

## 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 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 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 have an effect on the lake. The District must grapple with this reality as it still performs its quotidian management duties.

Foundationally, the District wishes to contextualize its baseline data by refreshing the original 2002 study in order to determine a trend. This includes:

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

Based on data collected through the new study, the District wishes to build a nutrient budget and plant management protocol. 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.

Educationally, the District wishes to make residents of, and users of, the lake 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, 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.

And in keeping with its mission to expand its understanding of its role in the environment (natural, economic, political, and social), our educational efforts need to tie our scientific desires to the community and give our residents a sense of the “whole”.

The Peppermill Lake Management Plan was approved the Wisconsin Department of Natural Resources on \_\_\_\_\_, 2019.

The Peppermill Lake Management Plan was adopted by the Peppermill Lake Management District on \_\_\_\_\_, 2019.

## Peppermill Lake History

Peppermill Lake is in southeast Adams County in the Town of Jackson, Wisconsin. The lake is a human-made (impoundment) lake of approximately 67 acres. 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 construction of a dam in 1967, and dredging operations continued until late 1974. Peppermill Lake has only been in its current form for approximately 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, that 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 4<sup>th</sup>

Drive) 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 shore line 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 area of the north shore not owned by Coddington or Schmitt was not dredged using either method and today is the location of 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 fish stocking.

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 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 .8 acres. Despite the use of chemical treatment (2,4-D), EWM population grew to approximately 11 acres by 2007. In the winter of 2007-2008, both aerator systems failed and were down for approximately a week. The resulting oxygen depletion caused a fish kill. Coincidentally, there was a significant change to the lake's aquatic plant population. In 2007, the District spent approximately \$17,000 on aquatic plant management; in 2008, the same costs were slightly over \$4,000. Since that 2008 fish kill, 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 significant 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 was abandoned because of poor results and over concerns that decaying plant matter would only add to the existing nutrient load. Philosophically, there is a reluctance to use chemical treatment unless no other options are viable. 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. No evidence of EWM encroachment has been found resulting from plant cuttings taking root. Diver assisted harvesting (DASH) 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 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 been active in several efforts in its 18 years of existence. The report, *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 Peppermill Lake Management Plan was approved, and the District participated in the *Clean Boats, Clean Water* program for two years. 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. A survey of residents was also conducted most recently in 2012.

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.

The District is active as an educational vehicle as members of 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 [www.peppermilllake.us/research](http://www.peppermilllake.us/research).

## Contributors

### Peppermill Lake District

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Adams County Land & Water Conservation Department

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#### Consultants

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- Bill Pegler (Supervisor II)
- Candace Pegler (Clerk)
- Dolores Benish (Treasurer)

## Present Day Challenges and Action Items

Three primary goals must be pursued through this Plan:

- 1) The establishment of a nutrient budget and management plan that is actionable and measurable
- 2) Greater understanding of Peppermill Lake's role in the watershed both up and down stream
- 3) Information and Education.

The District has been managing its aquatic plant population since it was formed in 2002 but has done little to evaluate the full impact of its initial chemical treatment efforts or its more current mechanical harvesting tasks other than to meet the boating and swimming needs of residents. For example, no data was collected that could model increases in phosphorus loading as a result of decaying EWM after chemical treatment. Nor were water samples taken at the dam to measure 2,4-D impacts as water exited into Peppermill Creek and eventually to Neenah Creek.

The original 2002 study did make a first attempt at modeling phosphorus (P) loading on the lake, but total nitrogen (N) must now also be a consideration. Because the ground watershed extends north of Peppermill Lake into agricultural land, inputs from agriculture must be measured. And toxic algal blooms from blue-green algae may become a threat because they thrive on high amounts of phosphorus and nitrogen. 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.

The District must identify a nutrient budget for P and N in order to give guidance on harvesting best practices. At this time, the District is utilizing only one management technique – harvesting. The District needs a better understanding of how to use its current approach and identify new management techniques that are appropriate for Peppermill Lake. In order to accomplish this, the District will be

applying for a lake study grant for 2020 that will update all data collected from the original 2002 study and add total N loading.

As part of the study we propose to monitor dissolved oxygen readings at three depths in the water column at 4 locations on the lake and at least one location outside the lake downstream of the dam. This will be done in conjunction with other water quality tests like secchi, chlorophyll A, etc. Some dissolved O<sub>2</sub> data has been collected spanning two winters and the Board will request that this data be quantified and added to new data collected as part of the proposed lake study grant. As a new consideration, the District would like to add the monitoring of snow depth at each location.

A protocol for routine data collection of P and N and tonnage removed to be used by harvesters will be developed in order to refine plant sample data analysis results.

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.

To better understand the District's place and role within the ground watershed, the District has begun to inventory all 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 ground water basin as a result of agricultural operations north of the District. Deforestation as a means to augment agricultural operation 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.

For residents of the District, the District will create an annual private well testing program.

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.

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.

The District is also 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 Website.

Going forward, the District will continue to send regular informational newsletters and maintain its website which currently contains a copy of every report and study done on Peppermill Lake along with all meeting minutes since inception. Once a nutrient budget has been established through the proposed grant application, the District would like to present at the Wisconsin Lakes Partnership Conference.

The District has conducted two resident surveys. The last survey was conducted in 2012. With the significant turnover in property ownership within the District, a new survey is proposed as part of the lake study grant proposal to be submitted.

Through its affiliation with the Adams County Lake Alliance (ACLA), the District will 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.

Annual meetings, open to all users of Peppermill Lake will be held to collect input to refine the Lake Management and evaluate data collected from the previous year.

## Appendices

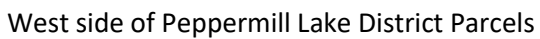
### Summary of Septic Data

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

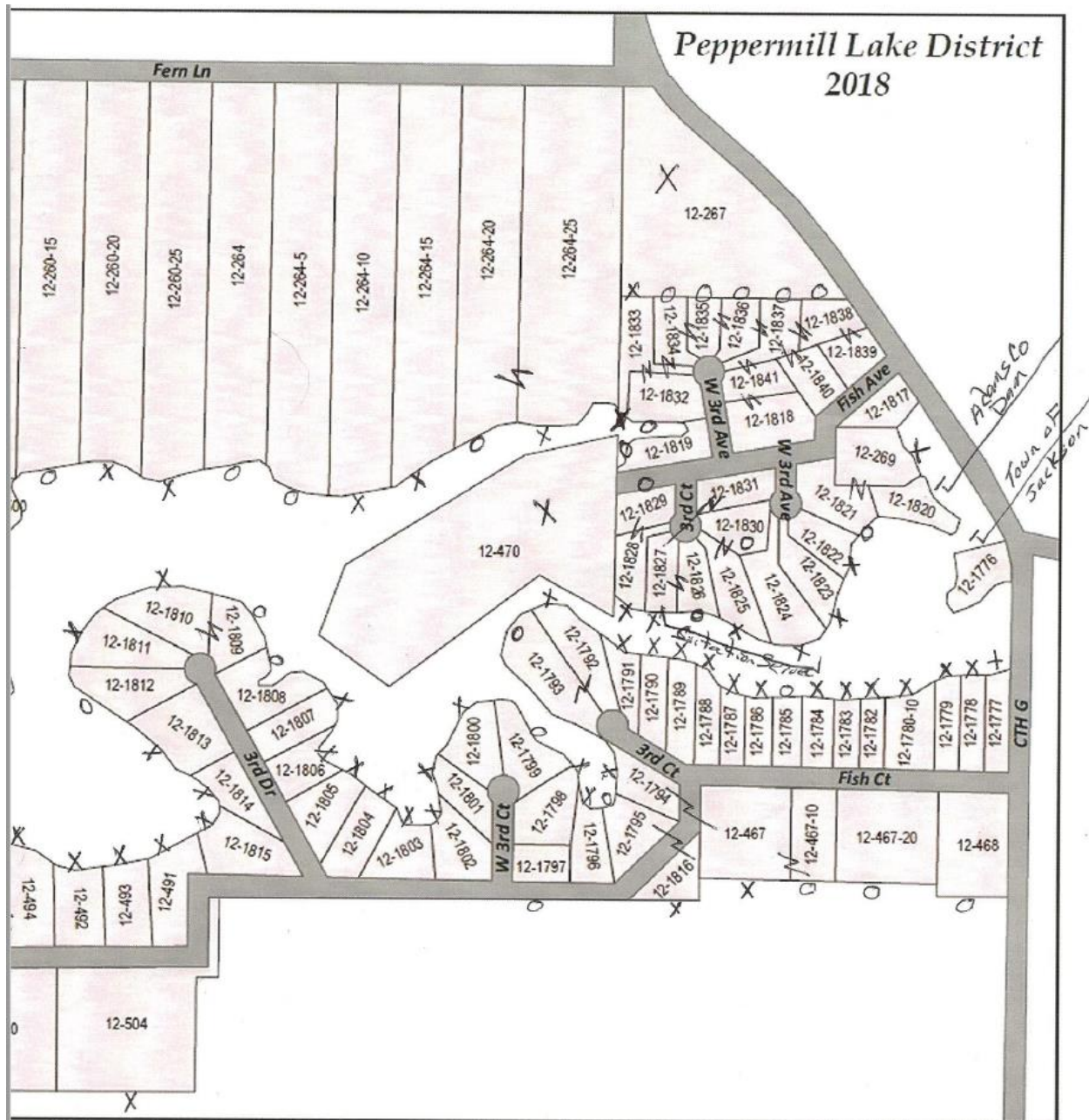
In the table above, there are three groups of parcels – Lake Parcels (the parcel contains lake shore), Lake District (the parcel is within the defined Peppermill Lake Management District), and Surface Watershed parcels. The Surface Watershed here is the area to the west of the Lake District area, as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

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

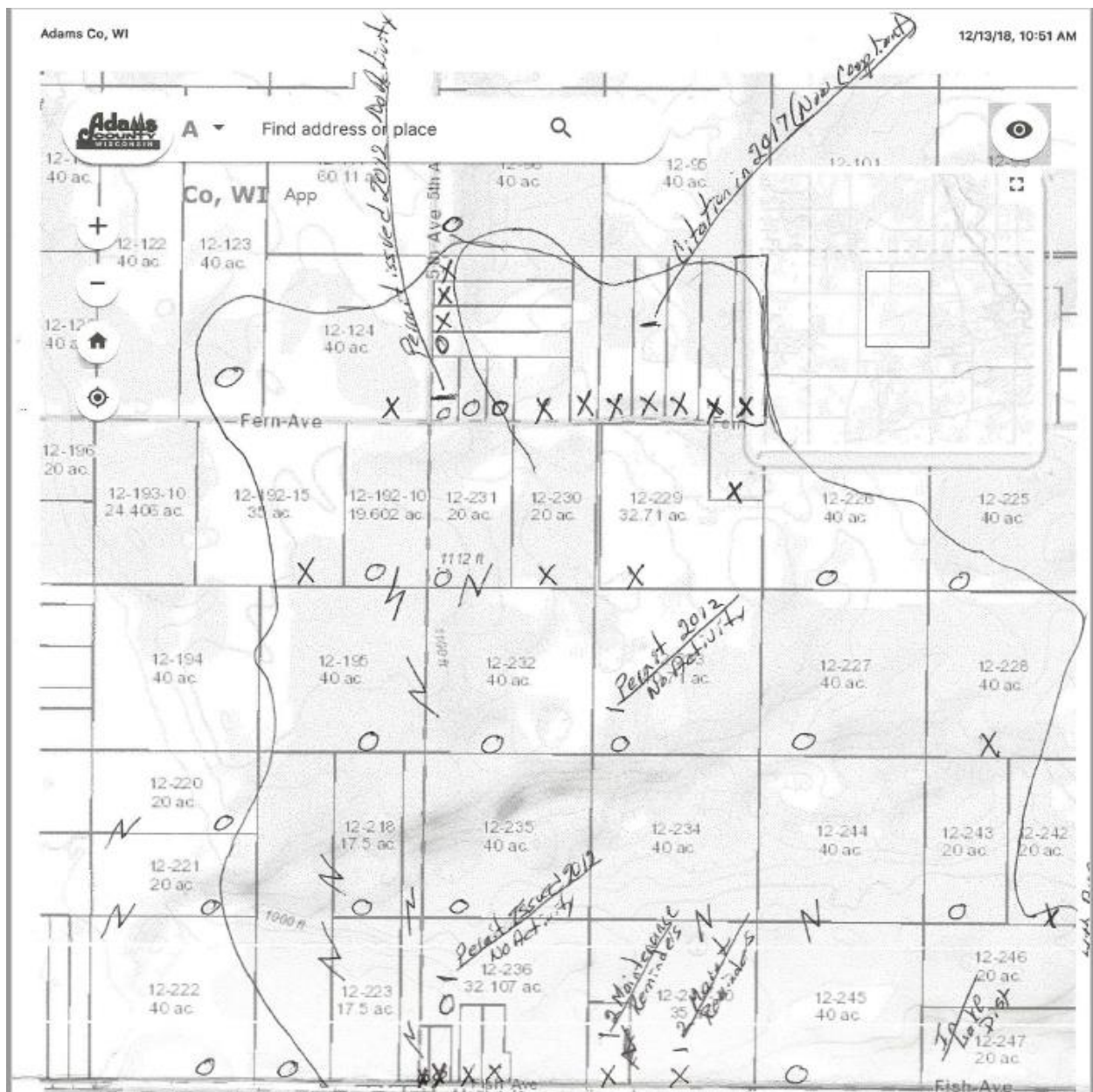
The annotated maps are presented below.



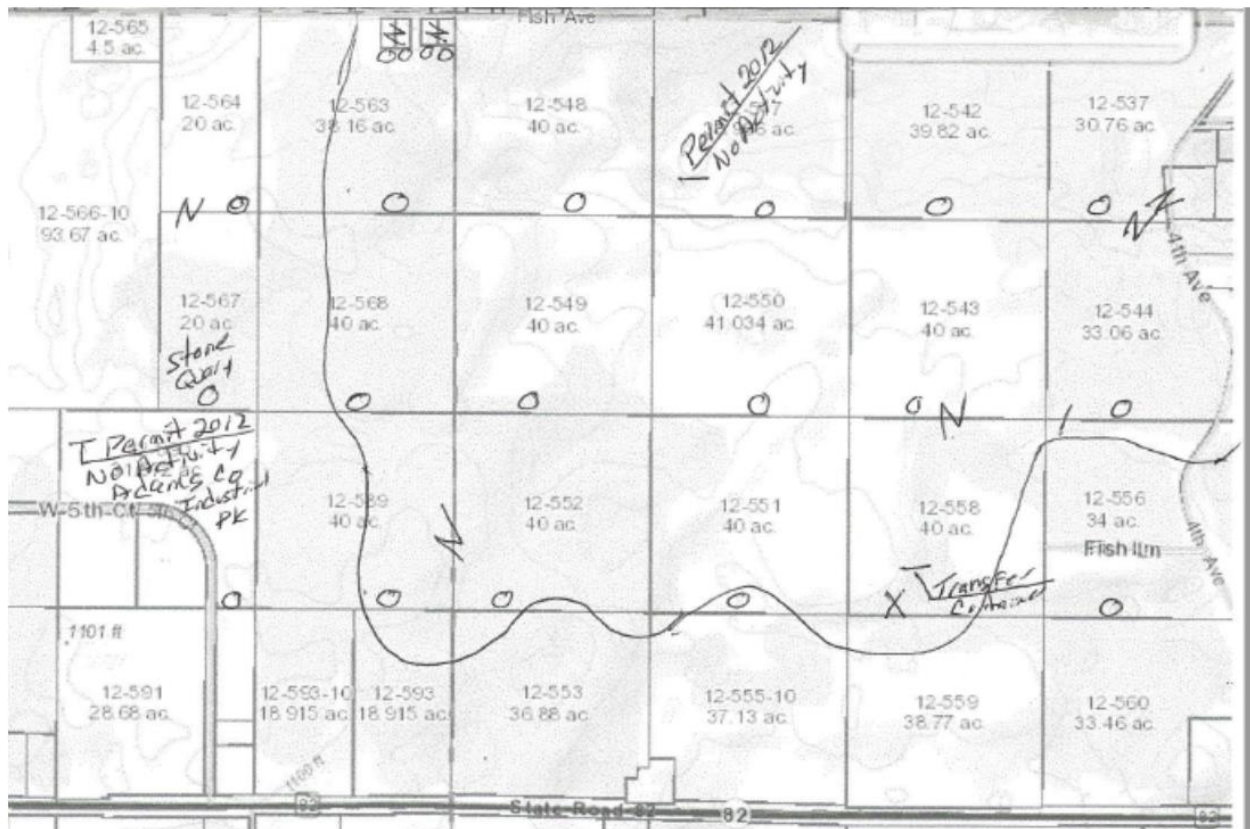
## West side of Peppermill Lake District Parcels



## East Side of Lake District



Northern Half of Surface Watershed (West of lake)



Southern Half of the Surface Watershed (West of lake)

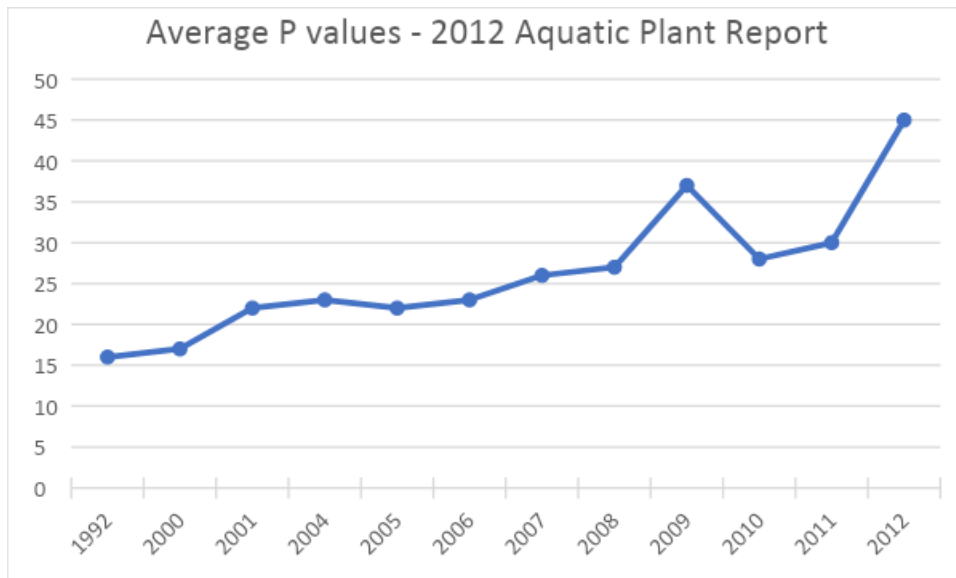
### Summary of DO (Dissolved Oxygen) Data

The Peppermill Lake Management District has been compiling DO data since 02/2016. There are also DO data sets prior to that date, that need to be evaluated. DO monitoring has been practiced in Peppermill Lake since there was a fish kill in 2008, caused when winter oxygen levels dropped. Due to this fish kill, the District operates two aerators during the winter months (roughly mid-November to mid-March).

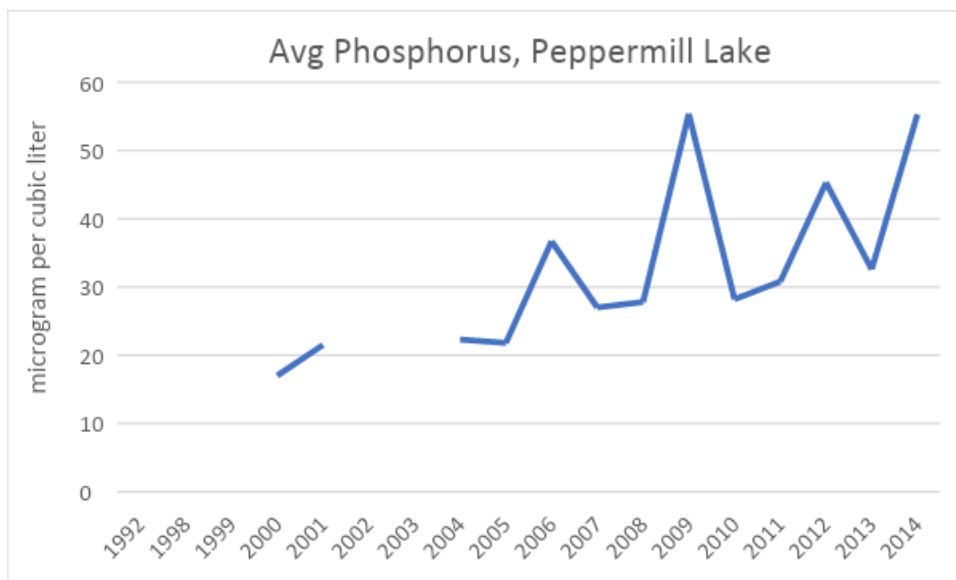
This data needs to be tabulated and analyzed. Additionally, the District would like to add snow depth measurements at each location and take readings at one foot increments along the water column. Currently measurements are taken at lake bottom, at mid-point, and near surface.

### Summary of Phosphorus Data

Data has been collected continuously since 1992, and there are several data sets for Phosphorus. These data sets have been compiled and analyzed, but not updated 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 levels of P.

### Summary of Nitrogen Data

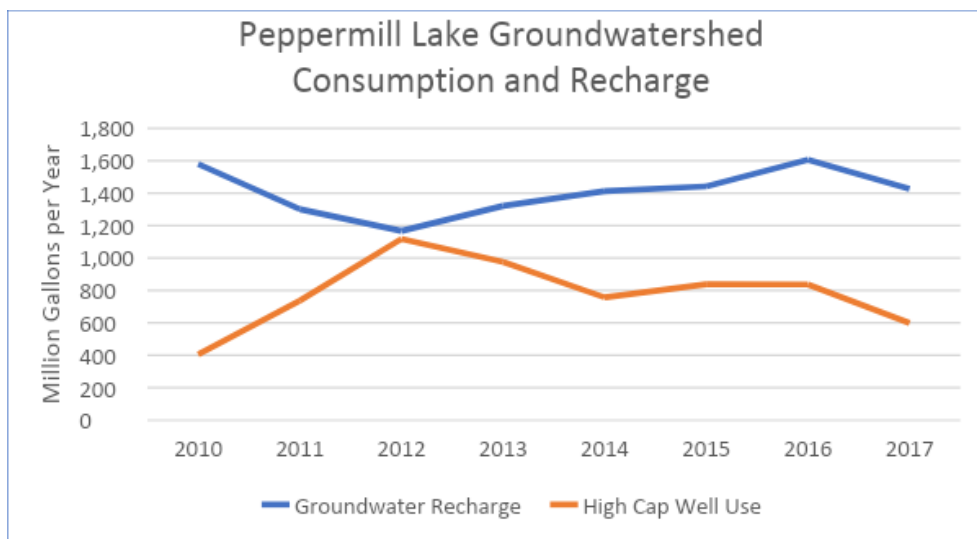
There is very little data for Nitrogen. The data that does exist needs to be compiled and analyzed. Currently the only nitrogen data available to us comes from **lab** results of plants removed during mechanical harvesting. Most likely, this data will originate through implementation of this plan if our 2020 grant application is successful.

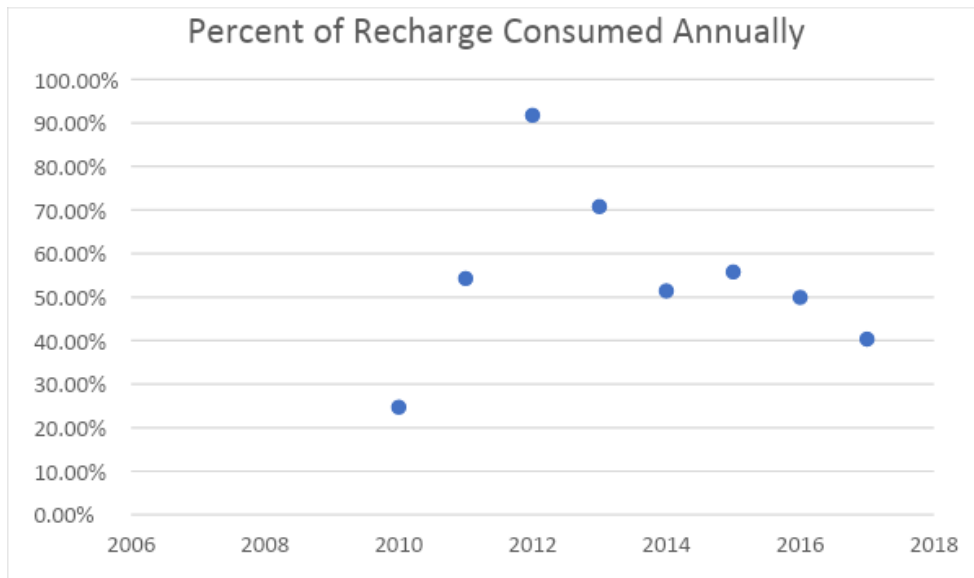
### Summary of Water Clarity Data

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 also a good proxy for Phosphorus, and should also be analyzed for that correlation.

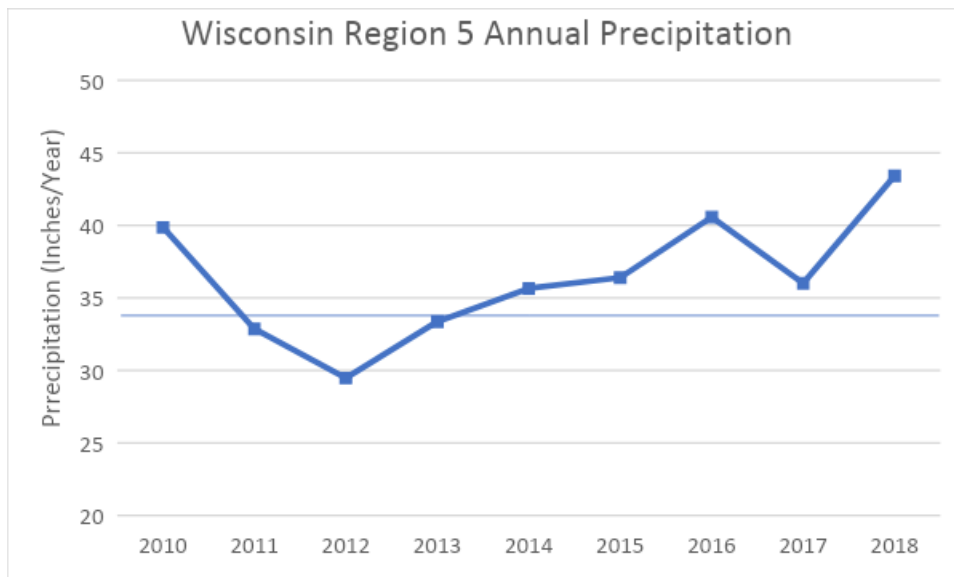
### Summary of Groundwater Data

The groundwater-shed area of Peppermill Lake extends over 4712 acres. Within this area there are 23 high-capacity wells. These wells aggregated together are constructed to consume a maximum of 18,294 gallons/minute (26.34 Million gallons/day). Since 2010 these wells have been consuming between 0.4 billion gallons/year to 1.17 billion gallons/year, averaging 0.78 billion gallons/year. In this same time period, the rate of annual groundwater recharge has varied between 1.2 billion gallons/year to 1.67 billion gallons/year. The percentage of the annual groundwater shed recharge being consumed by high capacity well pumping since 2010 has varied between 24% to 91%, and averages 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 4712-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 with-in 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.

### Summary of Yearly Aquatic Plant Management Data

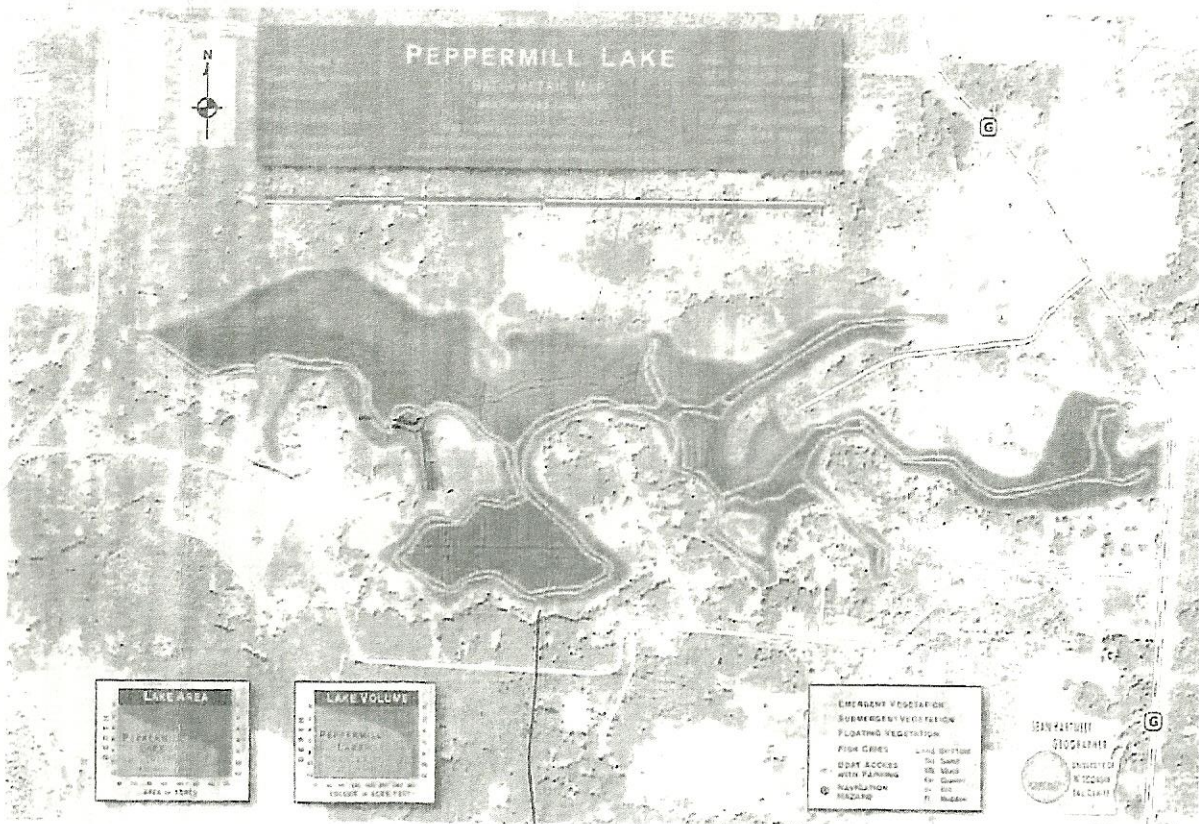
The Peppermill Lake Management District removes approximately 400,000-500,000 pounds of plant material from the lake annually. Since 2011, the District has been analyzing the amount of nutrients (by percentage of weight):

|         | 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.

[Approved Harvesting Map 2017-2022 \(see attached file\)](#)

# Harvesting Map (proposed)



→ SOUTH BAY  
UNDER THIS MAP  
DOES LAKE AREA