Peppermill Lake Management District (PLMD)

Lake Management Plan

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Executive Summary

The Lake Management Plan for Peppermill Lake should be considered a living document. The original plan, adopted in 2011, was created nine years after the first substantive lake study was completed in 2002. Version 2.0 of the lake management plan was drafted in 2016 and approved by the District Board in February 2017, but never was formally approved by Wisconsin Department of Natural Resources (DNR) staff. This document, Version 3.0 as it were, seeks to engage the next generation of leaders and residents with new tools as our lake ecosystem continues to change.

Peppermill Lake is an impoundment, a human-made body of water, that feeds into Peppermill Creek, which then connects to Neenah Creek, a Class I trout stream. All are part of the Neenah Creek Watershed (UF14) of the Upper Fox River Basin. Because it is an impoundment, the District has an obligation to find a balance between the ecosystem of the lake in its current configuration while understanding that, if left unattended, the area would likely return to its marshy origins leaving much of the lake difficult to navigate. Ninety-seven percent of the lake is in the littoral zone. Less than 20% of the residents are considered year-round, however during the warmer growing season when aquatic plants are present, there is considerable use of the lake by all residents and transient anglers as well. Aquatic plant management is needed for the more common recreational activities on Peppermill Lake.

In many respects, humans, fish, turtles, macrophytes, phytoplankton, etc., have all moved into a relatively newly modified aquatic ecosystem. While only 67-acres, it is home to 40+ aquatic plant varieties, several turtle species, largemouth bass, northern pike, yellow perch, assorted pan fish, sand hill cranes, Canadian geese, deer, foxes, beavers, muskrats, otters, mink, and a multitude of invertebrates, and is a verdant waystation for hundreds of migratory birds Approximately 100 parcels of land are interspersed with this rich population.

As a fledgling Lake District in 2002, the District saw itself as an isolated body of water. While the 2002 study did put Peppermill Lake in a larger ground watershed context, management practices have primarily just focused on the lake. The District now must look outward as well as inward. Farming practices, deforestation and other land use changes along with our own contributions, all effect the lake. The District must grapple with this reality as it still performs its normal management duties.

Peppermill Lake Management District (PLMD)'s management goals and objectives are designed to maintain and improve Peppermill Lake's ecological health and recreational appeal. In 2024 the district purchased a harvester to facilitate plant management. By focusing on aquatic invasive species (AIS) control, nutrient management, sustainable recreation, watershed impact, fisheries management, and community engagement, these goals aim to create a balanced and sustainable approach for managing the lake. The goals include:

1) Control Aquatic Invasive Species (AIS) and Improve Plant Management
2) Promote Sustainable Recreational Use and Public Access
3) Develop and Implement an Actionable and Measurable Nutrient Management Plan
4) Assess and Address Watershed and Ground-Watershed Impacts on Lake Health
5) Manage and Enhance the Fishery in Collaboration with the DNR
6) Strengthen Community Education and Engagement

Foundationally, the District wishes to contextualize its baseline data by refreshing the original 2002 study in order to determine if there are trends. We hope to include the following updated data at a minimum:

- Phosphorus load modeling
- Fish survey
- Aquatic Plant Survey
- Nitrogen load modeling (new)
- Dissolved oxygen monitoring (new) (including snow pack measurements)
- Septic management
- High-capacity well impact modeling (new)

Based on data collected through new studies, the District wishes to build a nutrient budget and plant management protocol which promote sustainable recreational use and improve the health of the lake. Current aquatic plant management methods primarily include mechanical harvesting and limited hand-pulling. Chemical treatment has not been used since 2007. Nutrient load analysis, to date, consists of rough estimates of tonnage removed combined with Soil and Plant Lab test results for Total P, Total N, etc.

Currently, the District has no rational way to compare nutrient removal to nutrient inputs.

Additionally, the District wishes to educate lake residents and other users of the lake to make everyone more aware of the interconnectedness of the waters above and below ground and how we as a district can maximize our stewardship role while still enjoying the beauty and the serenity of our community.

While The Peppermill Lake District is not heavily developed now, future land use is unpredictable. The District Board plans to educate its community on conservation easements as a tool for protecting the long-term health of the lake. Our residents continue to embrace good shoreline protection practices using buffers and tree-drops (fish sticks) but more work can be done encouraging the planting of native plants.

Since the recession of 2008, owner turnover has been significant on our lake, and best practices relating to fertilizer and invasive species control will always be ongoing. And recently, beavers, our original inhabitants, have returned, establishing three lodges. This has presented the Board with a new educational opportunity.

In keeping with the District mission to expand its understanding of its role in the environment and the community (natural, economic, political, and social), education needs to include outreach of relevant scientific knowledge to the community to give our residents a sense of the “whole”.

This plan is intended to be a living document that guides ongoing lake management decisions. The District will revisit priorities as needed and share periodic progress updates with the public through board meetings, annual meeting and other communication channels.

The Peppermill Lake Management Plan was approved the Wisconsin Department of Natural Resources on _____, 2025

The Peppermill Lake Management Plan was adopted by the Peppermill Lake Management District on _____, 2025

Peppermill Lake Management Plan

Peppermill Lake is a spring-fed impoundment, approximately 67 acres in size, located in the southeast corner of Adams County in the Town of Jackson, Wisconsin. It is a shallow lake with a trophic status ranging between mesotrophic to eutrophic. Supported in the past by 2 lake associations, popular support grew for the creation of a Lake District and in 2002, the Peppermill Lake Management District (PLMD) was formed. This document is the PLMD Lake Management Plan to maintain and improve the lake health and provide recreational activities. Peppermill Lake has one public landing (owned by the Town) and one dam (owned by the County) and is home to abundant aquatic plant varieties, turtles, blue gills, crappies, largemouth bass, northern pike, perch, and a robust Sandhill crane population. A more detailed history is found in the first Appendix.

Present Day Challenges, Goals and Key Actions

The mission of the PLMD Lake Management Plan: Maintain and Improve Peppermill Lake's Ecological Health and Recreational Opportunities.

Six primary goals are to be pursued through this Plan:

1) Control Aquatic Invasive Species (AIS) and Improve Plant Management
2) Promote Sustainable Recreational Use and Public Access
3) Develop and Implement an Actionable and Measurable Nutrient Management Plan
4) Assess and Address Watershed and Ground-Watershed Impacts on Lake Health
5) Manage and Enhance the Fishery in Collaboration with the DNR
6) Strengthen Community Education and Engagement

Goal 1: Control Aquatic Invasive Species (AIS) and Improve Plant Management

- **Objective**: **Effectively manage aquatic invasive species (AIS) and aquatic plants** to maintain and enhance the overall ecological health and sustainability of Peppermill Lake. Protect critical habitat areas and native plant biodiversity, ensuring good water quality, a healthy ecosystem, and high-quality recreational access and enjoyment.

- Key Actions:
    - **Emphasize routine, early detection of AIS** (beyond point-intercept surveys). Educate District members on basic ID of prohibited and restricted species and where to report. Adams County Land and Water Conservation Department (608) 339-4268. LWCD can help and can also support by doing "routine early detection surveys", be it a meander/snorkel survey, one-on-one landowner invite, or

stopping regularly to look at boat launch or County dam property (aka access sites) for anything suspicious.

- **Optimize Mechanical Harvesting:** Develop and regularly refine harvesting schedules, locations, and depths to control AIS and manage excessive aquatic plant growth, enhancing both water quality and overall lake ecosystem health, while simultaneously improving recreational navigation and usability. Utilize the District's own equipment to strategically align harvesting activities with peak recreational needs and ecological considerations. All mechanical harvesting activities will be conducted in accordance with the District's aquatic plant management permit issued by the Wisconsin DNR, which governs harvesting locations, timing, methods, and environmental protections. To promote transparency, the District will develop and share an annual Harvesting Operations Overview, outlining anticipated harvesting periods and focus areas. This overview will be shared via the District website, email list, or other appropriate channels before the start of each harvesting season. Monthly progress reports through the season will be provided.
- **Consider Hand-Pulling for Targeted Removal:** Review the consideration of hand-pulling in sensitive areas and near the shoreline where traditional harvesting may disrupt native species and stir sediments, releasing nutrients. This could be done by wading, swimming, snorkeling, or diving.
- **Minimize Fragmentation to Prevent Spread of Eurasian and Hybrid Water Milfoil (E/HWM) During Harvesting:** Use best practices to minimize the spread of AIS from harvesting activities.
- **Educate Lake Users on Preventive Measures:** Install AIS signage at public boat ramp and educate lake users on AIS prevention techniques. Provide AIS information to contractors (e.g. dock service providers, landscapers working on shoreline or riparian areas). Consider sharing a disinfection protocol for those contractors.
- **Investigate the use of Diver-Assisted-Harvesting.** Explore the feasibility and effectiveness of diver-assisted harvesting methods to enhance AIS control efforts.
- **Evaluate Future Management Options:** Despite historical chemical treatment being abandoned in our flow-through lake because of poor results, concerns that decaying plant matter would add to the nutrient load, and a reluctance in the community to use it when there are other options, chemical treatment might be desired in the future as technologies change. The District should continue to evaluate emerging aquatic-plant-management technologies, including chemical treatments, if they become ecologically viable and supported by the community, to ensure ongoing lake health and usability.
- **Promote and Regularly Review Critical Habitat Designation:** Educate lake residents and stakeholders about the Critical Habitat Designation, including its purpose, importance, and specific management recommendations. Regularly review and update critical habitat designation area and management strategies based on these recommendations to ensure they effectively support Peppermill Lake's ecological health and recreational opportunities.

Goal 2: Promote Sustainable Recreational Use and Public Access

Objective: Balance recreational opportunities and lake health by promoting responsible lake use and maintain boat ramp to support sustainable access.

Key Actions:

- **Support No-Wake Rules:** Add signage to support and collaborate with local authorities to promote compliance, protecting shorelines from erosion and promoting safe recreational conditions.
- **Promote Responsible Outdoor Lighting:** It should:
  Meet the needs of people to see at night
  Conserve energy
  Avoid harmful effects on wildlife
  Include useful, targeted, low-level, controlled, warm-colored lighting
- **Implement Seasonal "Quiet Zones" for Sensitive Times:** Implement voluntary quiet zones during key periods, such as fish spawning or bird nesting seasons, to protect wildlife while accommodating lake users.
- **Consider Emerging Technologies** to control AIS, such as dredging.
- **Install Educational Signage for Responsible Recreation:** Install clear, user-friendly signage at public boat ramp with guidelines for eco-friendly lake use.
- **Provide online (Website and Facebook) resources explaining best practices for lake users in critical habitat zones.** Use language that reflects DNR standards, educating users on how their actions contribute to lake stability and ecological health.
- **Develop a volunteer program to observe habitat health**, using simple DNR-aligned indicators like water clarity and shoreline stability. Regular monitoring allows for informed management and rapid response to emerging or urgent issues.
- **Provide an annual report summarizing habitat conditions, boundary conditions, and volunteer-led actions**: Distribute it via newsletters, meetings, and the Lake District's website. Clear, consistent communication helps the community understand the benefits and responsibilities of critical habitat protections.

Goal 3: Develop and Implement an Actionable and Measurable Nutrient Management Plan

Objective: Reduce nutrient inputs from phosphorus and nitrogen to improve water clarity, prevent algal blooms, and enhance aquatic habitats.

Key Actions:

- Recruit Volunteers or find funding for staff for the following actions: MOVE up above goals…
  - **Establish a Nutrient Budget and Track Key Indicators:** Determine baseline levels for phosphorus, nitrogen, and other key indicators, and monitor nutrient levels regularly to assess progress. Baseline nutrient levels will be informed by the 2023 Nutrient Budget and further refined through ongoing water quality monitoring in

partnership with UW-Stevens Point, Adams County Land and Water Conservation, and the Wisconsin DNR.

- **Encourage Shoreline Buffer Installation: S**upport lakefront owners in installing or enhancing vegetative buffers to absorb runoff and limit nutrient inflow.
- **Promote Septic System Maintenance: E**ducate residents on septic system upkeep to prevent nutrient leakage and offer workshops or resources on best practices.
- **Engage with Upstream Agricultural and Other Stakeholders:** Work with upstream landowners to prevent transition of forests to ag land, and to reduce nutrient runoff through practices like riparian buffers, cover cropping, and reduced fertilizer use.
- **Implement Recommendations from the Peppermill Lake Nutrient Budget Report** (prepared through surface water grant):

  Continue the Secchi depth, total phosphorus and chlorophyll measurements during the summer as these are useful ways to track changes to the suspended algal population;

  Consider adding nitrogen to the routine sampling such as sampling the outflow in the winter and the summer testing locations for nitrate/nitrite, total Kjeldahl, and ammonia;

  Continue to track the plant communities to identify if there are changes in the charophyte, pondweed and invasive populations;

  Develop a monitoring program to track the density of attached algae and filamentous algae clusters.

  Identify a nutrient budget for P and N in order to give guidance on harvesting best practices. A combination of modeling and data collection would be useful.

- **Supporting Information and Rationale:**
  - **Management Context:** The District has been managing its aquatic plant population since it was formed in 2002 but has limited data to evaluate the full impact of the initial chemical treatments, or more recent mechanical harvesting beyond the boating and swimming needs of stakeholders. Data was not collected to support modeling of increased phosphorus loading from decaying EWM after chemical treatment, nor were downstream water samples taken to measure 2,4-D impacts exiting the lake. At this time, the District primarily utilizes mechanical harvesting and needs a better understanding of how to optimize this approach and identify new techniques appropriate to Peppermill Lake.
  - **P and N Modeling Details:** The original 2002 study included first-attempt modeling of phosphorus (P) loading on the lake, but total nitrogen (N) should now be included. Inputs from agricultural land located within the ground watershed north of the lake must be measured. Toxic blue-green algal blooms which thrive on high P and N may become a threat. A nutrient budget for P and N is needed to give the best guidance on harvesting best practices.

    A protocol needs to be developed for our routine harvesting, to collect data on P and N and biomass tonnage removed. This will allow us to refine harvesting data analysis. As climate change adds greater variability to weather cycles, we will need better tools to control algae growth, encourage plant diversity and

manage the risk of extracting too much floral biomass through mechanical harvesting.

- **Winter Monitoring Details:** We propose recording percentage of lake covered by ice, and winter snow depth with dissolved oxygen readings (at three depths in the water column, at 4 locations on the lake and at least one location downstream of the dam). This will supplement water quality tests including Secchi and chlorophyll A and potentially others. Two years of dissolved oxygen data collected during previous winters needs to be analyzed.

Goal 4: Assess and Address Watershed and Ground-Watershed Impacts on Lake Health

Objective: Mitigate the impact of upstream land use, erosion, and groundwater on lake water quality and habitat health.

Key Actions:

- **Collaborate with Watershed Partners**: Engage with upstream landowners, and relevant local groups to promote practices that reduce nutrient loading to the groundwater. Local groups include Adams County Land and Water, Adams County Lake Association, any producer-led groups, Adams County Forest Initiative.
- **Conduct Land Use and Hydrological Studies:** Use GIS mapping and hydrological assessments to pinpoint high-risk areas for surface runoff and sediment influx.
- **Implement Erosion Control in High-Risk Zones**: Focus erosion control efforts on vulnerable areas using:
  Planting native vegetation
  Bioengineering - use of swales to capture rainwater runoff from roads and driveways and use of rain gardens to capture runoff from roofs and other impermeable surfaces
  Shoreline stabilization where necessary, preferably using tree drops/large woody debris and other bioengineering.
- **Community Education on Watershed Stewardship:** Raise awareness about the dynamic nature of healthy lakes and lakeshores, , emphasizing that adjacent land use (forest, lawn, fertilization, native planting, paving) impacts lake health
- **Private Well Testing: F**or residents of the District, the District will create an annual private well testing program.
- **Aquatic Plant Survey**: For aquatic invasive-species control, the District will work with LWCD to conduct another aquatic plant survey of all 209 locations in the lake to evaluate EWM and reed canary grass populations. Zebra mussel monitoring is ongoing given that some lakes in Adams County have them. Watercraft inspectors could be an effective tool for control.

In addition, to better understand the District's place and role within the ground watershed, the District has begun to inventory all Private Onsite Wastewater Treatment Systems (POWTS) within the watershed and identify noncompliance by owners. The District will continue this. As of 2019, approximately 26 high-capacity wells have been identified within the groundwater basin as a result of agricultural operations north of the District. Deforestation as a means to augment agricultural operations is

common in Adams County, and it is, therefore, reasonable to assume that more high-capacity wells will appear in and around the watershed affecting Peppermill Lake. The District will continue to refine its groundwater recharge model based on publicly available data to monitor potential water level variations with an eye to anticipating risks in times of drought.

Goal 5: Manage and Enhance the Fishery in Collaboration with the Wisconsin Department of Natural Resources (DNR)

Objective: Support a balanced fishery that enhances recreational fishing opportunities while sustaining fish populations and promoting lake ecosystem health.

Key Actions:

- **Conduct checks of critical habitat boundaries**: Focus on DNR-identified indicators including water clarity, shoreline integrity, and presence of key fish or wildlife species. Volunteers trained by the DNR can use these checks to monitor and report on the health of designated areas to alert the PLMD of degradations to the areas that could use greater protection/management strategies, and to ensure heavily-used areas are able to sustain their healthy vis-à-vis critical parameters.
- **Critical Habitat Education:** Educate the community (including Real Estate agents) about our State- Designated Critical Habitat areas, and the relevant protections for fish and related restrictions.
- **Regular Fish Population Surveys:** Partner with the DNR to conduct regular fish population assessments, tracking species diversity, size distributions, and health metrics to monitor the overall fishery status. See note below.
- **Collaborate with the DNR on Bag Limit Adjustments:** Continue to work with the DNR to adjust bag limits as needed to align with fish population trends and ensure sustainable harvest levels, particularly for popular species like largemouth bass, bluegill, and northern pike. Updates are expected as we finalize work with the DNR on this process in 2025.
- **Protect and Enhance Spawning Habitats:** Identify and preserve key spawning areas for native fish species. Consider seasonal protections or restrictions in these zones to safeguard fish reproduction cycles.
- **Promote Catch-and-Release Practices:** Encourage responsible fishing practices, including catch-and-release for larger fish, to maintain the health of fish populations and enhance the recreational fishing experience.
- **Community Education on Sustainable Fishing:** Provide resources and signage at access points promoting sustainable fishing practices, including bag limit adherence, catch-and-release, and proper fish handling techniques to protect fish health.
- **Review the Critical Habitat Study:** Review and promote recommendations for maintaining lake health as an important tool when looking at fishery management strategies.

Note regarding fish population study: As in the 2002 study, a fish population survey should be conducted. The last fish survey was conducted in response to concerns of the 2008 fish kill which was caused by the combination of a hard winter and aerator failure. A new survey will give the District a baseline by which to measure efficacy of any new harvesting protocols established. The District will coordinate with the Department of Natural resources to schedule this survey. A study in 2023 was cut short because of weather, and needs to be completed.

Goal 6: Strengthen Community Education and Engagement

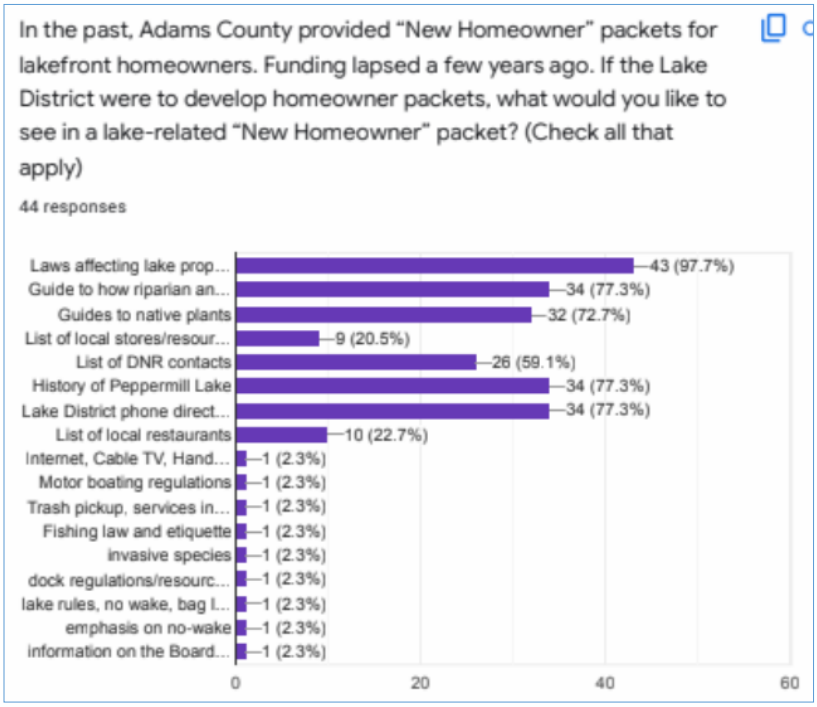
Educational opportunities continue to be a major function of the District. Through active participation with organizations like the Adams County Lake Alliance and the Central Sands Water Action Coalition, participation at Wisconsin Lakes Conference, the District educates residents about the impacts of high capacity wells, the need for private well testing and shoreline protection. Board members are active visitors to the annual Wisconsin Lakes Conference and the District has sponsored five graduates of the Lake Leaders Institute. The District would like to expand its educational outreach to include understanding the benefits of land conservancy and the need for resiliency as a response to the unknowns of climate change.

Objective: Foster a culture of lake stewardship, encouraging residents and lake users to take active roles in conservation and management initiatives.

Key Actions:

- E**ducate the Community on Critical Habitat Designation (CHD)**
  Hold meetings to explain CHD, provide links and copies of our Critical Habitat Designation report and references to the DNR goals.
  Place the Critical Habitat map at the boat launch.
  Host guided "walks" to educate lake users about the ecological value of critical habitat areas as defined by the DNR, showing how users can enjoy these spaces responsibly. "Walks" led by knowledgeable volunteers reinforce the connection between recreational enjoyment and habitat health.
- **Hold annual meetings:** Hold meetings open to all users of Peppermill Lake to collect input to refine the Lake Management Plans and to evaluate data collected from the previous year.
- **Conduct regular resident surveys:** Conduct surveys at least every 5 years, given the regular turnover of residents and owners. Surveys were conducted in 2001, 2004, 2012, and 2022. As noted recently by DNR staff, survey questions must be approved by a DNR sociologist.
- **Catch & Release educational materials:** The District will reintroduce and distribute to promote responsible fishing practices and support fish population health. This may include updated brochures, signage, or digital communications through the District's website and newsletters.
- **Membership Communication:** Continue to send regular informational newsletters to District members
- **Share the Critical Habitat Area map:** Share with stakeholders by posting a copy near the boat launch, and share it through the newsletter, Facebook and the more prominently on the website (there is currently a link to the Assessment report with the map on the site).
- **Wisconsin Lakes Partnership Conference Participation: O**nce a nutrient budget has been established, the District can present at the Wisconsin Lakes Partnership Conference
- **Citizen Projects:** The District has been and should continue to be active in citizen science projects like the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS). Water year data for the 2018-2019 season has been posted to the District's Website.

- **Association Participation:** Through its affiliation with the Adams County Lake Alliance (ACLA), continue to be an active voice in supporting County, State and Federal Government efforts to advance programs like the creation of a County forest program and promote the science and philosophy behind the Wisconsin River TMDL project and the proposed Nine Key Element plan for the 14 Mile Creek Watershed.
- **Offer Educational Workshops and Events:** Organize events on topics like AIS prevention, shoreline management, nutrient reduction, and sustainable fishing to provide actionable knowledge.
- D**evelop specific educational materials for short-term rentals** if they become more common; a "guestbook" of sorts about the lake that concisely highlights things like ordinances, voluntary quiet times, critical habitat, AIS etc.
- **Provide New-Homeowner Welcome Packets**: Distribute packets with information on lake rules, conservation practices, and local contacts to introduce new residents to responsible lake use. (From most recent survey :)



Appendices

Peppermill Lake History

Peppermill Lake is in southeast Adams County in the Town of Jackson, Wisconsin. The lake is a 67-acre human-made impoundment. Peppermill Lake is the headwaters of Peppermill Creek which is a tributary of Neenah Creek. The lake was developed beginning in the mid-1960s with removal of a beaver dam, and construction of a downstream dam in 1967. Dredging operations continued until late 1974. Peppermill Lake has only been in its current configuration for about 50 years.

Prior to development, the major features of the area, now occupied by the Lake, was a grass marsh area with numerous springs and fens, and a small pond, known locally as Fish Pond or Fish Lake, which drained into a small creek. The lake was created by beavers, which built a dam across a small unnamed creek that flowed out of the marsh area and into Neenah Creek approximately 1.5 miles downstream. The unnamed creek is shown on various Town of Jackson plat maps dating back to at least 1880. Over time people in the area reinforced the beaver dam with rocks. The marsh area around the west end (near 4th Ave) of the pond was locally referred to as Rodgers Marsh, named for the Rodgers family who owned 40 acres of the marsh area.

Adams County has historically been a popular tourist destination (now, 19th in the State In tourism) with many visitors traveling from large urban areas. With its abundance of small lakes, streams and woods an increasing number of visitors were interested in acquiring vacation property, with property on water being the most desirable.

A local developer, Melvern Coddington, seeing a demand for waterfront property began buying land around and including Rodgers Marsh, the beaver pond and the small stream flowing out of it. Coddington eventually acquired most of the property around what is now the south side, east end and parts of the northeast shore of the planned Lake. At the same time but unknown to either, Hugh Schmitt was buying property on the northwest shore of the lake as well as other properties around what would eventually become Peppermill Lake.

To form the Lake, dredging operations using first a dragline and later a barge mounted suction dredge were carried out from the late 1960s through 1974. The use of the dragline dredge was limited primarily from the northwest corner round and down the south shoreline of the planned lake. Many of the current properties have very flat shorelines as a result of this dredging. After the water level reached sufficient depth a suction dredge was used for the balance of the dredging work. The north shore areas not owned by Coddington or Schmitt were not dredged with either method and today are the shallowest areas of the Lake.

As the property around the Lake was partitioned and sold, the Lake community began to form. In 1983 the Peppermill Lake Property Owners Association was formed. Over the years the Association took on a number of projects with a goal to improve the fishery and overall health of the Lake. Projects included placing fish cribs, tree drops, spawning beds and stocking fish.

In 1984 a public boat launch was developed on County G next to the dam. Also, in 1984, after a petition by property owners, the Town of Jackson designated the entire lake as “No Wake.”

In 1991, after a severe fish kill over the winter, a second group of property owners was formed. The Sportsman's Club was instrumental in installing an aerator in the east end of the Lake to help prevent future fish kills. Another aerator was added a few years later in the west end of the Lake.

In 1998 the County assumed ownership of the dam.

In 2002, after many years of discussion, the property owners around the Lake gained approval from the Town of Jackson to form the Peppermill Lake Management District. The two property owner organizations disbanded over time once the Lake District assumed management responsibility.

Since its inception, the Peppermill Lake Management District has primarily focused on aquatic plant management and navigation as its primary goals. In 1998, Eurasian Water Milfoil (EWM) was discovered covering approximately 0.8 acres. Despite the use of chemical treatment (2, 4-D), EWM grew to cover about 11 acres by 2007. In the winter of 2007-2008, both aerator systems failed simultaneously for about a week. The resulting oxygen depletion caused a fish kill. That same snowy year, there was also a significant change to the lake's plant population as EWM was virtually eliminated. In 2007, the District spent approximately $17,000 on aquatic plant management; in 2008, the same costs were slightly over $4,000. Since 2008, the District has not used chemical treatment for plant management and has only relied on mechanical harvesting and hand-pulling. EWM (in some cases in hybrid form) has returned to some extent but not at its previous peak of 11 acres. In its place, chara has moved eastward covering a significant portion of the lakebed. While beneficial as a phosphorus limiter, chara has become a navigational challenge in warm months. Currently, the chara mounds, or mats, are managed through mechanical harvesting.

Historically, three forms of aquatic plant management have been applied across the lake.

- Chemical treatment, which was abandoned because of poor results and concerns that decaying plant matter would add to the existing nutrient load. There is a reluctance in the community to use chemical treatment when there are other options.
- Hand-pulling was successful in the small inlets but more difficult to accomplish in the open areas of the lake.
- Mechanical harvesting, which began in 2007, has proven effective in removing plant mass. The spread of chara has kept EWM in check and has allowed mechanical harvesting operations to control growth of localized EWM populations. As of 2022, there was no evidence of EWM encroachment and rooting resulting from plant harvesting.

Diver assisted suction harvesting (DASH) is not appropriate with our shallow peat muck, and diver-assisted (non-suction) harvesting has not been attempted yet. A draw down of the lake as a means of EWM control is not favored out of concerns that other plant and animal populations would suffer given the shallowness of the lake. A draw down should only be considered when repairs to the dam are required.

The District has participated in several studies in its 18 years to better know the lake.

- *The Assessment of Lake and Groundwater Chemistry, Shallow Groundwater Flow, and the Aquatic Macrophyte Community Peppermill Lake, Adams County, Wisconsin* was completed in May of 2002 by the Center for Watershed Science and Education University of Wisconsin-Stevens Point.
- In 2006 a Critical Habitat report was completed by Adams County Land & Water Conservation Department.

- In 2011, the first Peppermill Lake Management Plan was approved.
- The District participated in the *Clean Boats, Clean Water* program for two years starting in 2011.
- In 2012 and 2016, The Adams County Land and Water Conservation Department conducted detailed aquatic plant surveys at 209 locations on the lake identifying over 40 species of submergent and emergent plants.
- Resident surveys were conducted in 2001, 2004, 2012 and most recently in 2022.
- In 2016, a shoreline survey was conducted identifying approximately 50 sites of woody debris (fish sticks). After the 2008 fish kill only one fish population survey was performed. The findings of the survey did not recommend fish stocking of any kind. In 2018, isolated sightings of carp were reported but none have been caught for conclusive identification.
- In 2023, a fish population survey was started but not fully completed due to poor weather.
- An aquatic plant survey was completed in 2023 as part of a surface water grant awarded to the district in 2020.

The District acts as an educational vehicle by its membership in the Adams County Lake Alliance (ACLA) and the Central Sands Water Action Coalition (CSWAC). The District issues regular newsletters to its members and has maintained a website since its inception in 2002. All reports related to Peppermill Lake can be found at https://peppermilllake.org/peppermill-lake-data/

Summary of Septic Data

Area	Total Parcels	Monitored	Not Monitored	No Septic	Out-of-compliance
Lake parcels	91	62	0	28	1
Lake District Parcels	132	74	0	57	1
Surface Watershed Parcels	68	23	0	37	0

In the table above, there are three groups of parcels – Lake Parcels (the parcel contains lake shore), Lake District (the parcel is within the defined Peppermill Lake Management District), and Surface Watershed parcels. The Surface Watershed here is the area to the west of the Lake District area. The surface watershed does contain parcels that are within the Lake District, but those parcels are accounted for in the Lake District group.

In the future, this analysis will be extended to include septic information on all of the parcels in the entire Groundwater shed (4712 acres) as well.

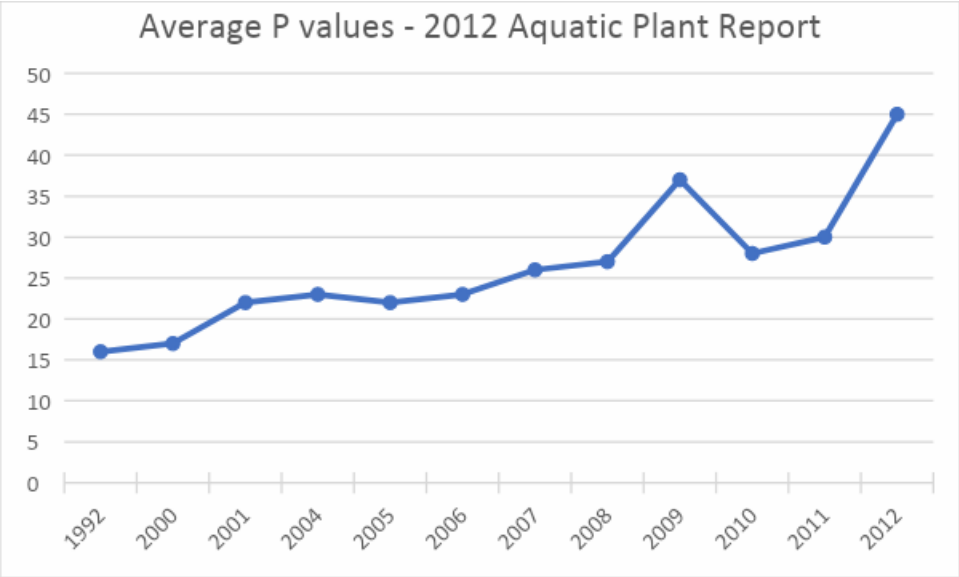
Summary of Dissolved Oxygen (DO) Data

The Peppermill Lake Management District has been compiling DO data since February, 2016. There are DO data from prior to that date that need to be evaluated. DO monitoring has been practiced in Peppermill Lake since there was a winter fish kill in 2008, from depressed oxygen levels. Due to this fish kill, the District operates two aerators during the winter months (roughly mid-November to mid-March).

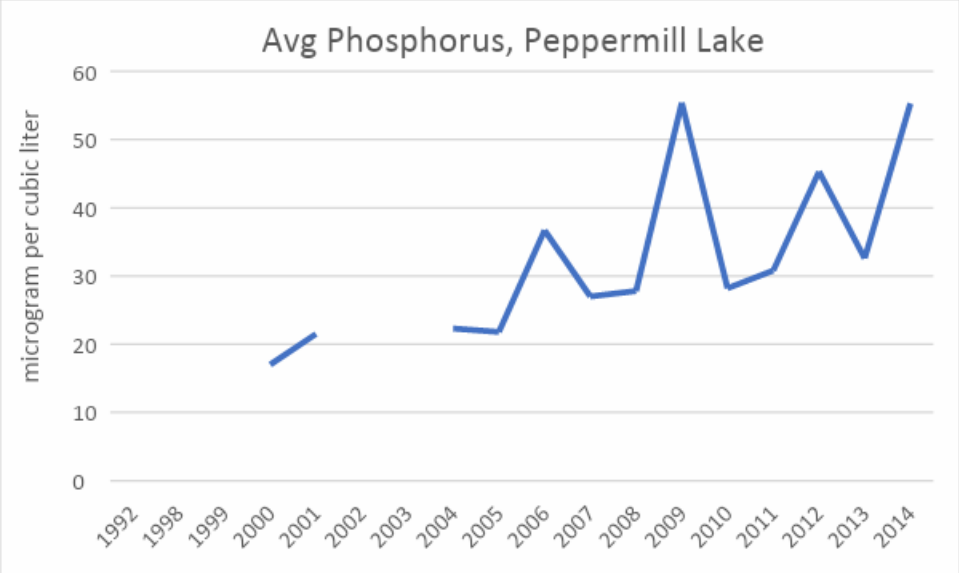
This data needs to be tabulated and analyzed. Additionally, the District would like to add snow depth measurements at each location and take readings at one foot increments along the water column. Currently measurements are taken at lake bottom, at mid-point, and near surface.

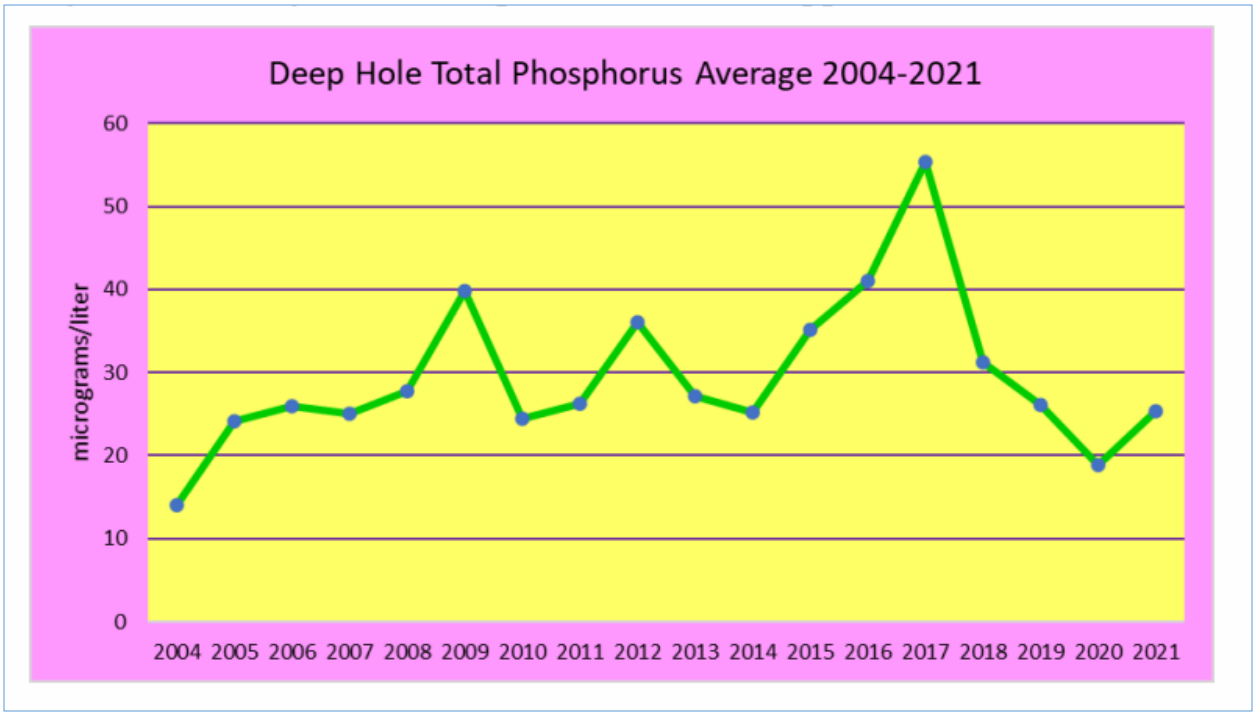
Summary of Phosphorus Data

Phosphorus data has been collected continuously since 1992, with several data sets. Most data sets have been compiled and analyzed, but not in several years, and thus are in need of updating. We see from the data analysis that there is a gradual upward trend. Peppermill Lake is now at risk of becoming a eutrophic lake if nutrient inputs increase. It has always been mesotrophic.



The following graph is from the Adams County data:





While the data sets don't exactly correspond, they do show a trend of increasing P levels.

Summary of Nitrogen Data

PLMD has some Nitrogen data, and modeling has been done as well. The nitrogen data we have comes from analysis of harvested plants removed during mechanical harvesting. More details can be found in the 2023 Peppermill Lake Nutrient Budget.

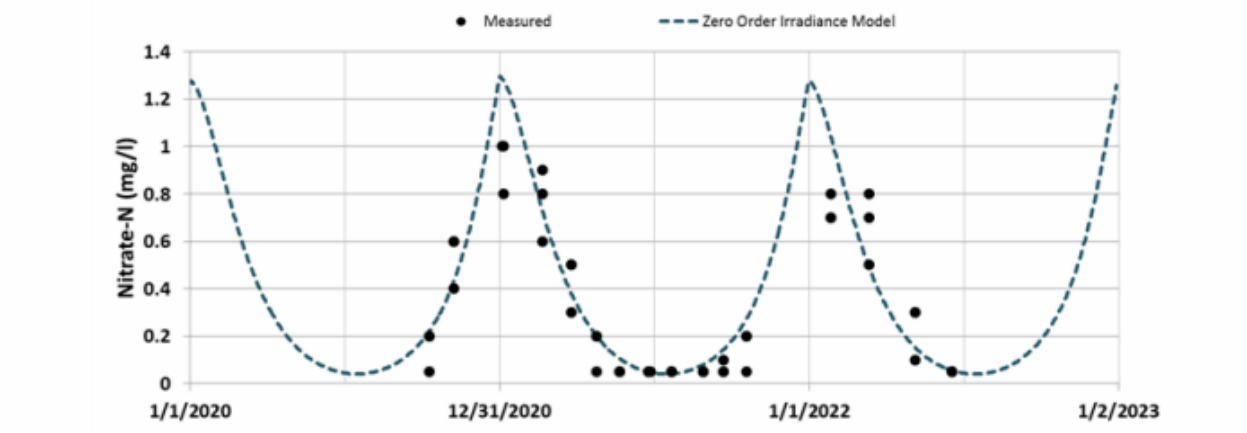
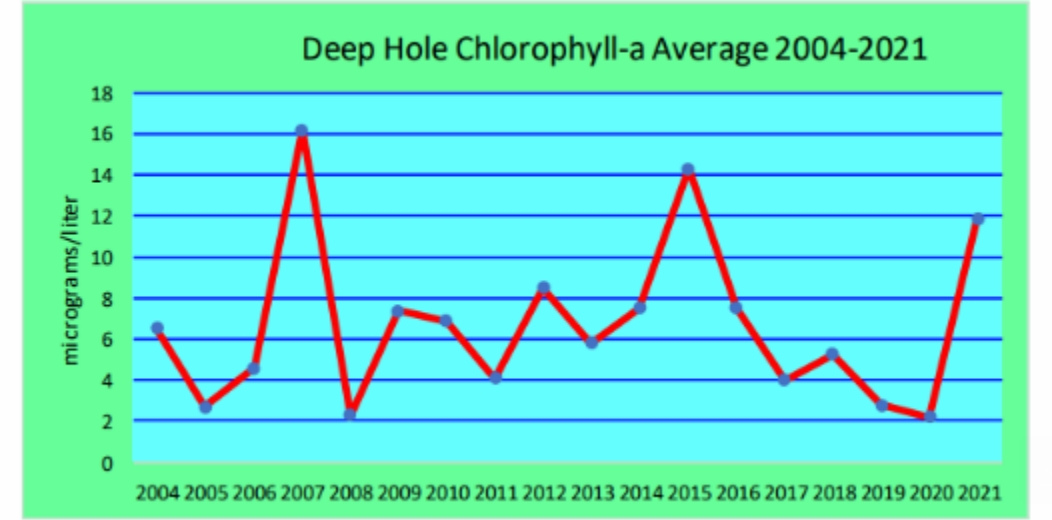


Figure 4. Measured nitrate-nitrogen concentration in Peppermill Lake compared with results of a simulation model that links removal of nitrate with light intensity. The simulation model used an inflow concentration of 2.3 mg N/l and fitted removal rates leading to a summer depletion rate of 140 mg N/m2-day.

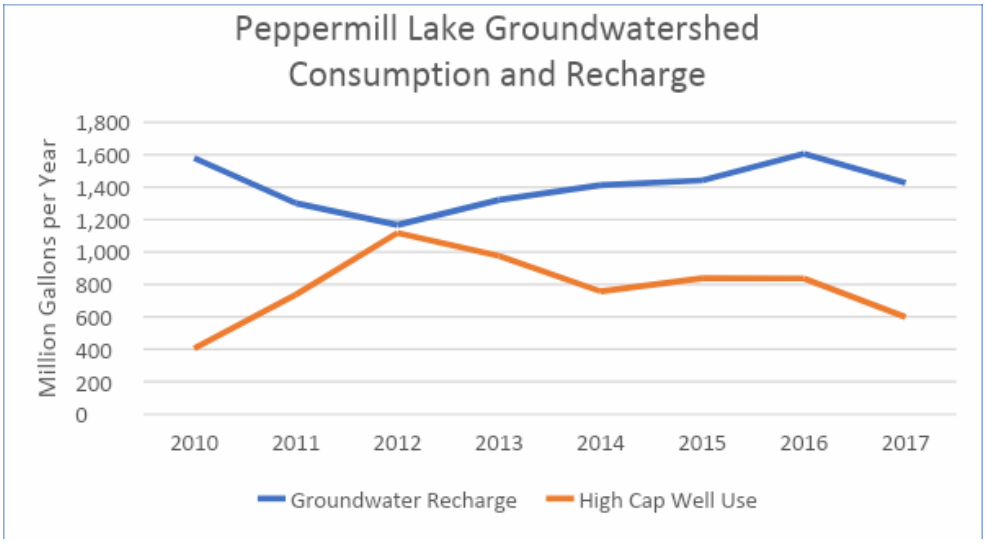
Summary of Water Clarity Data

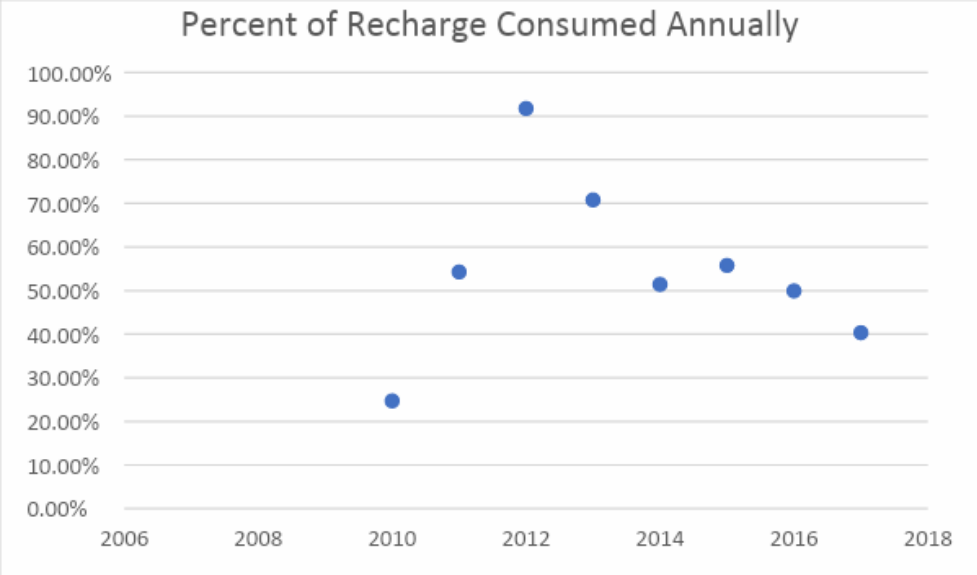
There are two existing data sets for water clarity; Secchi disk readings, and Chlorophyll A. This data needs to be compiled and analyzed. Note that Chlorophyll A is a good proxy for Phosphorus, and should be analyzed for that correlation.



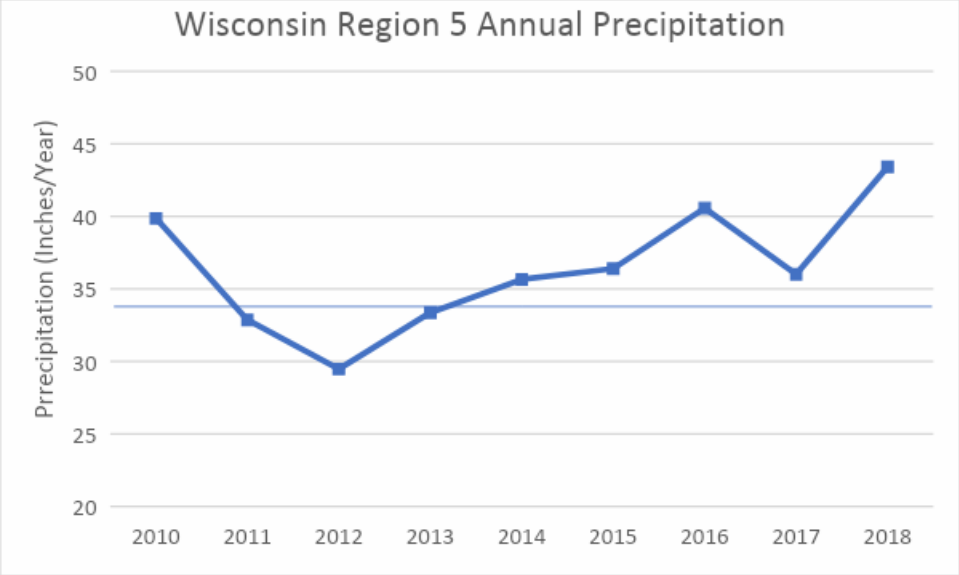
Summary of Groundwater Data

The groundwater-shed area of Peppermill Lake extends over 4,712 acres. Within this area there are 23 high-capacity wells. These aggregated wells are constructed to consume a combined maximum of 18,294 gallons/minute (26.34 Million gallons/day). Since 2010 these wells have been consuming between 0.4 and 1.17 billion gallons/year, averaging 0.78 billion gallons/year. During this same period, the groundwater recharge rate has varied between 1.2 and 1.67 billion gallons/year. The percentage of the groundwater shed recharge being consumed by high capacity wells since 2010 varied between 24% and 91%, with an average of 54%. Clearly, groundwater consumption is having a significant effect on the overall amount of water stored in the Peppermill Lake groundwater shed. During the last drought year almost all the recharge volume for that year was consumed. The next drought year will be worse, because pumping capacity has increased by 26% since 2012.





This data set can be further improved. The recharge rate calculations can be made more accurate by factoring in land-use data, rather than using a single recharge rate (adjusted by yearly precipitation) for the entire 4,712-acre area.



Precipitation in the Central Sands region (Wisconsin Region 5) has recently been unusually high.

Summary of Land-use Data

The Peppermill Lake Management District has complete land-use data for all sectors within the groundwater shed. There are two sectors in the surface watershed that are currently lacking land-use data. The land-use data is current but has not yet been analyzed to determine aggregate statistics. There is a land use map on page 35 of The Town of Jackson's Comprehensive Plan found here: https://www.ncwrpc.org/town-of-jackson-comprehensive-plan/

Summary of Aquatic Plant Surveys

- 2001 (University of Wisconsin – Stevens Point)
- 2006 Aquatic Plant Survey (WDNR and Adams Co L&W)
- 2012 Aquatic Plant Survey
  - 2012 Aquatic Plant Survey GPS Coordinates
  - 2012 Survey Presentation
- Aquatic Plant Community of Peppermill Lake 2001-2016
- Aquatic Plant Community of Peppermill Lake 2001-2021
- Eurasian Milfoil Aquatic Plant Survey June 2023 Map
- Aquatic Plant Survey July 18, 2024 (Point-Intercept) by Adams County Land and Water Conservation Department
- 2024 Aquatic Invasive Species (EWM/HWM) Survey Summary by consultant Cason Land and Water Management LLC

Summary of Resident Surveys:

- Resident Survey - 2001 Results
- Resident Survey - 2004 Results
- Resident Survey - 2012 Analysis
- Resident Survey - 2022

Summary of Yearly Aquatic Plant Management Data

The Peppermill Lake Management District removes approximately 400,000 to 500,000 pounds of plant material from the lake annually. Between 2011 and 2022, the District analyzed the amount of nutrients (by percentage of weight):

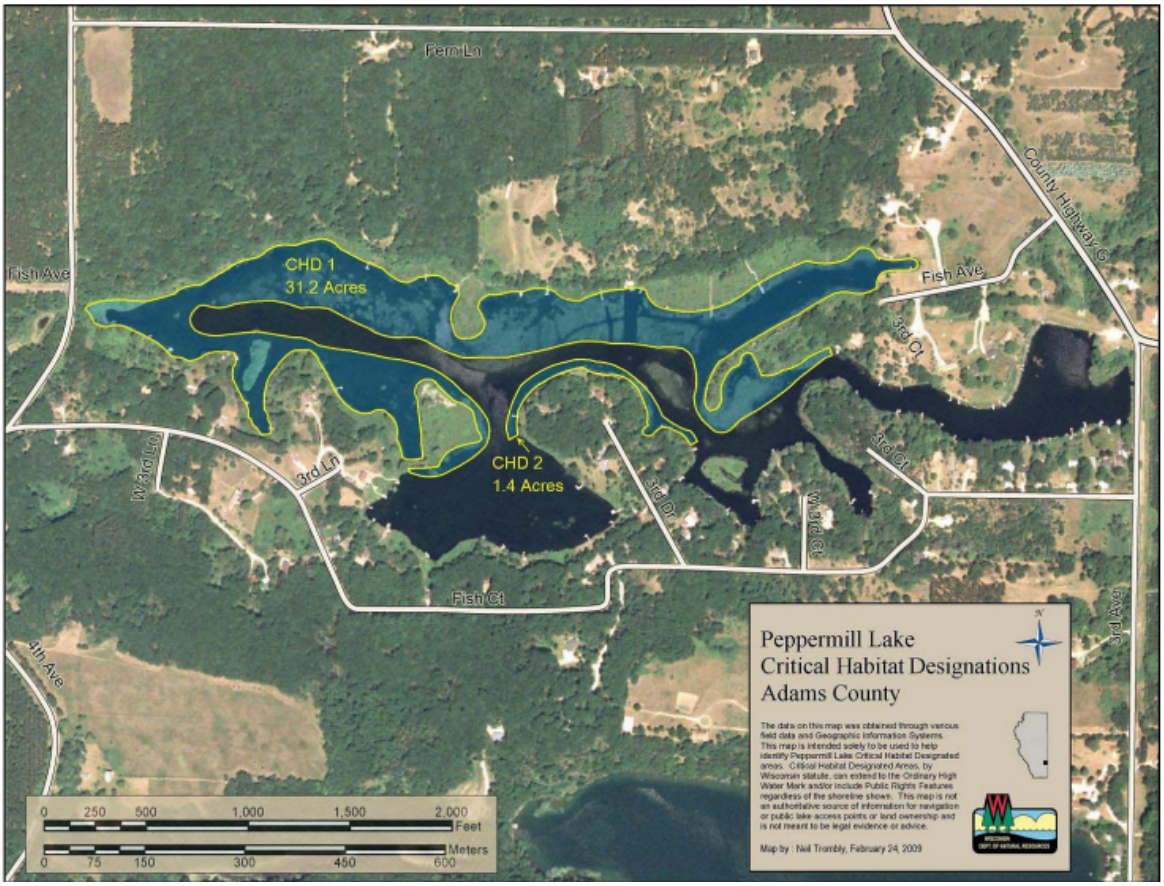
	min	max	AVG
Element			
N (%)	1.37	1.89	1.63
P (%)	0.08	0.23	0.14
K (%)	0.25	0.91	0.50
Ca (%)	4.82	16.02	9.86
Mg (%)	0.27	0.82	0.57

The tremendous amount of calcium carbonate that clings to the harvested Chara is reflected here by the average Calcium value of about 10% of the total weight of the plant material. Calcium also helps binds P in aerobic environments. By removing the plant material via harvesting, the calcium-bound phosphorus is also being removed.

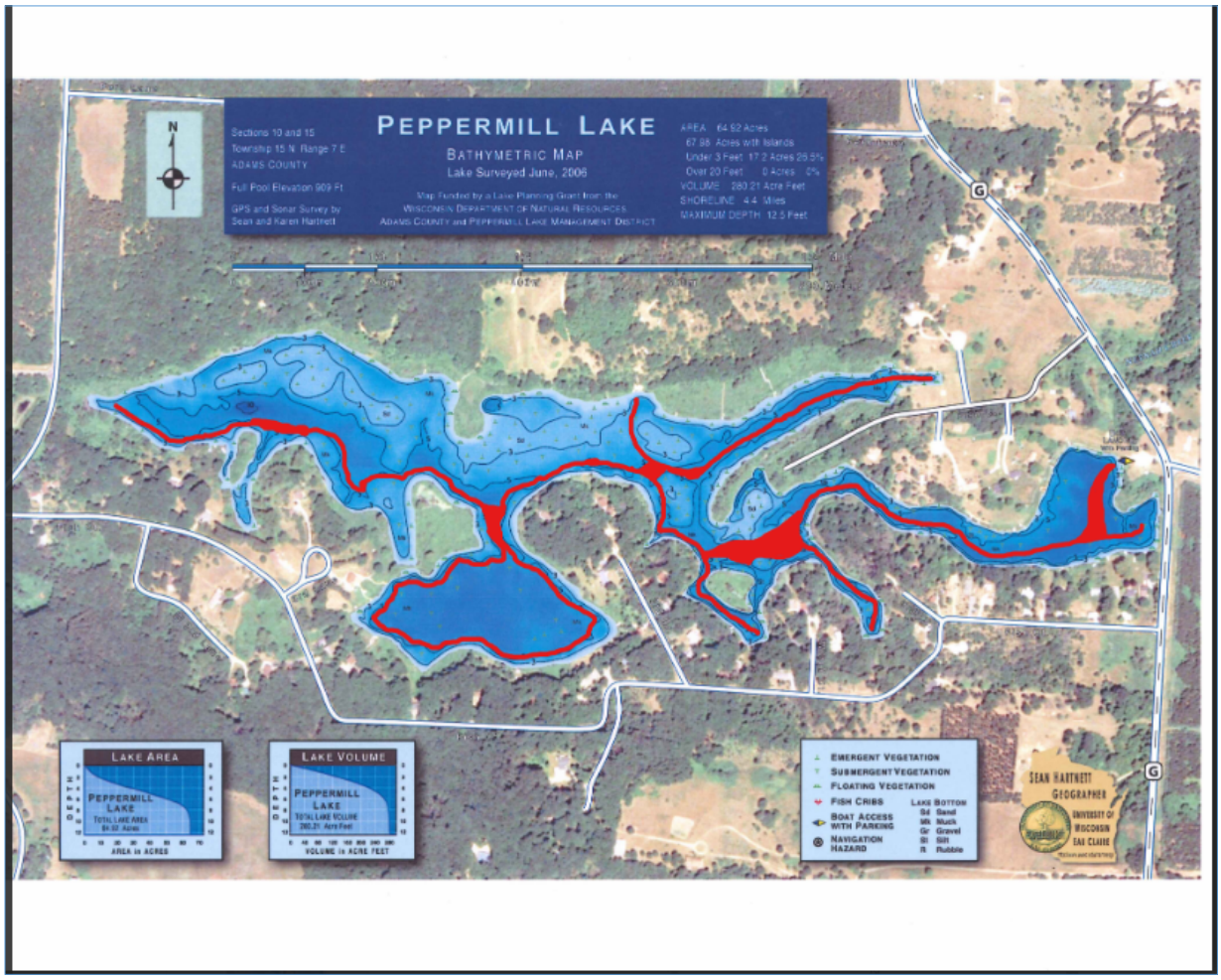
Designated Critical Habitat Assessment and Map

The Critical Habitat Assessment was completed by the Wisconsin DNR in 2006. The Assessment and Critical Habitat Map can be accessed here: [WI DNR CH Designation Peppermill Lake](). The map is useful in conjunction with the Harvesting Maps to protect State-designated, ecologically sensitive 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.

The report lists recommendations associated with the two designated areas.



Harvesting Map 2023-2024



Other Studies and Reports (with some links)

- Peppermill Lake Water Year data 2018-2019 and summary chart benchmarked against 30-year average
- April 2014 Chara Presentation from LWCD
- July 2010 Peppermill Lake Dam Hazard Report
    - Adams County Flood Plain Ordinance
    - Proposed Changes to Floodplain Ordinance based on 7/2010 report
- Management Plans
    - Report from Lake Planning Study - circa 2002
    - Lake Management Plan - 2011
- Lake Classification Report (very large) - 2008
- Maps
    - Sediment Map - 2006
    - Peppermill Lake Soils Map
- Fish and Fishery Reports
    - 2002 Fish Survey
    - Peppermill Lake Fishery Report - 2010-2011
    - 2022 DNR Fisheries Information