LAKE CLASSIFICATION SHORT REPORT ON PEPPERMILL LAKE, ADAMS COUNTY, WI

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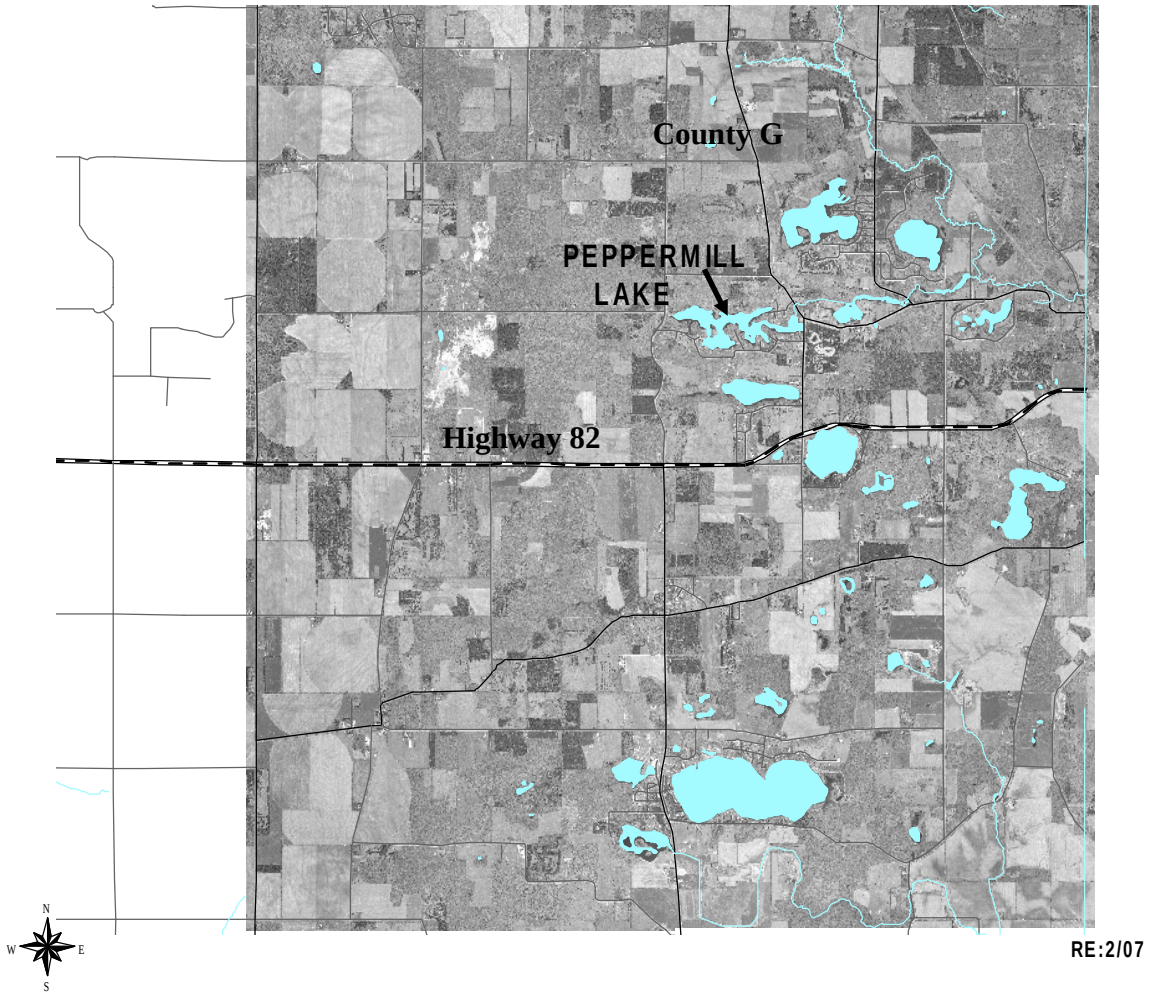
Introduction

Information about Peppermill Lake: Peppermill Lake is located in the Town of Jackson, Adams County, WI, in the south central part of Wisconsin. It is reached off of County G as it goes south. Peppermill Lake is a mesotrophic impoundment with good to very good water quality and very good water clarity. It has 65 surface acres, with a maximum depth of 14 feet and an average depth about 6 feet. Peppermill Lake is at the head of a stream subsystem that flows eventually into the Fox River and Lake Michigan. There is a public boat ramp on the northeast end of the lake owned by the Town of Jackson. The dam is owned and maintained by Adams County.



Land Use

Both the surface and ground watersheds of Peppermill Lake are fairly small. The ground watershed extends north and west of the lake. Studies have shown that lakes are products of their watersheds. Land use in a watershed has a great impact on the water quality of its lake, especially in the amount and content of stormwater runoff from the surface. 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 amounts.

Land use acres and percent of total are shown on the chart below:

	Surface		**Ground**		**Total**	
Peppermill Lake	**Acres**	**% of Total**	**Acres**	**% of Total**	**Acres**	**% of Total**
Agriculture--Non Irrigated	97.51	9.31%	300.12	18.26%	397.63	14.77%
Agriculture--Irrigated	0	0.00%	214.39	13.04%	214.39	7.97%
Government	0	0.00%	45.2	2.75%	45.2	1.68%
Grassland/Pasture	0	0.00%	7.89	0.48%	7.89	0.29%
Residential	391.56	37.38%	233.21	14.19%	624.77	23.22%
Water	65.9	6.29%	0	0.00%	65.9	2.45%
Woodland	492.6	47.02%	842.77	51.28%	1335.37	49.62%
total	1047.57	100.00%	1643.58	100.00%	2691.15	100.00%

Woodlands are the largest land use category in the surface watershed and contribute less than 10% of phosphorus entering Peppermill Lake waters. Since forest floors are often full of leaves, needles and other duff, runoff from forested lands is may be more filtered than that from agricultural or residential lands.

Residential land use is the second most common land use category in the Peppermill Lake surface watershed, especially around the lake itself, where residential land use is most concentrated. This land use category may contribute a significant amount of nutrients to the water from stormwater runoff, mowed lawns, and impervious surfaces.

Only 9.3% of the Peppermill Lake surface watershed is in agricultural use. Traditionally, agriculture may contribute significantly to the amount of nutrients in water.

The ground watershed land use is mainly of agricultural, woodland and residential use.

There are also wetlands in the Peppermill Lake watersheds. Most of the wetlands in the ground watershed are scattered, but those in the surface watershed are concentrated near the lake. Wetlands play an important role in water quality by trapping many pollutants in runoff waters and by serving 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 also serve as spaces for wildlife habitat, wildlife reproduction & nesting, and wildlife food.

The photo to the right shows one of the wetlands along Peppermill Lake's shore. It is essential to preserve the wetlands for the continued health of Peppermill Lake waters.

Some wetland area on Peppermill Lake

Like many lakes in Wisconsin, Peppermill Lake is a phosphorus-limited lake. This means that of the pollutants that end up in the lake, the one in the shortest supply and most affects the overall quality of the lake water is phosphorus. Land use types play a major role in determining the amount of phosphorus being loaded into the lake.

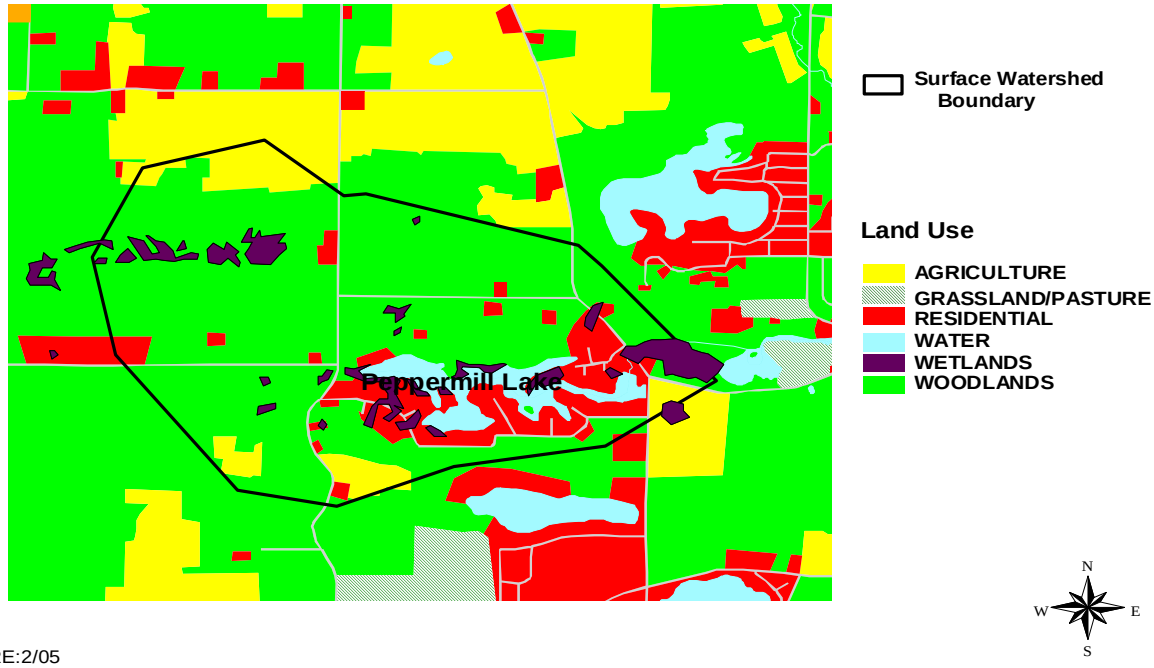
Some aspects of phosphorus loading can't be modified by human behavior—they are simply part of the natural landscape. However, phosphorus loading from agriculture, residential, recreational and septic use of the land can be decreased or increased.

MOST LIKELY CURRENT PHOSPHORUS LOADING		
Land Use	**% Loading**	**P in lbs /yr**
Non-Irrigated Agriculture	15.4%	35.20
Residential	22.8%	50.60
Woodlands	9.7%	22.00
Ground Watershed	32.3%	332.20
Lake Surface	3.8%	8.80
Septics	16.0%	36.30
	100.0%	485.10

Simply reducing the phosphorus output in these areas—agricultural, residential and septic—by 10% would result in 924.77 **fewer** pounds of phosphorus per year. While this initially may not sound like much, when it is considered that one pound of phosphorus may produce up to 500 pounds of phosphorus, a reduction of 924.77 pounds of phosphorus per year could result in 462,385 pounds **fewer** of algae per year!

Land Use	**P in lbs//yr**	-10%	-25%	-50%
Non-Irrigated Agriculture	35.20	31.68	26.40	17.60
Residential	50.60	45.54	37.95	25.30
Woodlands	22.00	22.00	22.00	22.00
Ground Watershed	332.20	298.98	249.15	166.10
Lake Surface	8.80	8.80	8.80	8.80
Septics	36.30	32.67	27.23	18.15
total in pounds/year	485.10	439.67	371.53	257.95

Land Use--Peppermill Lake Surface Watershed



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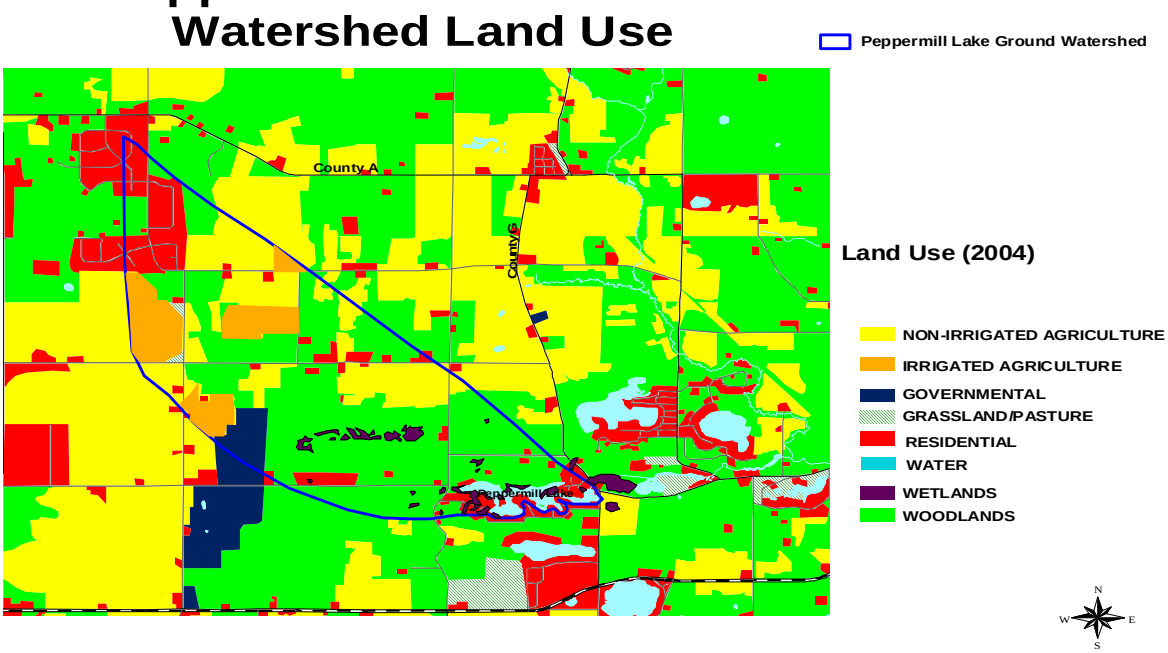
Peppermill Lake--Ground Watershed Land Use



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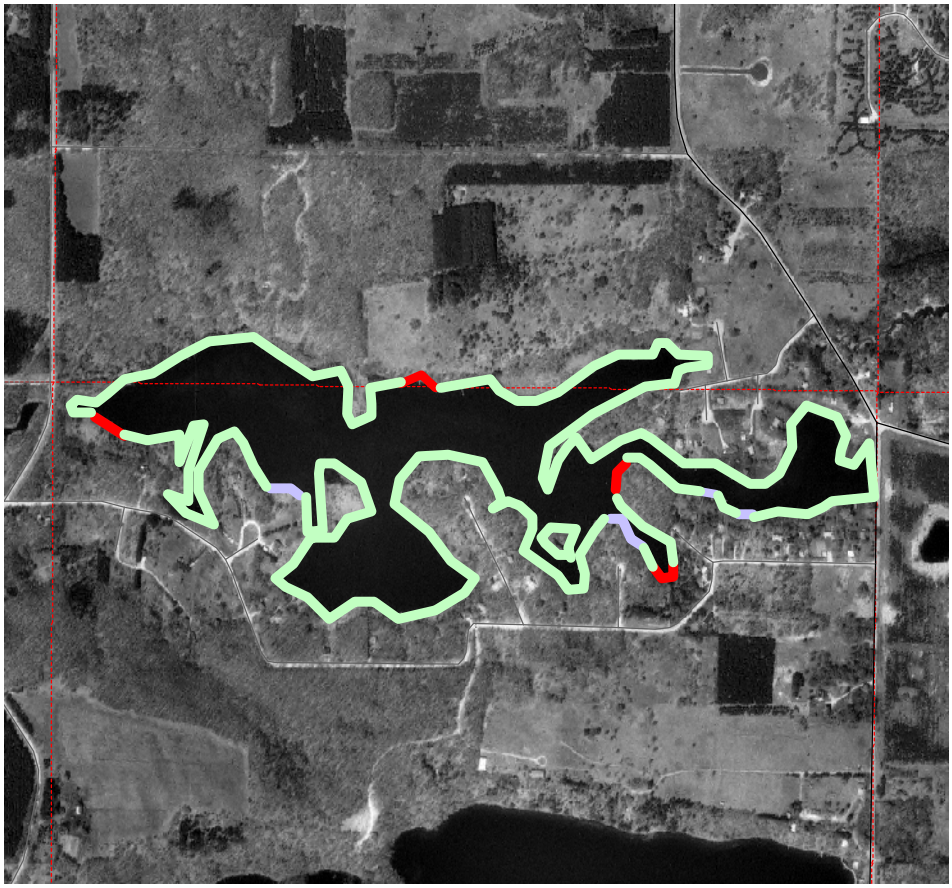
Shorelands

Peppermill Lake has a total shoreline of 4.4 miles (23,232 feet). Much of the northern shore of the western lobe of the lake has been left unaltered and contains some wetland areas. The rest of the lakeshore is in residential use. Residential concentration tends to vary in density, depending on the lobe of the lake and shore direction. Small parts of the shore are steeply sloped, but much of it is only gently sloped. Most of Peppermill Lake's shoreline is vegetated.

Peppermill Lake Shoreline



Active Erosion
Hard Structure
Vegetated Shore

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A 2004 shore survey showed that much of the shore had an “adequate buffer. As “adequate buffer” is a native vegetation strip at least 35 feet landward from the shore. Still, some 24% had inadequate buffers. Most of the “inadequate” buffer areas were those with mowed lawns and insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

Peppermill Lake Buffers

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Adequate Buffer

Inadequate Buffer

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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 by the Wisconsin Department of Natural Resources 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 filtering process and bank stabilization that buffers provide help improve or maintain a lake's water quality, including water clarity.

Example of Adequate Buffer

Example of Inadequate Buffer

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. A vegetated shore is especially important when shores are soft, as are many of the Peppermill Lake shores.

Water Quality Information

One of the measures Wisconsin uses to give a general estimate of a lake's water quality is the **trophic state index.** This index looks at a lake's water clarity, its amount of total phosphorus (the element most related to aquatic plant and algal growth), and its chlorophyll-a level (chlorophyll-a is a pigment used by algae for photosynthesis).

Depending on the trophic index score, lakes are then classified as **Oligotrophic** (good)**, Mesotrophic** (fair)**,** or **Eutrophic** (poor)**:**

- **Good:** Oligotrophic lakes have clear, deep water with few algal blooms. Larger game fish are often found in such lakes.
- **Fair:** Mesotrophic lakes have more aquatic plant and algae production, with occasional algal blooms and a good fishery. The water is usually not as clear as that of oligotrophic lakes.
- **Poor:** Eutrophic lakes are very productive, with lots of aquatic plants and algae. Algal blooms are often frequent in these lakes. They may have a diverse fishery, but rough fish (such as carp) are also common. Water is often cloudy or murky. Small shallow lakes are more likely to be eutrophic.

Peppermill Lake's overall TSI is 46

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

Water clarity readings are usually taken by using a Secchi disk (shown at right). Average summer Secchi disk clarity in Peppermill Lake in 2004-2006 was 9.2 feet. Secchi disk average from 1992-2006 is 9.8 feet. These are both in the "very good" clarity category. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water.

Increased phosphorus levels in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 summer average phosphorus concentration in Peppermill Lake was 28.03 micrograms/liter, in the "good" category for total phosphorus. The average TP level for impoundments in Wisconsin is 30 mg/l, so Peppermill Lake is slightly less than that. However, this reading is nearly twice the average reading for 1992-2002 of 15.38 micrograms/liter. Such a substantial change in phosphorus readings need to be addressed in the lake management plan. Phosphorus increases can be caused by sediment disturbance, increased nutrient runoff, and increased decay of organic matter in the lake.

The third measure used in trophic state classification is the amount of chlorophyll-a contained in the lake. The amount of chlorophyll-a found in a lake is an indication about the amount of algae in the lake. The 2004-2006 summer average chlorophyll-a concentration in Peppermill Lake was 4.98 micrograms/liter. This level of chlorophyll-a gives Peppermill Lake a "very good" ranking for chlorophyll-a (i.e., it's low). The average for 1992-2002 was 4.34 micrograms/liter, similar to the average for 2004-2006.

In-Lake Habitat

Aquatic Plants

A diverse aquatic plant community plays a vital role 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.

An updated aquatic plant survey was performed in 2006. The 0-1.5ft depth zone supported the most abundant aquatic plant growth. The Peppermill Lake aquatic plant community is characterized by high quality and excellent species diversity. *Chara* spp (muskgrass) and *Myriophyllum spicatum* (Eurasian watermilfoil, an invasive exotic) were the most common aquatic species.

Important to maintaining such a high quality, diverse aquatic plant community is an integrated aquatic plant management plant that controls the invasive plants in the lake. The most prevalent invasive exotic in Peppermill Lake is currently *Myriophyllum spicatum* (Eurasian watermilfoil).

Eurasian watermilfoil did not grow at a greater than average density in Peppermill Lake in 2006. All of the few species that grew at more than average density where present were native.

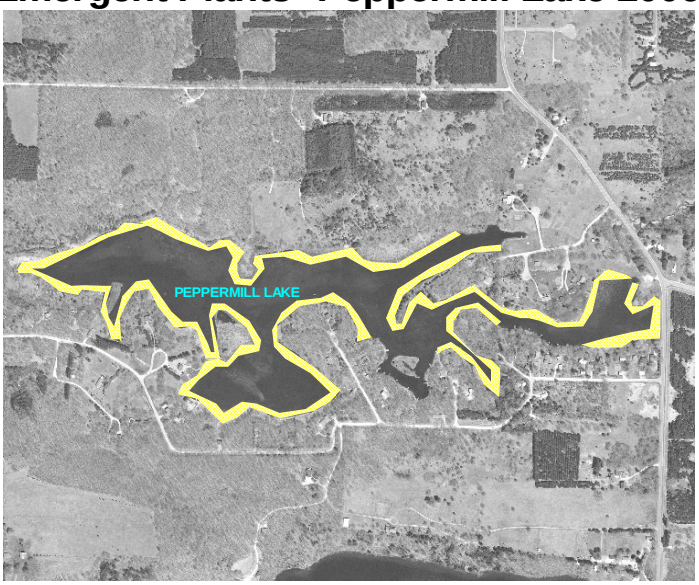
Visual surveys conducted on Peppermill Lake during the 2007 growing season suggested that the density and frequency of Eurasian Watermilfoil had increased over the past few years. Changes in the aquatic plant management regime are recommended.

Chara spp.

Eurasian Watermilfoil

More detailed information can be found in the aquatic plant report of the 2006 survey, available on request from the WDNR or Adams County Land & Water Conservation Department.

Emergent Plants--Peppermill Lake 2006



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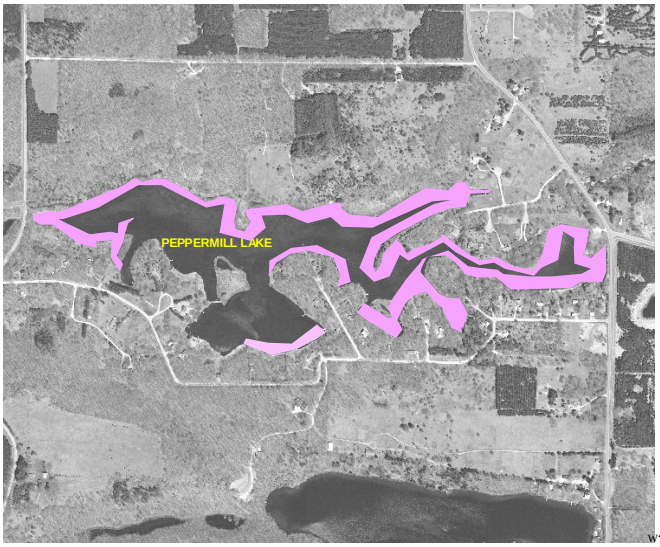
Emergent Aquatic Vegetation Found--2006

Floating Plants--Peppermill Lake 2006



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Floating Vegetation Found 2006

Submerged Plants---Peppermill Lake 2006

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Submerged Plants Found 2006

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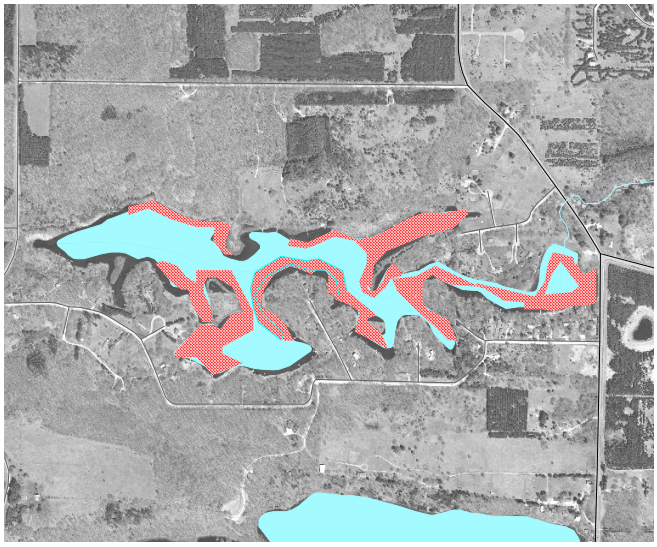
EWM in Peppermill Lake 2006



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Section Lines

EWM Found

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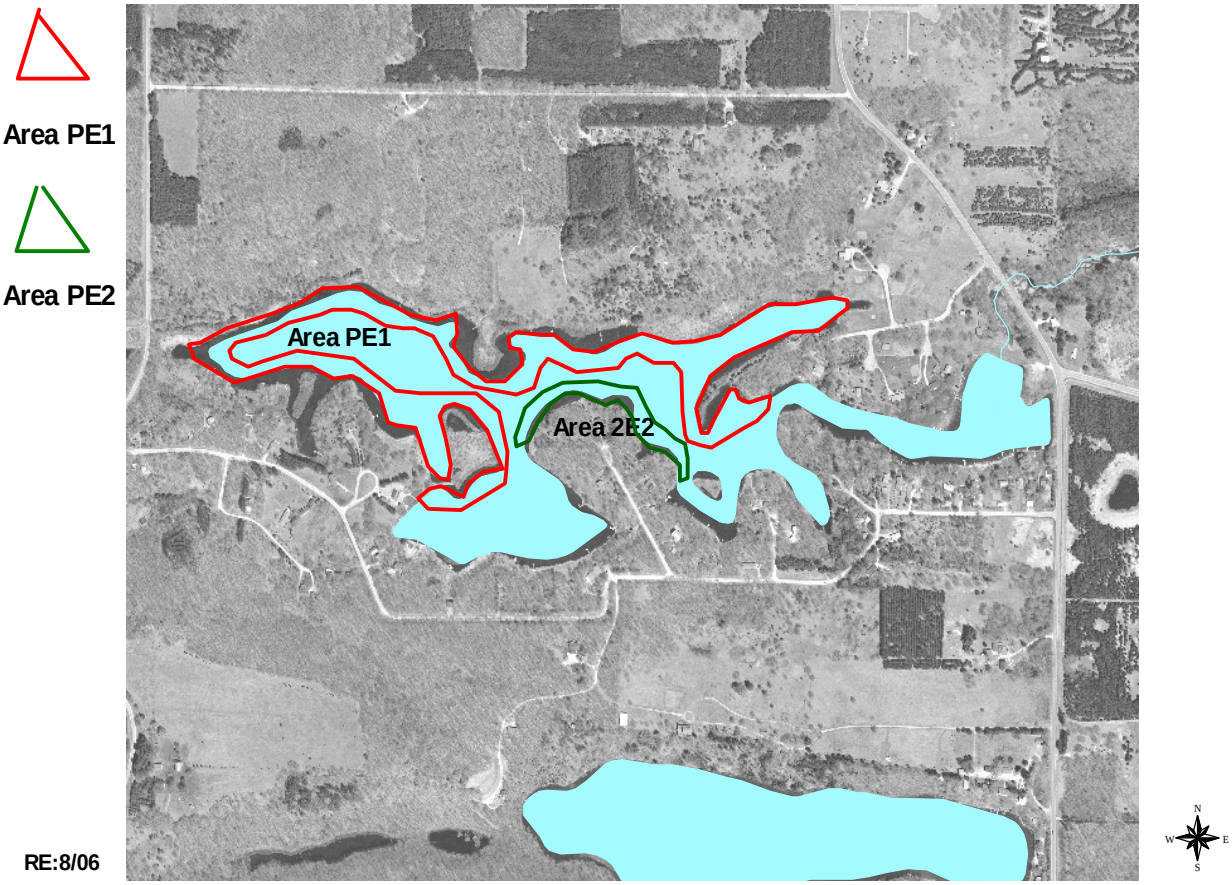
Critical Habitat

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 in the first place.

Critical Habitat Areas--Peppermill Lake



Two areas on Peppermill Lake were determined to be appropriate for critical habitat designation. PE1 extends along approximately 7000 feet of the northwest 2/3 shoreline of the lake, up to the ordinary high water mark. PE2 extends along approximately 800 feet in the middle of the southern shore.

Part of PE1

Part of PE2

The Critical Habitat Report for Peppermill Lake has more specific information on these sites. Copies are available from the Adams County Land & Water Conservation Department.

Fishery/Wildlife/Endangered Resources

WDNR fish stocking for Peppermill Lake occurred mainly in the 1990s and consisted of northern pike and largemouth bass. A fish inventory recorded in 1970 found that largemouth bass, bluegills, pumpkinseeds and white suckers were common, with northern pike and rock bass present. By 1999, bluegills were abundant, but had stunted growth. A threatened fish species, *Fundulus diaphanous* (red-banded killifish), was found in the lake in 1995. The most recent inventory, occurring in 2001, found that bluegills and yellow perch were abundant; crappie, green sunfish, largemouth bass, northern pike, pumpkinseed and rock bass were common; brown bullheads were scarce.

Muskrat are also known to use Peppermill Lake for cover, reproduction and feeding. Seen during the field survey were various types of waterfowl, songbirds, and turkey. 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.

Endangered resources reported in the Peppermill Lake watersheds include ***Anemone nemorosa*** (Early Anemone) and ***Plantanthera hookeri*** (Hooker's orchid).

Hooker's Orchid

Early Anemone

Recommendations

Lake Management Plan

- The lake management plan needs to include at least the following aspects concerning the management of the lake: aquatic species management; control/management of invasive species; wildlife and fishery management; nutrient budgeting; shoreland protection; critical habitat protection; water quality protection. The current plan does not include protection of critical habitat. This needs to be covered by a modification of the lake management plan.

Watershed Recommendations

- Since computer modeling results suggest that input of nutrients, especially phosphorus, are a factor that needs to be explored for Peppermill Lake, it is recommended that both the surface and ground watersheds be inventoried, 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, the Peppermill Lake District should encourage landowners and Adams County Land & Water Conservation Department to design and implement practices to address any issues.

Water Quality Recommendations

- All lake residents should practice best management on their lake properties, including keeping septic systems maintained in proper condition and pumped every three years, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.
- Reducing the amount of impervious surface around the lake and management of stormwater runoff will also help maintain water quality. This is especially important since computer modeling indicates that residential land use is a significant contributor to nutrient loading in the lake.
- Residents should continue involvement in the Citizen Lake Water Monitoring Program and become involved in the county program that includes water quality monitoring, invasive species monitoring and Clean Boats, Clean Waters.
- Lake residents should protect and restore natural shoreline around Peppermill Lake. Studies show that shore disturbance can negatively impact the aquatic plant community and water quality.
- Identify any failing septic systems around the lake or any not regularly pumped. Arrange for inspection and/or repair of any such systems.
- A phosphorus budget needs to be determined for the Peppermill Lake watersheds. The lake management plan should be modified to address steps to be taken to implement a phosphorus budget and steps to be taken to meet the reduction goals.

Aquatic Plant Recommendations

- All lake users should protect the aquatic plant community in Peppermill Lake by assisting in reviewing and implementing an integrated aquatic plant management plan that uses multiple methods of control. Based on the visual surveys in 2007, the aquatic plant management plan needs to be modified to address issues such as timing of chemical treatment and no arvesting in shallow areas, as well as others.
- The Lake District should maintain exotic species signs at the boat landings and contact DNR if the signs are missing or damaged.
- The Lake District should continue monitoring and control of Eurasian Watermilfoil maintain the most effective methods and modify if necessary. The Lake Association should investigate ways to increase treatment effectiveness in the deeper water. Residents may need to hand-pull scattered plants.
- A milfoil weevil survey was conducted on Peppermill Lake in 2007 in order to evaluate milfoil weevil availability for assistance in controlling the Eurasian Watermilfoil. The Lake District needs to decide if it is feasible to increase weevil reproduction in order to use weevils for part of EWM control.
- Shores with inadequate buffers need to restore the buffers to an adequate condition to provide winter habitat for the weevils, as well to assist in maintaining water quality.
- Lake residents should get involved in the county-sponsored Citizen Aquatic Invasive Species Monitoring Program. This will allow not only noting changes in the Eurasian Watermilfoil pattern, but also those for Curly-Leaf Pondweed and other invasives. Noting the presence and density of these species early is the best way to take preventive action to keep them from becoming a bigger problem.

Critical Habitat Recommendations

- Maintain current habitat for fish and wildlife and wildlife corridor.
- Leave fallen trees along shoreline & in water.
- Seasonal protection of spawning habitat. No disturbance of the littoral zone except that permitted for the viewing/access corridor or WDNR-approved projects.
- Maintain or install nest boxes.
- Seasonal control of exotics.
- No bank grading or grading of adjacent land.
- Maintain aquatic vegetation in undisturbed condition for wildlife habitat, fish use and water quality protection. Protect emergent vegetation.
- Maintain lake no-wake designation.