back into the lake water. The distribution of oxygen within a lake is affected by many factors, including water circulation, water stratification, winds or storms, air temperature; water temperature, nutrient availability, and the density and location of algae and/or aquatic plants. In general, Mason Lake's dissolved oxygen levels remain over the 5 milligrams/liter required for most fish survival. This may be due to the overall shallow level of the lake, which allows aerating water movement all the way to the lake bottom, keeping the water fairly oxygenated.

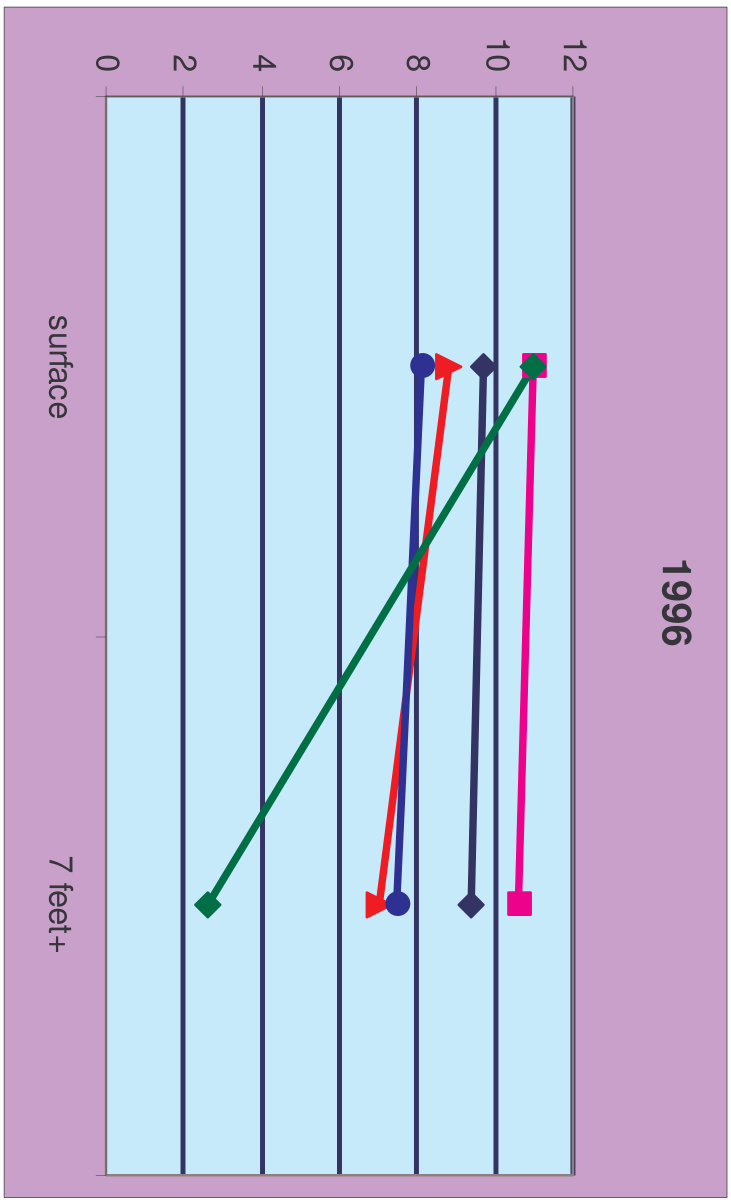


Figure 25a: Dissolved Oxygen Levels 1996 in milligrams/liter

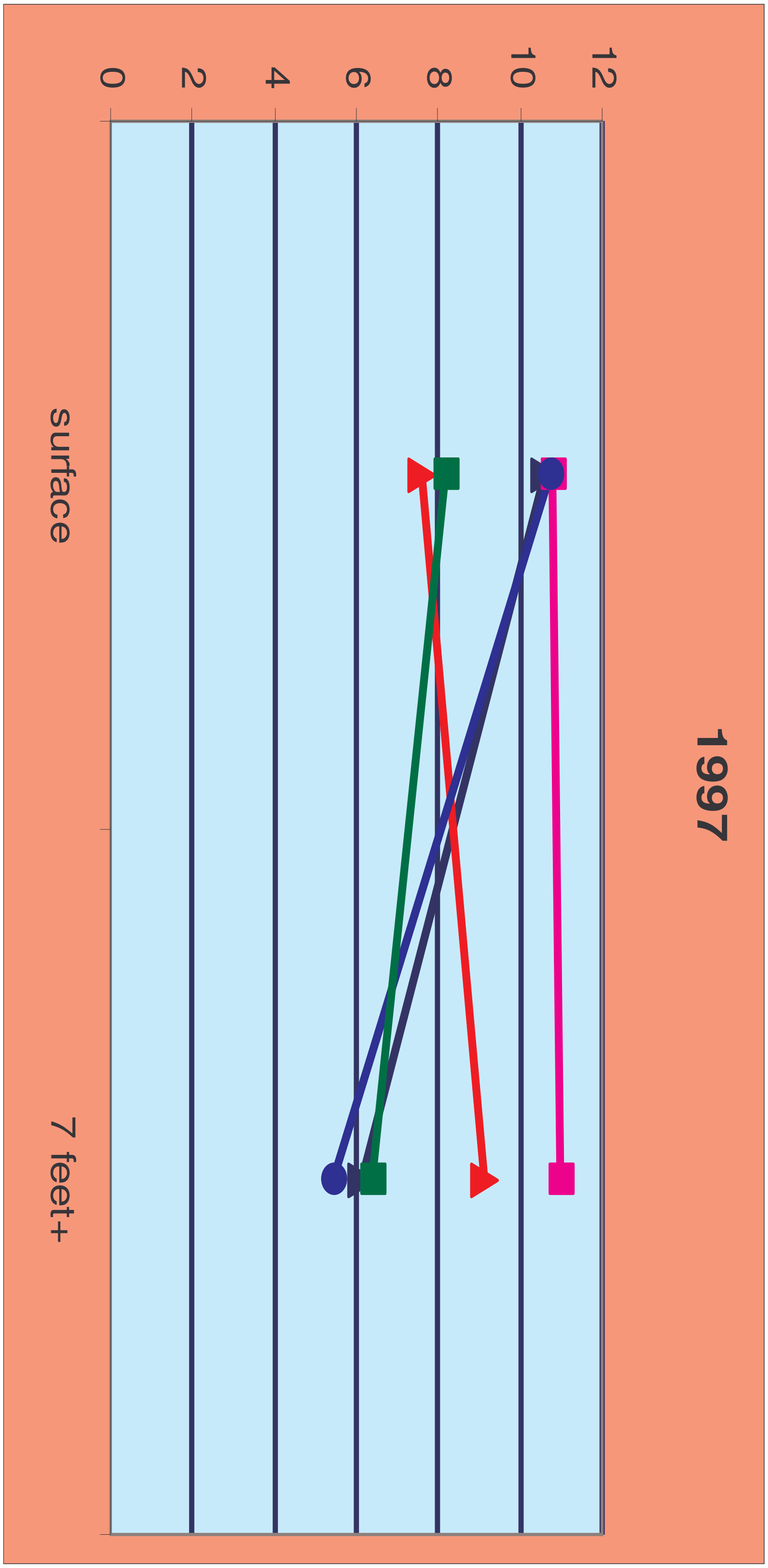


Figure 25b: Dissolved Oxygen Levels During 1997 Water Testing in milligrams/liter

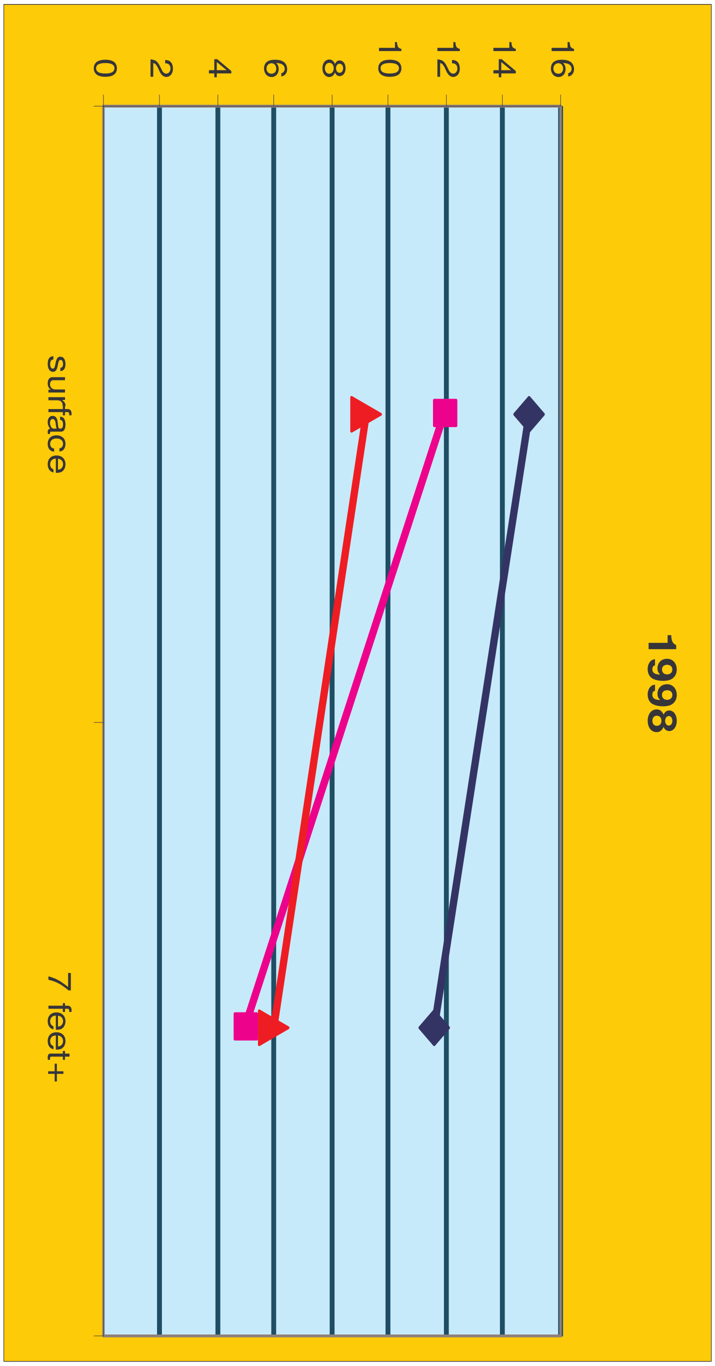


Figure 25c: Dissolved Oxygen Levels During 1998 Water Testing in milligrams/liter

6/98

7/98

8/98

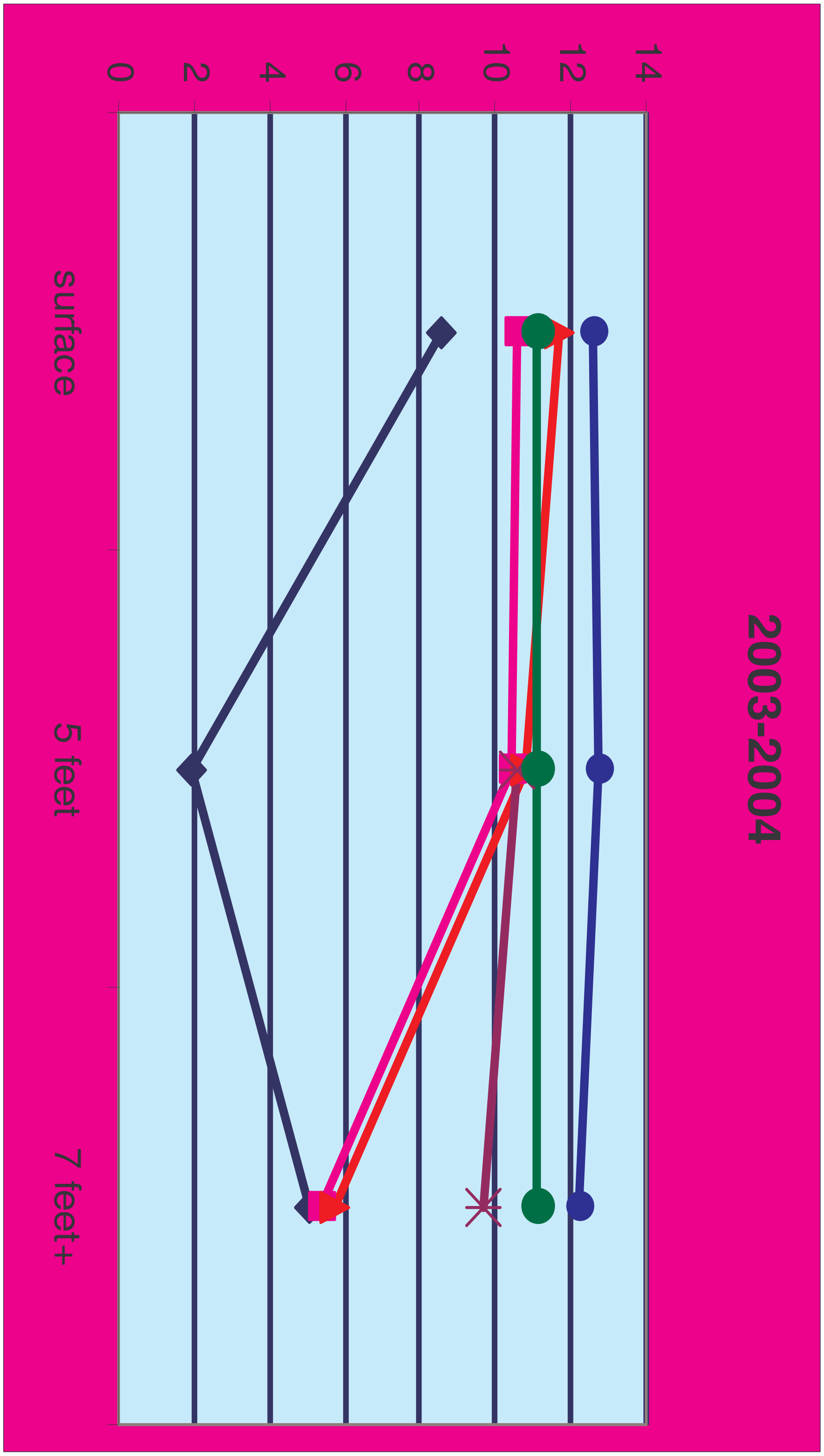


Figure 25d: Dissolved Oxygen Levels During 2003-2004 Water Testing in milligrams/liter

6/03

4/04

6/04

8/04

9/04

11/04

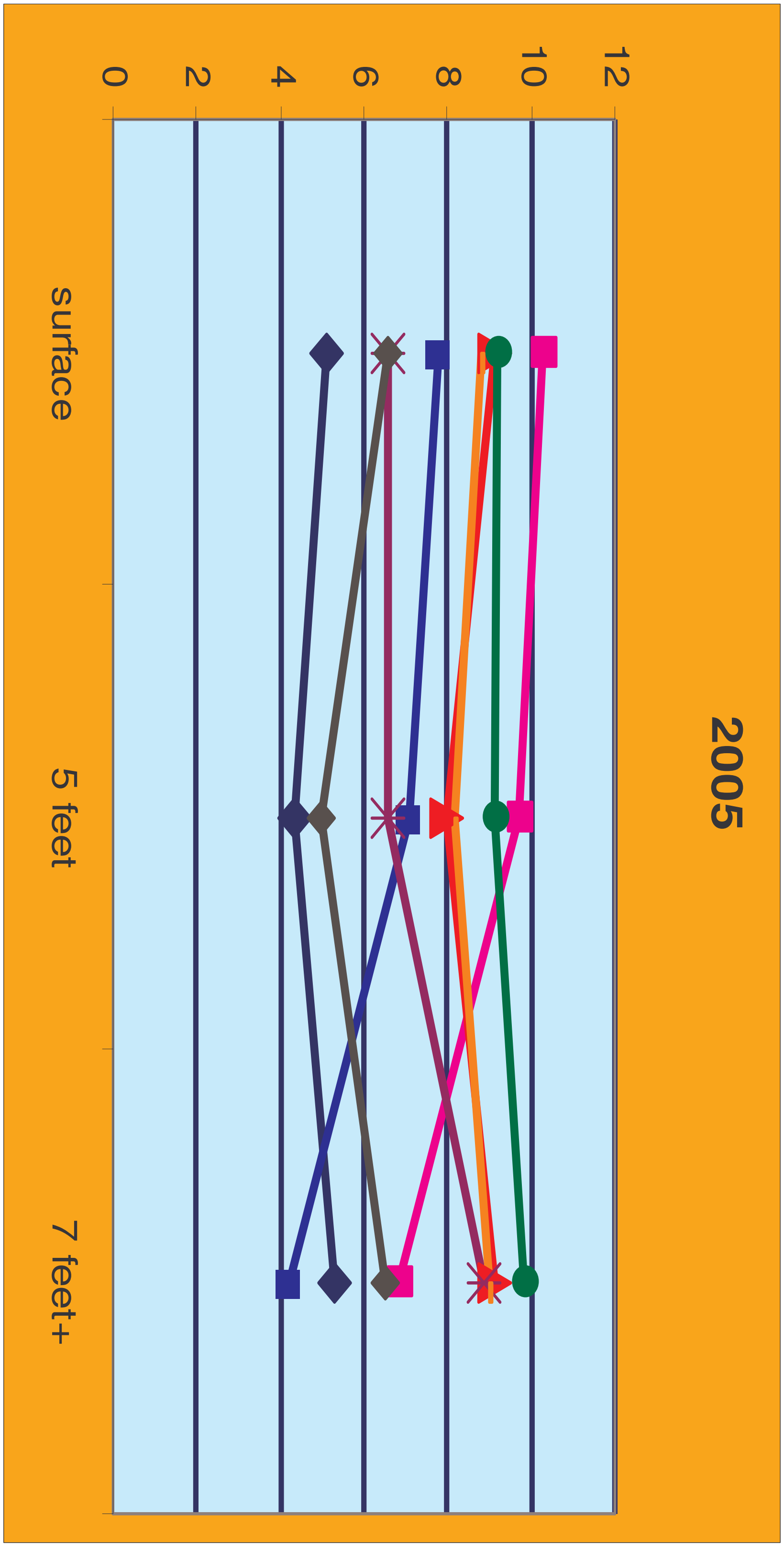
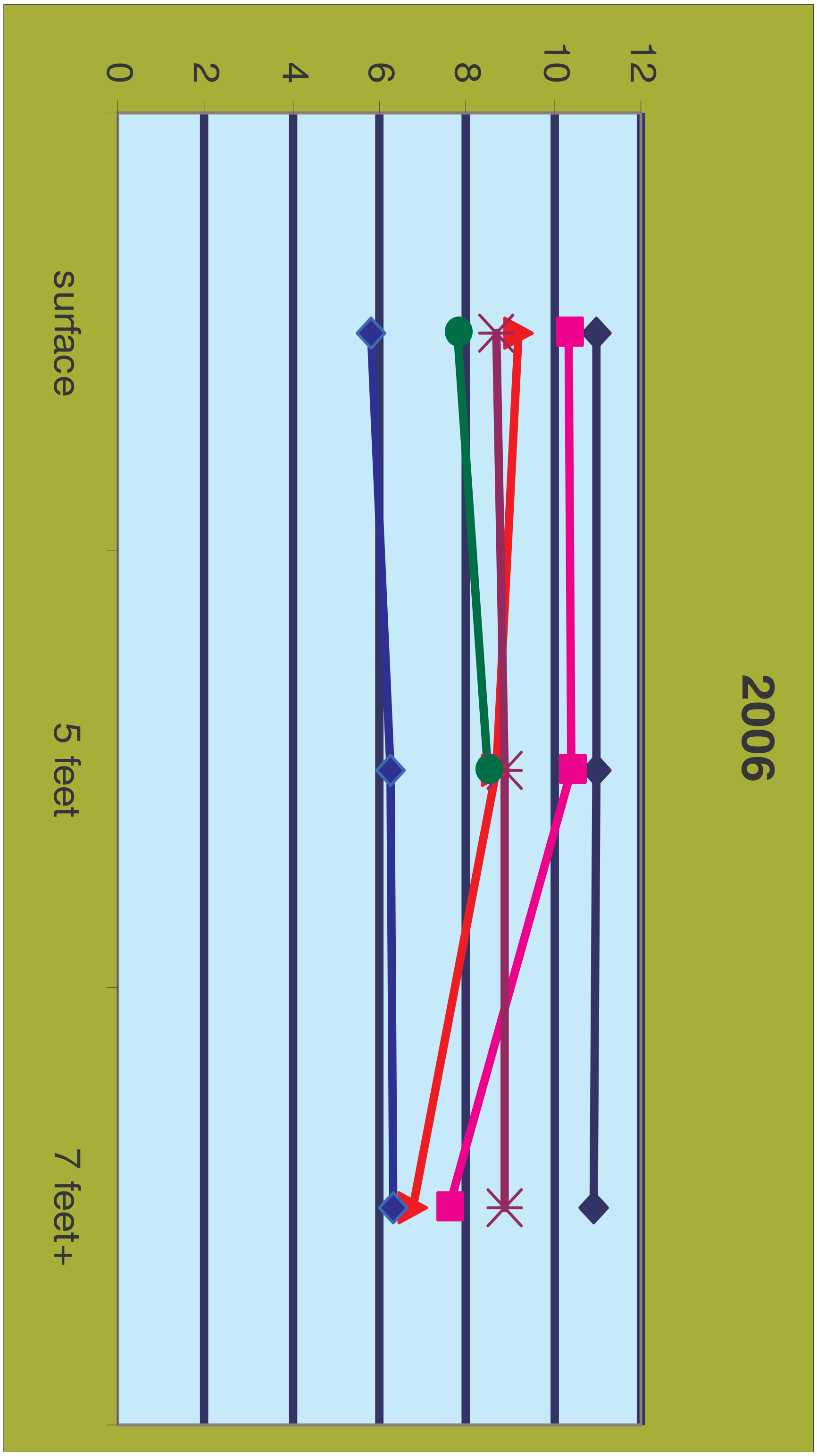


Figure 25e: Dissolved Oxygen Levels During 2005 Water Testing in milligrams/liter

2/05
4/05
6/05
7/05
8/05
9/05
9/05
11/05

Figure 25f: Dissolved Oxygen Levels During 2006 Water Testing in milligrams/liter



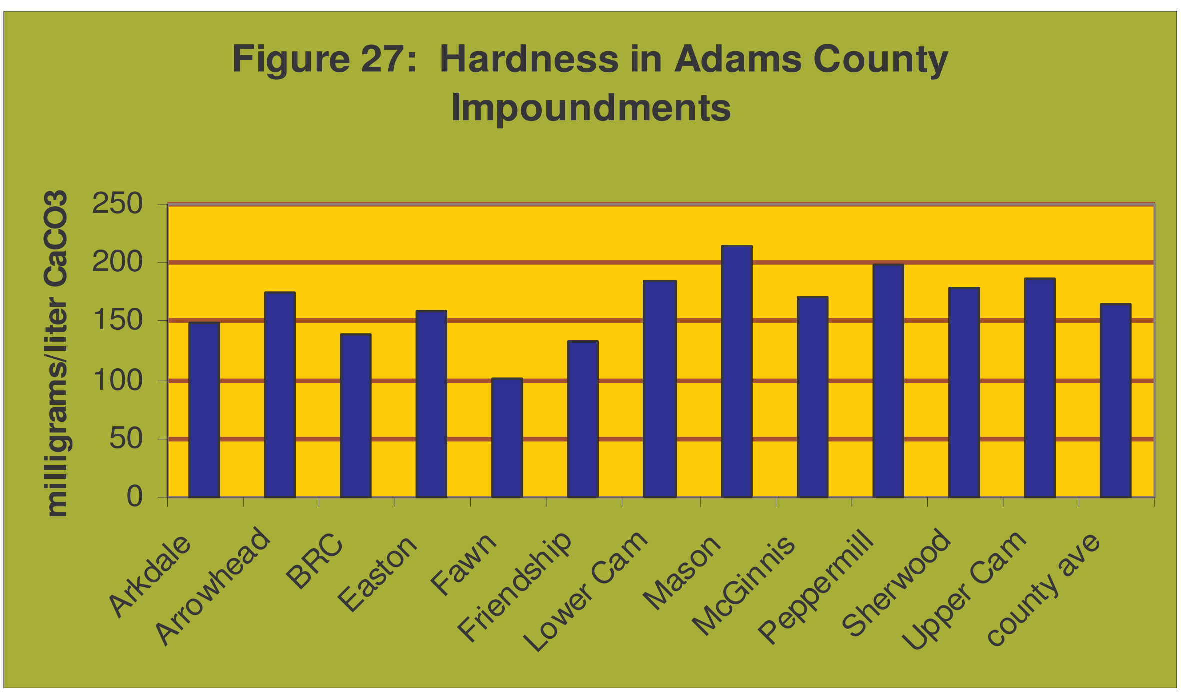
Water Hardness, Alkalinity and pH

Testing done by Adams County LWCD on Mason Lake included annual testing for water alkalinity and water hardness. Hardness and alkalinity levels in a lake are affected by the soil minerals, bedrock type in the watershed, and frequency of contact between lake water & these materials.

Level of Hardness	Milligrams/liter CaCO3
SOFT	0-60
MODERATELY HARD	61-120
HARD	121-180
VERY HARD	>180

Figure 26: Hardness Table

One method of evaluating hardness is to test the water for the amount of calcium carbonate ($CaCO_3$) it contains. The surface water of all of the public access lakes in Adams County have water that is moderately hard to very hard, whether they are impoundments (man-made lakes) or natural lakes. In 2005 and 2006, random samples were also taken of wells around Mason Lake to measure the hardness of the water coming into the lake through groundwater. Hardness in the groundwater averaged 294.25 milligrams/liter. This was 1.3 times harder than the lake's surface water hardness of 192.5 milligrams/liter. The hardness in both surface and groundwater is likely due to the underlying bedrock in Adams County, which is mostly sandstone with pockets of dolomite and shale.



The hardness level for Mason Lake's surface water was more than the overall hardness average impoundments in Adams County of 166 milligrams/liter of Calcium Carbonate. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes because they are often located in watersheds with soils that load phosphorus into the lake water.

Alkalinity is important in a lake to buffer the effects of acidification from the atmosphere. "Acid rain" has long been a problem with lakes that had low alkalinity level and high potential sources of acid deposition.

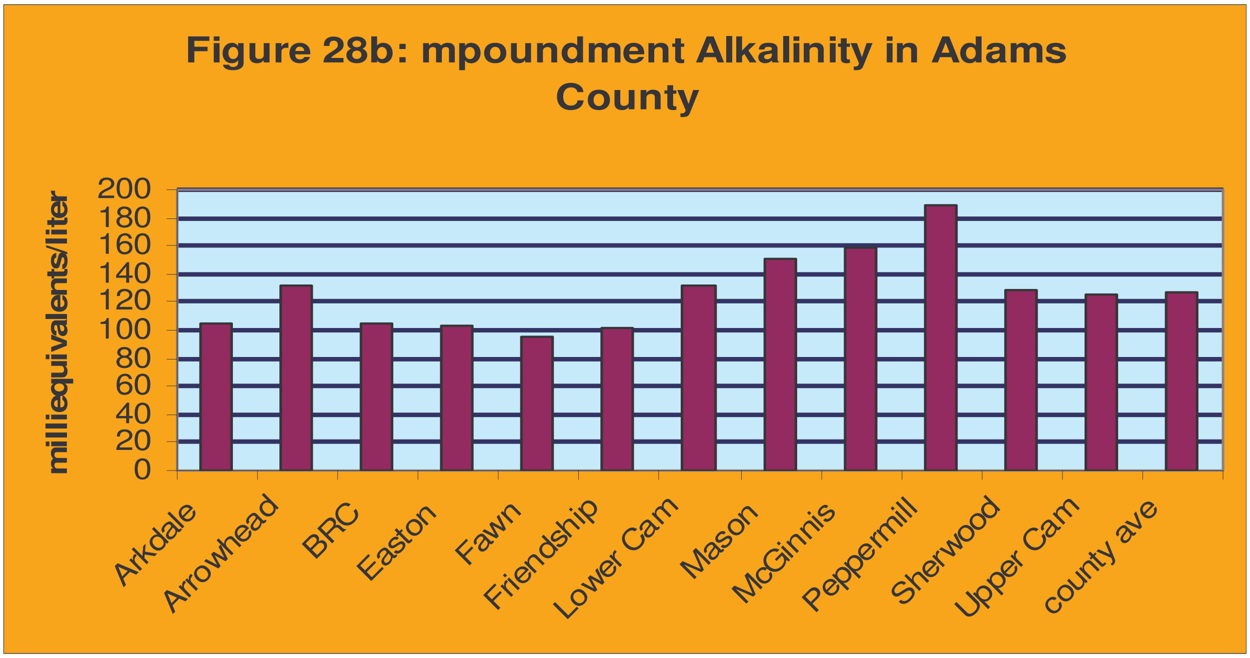
Acid Rain Sensitivity	ueq/l $CaCO_3$
High	0-39
Moderate	49-199
Low	200-499
Not Sensitive	>500

Figure 28a: Acid Rain Sensitivity

Well water testing results averaged 214.5 milliequivalents/liter, higher than the surface water average of 166 milliequivalents/liter and higher than the county impoundment average of 127 milliequivalents/liter. Mason Lake's potential sensitivity to acid rain is low to moderate, but luckily for Adams County, the acid deposition rate is very low, probably due to the little industrialization in the county.

Alkalinity also affects the pH level of lake water. The acidity level of a lake's water regulates the solubility of many minerals. A pH level of 7 is neutral. The pH level in Wisconsin lakes ranges from 4.5 in acid bog lakes to 8.4 in hard water, marl lakes.

Some of the minerals that become available under low pH, especially the metals aluminum, zinc and mercury, can inhibit fish reproduction and/or survival. Even what seems like a small variance in pH can have large effects because the pH scale is set up so that every 1.0 unit change increases acidity tenfold, i.e., water with a pH of 7 is 10 times more acid than water with pH of 8. Mercury and aluminum are not only toxic to many kinds of wildlife; they can also be toxic to humans, especially those that eat tainted fish.



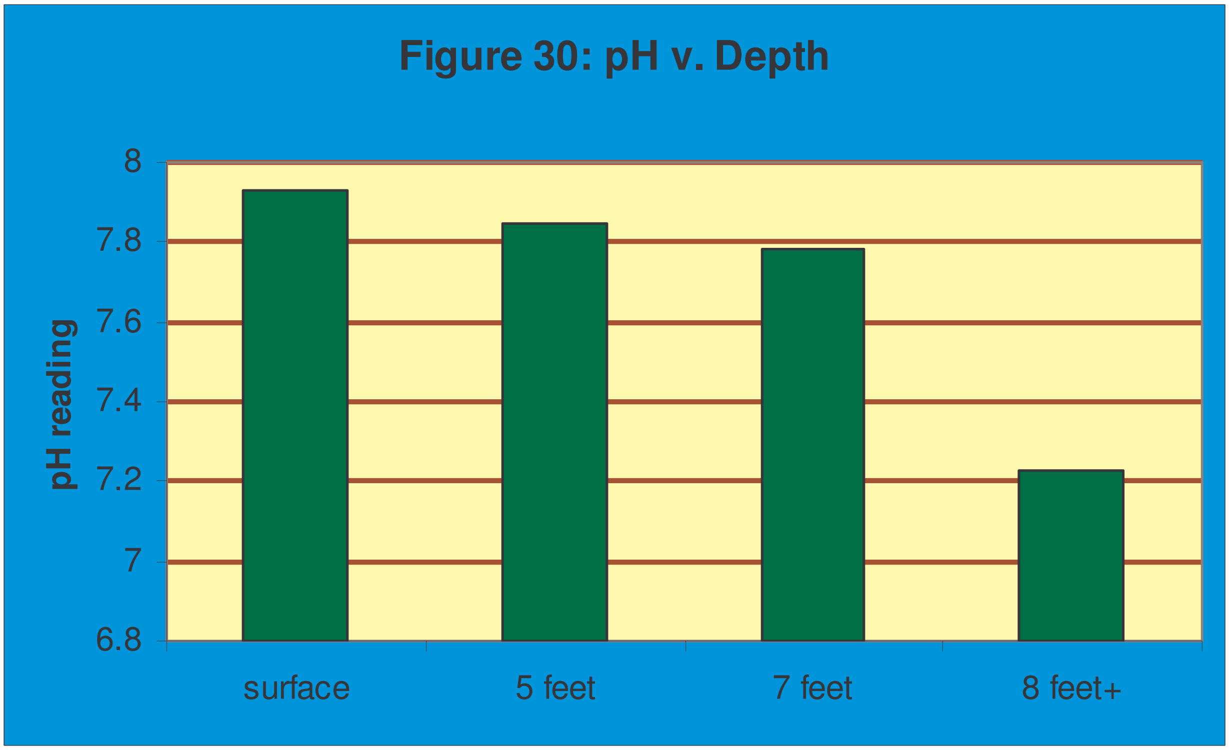
The testing occurring from 2004-2006 also included regular monitoring of the pH at several depths in Mason Lake. As is common in the lakes in Adams County, Mason Lake has pH levels starting at about neutral (7.23) at 8 feet depth and increasing in alkalinity as the depth gets less, until the surface water pH averages 7.93. A lake's pH level is important for the release of potentially harmful substances and also affects plant growth, fish reproduction and survival. Most plants grow best at pH levels between 5.5 and 8.

More importantly for many lakes, fish reproduction and survival are very sensitive to pH levels. The chart below indicates the effect of pH levels under 6.5 on fish (Figure 32):

Figure 29: Effects of pH Levels on Fish

Water pH	Effects
6.5	walleye spawning inhibited
5.8	lake trout spawning inhibited
5.5	smallmouth bass disappear
5.2	walleye & lake trout disappear
5	spawning inhibited in most fish
4.7	Northern pike, sucker, bullhead, pumpkinseed, sunfish & rock bass disappear
4.5	perch spawning inhibited
3.5	perch disappear
3	toxic to all fish

No pH levels taken in Mason Lake between 2004 and 2006 fell below the pH level that inhibits walleye reproduction. A lake with a neutral or slightly alkaline pH like Mason Lake is a good lake for fish and plant survival. Natural rainfall in Wisconsin averages a pH of 5.6. This means that if the rain falls on a lake without sufficient alkalinity to buffer that acid water coming in by rainfall, the lake's fish cannot reproduce. That is not a problem at Mason Lake. Mason Lake has a good pH level for fish reproduction and survival.



<u>Other Water Quality Testing Results</u>

CHLORIDE: Chloride does not affect plant and algae growth and is not known to be harmful to humans. It isn't common in most Wisconsin soils and rocks, so is usually found only in very low levels in Wisconsin lakes. However, the presence of a significant amount of chloride over a period of time indicates there may be negative human impacts on the water quality present from septic system failure, the presence of fertilizer and/or waste, deposition of road-salt, and other nutrients. An increased chloride level is thus an indication that too many nutrients are entering the lake, although the level has to be evaluated compared to the natural background data for chloride. The average chloride level found in Mason Lake during the testing period was 3.7 milligrams/liter, just a little above the natural level of 3 milligrams/liter for chloride in this area of Wisconsin.

NITROGEN: Nitrogen is necessary for plant and algae growth. A lake receives nitrogen in various forms, including nitrate, nitrite, organic, and ammonium. In Wisconsin, the amount of nitrogen in a lake's water often corresponds to the local land use. Although some nitrogen will enter a lake through rainfall from the atmosphere, that coming from land use tends to be in higher concentrations in larger amounts, coming from fertilizers, animal and human wastes, decomposing organic matter, and surface runoff. For example, the growth level of the exotic aquatic plant, Eurasian Watermilfoil (*Myriophyllum spicatum*) has been correlated with fertilization of lake sediment by nitrogen-rich spring runoff.

Nitrogen levels can affect other aspects of water quality. The sum of water testing results for nitrate, nitrite and ammonium levels of over .3 milligrams/liter in the spring can be used to project the likelihood of an algal bloom in the summer (assuming sufficient phosphorus is also present). Mason Lake's combination spring levels from 2004 to 2006 averaged 0.58 milligrams/liter, somewhat above the .3 milligrams/liter predictive level for nitrogen-related algal blooms. These elevations suggest that some of the algal blooms on Mason Lake may be at least partly nitrogen-related. Mason Lake has had a long-standing problem with fairly large and frequent algal blooms during the growing season.

CALCIUM and MAGNESIUM: Calcium is required by all higher plants and some microscopic lifeforms. Magnesium is needed by chlorophyllic plants and by algae, fungi and bacteria. Both calcium and magnesium are important contributors to the hardness of a lake's waters. Magnesium elevated about 125 milligrams/liter may have a laxative effect on some humans. Otherwise, no health hazards to humans and wildlife are known from calcium and magnesium. The average Calcium level in Mason Lake's water during the testing period was 31.31 milligrams/liter. The average Magnesium level was 21.96 milligrams/liter. Both of these are low-level readings.

SODIUM AND POTASSIUM: These elements occur naturally only in low levels in Wisconsin waters and soils. Their presence may indicate human-caused pollution. Sodium is found with chloride in many road salts and fertilizers and is also found in human and animal waste. Potassium is found in many fertilizers and also found in animal waste. The level of these two is generally not useful as a specific pollution indicator, but increasing levels of one or both of these elements can indicate possible contamination from damaging pollutants. High levels of sodium have also been found to influence the development of a large population of cyanobacteria, some of which can be toxic to animals and humans. Some health professionals have suggested that sodium levels over 20 milligrams/liter may be harmful to heart and kidney patients if ingested. Both sodium and potassium levels in Mason Lake are very low: the average sodium level was 2.5 milligrams/liter; the average potassium reading was 1.28 milligrams/liter.

SULFATE: In low-oxygen waters (hypoxic), sulfate can combine with hydrogen and becomes the gas hydrogen sulfate, which smells like rotten eggs and is toxic to most aquatic organisms. Sulfate levels can also affect the metal ions in the lake, especially iron and mercury, by binding them up, thus removing them from the water column. To prevent the formation of hydrogen sulfate, levels of 10 milligrams/liter are best. A health advisory kicks in at 30 milligrams/liter. Mason Lake sulfate levels averaged 2.2 milligrams/liter during the testing period, below both levels on concern.

TURBIDITY: Turbidity reflects water clarity. The term refers to suspended solids in the water column—solids that may include clay, silt, sand, plankton, waste, sewage and other pollutants. Turbid water may mask the presence of bacteria or other pollutants because the water looks murky or muddy. In general, turbidity readings of less than 5 NTU are best. Very turbid waters may not only smell, but also tend to be aesthetically displeasing, thus curtailing recreational uses of the water. Turbidity levels for Mason Lake's waters were 3.2 NTU in 2004, 4.24 NTU in 2005 and 5.22 NTU in 2006. These levels suggest that further research should be done on what appears to be increasing turbidity levels in Mason Lake.

Figure 31:
Examples of Very
Turbid Water

HYDROLOGIC BUDGET

According to date in a 1970 WDNR bathymetric (depth) map, Mason Lake has 855.6 surface acres, and the volume of the lake is 5783.7 acre-feet. At that time, 8% of the lake was less than 3 feet deep. The maximum depth was 9 feet.

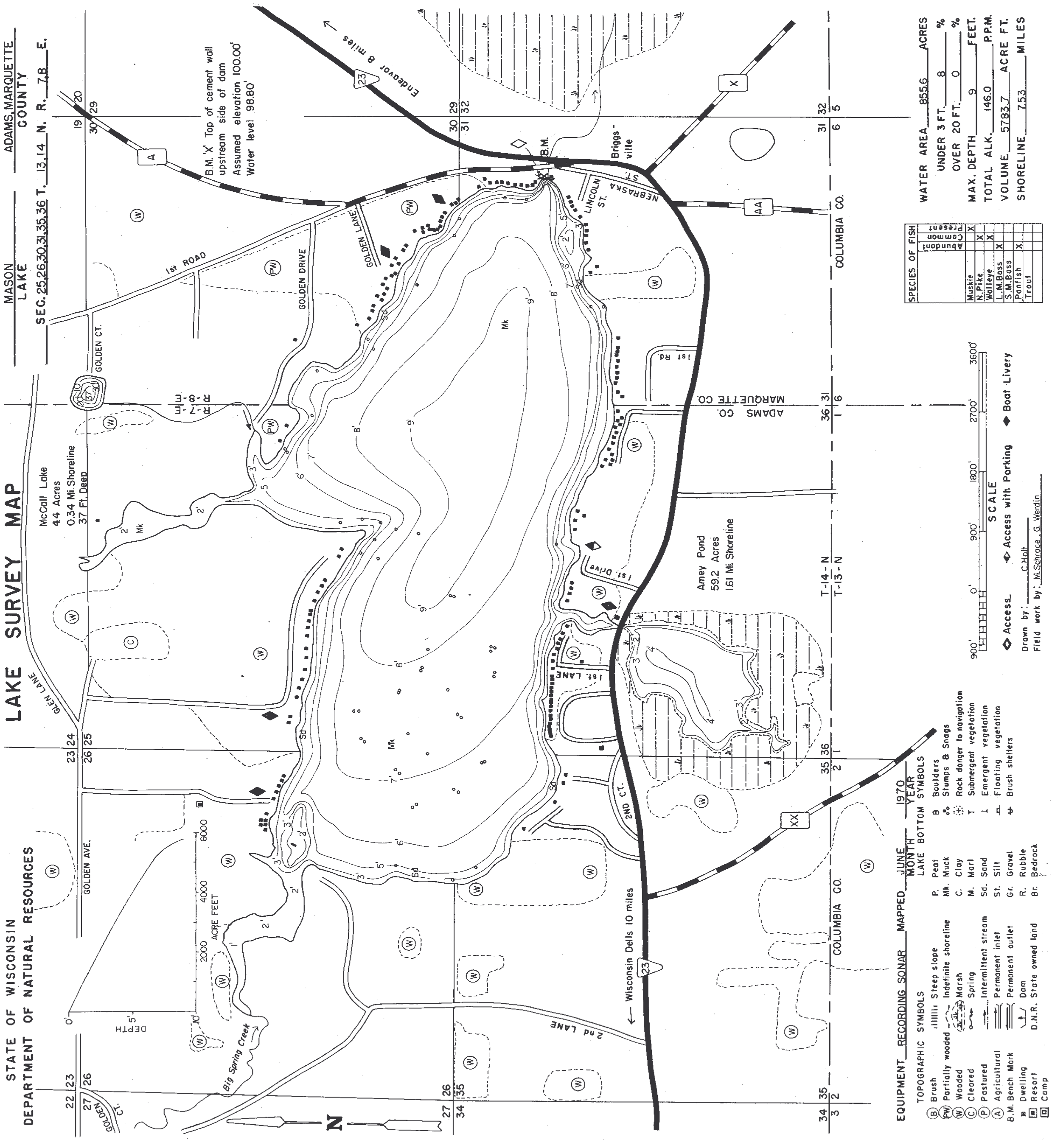


Figure 32: Bathymetric Map of Mason Lake (1970)

A “hydrologic budget” is an accounting of the inflow to, outflow from and storage in a hydrological unit (such as a lake). “Residence time” is the average length of time particular water stays within a lake before leaving it. This can range from several days to years, depending on the type of lake, amount of rainfall, and other factors. “Flushing rate” is the time it takes a lake’s volume to be replaced. “Annual runoff volume”, as used in WiLMS, is the total water yield from the drainage area reaching the lake. The “drainage area” is the amount of area (in acres) contributing surface water runoff and nutrients to the lake. The “areal water load” is the total annual flow volume reaching the lake divided by the surface area of the lake. “Hydraulic loading” is the total annual volume of all water sources (including precipitation, non-point sources & point sources) loading into the lake.

Using the data gathered from historical testing and that done by the Adams County LWCD from 2004-2006, the WiLMS model calculated the tributary drainage area for Mason Lake as 31582.4 acres. The average unit runoff for Adams County in the Mason Lake area is 9.4 inches. WiLMS determined the expected annual runoff volume as 24739.5 acre-feet/year. Anticipated annual hydraulic loading is 24824.8 acre-feet/year. Areal water load is 29.2 feet/year.

In an impoundment lake like Mason Lake, a significant portion of the water and its nutrient load running through it from the impounded creek(s) tend to flush through the lake and continue downstream—in Mason Lake’s case, modeling estimates a water residence of 0.22 year. The calculated lake flushing rate is 4.51 1/year. Water and its load flow through Mason Lake somewhat quickly.

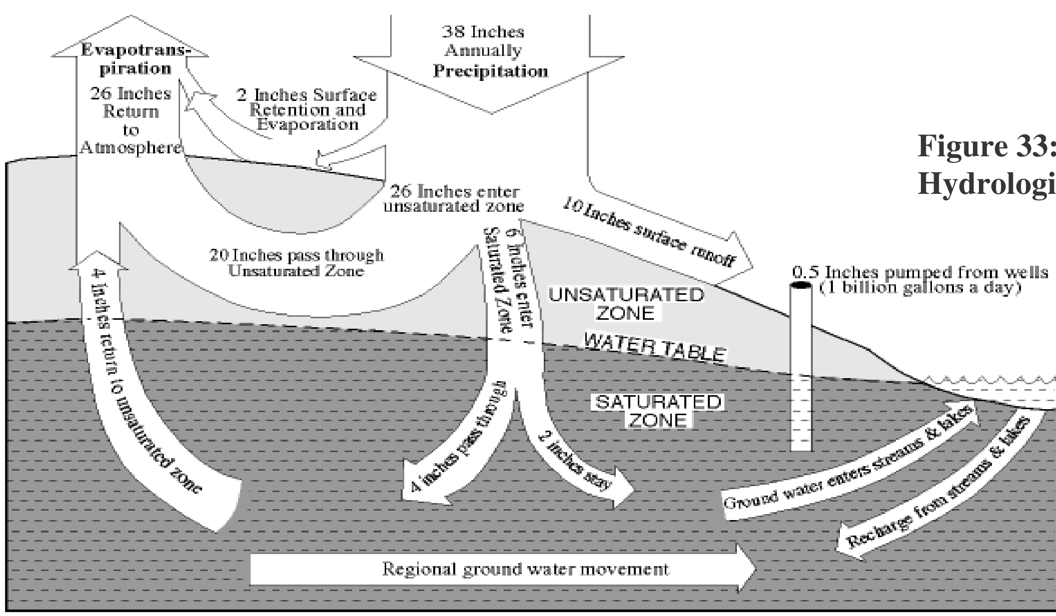


Figure 33: Example of Hydrologic Budget

TROPHIC STATE

The trophic state of a lake is one measure of water quality, basically defining the lake's biological production status. **Eutrophic lakes** are very productive, with high nutrient levels, frequent algal blooms and/or abundant aquatic plant growth. **Oligotrophic lakes** are those low in nutrients with limited plant growth and small populations of fish. **Mesotrophic lakes** are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes; often with a more varied fishery than either the eutrophic or oligotrophic lakes. In comparing water quality testing results with the prediction from the computer modeling of this modeling with the actual figures outlined above, the actual Trophic State of Mason Lake is what was predicted from the modeling. Modeling results predicted that the overall TSI for Mason Lake would be **65**. This score places Mason Lake's overall TSI at above average for impoundment lakes in Adams County (52.83). In the instance of a TSI reading, the lower the better, so having an above-average TSI score indicates that Mason Lake has a heavier nutrient load than the average impoundment in Adams County.

Figure 34: Trophic Status Table

Score	TSI Level Description
30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant growth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

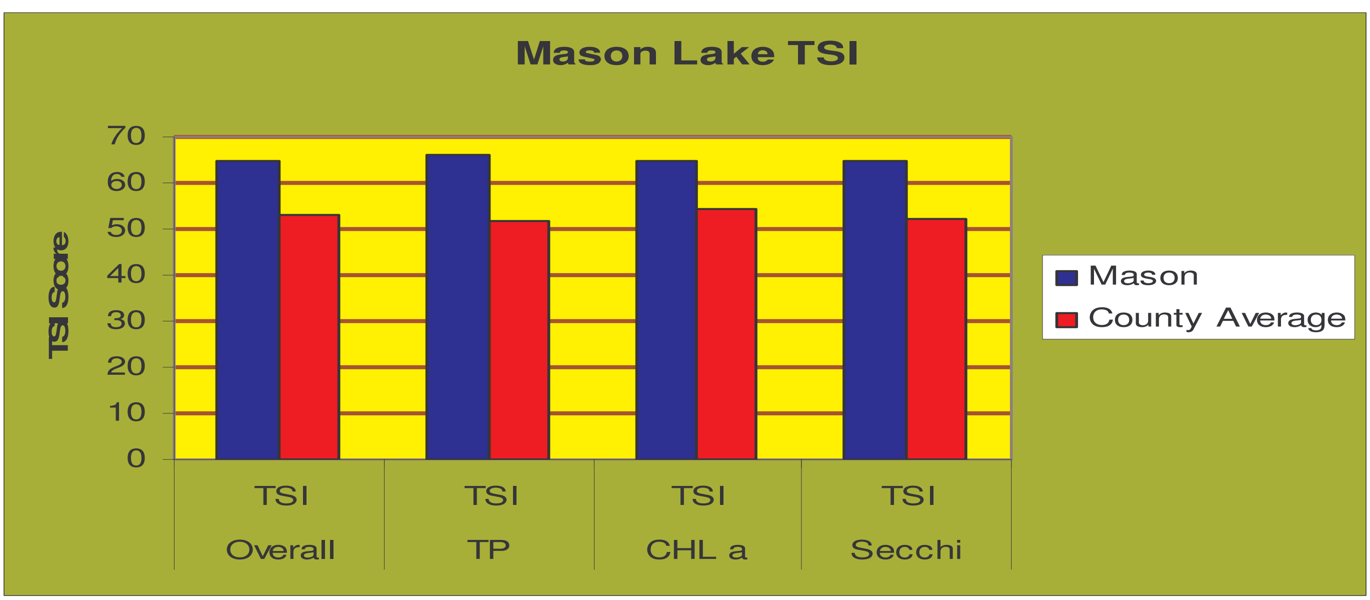
Mason Lake = 65

Phosphorus concentration, chlorophyll-a concentration and water clarity data are collected and combined to determine a trophic state. As discussed earlier, the average growing season epilimnetic total phosphorus for Mason Lake was 73.25 micrograms/liter. The average growing season chlorophyll-a concentration was 31.91 micrograms/liter. Growing season water clarity averaged a depth of 2.5 feet. Figure 35 shows where each of these measurements from Mason Lake falls in trophic level.

Figure 35: Mason Lake Trophic Status Overview

Trophic State	**Quality Index**	**Phosphorus**	**Chlorophyll a**	**Sechhi Disk**
		(ug/l)	**(ug/l)**	**(ft)**
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	1 to 5	8 to 19
Mesotrophic	Good	10 to 30	5 to 10	6 to 8
	Fair	30 to 50	10 to 15	5 to 6
Eutrophic	Poor	**50 to 150**	15 to 30	3 to 4
	Very Poor	Over 150	**Over 30**	**Under 3**
Mason Lake		**73.25**	**31.91**	**2.5**

These figures show that Mason Lake has very poor to poor levels overall for the three parameters often used to described water quality: Secchi disk depths; average TP for the growing season; and chlorophyll a levels. It is normal for all of these values to fluctuate during a growing season. However, they can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. Overall, Mason Lake scores as a hypereutrophic lake.



IN-LAKE HABITAT

Aquatic Plants

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants play in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of the most tolerant species.

Studies of the aquatic plants (macrophytes) in Mason Lake were conducted in 1988, June/July 1992 and August 1995 by Water Resource Staff of the North-Central District - Department of Natural Resources (DNR). Using the same methods and sample sites, studies of the aquatic plants were conducted during June and August of 1998 and 1999 and June 2001 and 2005.

In 2005, an updated aquatic plant survey was done on Mason Lake by staff from WDNR and Adams County Land & Water Conservation Department. The aquatic plant community characterized by good diversity, low quality, a high tolerance to disturbance, a condition far from an undisturbed condition and abundant growth distributed throughout the entire lake basin. Plant growth colonized 82% of the entire lake basin and 91% of the shallow area.

A total of 36 different species of aquatic plants were found during the 1988-2005 studies: 15 emergents species, 5 floating leaf species, and 16 submergent species. No endangered of threatened species were found. Two non-native species were found: *Myriophyllum spicatum* (Eurasian water milfoil) and *Potamogeton crispus* (curly-leaf pondweed).

The 1988 data can not be compared to later data, since only 6 species were recorded in 1988 and no distinction was made between native watermilfoil and Eurasian watermilfoil. *Myriophyllum spicatum* (Eurasian watermilfoil) was the most frequently occurring species in 1992. Its frequency declined in 1998**,** then increased to the most frequent again in 2001, along with *Potamogeton crispus***,** and declined again in 2005. When *Myriophyllum. spicatum* declined, *Ceratophyllum. demersum* (coontail) became the most frequent species in 1995 and 1998.

Figure 36. Mason Lake Aquatic Plant Species, 2005

Scientific Name	**Common Name**
Emergent Species	
1) *Asclepias incarnata* L.	swamp milkweed
2) *Bidens connata* Muhl.	purplestem beggar-tick
3) *Carex* spp.	sedge
4) *Cornus sericeus* L.	red-osier dogwood
5) *Decodon verticillatus* (L.) Elliott.	water willow
6) *Echinochloa walteri* (Pursh) Heller.	wild millet
7) *Eleocharis palustris* L.	creeping spikerush
8) *Impatiens capensis* Meeb.	orange jewelweed
9) *Iris versicolor* L.	northern blue flag
10) *Phalaris arundinacea* L.	reed canary grass
11) *Polygonum amphibium* L.	water smartweed
12) *Sagittaria latifolia* Willd.	common arrowhead
13) *Scirpus validus* Vahl.	softstem bulrush
14) *Sparganium eurycarpum* Engelm.	giant bur-reed
15) *Typha angustifolia* L.	narrow-leaf cattail
Floating leaf Species	
16) *Lemna minor* L.	small duckweed
17) *Nuphar variegata* Durand.	bull-head pond lily
18) *Nymphaea odorata* Aiton.	white water lily
19) *Spirodela polyrhiza* (L.) Schleiden.	great duckweed
20) *Wolffia columbiana* Karsten.	common watermeal
Submergent Species	
21) *Ceratophyllum demersum* L.	coontail
22) *Chara* sp.	muskgrass
23) *Elodea canadensis* Michx.	common waterweed
24) *Myriophyllum sibiricum* Komarov.	common water milfoil
25) *Myriophyllum spicatum* L.	Eurasian watermilfoil
26) *Najas flexilis* (Willd.) Rostkov & Schmidt.	slender naiad
27) *Potamogeton amplifolius* Tuckerman.	large-leaf pondweed
28) *Potamogeton crispus* L.	curly-leaf pondweed
29) *Potamogeton foliosus* Raf.	leafy pondweed
30) *Potamogeton nodosus* Poiret.	long-leaf pondweed
31) *Potamogeton pectinatus* L.	sago pondweed
32) *Potamogeton praelongus* Wulf.	whitestem pondweed
33) *Potamogeton pusillus* L.	slender pondweed
34) *Potamogeton richardsonii*	clasping-leaf pondweed
35) *Ranunculus longirostris* Gordon.	white water-crowfoot
36) *Zosterella dubia* (Jacq.) Small.	water stargrass

Ceratophyllum demersum (coontail) was the dominant species in 2005, especially in the shallowest and deepest depth zone. The frequency and density of *Ceratophyllum demersum* increased with increasing depth. *Myriophyllum spicatum* (Eurasian watermilfoil), an aggressive non-native species, was the sub-dominant species. The frequency and density of this species also increases with increasing depth and may be due to the impact of winter drawdown.

Myriophyllum spicatum (Eurasian watermilfoil) had the highest mean density in 1992. When the density of *Myriophyllum spicatum* declined in 1998, *Potamogeton crispus* (curly-leaf pondweed) had the highest mean density. Density of *Myriophyllum. spicatum* increased again by 2001 to its highest level. In 2005, *Myriophyllum spicatum* declined again, and *Ceratophyllum demersum* was the species with the highest mean density.

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The "mean density where present" measures the aggregation or density of growth form of a species. For the first time in 2005, no species exhibited a growth form of above average density in Mason Lake. In previous years, *Certophyllum demersum, Chara* spp., *Lemna minor, Myriophyllum sibiricum, Myriophyllum spicatum, Najas flexilis* (bushy pondweed), *Potamogeton crispus, Potamogeton pectinatus* (sago pondweed) and *Potamogeton. Zosteriformis* (flat-stemmed pondweed) had exhibited dense growth forms in some years.

Combining the relative frequency and relative density of a species into a Dominance Value indicates how dominant a species is in the community. *Myriophyllum spicatum* (Eurasian watermilfoil) was the dominant species in 1992 with *Ceratophyllum demersum* as sub-dominant. In 1998, *Potamogeton crispus* was co-dominant with *Ceratophyllum demersum*. In 2001, *Myriophyllum spicatum* (Eurasian watermilfoil) again became the dominant with *Potamogeton. crispus* as sub-dominant. In 2005, C*eratophyllum. demersum* was again the dominant species with *Myriophyllum. spicatum* the sub-dominant.

Aquatic plants occur throughout Mason Lake, colonizing about 700-acres (82%) of the lake and 91% of the sampling sites. The percentage of vegetated sites has been high in all depth zones and all years. The highest percentage of vegetated sites was in 1992, the lowest in 2005. The highest total occurrence of aquatic plant growth was in 2001; the lowest total occurrence was in 1992 and 2005. The depth zone with the highest total occurrence of plants has been the 1.5-5 ft. depth zone. Total occurrence of plants has been very similar over the years.

Myriophyllum spicatum was the dominant species in 1992 and dominated at depths greater than 1.5 feet. *Myriophyllum. spicatum* declined in 1998, but increased again in 2001, becoming the dominant species again, this time dominating depths greater than 5 feet deep. *Myriophyllum spicatum* declined again in 2005 to its lowest frequency. The frequency and density of *Myriophyllum spicatum* has increased with increasing depth and may likely be due to the winter drawdowns that control this species in the shallow water areas.

Potamogeton pectinatus, (sago pondweed) appears to be becoming more abundant in Lake Mason, perhaps due to the winter drawdowns favoring it. Both the frequency and density of *Potamogeton pectinatus* have increased and decreased from one survey year to the next, with an increase in 2005. These cycles may be natural or may be determined by winter drawdowns.

The Coefficient of Community Similarity indicates the percent similarity between two communities; values less than 0.75 indicate the two communities are less than 75% and therefore significantly different. The Coefficients for Mason Lake indicate that the aquatic plant community in Mason Lake has changed significantly between some years. For example, the 1992 and 1998 aquatic plant communities were significantly different. However, the 1998 and 2001 communities were not significantly different. But then the plant community changed significantly again between 2001 and 2005. The accumulated change over the years of the various aquatic plant surveys have resulted in the present (2005) community being only 58% similar to the plant community in 1992. This means that only 58% of the community in 1992 has been retained in the 2005 community.

The number of species occurring at the sample sites**,** species richness, cover of emergent species and cover of floating-leaf lily pad specie all increased from 1992 to 2001 and then declined in 2005. The percentage of the littoral zone that is vegetated and coverage of submergent species has steadily decreased. The cover of emergent species has increased the most, more than doubling. The cover of submergent species has decreased the most (15% decrease). The coverage of free-floating species has varied up and down**,** as have the Average Coefficients of Conservatism and Floristic Quality Indices.

Simpson's Diversity Index has steadily increased from poor diversity in 1992 to good diversity in 2005. A Diversity index of 1.0 would mean that each individual in a community was a different species, the most diversity that could be found. The Aquatic Macrophyte Community Index (AMCI) developed for Wisconsin lakes (Nichols 2000) was applied to Mason Lake. The quality of the aquatic community in Mason Lake was in the lowest quartile for lakes in Wisconsin and in the North Central Hardwoods Region of the state in 1992. The quality increased to below average quality for lakes in the state in 1998-2001, although Mason Lake was still in the lowest quartile of lakes in the region. The quality dropped again in 2005 to the lowest quartile of lakes in the state and region. This indicates that Mason Lake is with in the group of lakes in the state and region with the lowest quality aquatic plant community.

Figure 37: Changes in the Macrophyte Community; Mason Lake, 1992-2005.

					1992-2005	
	1992	1998	2001	2005	Change	%Change
Number of Species	16	20	25	19	3.0	18.8%
Maximum Rooting Depth	8.0	9.0	8.0	7.0	-1.0	-12.5%
% of Littoral Zone Vegetated	100	93	93	91	-0.1	-9.0%
AMCI Index	39	46	45	42	3.0	7.7%
%Sites/Emergents	5	6	13	11	6.0	120.0%
%Sites/Free-floating	62	75	50	76	14.0	22.6%
%Sites/Submergents	99	92	91	84	-15.0	-15.2%
%Sites/Floating-leaf		1	3	0	0.0	
Species Richness	3.13	3.49	3.6	3.16	0.0	1.0%
Simpson's Diversity Index	0.84	0.86	0.87	0.89	0.1	6.0%
Average Coefficient of Conserv.	4.07	4.68	4.32	4.41	0.3	8.4%
Floristic Quality	15.75	20.42	20.25	18.19	2.4	15.5%

Figure 38: Aquatic Macrophyte Community Index Values for Mason Lake, 1992-2005.

	1992	1998	2001	2005
Maximum Rooting Depth	3	4	3	3
% Littoral Zone Vegetated	10	10	10	10
Simpson's Diversity Index	6	7	7	8
Relative Frequency of Submersed Species	9	9	9	6
Relative Frequency of Sensitive Species	1	5	5	4
Relative Frequency of Exotic Species	2	2	2	3
# of Taxa	8	9	9	8
Total	39	46	45	42

The maximum value is 70

The Average Coefficient of Conservatism for the Mason Lake aquatic plant community has always been in the lowest quartile for all Wisconsin lakes and lakes in the North Central Hardwood Region. This suggests that the plant community in Mason Lake is among the 25% of lakes most tolerant of disturbance, probably the result of being subjected to ongoing significant disturbance. Although the Average Coefficient has remained in the lowest quartile, it has increased slightly, suggesting a slight decrease in disturbance tolerance.

Figure 39: Floristic Quality and Coefficient of Conservatism of Mason Lake, Compared to Wisconsin Lakes and Region Lakes, 1992-2005.

	Average Coefficient of Conservatism†	Floristic Quality‡	Based on Relative Frequency	Based on Dominance Value
Wisconsin Lakes	5.5, 6.0, 6.9*	16.9, 22.2, 27.5*		
NCHF	5.2, 5.6, 5.8*	17.0, 20.9, 24.4*		
1992	4.07	15.75	11.36	11.08
1998	4.68	20.42	12.38	11.55
2001	4.32	20.25	12.21	11.26
2005	4.41	18.19	14.83	15.21

* Values indicate the highest value of the lowest quartile, the mean, the lowest value of the upper quartile

†Average Coefficient of Conservatism for all Wisconsin lakes ranged from a low of 2.0 (most tolerant of disturbance) to a high of 9.5 (least disturbance tolerant).

‡lowest Floristic Quality was 3.0 (farthest from an undisturbed condition) and the high was 44.6 (closest to an undisturbed condition)

The Floristic Quality of the plant community in Mason Lake was in the lowest quartile of Wisconsin lakes and Northern Central Hardwood lakes in 1992. In 1998 - 2005, the Floristic Quality increased to below average for both Wisconsin lakes and Region Lakes. This indicates that the plant community in Mason Lake was farther from an undisturbed condition than the average lake in the state and region.

These values were based only on the occurrence of disturbance tolerant or intolerant species and did not take into consideration the frequency or dominance of these tolerant or intolerant species in the community. The Floristic Quality was recalculated, weighting each species coefficient with its relative frequency and dominance value. The recalculated values indicated something slightly different. The values suggest the aquatic plant community in Mason Lake was within the lowest quartile for all study years, and that Mason Lake has remained within the group of lakes in the state and region farthest from an undisturbed condition. Although the Floristic Quality has remained within the lowest quartile, the Index has increased slightly, suggesting slightly less disturbance.

Major disturbances in Mason Lake likely include past broad-spectrum chemical treatments, boat traffic in the shallow basin, introduction of two exotic invasive aquatic plant species, winter drawdowns, shoreline development and very poor water clarity. Changes in the plant community are seen when there have been changes in the individual species within the community. Many species have changed in frequency and density in Mason Lake during the study years.

Nine species have appeared and disappeared in various years, but these species occurred at only one or two sites. These species are likely uncommon species that are being missed when study sites shift slightly. Six new species have appeared since 1992: *Chara* spp. (muskgrass), *Lemna minor* (small duckweed), *Phalaris arundinacea* (reed canarygrass, an invasive), *Potamogeton nodusus* (long-leaf pondweed), *Potamogeton. richardsonii* (clasping-leaf pondweed) and *Spirodela polyrhiza* (greater duckweed). In addition to the newly appearing species, five other species have increased in frequency, density and dominance. *Elodea canadensis* (common waterweed) has increased the most, nearly 10-fold in frequency and 16-fold in density and dominance, increasing from a rarely occurring species to a common species. The frequency and density of *Elodea canadensis, Lemna minor* and *Spirodela polyrhiza* have increased steadily since 1992. Of the species that have increased or appeared since 1992, three-quarters of the species are species that are tolerant of lower water clarity and favor soft substrate. In addition, the presence of filamentous algae has increased dramatically and is abundant throughout the lake.

Three species have disappeared from the study sites since 1992: *Nitella* spp., *Potamogeton zosteriformis* and *Ranunculus longirostris.* Each of these species had been commonly occurring at one time. In addition to the species that have disappeared, three species have decreased in frequency, density and dominance, including the two exotic species *Myriophyllum spicatum* and *Potamogeton crispus*.

Plant growth in Mason Lake is favored by the high nutrients of its trophic state, the hard water, the dominance of rich sediments, the shallow depth of the lake and the very gradually sloped littoral zone. The predicted maximum rooting depth is nearly equal to the maximum depth of Mason Lake. This means that there is a potential for plant growth to colonize the entire basin. The very poor water clarity could limit aquatic plant growth.

Figure 40a: Emergent Aquatic Plants in Mason Lake (2005)

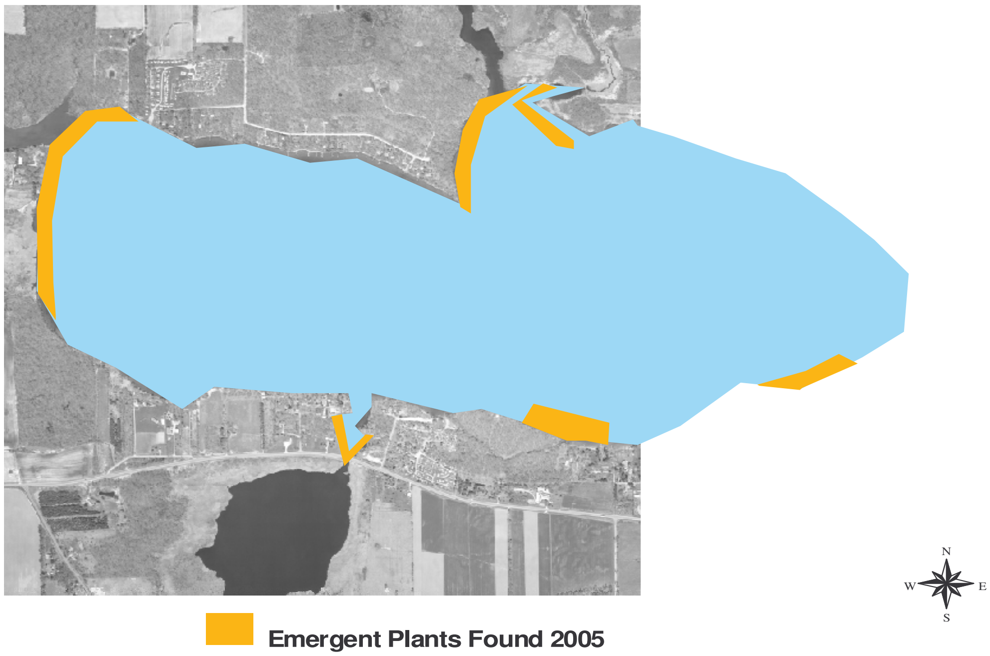

Figure 40b: Floating Aquatic Plants in Mason Lake (2005)

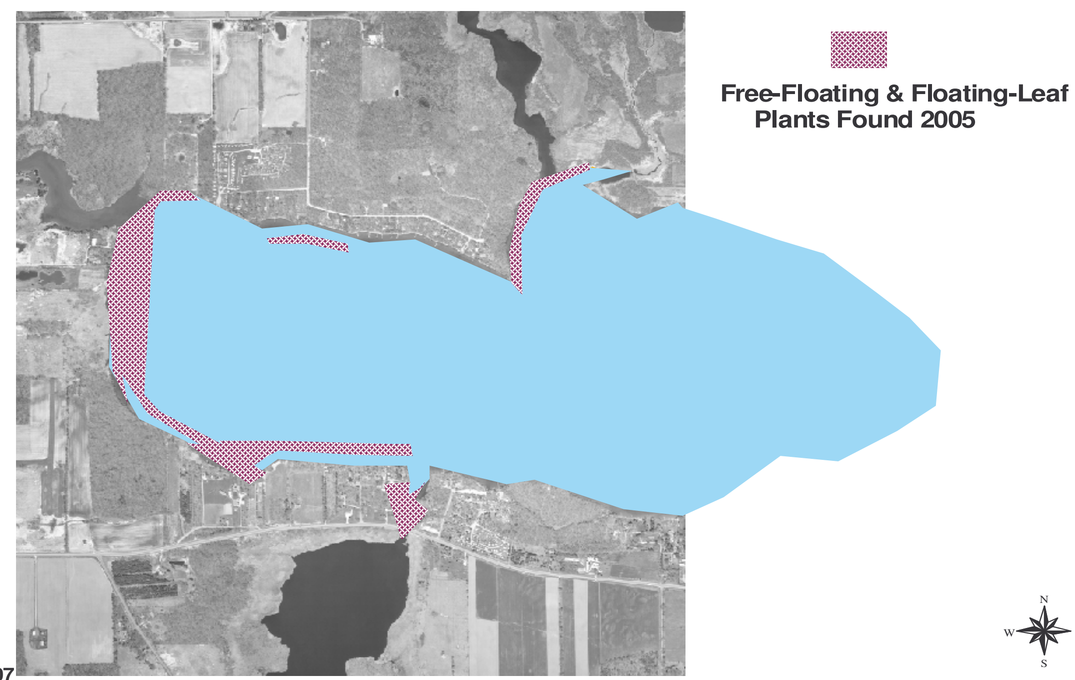

Figure 40c: Submergent Aquatic Plants in Mason Lake (2005)

Coontail and Eurasian watermilfoil can be limiting for habitat; when they occur as dense mats, fish movement is hindered. The two exotic species (Eurasian watermilfoil and curly-leaf pondweed) can limit the quality of the habitat in the lake when they become too dominant. Dense plant beds of exotic species do not provide a diverse habitat; this lack of diversity can not provide a variety of microhabitats to accommodate a variety of insect, fish and wildlife species. Curly-leaf pondweed adds an extra problem because it dies back early in the summer, removing habitat and allowing the decaying pondweed to release nutrients for algae growth, reducing water clarity.

As a shallow water resource, Mason Lake will always support plant growth throughout the lake. Two methods have been used in the past to manage the aquatic plant growth in Mason Lake: chemical treatments and winter drawdowns.

Chemical treatments were used in 1972-82 and 1990-2005. These chemicals were usually applied to almost the entire littoral zone and several channels across the lake. The drawbacks of chemical treatments are: (1) they leave the plant material in the lake to decay, adding nutrients and fertile sediment for increased algae and plant growth;

(2) copper added to control the algae will build up in the sediment, resulting in toxicity to portions of the aquatic food chain; (3) broad-spectrum chemical used in 1972-2000 non-selectively killed all plant species, facilitating the spread of the exotic species; (4) many invertebrates (food source for fish) are killed by aquatic herbicides.

Winter drawdowns were used in 1988-1995 and 1998-2005. The winter drawdowns in Mason Lake were conducted by drawing the lake down 1.5-4 feet to control drawdown sensitive species like Eurasian watermilfoil. Drawdowns of 1.5 feet could provide control up to depths of 3 feet; drawdowns of 4 feet could potentially provide control up to depths of 5.5 feet. The drawbacks of winter drawdowns are: (1) they are only somewhat selective, controlling all species that are sensitive to winter drawdown; (2) they only impact plant species up to a depth of about 3-5.5 feet, depending on the depth of the drawdown. In spite of the drawback to winter drawdowns, some improvements were seen in the aquatic plant community in Mason Lake in 1995, after seven years of winter drawdown. All of these improvements were reversed in the 1998 aquatic plant community after three years of no winter drawdowns (Konkel 2002). However, after 6 years of annual winter drawdowns, *Potamogeton pectinatus* appeared to be becoming more abundant in the shallow areas. *Potamogeton pectinatus* tolerates winter drawdowns, so the lake's annual drawdowns were likely favoring this species. It was decided that winter drawdowns should be conducted only once every 3 to 5 years in order to control Eurasian watermilfoil.

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Figure 41: Recorded Chemical Treatments in Mason Lake, 1972-2005.

	$CuSO_4$ (lbs.)	Cutrine (gal.)	Endothall	Diquat (gal.)	2,4-D
1972	700		50 lbs.	1	
1973	1000		10 gal.	4	
1974	750			9	
1975	550			20	
1976	750			25	
1977	440			40	
1978	625			39	
1979	650		5 gal. H*	42	
1980				46	
1981	250		30 gal.; 118gal. H		
1982		15	30 gal.; 5 gal. H		
1990		1			32 lbs.
1991		10	40 lbs.		30 lbs.
1992	100		17 gal.	14	8 gal.
1993	400		25 gal.	20	
1994			10.5 gal.	7	
1995		20	20 gal.	20	
1996	600		30 gal.	49.5	
1997	420		44 gal.	59	
1998		~50	~50 gal.	~50	
1999			55 gal.		1600 lbs
2000			49.25 gal.		1646 lbs
2001					1700 lbs
2003					320 gal
2004				65.09gal	1450#
2005			86.5 gal		360gal
Totals	7235 lbs.	96gal.	457.25 gal. & 90 lbs (128gal. H)	510gal.	6458 lbs. 688 gal.

* H = Hydrothol formulation of endothall more damaging to young fish

Figure 42: Winter Drawdowns on Mason Lake

	Winter	Depth of Drawdown
Two-year Permit	1988-1989	5 Feet
	1989-90	4 Feet
Five-year Permit	1990-91	4 Feet
	1991-92	4 Feet
	1992-93	4 Feet
	1993-94	4 Feet
	1994-95	4 Feet
Two-year Permit	1998-99	1.5 Feet
	1999-2000	1.5 Feet
Five-year Permit	2000-2001	1.5 Feet
	2001-2002	3.0 Feet
	2002-2003	
	2003-2004	
	2004-2005	

Changes in the aquatic plant community of Mason Lake, in 1992-2005, mostly attributed to the various aquatic control methods:

1) There was a slight decrease in coverage of vegetation in the 0-5 foot depth zone (in the zone impacted by drawdown).
2) There was a slight decrease in coverage of submerged plant growth.
3) There was decreased total occurrence and total density of plants.
4) The frequency, density and dominance of the two exotic, nuisance plant species, Eurasian watermilfoil and curly-leaf pondweed**,** have decreased.
5) There was increased quality of the plant community as measured by the Aquatic Macrophyte Community Index (AMCI).
6) There was increased diversity in the plant community seen in an increase in species richness, number of species and Simpson's Diversity Index.

7) There was an increase in coverage of emergent species. These species are valuable habitat species favored by winter drawdown. Seed germination is more effective on mud flats.
8) The number of species that exhibited a dense form of growth decreased from 5 in 1992 to none in 2005.
9) There was a slight decrease in disturbance as measured by the Floristic Quality Index and Average Coefficient of Conservatism.

Some of these changes such as decreased plant cover, decreased density of plants, decrease in exotic species and increase in emergent species are likely due to winter drawdown. Some changes may be due to poor water clarity. 75% of the species that have increased or newly appeared since 1992 are tolerant of poor water clarity and favor soft substrate. This includes the free-floating species: (coontail, lesser duckweed, greater duckweed and watermeal).

Decreased vegetation is not always an improvement in a lakes ecosystem, but since plant coverage greater than 85% is not ideal for fish habitat, a decrease in vegetation can be an improvement in Mason Lake.

In 1998 and 1999, the impacts of winter drawdown were compared to the impacts of selective chemical treatments (Konkel 2002). Both winter drawdown and selective chemical treatments resulted in increased disturbance to the aquatic plant community (FQIndex).

It was discovered that the winter drawdown resulted in a 3-14% decline in plant species diversity, but the selective chemical treatment resulted in a 30% decline in plant species diversity. The winter drawdown resulted in a decrease in the two exotic species and the three duckweed species while the selective chemical treatment resulted in an increase of one of the exotic species (curly-leaf pondweed) and a decrease in the other exotic species (Eurasian watermilfoil).

Large areas of the shoreline on Mason lake are disturbed (cultivated lawn, rip-rap and hard structures). Disturbed shoreline occurred at more than half of the sites and covered nearly half of the shoreline. Cultivated lawn was the dominant shoreline cover, with rip-rap and hard structures abundant. These types of disturbed shoreline can result in degraded water quality through increased run-off carrying added nutrients from lawn chemicals, soil erosion and pet waste. Mowed lawn, rip-rap and hard structures speed run-off to the lake without filtering out nutrients and impurities as natural shoreline would. To determine if there was a difference in the aquatic plant community at the sites with lawn, the aquatic plant transect sites of sites with 100% natural shoreline were compared to aquatic plant transect sites of shoreline that contained any amount of lawn or other disturbance.

The comparison of various parameters indicate that disturbance on the shore has impacted the aquatic plant community at those sites in Mason Lake. The number of species recorded at natural shoreline sites was greater, the Simpson's diversity Index was higher and species richness (mean number of species per site) was higher at natural shoreline. Species Richness was higher overall and at all depth zones at natural shore sites. Greater diversity in the plant community will support greater diversity in the fish and wildlife community.

Another indicator of better habitat at natural shore aquatic plant communities is that the colonization of emergent species is higher at natural shoreline communities. Emergent vegetation is very important habitat structure for fish spawning and wildlife resources.

Disturbed shoreline does appear to be creating a better habitat for one species – Eurasian watermilfoil. The frequency of occurrence of this exotic invasive species is higher at disturbed shoreline. This suggests that disturbance on the shore is providing a more ideal condition for the colonization and spread of exotic species.

Figure 43: Disturbed Shoreline Sites.

Parameter		Natural Shoreline	Disturbed Shoreline
Simpson's Diversity Index		0.920	0.872
Number of species		17	16
Species Richness	Overall	3.85	2.96
	0-1.5ft	3.62	2.61
	1.5-5 ft	3.62	3.17
	5-10ft	4.75	3.11
Eurasian watermilfoil	Frequency	35%	46%
	Density where present	1.33	3.00
Important habitat	Emergent species	33%	6%

Recommendations to Mason Lake District and Lake Residents for Aquatic Plant Management

1) **Continue winter drawdowns on a decreased frequency of drawdown**. This method has been shown to reduce the two exotic plant species in the zone impacted by drawdown and reduce overall plant density to some extent. When compared with selective chemical treatments, winter drawdown had a less severe impact on species diversity and was more successful in controlling both exotic species and opening up areas in the dense vegetation beds. However, winter drawdowns could not have an impact on vegetation in the deeper portions of the lake. Eurasian watermilfoil and curly-leaf pondweed show a lower frequency and density in the shallow water that is impacted by winter drawdown.

2) **Decrease frequency of winter drawdowns to once every 3 to 5 years.** Some species that tolerate winter drawdowns appear to be increased and may be favored by the annual drawdowns. Less frequent drawdowns can control Eurasian water milfoil without encouraging increased abundance of drawdown tolerant species

3) **Limit broad spectrum chemical treatments**. The earlier chemical treatments that were not selective for the exotic nuisance-causing species. Ironically, this promoted the spread of these nuisance-causing, exotic plant species. Future chemical treatments should be conducted to target the two non-native species: Eurasian watermilfoil and curly-leaf pondweed.

4) **Start a mechanical harvesting program**. This program should target the exotic species. Harvesting the exotic species will have short-term and long-term benefits.
    h. Harvesting curly-leaf pondweed in May has the potential to prevent the formation of the curly-leaf pondweed's turions (the source of the next year's curly leaf problem).
    i. May and June harvesting of curly-leaf will reduce the amount of curly-leaf decomposing in the lake, thus reducing nutrients released that feed summer algae blooms.
    j. Harvesting Eurasian watermilfoil just before it reaches the surface in May and June will reduce the vigor of this species and remove more nutrients.
    k. Harvesting through the summer will remove more nutrients in the plant biomass and keep navigation channels open for boat use and fishing.
    l. Cutting channels can modify the habitat by creating openings in the dense plant beds and increase the success of predatory fish, promoting a more balanced fish community.

m. Harvesting Eurasian watermilfoil in the late summer/fall will remove biomass before it autofragments to further its spread in the lake.
n. Harvesting removes plant material from the lake, unlike chemical treatments that allow the vegetation to decompose in place, consuming dissolved oxygen, releasing nutrients and further enriching the sediments.

5) **Establish a natural buffer zone of native vegetation around Mason Lake.** There is too much cultivated lawn, rip-rap and hard surfaces at the shoreline and not enough natural area to absorb nutrients, pesticides or toxics. Protecting the shoreline will improve water quality and increase wildlife habitat. Comparisons of the aquatic plant communities at natural and disturbed shoreline show that disturbed shoreline has impacted the habitat in the lake.
   a. Disturbed shore communities support a less diverse plant community that will support a less diverse fish and wildlife community.
   b. Disturbed shoreline supports much less emergent plant growth, an important component for wildilfe and fish habitat.
   c. Disturbed shore supported a higher frequency and density of Eurasian watermilfoil, providing a more ideal condition for its growth.

6) **Preserve and enhance wetlands in and around Mason Lake and in the watershed.** The wetlands are acting as filters that clean the water before it enters the lake. They also regulate the water flow so that there are not drastic changes in the water level of the lake.

7) **Cooperate with educational and other efforts** in the watershed to reduce nutrient and toxic run-off.

Elodea canadensis
(Common waterweed)

Figure 44: Some Common Native Aquatic Species in Mason Lake

Ceratophyllum demersum
(Coontail)

Chara **spp**
(**Muskgrass)**

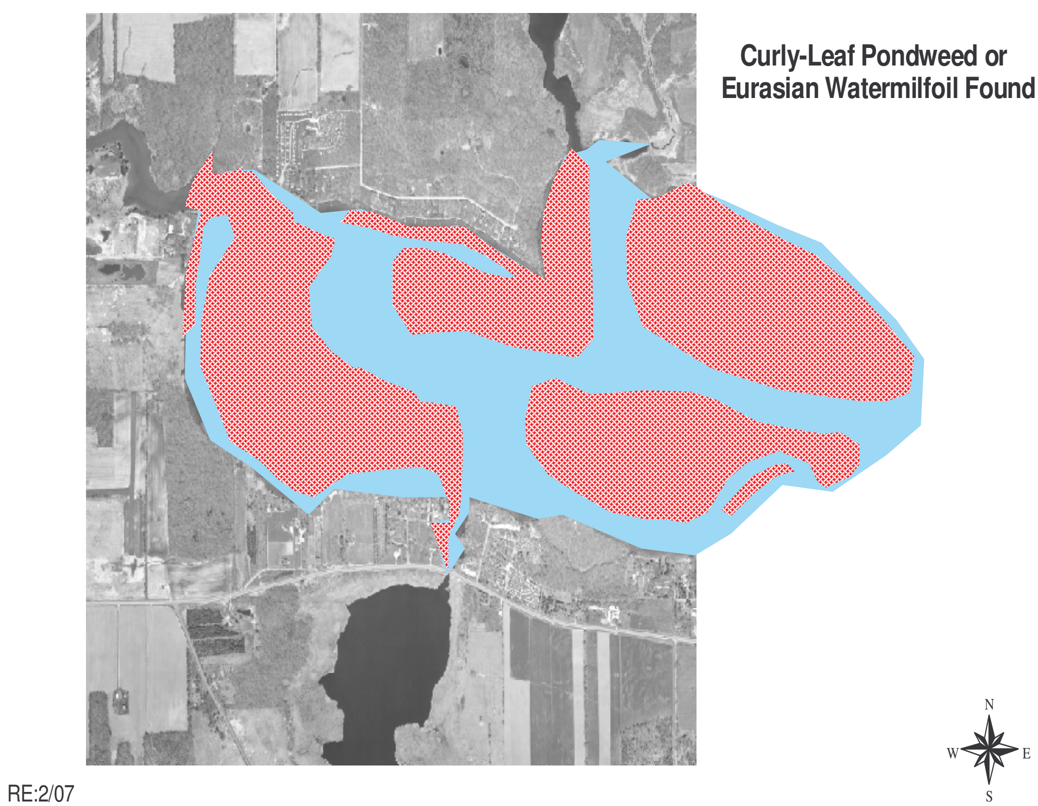
Myriophyllum sibircum
(Northern Watermilfoil)

Aquatic Invasives

Mason Lake has three known invasive aquatic plant species: Reed Canarygrass (emergent); Curly-Leaf Pondweed (submergent) and Eurasian Watermilfoil (submergent).Two species of aquatic invasive animals were also found: Rusty crayfish and carp. The lake gets a significant amount of transient boat traffic due to its location (right off a main highway) and several public boat ramps. Fishing pressure is heavy.

The Mason Lake District has drafted lake management plan that includes management of aquatic invasives, but that plan has not yet been approved by the WDNR. At this time, no regular invasive species monitoring is occurring, nor are members of the lake district involved in the Clean Boats, Clean Waters boater education program.

Figure 45: Distribution of Exotic Aquatic Plants in 2005



Myriophyllum spicatum
(Eurasian Watermilfoil)

Phalaris arundinacea
(Reed Canarygrass)

Figure 46: The Three Invasive Aquatic Plants in Mason Lake

Potamogeton crispus
(Curly-Leaf Pondweed)

Critical Habitat

Designation of critical habitat areas within lakes provides a holistic approach for assessing the ecosystem and for protecting those areas in and near a lake that are important for preserving the qualities of the lake. Wisconsin Rule 107.05(3)(i)(I) defines a "critical habitat areas" as: "areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes.

Protection of critical habitat areas must include protecting the shore area plant community, often by buffers of native vegetation that absorb or filter nutrient & stormwater runoff, prevent shore erosion, maintain water temperature and provide important native habitat. Buffers can serve not only as habitats themselves, but may also provide corridors for species moving along the shore.

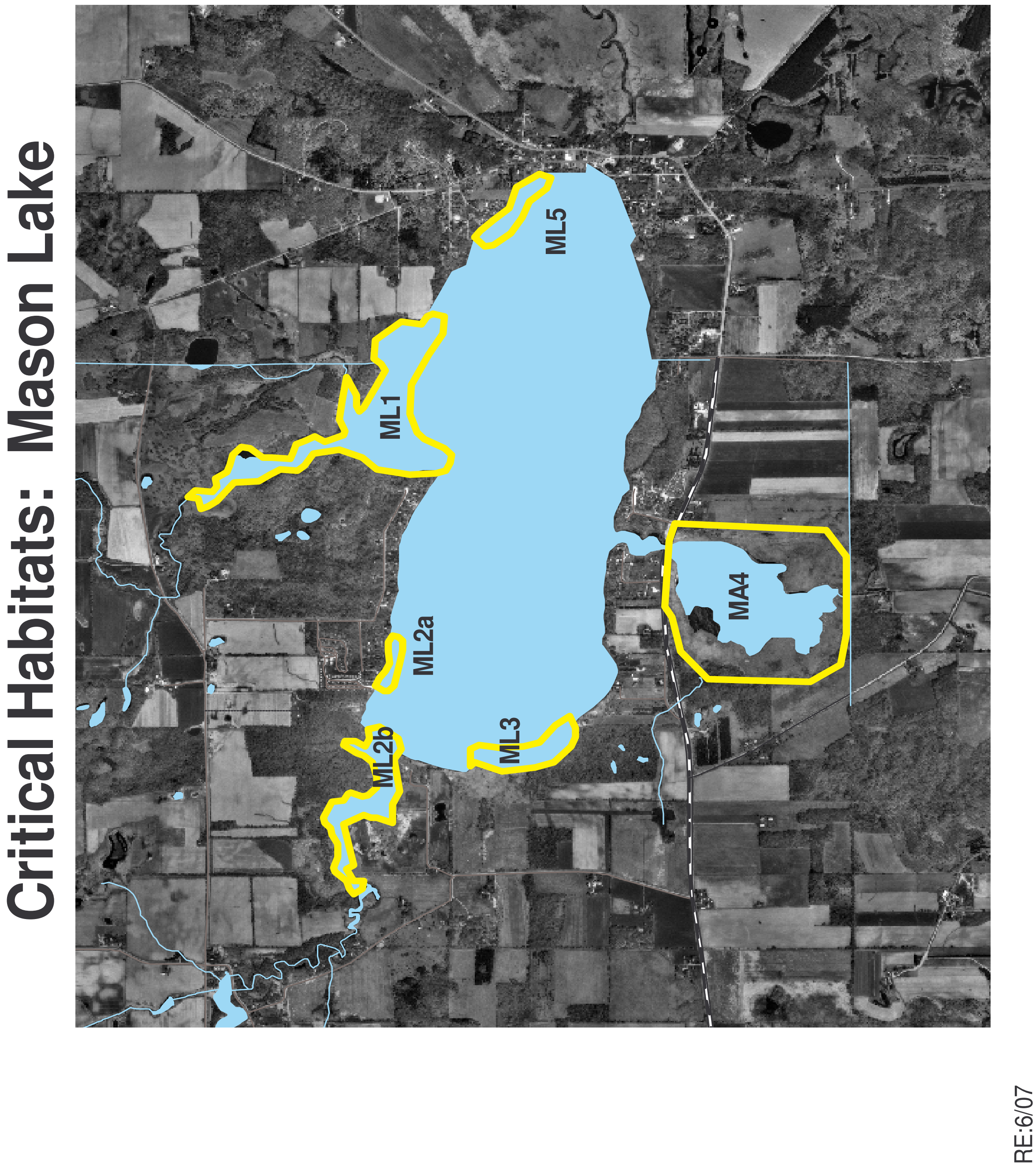
Besides protecting the landward shore areas, preserving the littoral (shallow) zone and its plant communities not only provides essential habitat for fish, wildlife, and the invertebrates that feed on them, but also provides further erosion protection and water quality protection.

Field work for a critical habitat area study was performed on September 29, 2003, on Mason Lake. The study team included: Scot Ironside, DNR Fish Biologist; Deborah Konkel, DNR Aquatic Plant Specialist; Buzz Sorge, DNR Lakes Manager; and Gregg Breese, DNR Aquatic Habitat Expert. Areas were identified visually. Five areas on Mason Lake were determined to be appropriate for critical habitat designation.

Critical Habitat Area ML1

ML1 extends along approximately 4000 feet of shore in Burn's Cove and up into the stream, up to the ordinary high water mark. Fallen woody material is common in the shallow zone for habitat. 9 emergent aquatic plant species were found here. Emergent vegetation protects the shoreline, as well as providing important food sources and cover for fish and wildlife and fish spawning habitat. Two species of free-floating plants were also found. At least 10 species of submergents were found, including the exotic invasives Eurasian watermilfoil and Curly-Leaf pondweed. *Chara* spp., a macrophytic alga, was also present at this site. Filamentous algae were present. Wetlands are also present around the mouth of this cove. Several fish spawning areas were also noted for species such as northern pike, largemouth bass, bluegill, pumpkinseed, crappie, bullhead and yellow perch. The area also provides nursery, feeding sites and covers for these fish. Carp and rusty crayfish, both invasive species, were also present at this site.

Figure 47: Critical Habitat Areas on Mason Lake



Critical Habitat Area ML2

ML2a extends along 800 feet of shore and supports near-shore terrestrial habitat. The shoreline is wooded, with both tree and shrub growth sandwiched between cottage development. Large woody debris is abundant in the shallows. No emergents were found here. Two species of free-floating aquatic plants were present, as well as five species of native submergent plants. Also found were the invasive aquatic plants, Eurasian watermilfoil and Curly-leaf pondweed, and the invasive aquatic animals, rusty crayfish and carp. Filamentous algae were abundant. The area provides spawning, nursery, and feeding sites for fish, as well as cover.

ML2b covers 800 feet of shore at the mouth of the Big Spring tributary, averaging 2 feet in depth. It provides near-shore terrestrial, shoreline and shallow water habitats. The shore is entirely wooded, with small areas of shrubs and herbaceous plant growth. Wetland areas here contain emergent herbaceous wetlands and shallow open water wetlands. Fallen woody debris is present in the shallows. The area provides both visual and audio buffers and is a unique area of scenic beauty for lake residents and visitors. Several species of emergent aquatic plant growth were found, as well as one species of floating-leaf rooted plant and two species of free-floating aquatic plants. At least 8 submergent aquatic plants were present. Exotic invasive noted were Eurasian watermilfoil, Curly-leaf pondweed, Reed canarygrass, rusty crayfish and carp. Filamentous algae were abundant. The area provides spawning, nursery, and feeding sites for fish, as well as cover. This area is important for protecting the water quality of Mason Lake, as it is one of the stream inlet water sources for the lake.

Critical Habitat Area ML3

This sensitive area covers 2000 feet of shore along the west side of Mason Lake, averaging 2 feet in depth. It provides shoreline and near-shore terrestrial habitat. About half the shore is wooded, with the other half being emergent wetland. Large woody cover is common in the wooded area, and sparser in the wetland area. The area serves as a visual and audio buffer, as well as an area of scenic beauty. At least 8 species of aquatic emergent plants were noted, as well as 3 species of free-floating aquatic plants. 9 native submergent aquatic plants were present. The macrophytic algae *Chara* spp (muskgrass) was also found here. Aquatic invasives present included Reed canarygrass, Eurasian watermilfoil, Curly-Leaf Pondweed, rusty crayfish and carp. Filamentous algae were common. The area provides spawning, nursery, and feeding sites for fish, as well as cover.

Critical Habitat Area ML4

ML4 covers Amey's Pond, an approximately 60-acre wetland south of Highway 23, averaging 3 feet in depth, with near-shore terrestrial, shoreline and shallow water habitat. This area is jointly managed by the Wisconsin Department of Natural Resources and Ducks Unlimited as a waterfowl preserve. The area is recognized as very important waterfowl habitat. The entire shore is an emergent shallow water marsh, with deep water marsh found in the pond itself. 3 species of emergent aquatic plants were found, as well as one floating-leaf rooted plant and 3 free-floating plants. At least 6 native species of submergents were present. Aquatic invasives present were Eurasian watermilfoil, Curly-leaf pondweed, rusty crayfish and carp. Filamentous algae were abundant. There was large woody cover along some of the shoreline. The area provides spawning, nursery, and feeding sites for fish, as well as cover.

Critical Habitat Area ML5

This area extends along 1000 feet of shoreline and supports important spawning habitat. The shore is 75% developed, 20% wooded and 5% native shrub and herbaceous growth. Only one species of emergent aquatic plants was present. At least 7 species of submergent plants were noted. Exotic invasive aquatic plants found were Eurasian watermilfoil and Curly-leaf pondweed.

Figure 48: ***Orconectes rusticus*** **(rusty crayfish)**

Critical Habitat Recommendations

(1) Maintain current habitat for fish and wildlife.
(2) Maintain snag, cavity and fallen trees along the shore for nesting & habitat.
(3) No alteration of littoral zone unless to improve spawning habitat.
(4) Seasonal protection of spawning habitat.
(5) Maintain any snag/cavity trees for nesting.
(6) Install nest boxes.
(7) Maintain corridor and restore natural shoreline vegetations where cleared to increase wildlife corridor.
(8) Designate critical habitat areas as no-wake lake areas.
(9) Protect emergent vegetation with no removal of emergent vegetation.
(10) No removal of submergent and floating-leaf vegetation. Minimize aquatic plant and shore plant removal to maximum 30' wide viewing/access corridor and navigation purposes. Leave as much vegetation as possible to protect water quality and habitat.
(11) Seasonal control of Eurasian Watermilfoil and other invasives with methods selective for control of exotics.
(12) Use winter drawdown for EWM control no more frequently than every 3 to 5 years, with drawdown occurring before October 1.
(13) Continue mechanical harvesting, thus removing some of the phosphorus from the lake.
(14) Use best management practices.
(15) No use of lawn products, including fertilizers, herbicides & other chemicals.
(16) No bank grading or grading of adjacent land.
(17) No pier placement, boat landings, development or other shoreline disturbance in the shore area of the wetland corridor.
(18) No pier construction or other activity except by permit using a case-by-case evaluation and only using light-penetrating materials.
(19) No installation of pea gravel or sand blankets.
(20) Install bank restoration in highly eroded areas. Otherwise, permit no bank restoration unless the erosion index scores moderate or high. Use bioengineering practices only, but not rock riprap, retaining walls or other hard armoring.
(21) No placement of swimming rafts or other recreational floating devices.
(22) Maintain aquatic vegetation buffer in undisturbed condition for wildlife habitat, fish use and water quality protection.
(23) Post exotic species information at public boat landing.
(24) Permit no dredging except for a single channel for navigation.
(25) Investigate making the far east end of the lake a conservancy or purchasing an easement to maintain its mostly undisturbed state.

FISHERY/WILDLIFE/ENDANGERED RESOURCES

WDNR stocking records for Mason Lake date back to the 1950's, when northern pike, walleye, bluegills, black crappie, white crappie and largemouth bass were stocked. There were large restockings of the lake in 1971 and 1972 after a chemical kill of fish in 1970 to rid the lake of carp. Rough fish removal in the tons started in the 1930s. The most recent fish inventory revealed that bluegills were abundant; black crappie, largemouth bass and yellow perch were common; but northern pike and green sunfish were scarce. Pumpkinseeds have also been found in Mason Lake.

Muskrat are known to use Mason Lake shores for cover, reproduction and feeding. Seen during the field survey were various types of waterfowl and songbirds. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Upland wildlife feed and nest here as well.

The Mason Lake surface watershed is reported to contain several endangered resources. Special natural communities in this watershed include northern sedge meadow, spring & pond runs (hard) and spring pond. Threatened wildlife include *Fundulus diaphanous* (banded killifish), *Tyto alba* (barn owl), and *Notropis texanus* (weed shiner fish). Two plant species, *Gentianopsis virgata* (lesser fringed gentian) and *Deschampsis caepitosa* (tufted hairgrass) have also been reported. Wild rice beds used to be found in Mason Lake as well.

Tufted Hairgrass

Figure 49: Some of the Endangered Resources in Mason Lake Watershed

Barn Owl

Weed Shiner

*information courtesy of Wisconsin Department of Natural Resources

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