Chilton Millpond

Calumet County, Wisconsin

Comprehensive Management Plan

November 2023

Sponsored by:

Chilton Lake District

WDNR Grant Program

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Onterra, LLC
Lake Management Planning

Chilton Millpond

Calumet County, Wisconsin

Comprehensive Management Plan

November 2023

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1.0 INTRODUCTION

Chilton Millpond, Calumet County, is an impoundment on the South Branch of the Manitowoc River with a maximum depth of 7 feet and a mean depth of 3 feet (Map 1). This highly productive lake has a very large watershed when compared to the surface area of the lake. Chilton Millpond contains 12 native plant species, of which common waterweed is the most common plant. No exotic plant species are known to exist in Chilton Millpond.

According to the 1964 recording sonar WDNR Lake Survey Map, Chilton Millpond is 9.5 acres. The WDNR website lists the lake as 11 acres. At the time of this report, the most current orthophoto (aerial photograph) was from the *National Agriculture Imagery Program* (NAIP) collected in 2022. Based on heads-up digitizing of the water level from that photo, the lake was determined to be 11.1 acres.

Chilton Millpond is managed by the Chilton Lake District (CLD) which was formed in 1978 by citizens to define present and anticipated problems of the millpond and to implement measures to resolve with them. Chilton Millpond's water level is maintained by the Chilton Dam at the outlet on the east side of the lake which is currently owned and operated by the CLD. The dam was first constructed to power a gristmill. The dam is inspected every two years by the WDNR.

The CLD previously completed a comprehensive management planning projects in 1998 and 2002. With Onterra's assistance, the CLD successfully applied for a WDNR grant in November of 2021 to update the CLD's management plan for the lake as well as consider changes to the lake over the past two decades. This was completed by gathering and analyzing historical and current ecological data, identifying threats, determine the goals and values of stakeholders, present feasible management actions, and increase the lake group's capacity to implement the management plan. Fieldwork for this effort was conducted during the summer of 2022, with planning discussions and public outreach occurring during the winter, spring, and summer of 2023.

2.0 STAKEHOLDER PARTICIPATION

Stakeholder participation is an important part of any management planning exercise. During this project, stakeholders were not only informed about the project and its results, but also introduced to important concepts in lake ecology. The objective of this component in the planning process is to accommodate communication between the planners and the stakeholders. The communication is educational in nature, both in terms of the planners educating the stakeholders and vice-versa. The planners educate the stakeholders about the planning process, the functions of their lake ecosystem, their impact on the lake, and what can realistically be expected regarding the management of the aquatic system. The stakeholders educate the planners by describing how they would like the lake to be, how they use the lake, and how they would like to be involved in managing it. All of this information is communicated through multiple meetings that involve the lake group as a whole or a focus group called a Planning Committee, the completion of a stakeholder survey, and updates with the CLD Board of Commissioners.

The highlights of this component are described below. Materials used during the planning process can be found in Appendix A.

General Public Meeting

The general public meeting was used to raise project awareness, gather comments, and create the management goals and actions. The meeting was open to anyone interested in attending.

Kick-off Meeting

On August 17, 2022, a project kick-off meeting was held in the Community Room at Chilton City Hall to introduce the project to the general public. The meeting was announced using the City's public notice email system and postings at the city hall. The approximately 20 attendees observed a presentation given by Tim Hoyman, an aquatic ecologist with Onterra. Mr. Hoyman's presentation started with an educational component regarding general lake ecology and ended with a detailed description of the project including opportunities for stakeholders to be involved. The presentation was followed by a question-and-answer session.

Project Wrap-up Meeting

In lieu of a wrap-up meeting, the City of Chilton included a hardcopy of the management plan's Summary and Conclusions Section within the spring sanitary district mailing, which reaches every household in the Chilton Lake District.

Committee Level Meetings

Planning committee meetings, similar to general public meeting, were used to gather comments, create management goals and actions and to deliver study results. These two meetings were open only to the planning committee and were held during the week. The first, following the completion of the draft report sections of the management plan. The planning committee members were supplied with the draft report sections prior to the meeting and much of the meeting time was utilized to detail the results, discuss the conclusions and initial recommendations, and answer committee questions. The objective of the first meeting was to fortify a solid understanding of their lake among the committee members. The second planning committee meeting was held a few weeks after the first and concentrated on the development of management goals and actions that make up the framework of the implementation plan.

Planning Introduction

At the district's request, an introduction to lake planning meeting was held the fall prior to the start of the project on September 28, 2021. This meeting was facilitated by Tim Hoyman, Lead Aquatic Ecologist with Onterra, LLC. His presentation included a description of the process used by Onterra to assist a lake group in creating a management plan and an overview of the committee's role in that process.

Planning Committee Meeting I

On May 24, 2023, Tim Hoyman of Onterra met with the members of the Chilton Millpond Planning Committee for over two hours. In advance of the meeting, attendees were provided an early draft of the study report sections to facilitate better discussion. The primary focus of this meeting was the delivery of the study results and conclusions to the committee. All study components, including aquatic plant inventories, water quality analysis, and watershed modeling were presented and discussed. Many concerns were raised by the committee, including nuisance levels of aquatic plants, sedimentation, shoreline erosion, and fish kills. Dani Santry, Water Resource Specialist with the Calumet County Land and Water Conservation Department also presented information about the Lakeshore TMDL study and EPA Nine Key Element Watershed Management Plans.

Planning Committee Meeting II

On June 28, 2023, Tim Hoyman met with the members of the Planning Committee to discuss the stakeholder survey results and begin developing management goals and actions for the Chilton Millpond management plan. Tim also presented preliminary information regarding dredging on the Chilton Millpond and the use of mechanical harvesting, including a preliminary harvesting map of the committee's consideration.

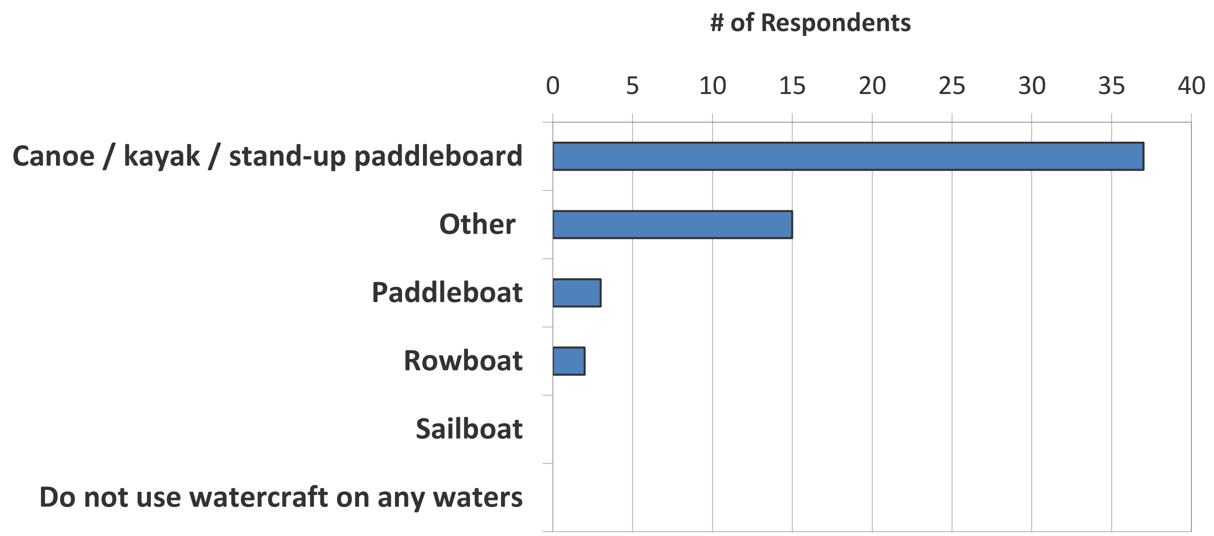
Stakeholder Survey

As a part of this project, a stakeholder survey was made available to all district households. The survey availability was announced via the City of Chilton's email distribution list, postings at the city hall, and via the city Facebook page. The survey was designed by Onterra staff and the Chilton Lake District planning committee, and reviewed by a WDNR social scientist. The survey was posted online through Survey Monkey and hardcopies were made available at the city hall. The returned hardcopy surveys were entered into the online version by city staff. Seventy-nine surveys were completed over the six weeks that it was available. The data were analyzed and summarized by Onterra for use at the planning meetings and within the management plan. The full survey and results can be found in Appendix B, while discussion of those results is integrated within the appropriate sections of the management plan and a general summary is discussed below.

The following sections (Water Quality, Watershed, Aquatic Plants and Fisheries Data Integration) discuss the stakeholder survey data with respect these particular topics. Figure 2.0-1 highlight a couple questions found within this survey. Based upon the results of the stakeholder survey, much was learned about the people who use and care for Chilton Millpond. According to Question 2, nearly 50% of respondents have resided in Chilton over 25 years. Majority of survey respondents indicate that they use a canoe/kayak/ stand-up paddleboard or do not use a vessel on Chilton Millpond (Question 10).

A concern of respondents noted throughout the stakeholder survey (see Question 13 and survey comments – Appendix B) was water quality within Chilton Millpond and the Manitowoc River. This topic is touched upon further in the Water Quality section.

Question 10: What types of watercraft do you currently use on Chilton Millpond?



Question 13: From the list below, please rank your top three concerns regarding Chilton Millpond, with 1 being your greatest concern.

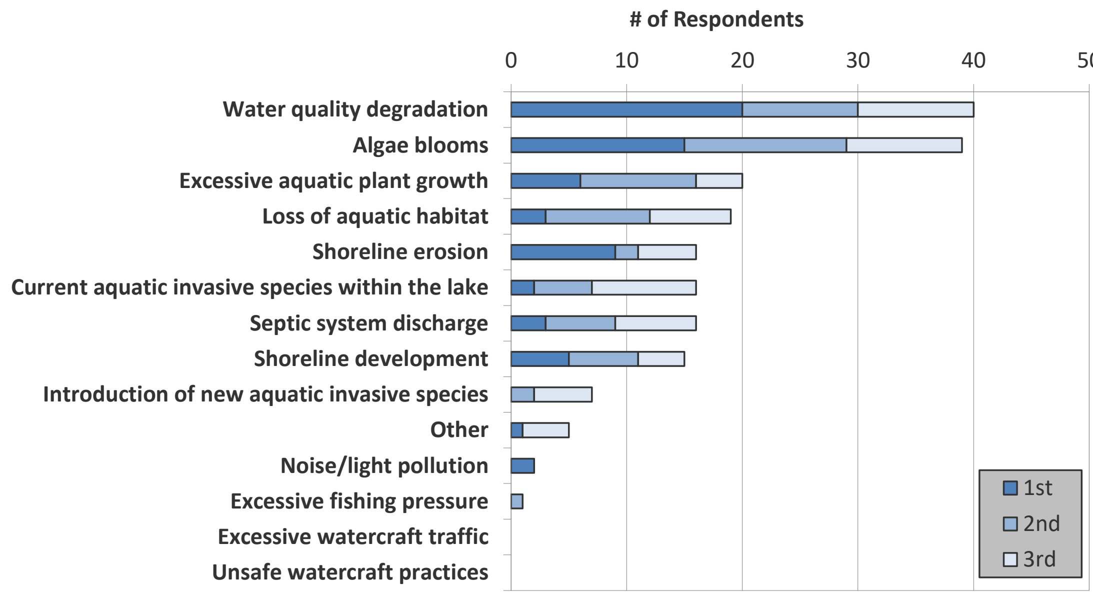


Figure 2.0-1. Select survey responses from the Chilton Millpond Stakeholder Survey. Additional questions and response charts may be found in Appendix B.

Management Plan Review and Adoption Process

Following the second planning meeting, Tim Hoyman participated in a conference call with City of Chilton staff on July 12, 2023, to discuss the implementation plan specifics. The discussion centered on potential dredging in the millpond and the use of a mechanical harvester. On July 20, 2023, a draft of the Implementation Plan was provided to the Planning Committee for review. Minimal comments were received from the planning committee members; however, one alderperson responded with positive comments and Dani Santry, Calumet County Land and Water Conservation Department, provided several comments that were integrated within the plan.

The Official First Draft of the Chilton Millpond Comprehensive Management Plan was provided to the WDNR on November 9, 2023. On November 15, 2023, Mary Gansberg, WDNR Water Resources Management Specialist, responded with valuable comments that were integrated into the final draft of the plan. No other WDNR comments were received. Responses to the WDNR comments and Ms. Gansberg's final approval of the comprehensive management plan are included in Appendix C.

The draft comprehensive plan was uploaded to the City of Chilton website on November 10, 2023. On that same day, an announcement of the plan's availability for public review was sent out on the city's listserv stating comments would be received through the included email address of the City Administrator through December 1, 2023. A single comment was received praising the effort and report, questioning the department's willingness to participate, and stating that outside sources would need to be used to raise the funds to complete the actions beyond state grants. The city's notice of the public post is included in Appendix A.

On December 19, 2023, the Chilton City Council/Chilton Lake District Board voted unanimously to accept the management plan. The resolution is included in Appendix A.

3.0 RESULTS & DISCUSSION

3.1 Lake Water Quality

Water Quality Data Analysis and Interpretation

Reporting of water quality assessment results can often be a difficult and ambiguous task. Foremost is that the assessment inherently calls for a baseline knowledge of lake chemistry and ecology. Many of the parameters assessed are part of a complicated cycle and each element may occur in many different forms within a lake. Furthermore, water quality values that may be considered poor for one lake may be considered good for another because judging water quality is often subjective. However, focusing on specific aspects or parameters that are important to lake ecology, comparing those values to similar lakes within the same region and historical data from the study lake provides an excellent method to evaluate the quality of a lake's water.

Many types of analyses are available for assessing the condition of a particular lake's water quality. In this document, the water quality analysis focuses upon attributes that are directly related to the productivity of the lake. In other words, the water quality that impacts and controls the fishery, plant production, and even the aesthetics of the lake are related here. Specific forms of water quality analyses are used to indicate not only the health of the lake, but also to provide a general understanding of the lake's ecology and assist in management decisions. Each type of available analysis is elaborated on below.

As mentioned above, chemistry is a large part of water quality analysis. In most cases, listing the values of specific parameters really does not lead to an understanding of a lake's water quality, especially in the minds of non-professionals. A better way of relating the information is to compare it to lakes with similar physical characteristics and lakes within the same regional area. In this document, a portion of the water quality information collected on Chilton Millpond is compared to other lakes in the state with similar characteristics as well as to lakes within the northern region. In addition, the assessment can also be clarified by limiting the primary analysis to parameters that are important in the lake's ecology and trophic state (see below). Three water quality parameters are focused upon in the Chilton Millpond water quality analysis:

> **Phosphorus** is the nutrient that controls the growth of plants in the vast majority of Wisconsin lakes. It is important to remember that in lakes, the term "plants" includes both algae and macrophytes. Monitoring and evaluating concentrations of phosphorus within the lake helps to create a better understanding of the current and potential growth rates of the plants within the lake.
>
> **Chlorophyll-*a*** is the green pigment in plants used during photosynthesis. Chlorophyll-*a* concentrations are directly related to the abundance of free-floating algae in the lake. Chlorophyll-*a* values increase during algal blooms.
>
> **Secchi disk transparency** is a measurement of water clarity. Of all limnological parameters, it is the most used and the easiest for non-professionals to understand. Furthermore, measuring Secchi disk transparency over long periods of time is one of the best methods of monitoring the health of a lake. The measurement is conducted by lowering a weighted, 20-cm diameter disk with alternating black and white quadrants (a Secchi disk) into the water and recording the depth just before it disappears from sight.

The parameters described above are interrelated. Phosphorus controls algal abundance, which is measured by chlorophyll-*a* levels. Water clarity, as measured by Secchi disk transparency, is directly affected by the particulates that are suspended in the water. In the majority of natural Wisconsin lakes, the primary particulate matter is algae; therefore, algal abundance directly affects water clarity. In addition, studies have shown that water clarity is used by most lake users to judge water quality – clear water equals clean water (Canter, Nelson, & Everett, 1994) (Dinius, 2007) (Smith, Cragg, & Croker, 1991).

Trophic State

Trophic states describe the lake's ability to produce plant matter (production) and include three continuous classifications: Oligotrophic lakes are the least productive lakes and are characterized by being deep, having cold water, and few plants. Eutrophic lakes are the most productive and normally have shallow depths, warm water, and high plant biomass. Mesotrophic lakes fall between these two categories.

Total phosphorus, chlorophyll-*a*, and water clarity values are directly related to the trophic state of the lake. As nutrients, primarily phosphorus, accumulate within a lake, its productivity increases and the lake progresses through three trophic states: oligotrophic, mesotrophic, and finally eutrophic. Every lake will naturally progress through these states and under natural conditions (i.e. not influenced by the activities of humans) this progress can take tens of thousands of years. Unfortunately, human influence has accelerated this natural aging process in many Wisconsin lakes. Monitoring the trophic state of a lake gives stakeholders a method by which to gauge the productivity of their lake over time. Yet, classifying a lake into one of three trophic states often does not give clear indication of where a lake really exists in its trophic progression because each trophic state represents a range of productivity. Therefore, two lakes classified in the same trophic state can actually have very different levels of production.

However, through the use of a trophic state index (TSI), an index number can be calculated using phosphorus, chlorophyll-*a*, and clarity values that represent the lake's position within the eutrophication process. This allows for a clearer understanding of the lake's trophic state while facilitating clearer long-term tracking. (Carlson, 1977) presented a trophic state index that gained great acceptance among lake managers.

Limiting Nutrient

The limiting nutrient is the nutrient which is in shortest supply and controls the growth rate of algae and some macrophytes within the lake. This is analogous to baking a cake that requires four eggs, and four cups each of water, flour, and sugar. If the baker would like to make four cakes, he needs 16 of each ingredient. If he is short two eggs, he will only be able to make three cakes even if he has sufficient amounts of the other ingredients. In this scenario, the eggs are the limiting nutrient (ingredient).

In most Wisconsin lakes, phosphorus is the limiting nutrient controlling the production of plant biomass. As a result, phosphorus is often the target for management actions aimed at controlling plants, especially algae. The limiting nutrient is determined by calculating the nitrogen to phosphorus ratio within the lake. Normally, total nitrogen and total phosphorus values from the surface samples taken during the summer months are used to determine the ratio. Results of this ratio indicate if algal growth within a lake is limited by nitrogen or phosphorus. If the ratio is greater than 15:1, the lake is considered phosphorus limited; if it is less than 10:1, it is considered nitrogen limited. Values between these ratios indicate a transitional limitation between nitrogen and phosphorus.

Temperature and Dissolved Oxygen Profiles

Lake stratification occurs when temperature gradients are developed with depth in a lake. During stratification the lake can be broken into three layers: The epilimnion is the top layer of water which is the warmest water in the summer months and the coolest water in the winter months. The hypolimnion is the bottom layer and contains the coolest water in the summer months and the warmest water in the winter months. The metalimnion, often called the thermocline, is the middle layer containing the steepest temperature gradient.

Temperature and dissolved oxygen profiles are created simply by taking readings at different water depths within a lake. Although it is a simple procedure, the completion of several profiles over the course of a year or more provides a great deal of information about the lake. Much of this information relates to whether the lake thermally stratifies or not, which is determined primarily through the temperature profiles. Lakes that show strong stratification during the summer and winter months need to be managed differently than lakes that do not. Normally, deep lakes stratify to some extent, while shallow lakes (less than 17 feet deep) do not.

Dissolved oxygen is essential in the metabolism of nearly every organism that exists within a lake. For instance, fish kills are often the result of insufficient amounts of dissolved oxygen. However, dissolved oxygen's role in lake management extends beyond this basic need by living organisms. In fact, its presence or absence impacts many chemical processes that occur within a lake. Internal nutrient loading is an excellent example that is described below.

Internal Nutrient Loading*

In lakes that support stratification, whether throughout the summer or periodically between mixing events, the hypolimnion can become devoid of oxygen both in the water column and within the sediment. When this occurs, iron changes from a form that normally binds phosphorus within the sediment to a form that releases it to the overlaying water. This can result in very high concentrations of phosphorus in the hypolimnion. Then, during turnover events, these high concentrations of phosphorus are mixed within the lake and utilized by algae and some macrophytes. In lakes that mix periodically during the summer (polymictic lakes), this cycle can *pump* phosphorus from the sediments into the water column throughout the growing season. In lakes that only mix during the spring and fall (dimictic lakes), this burst of phosphorus can support late-season algae blooms and even last through the winter to support early algal blooms the following spring. Further, anoxic conditions under the winter ice in both polymictic and dimictic lakes can add smaller loads of phosphorus to the water column during spring turnover that may support algae blooms long into the summer. This cycle continues year after year and is termed "internal phosphorus loading"; a phenomenon that can support nuisance algal blooms decades after external sources are controlled.

The first step in the analysis is determining if the lake is a candidate for significant internal phosphorus loading. Water quality data and watershed modeling are used to determine actual and predicted levels of phosphorus for the lake. When the predicted phosphorus level is well below the actual level, it may be an indication that the modeling is not accounting for all of the phosphorus sources entering the lake. Internal nutrient loading may be one of the additional contributors that may need to be assessed with further water quality analysis and possibly additional, more intense studies.

Non-Candidate Lakes

- Lakes that do not experience hypolimnetic anoxia.
- Lakes that do not stratify for significant periods (i.e. days or weeks at a time).
- Lakes with hypolimnetic total phosphorus values less than 200 µg/L.

Candidate Lakes

- Lakes with hypolimnetic total phosphorus concentrations exceeding 200 µg/L.
- Lakes with epilimnetic phosphorus concentrations that cannot be accounted for in watershed phosphorus load modeling.

Specific to the final bullet-point, during the watershed modeling assessment, the results of the modeled phosphorus loads are used to estimate in-lake phosphorus concentrations. If these estimates are much lower than those actually found in the lake, another source of phosphorus must be responsible for elevating the in-lake concentrations. Normally, two possibilities exist: 1) shoreland septic systems, and 2) internal phosphorus cycling. If the lake is considered a candidate for internal loading, modeling procedures are used to estimate that load.

Comparisons with Other Datasets

The WDNR document *Wisconsin 2020 Consolidated Assessment and Listing Methodology* (WDNR, 2019) is an excellent source of data for comparing water quality from a given lake to lakes with similar features and lakes within specific regions of Wisconsin. Water quality among lakes, even among lakes that are located in close proximity to one another, can vary due to natural factors such as depth, surface area, the size of its watershed and the composition of the watershed's land cover. For this reason, the water quality of Chilton Millpond will be compared to lakes in the state with similar physical characteristics. The WDNR groups Wisconsin's lakes into ten natural communities (Figure 3.1-1).

First, the lakes are classified into three main groups: (1) lakes and reservoirs less than 10 acres, (2) lakes and reservoirs greater than or equal to 10 acres, and (3) a classification that addresses special waterbody circumstances. The last two categories have several sub-categories that provide attention to lakes that may be shallow, deep, play host to cold water fish species or have unique hydrologic patterns. Overall, the divisions categorize lakes based upon their size, stratification characteristics, and hydrology.

An equation developed by Lathrop and Lillie (Lathrop & Lillie, 1980), which incorporates the maximum depth of the lake and the lake's surface area, is used to predict whether the lake is considered a shallow (mixed) lake or a deep (stratified) lake. The lakes are further divided into classifications based on their hydrology and watershed size:

> **Seepage Lakes** have no surface water inflow or outflow in the form of rivers and/or streams.

Drainage Lakes have surface water inflow and/or outflow in the form of rivers and/or streams.

Headwater drainage lakes have a watershed of less than 4 square miles.

Lowland drainage lakes have a watershed of greater than 4 square miles.

Because of its depth, large watershed and hydrology, Chilton Millpond is classified as a shallow lowland drainage lake (category 4 on Figure 3.1-1).

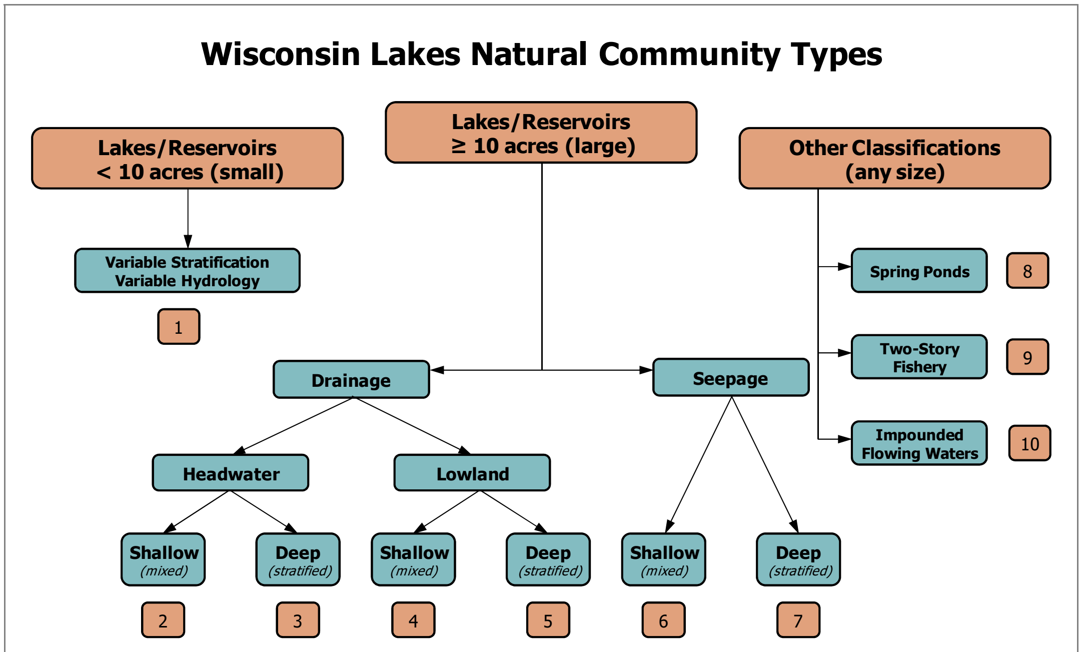


Figure 3.1-1. Wisconsin Lake Natural Communities. Adapted from WDNR 2017.

(Garrison, et al., 2008) developed statewide median values for total phosphorus, chlorophyll-*a*, and Secchi disk transparency for six of the lake classifications. Though they did not sample sufficient lakes to create median values for each classification within each of the state's ecoregions, they were able to create median values based on all of the lakes sampled within each ecoregion (Figure 3.1-2). Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states. Chilton Millpond is within the Southeastern Wisconsin Till Plains ecoregion.

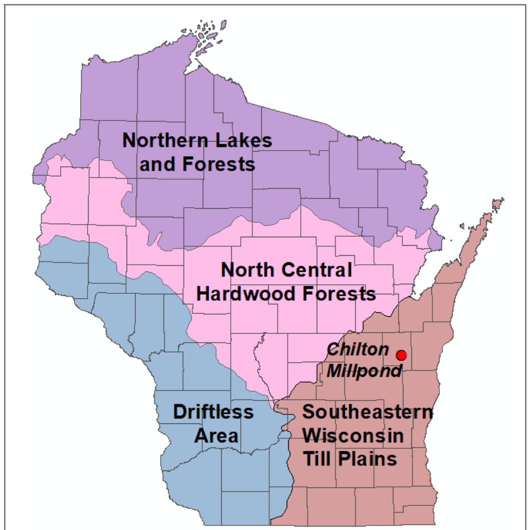


Figure 3.1-2. Location of Chilton Millpond within the ecoregions of Wisconsin. After Nichols 1999.

The Wisconsin 2020 Consolidated Assessment and Listing Methodology document also helps stakeholders understand the health of their lake compared to other lakes within the state. Looking at pre-settlement diatom population compositions from sediment cores collected from numerous lakes around the state, they were able to infer a reference condition for each lake's water quality prior to human development within their watersheds. Using these reference conditions and current water quality data, the assessors were able to rank phosphorus, chlorophyll-*a*, and Secchi disk transparency values for each lake class into categories ranging from excellent to poor.

These data along with data corresponding to statewide natural lake means, historic, current, and average data from Chilton Millpond is displayed in Figures 3.1-3 - 3.1-5. Please note that the data in these graphs represent concentrations and depths taken only during the growing season (April-October) or summer months (June-August). Furthermore, the phosphorus and chlorophyll-*a* data represent only surface samples. Surface samples are used because they represent the depths at which algae grow and depths at which phosphorus levels are not greatly influenced by phosphorus being released from bottom sediments.

Chilton Millpond Water Quality Analysis

Surface water samples were collected from the deepest location in the lake (Map 1, Station ID 10007721) by Onterra ecologists during spring, June, July, August, September, and October, 2022, and February 2023. All samples were collected with a Van dorn bottle and all analysis were completed by the WI State Laboratory of Hygiene in Madison. Results of the analysis were entered in the WDNR Surface Water Integrated Management System (SWIMS).

Chilton Millpond Long-term Trends

Very little water quality data are available for Chilton Millpond, which makes long-term trend analysis impossible. Total phosphorus (Figure 3.1-3) and Chlorophyll-*a* (Figure 3.1-4) data are available from three years, 1993, 2021, and 2022.and Secchi disk transparency (Figure 3.1-5) data are available for two years, 2021, and 2022. Still, comparisons of existing data can be made between Chilton Millpond data and median data from the Southeastern Wisconsin Till Plains ecoregion and shallow lowland drainage lakes in Wisconsin.

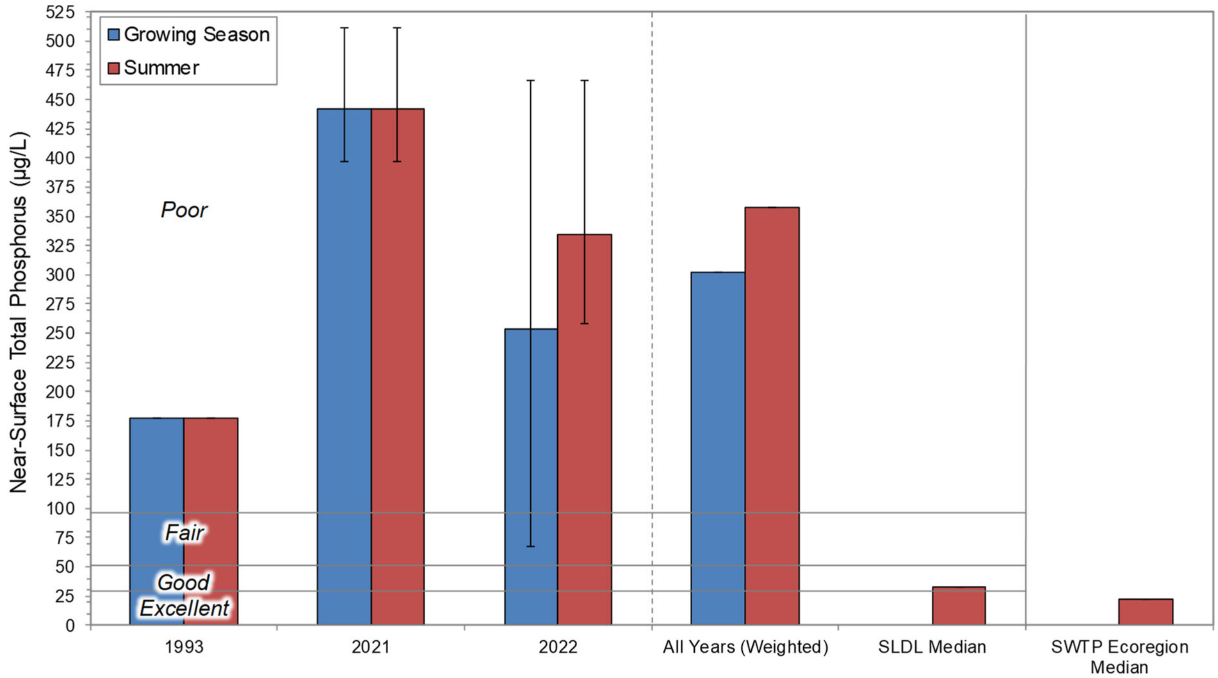


Figure 3.1-3. Chilton Millpond, statewide class 4 lakes, and regional total phosphorus concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Total phosphorus was sampled three times during the 2021 growing season and six times during the 2022 growing season. The millpond was sampled only once during 1993; therefore, the current data is a better representation of the total phosphorus concentrations found in Chilton Millpond over the summer and growing season months. During 2021, the concentrations ranged between 397 and 511 µg/L. They fluctuated even more during 2022 with a minimum concentration of 67 µg/L being collected in mid-April and the season high of 466 µg/L recorded just over 7 weeks later in mid-June. Wide variation in nutrient content is common in small waterbodies with very large surface watersheds feeding them.

The mean total phosphorus concentrations from all three sample years are considered poor for shallow lowland drainage lakes and are much higher than the median values for other lakes of that type in the state and all lake types in the Southeastern Wisconsin Till Plains ecoregion. The growing season mean for all available data from Chilton Millpond is high at 358 µg/L.

Chlorophyll-*a* concentrations are considered very low in Chilton Millpond with the lake's summer mean value of 3.2 µg/L, which is much lower than the median values from the Southeastern Wisconsin Till Plains ecoregion and other shallow lowland drainage lakes in the state.

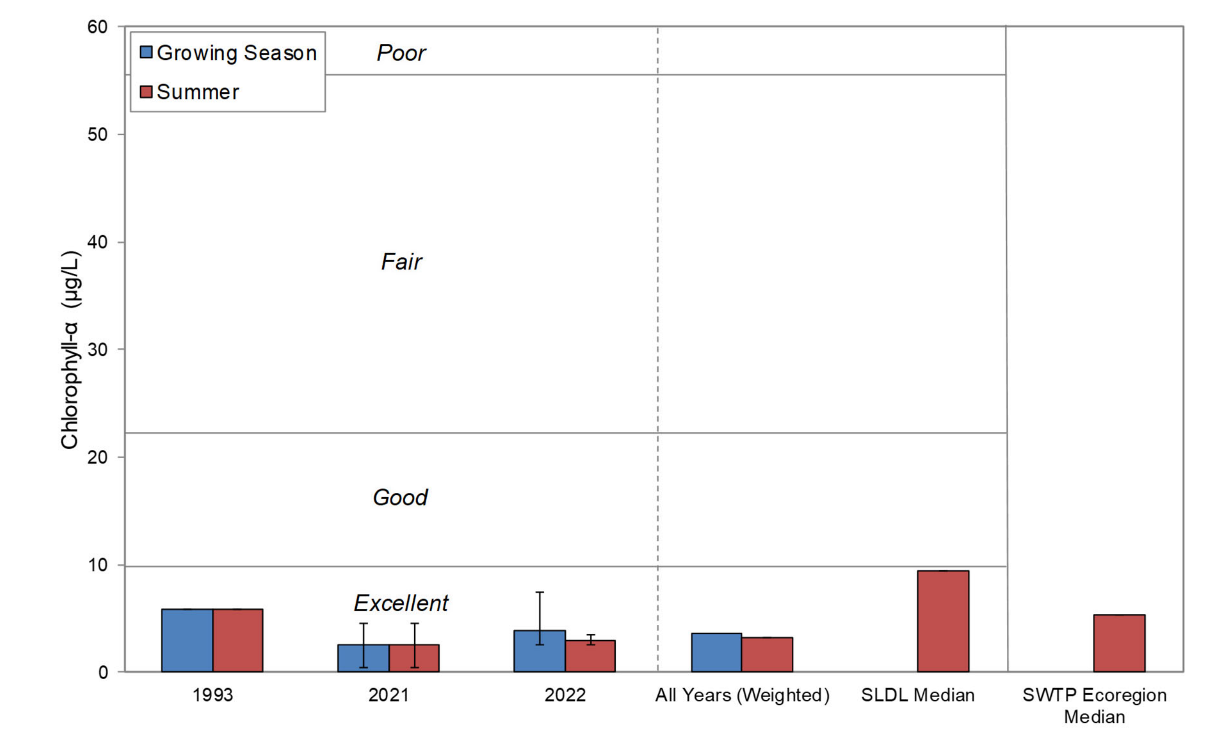


Figure 3.1-4. Chilton Millpond, statewide class 4 lakes, and regional chlorophyll-a concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

As described in the primer section above, total phosphorus and chlorophyll-*a* concentrations are typically correlated in Wisconsin lakes. This is due to the fact that phosphorus is typically the limiting nutrient controlling algal growth. The relationship between phosphorus and chlorophyll-*a* in Chilton Millpond is not strong for two reasons; first, phosphorus is not the limiting nutrient in Chilton Millpond (see below for more information), and second, and likely the most important, is the tremendously high flushing rate of the millpond. In flowages with flushing rates of less than 14 days, algae populations do not have time to build resulting in lower chlorophyll-*a* concentrations. As discussed in the Watershed Assessment Section 3.2, Chilton's flushing rate is less than a day, so chlorophyll-*a* concentrations remain low despite high nutrient levels. All sampling events at the millpond have resulted in chlorophyll-*a* concentrations considered *Excellent* with means below the median state and ecoregion values.

Secchi disk clarity during 2021 and 2022 is considered *Good* to *Fair* throughout the dataset with the exception of a 7-foot Secchi disk measurement during April 2022 which brought the 2022 growing season mean into the *Excellent* category. The mean value of 3.0 feet is below the median values from the ecoregion and state databases.

Water clarity is controlled by suspended particles in the water column (turbidity) and light absorption due to color. In the Chilton Millpond, the primary factor controlling water clarity is color. As detailed below, the millpond has tea-colored water, which limits light penetration. Suspended sediment likely also plays a role at times, as well.

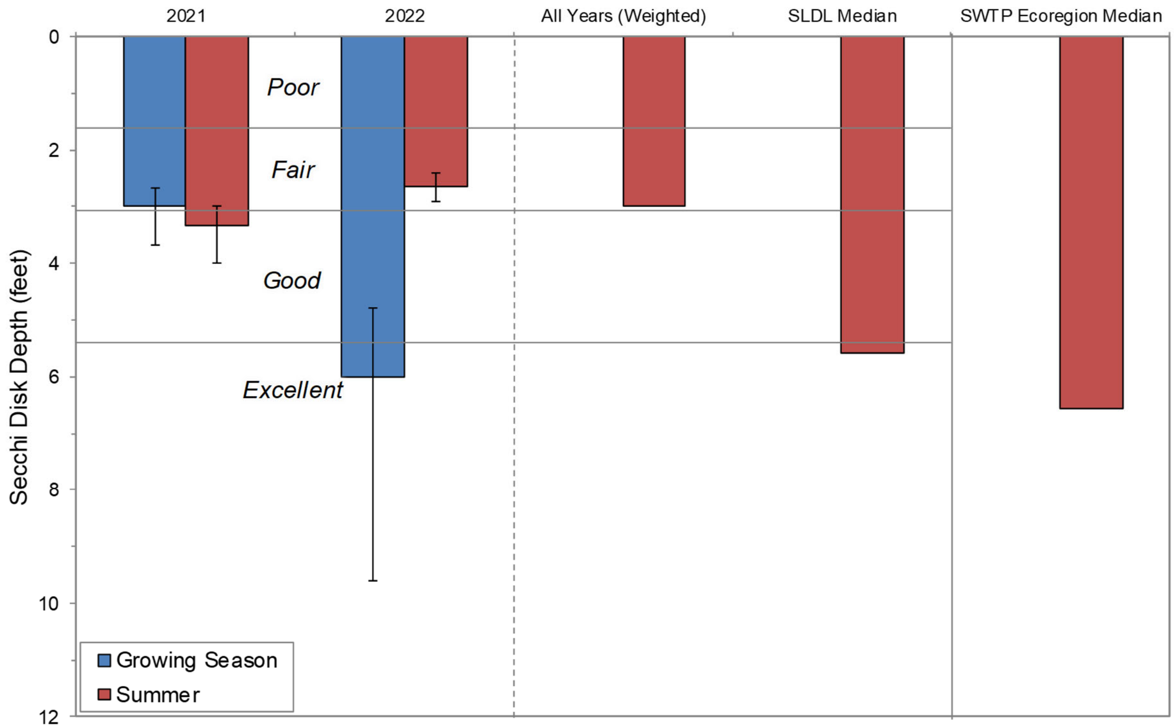


Figure 3.1-5. Chilton Millpond, statewide class 4 lakes, and regional Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR PUB WT-913.

Limiting Plant Nutrient of Chilton Millpond

Using midsummer nitrogen and phosphorus concentrations from Chilton Millpond, a nitrogen:phosphorus ratio of 9:1 was calculated. This finding indicates that Chilton Millpond nitrogen limited in terms of algae growth. This is not necessarily because the millpond has very low nitrogen concentrations, but more because it has unusually high phosphorus concentrations.

Chilton Millpond Trophic State

Figure 3.1-5 contains the Trophic State Index (TSI) values for Chilton Millpond. The TSI values are calculated with average Secchi disk, chlorophyll-*a*, and total phosphorus values. Typically, the values are similar between the three parameters because of the relationship of the three trophic parameters. This can be seen with the TSI values calculated for the median values from the Southeastern Wisconsin Till Plains ecoregion and statewide shallow headwater drainage lakes. The trophic level of a lake is an indicator of nutrification and productivity within the lake. Phosphorus values in Chilton Millpond are quite high, so using those values to calculate TSI indicates the lake has unhealthy (hypereutrophic) levels of nutrients; however, the lake's very low chlorophyll-*a* values produce TSI values within the low mesotrophic range. The millpond's Secchi disk values are high impacted by water color, which is not related to its trophic state; therefore, the TSI values produced with Secchi disk values are unrepresentative in this analysis (Figure 3.1-6). To approximate the trophic level of Chilton Millpond, we need to consider its macrophyte population, which is quite dense in much of the lake. That high level of plant production indicates that the lake is likely eutrophic.

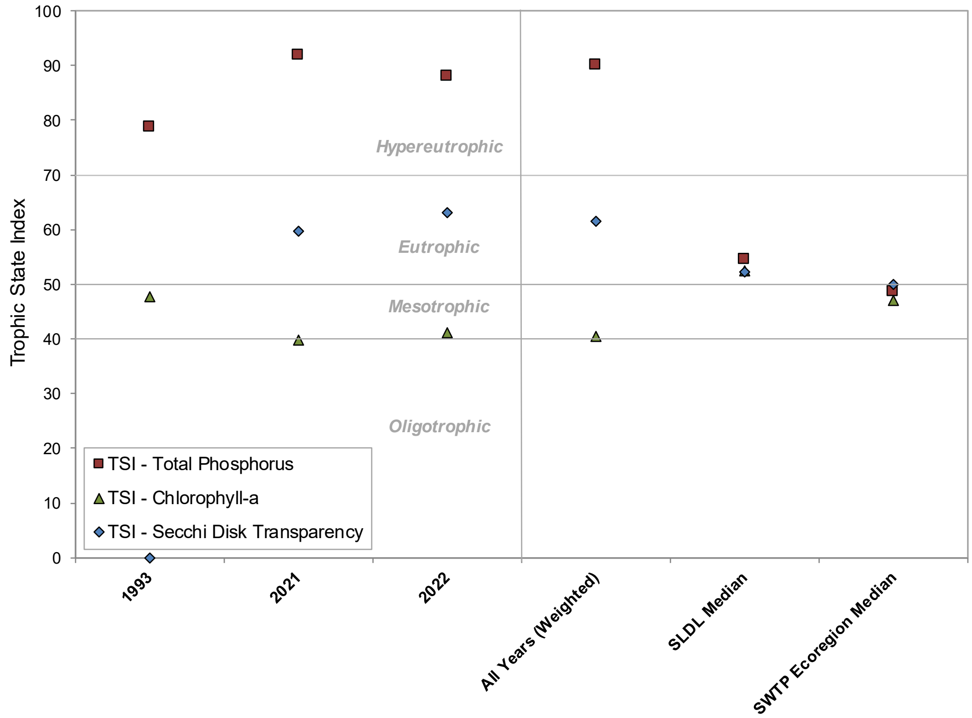


Figure 3.1-6. Chilton Millpond, statewide class 4 lakes, and regional Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Chilton Millpond

Dissolved oxygen and temperature were measured during water quality sampling visits to Chilton Millpond by Onterra staff. Profiles depicting these data are displayed in Figure 3.1-7. During these sampling periods, the deep hole sampling location held sufficient oxygen to support fish and other forms of aquatic wildlife.

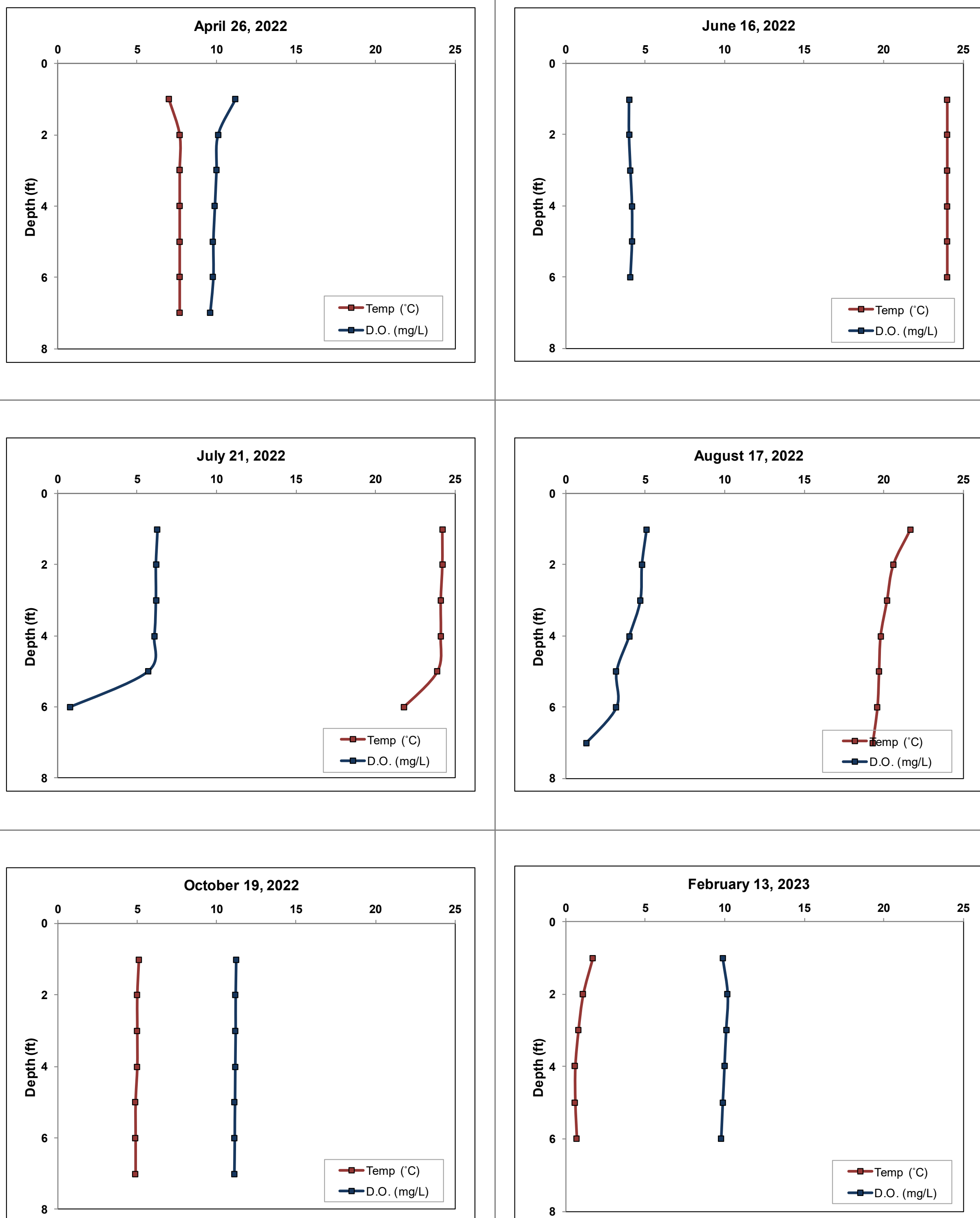


Figure 3.1-7. Chilton Millpond dissolved oxygen and temperature profiles.

Additional Water Quality Data Collected at Chilton Millpond

The water quality section is centered on lake eutrophication. However, parameters other than water clarity, nutrients, and chlorophyll-*a* were collected as part of the project. These other parameters were collected to increase the understanding of Chilton Millpond's water quality and are recommended as a part of the WDNR long-term lake trends monitoring protocol. These parameters include pH, alkalinity, and calcium.

The pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is an index of the lake's acidity. Water with a pH value of 7 has equal amounts of hydrogen ions and hydroxide ions (OH^-), and is considered to be neutral. Water with a pH of less than 7 has higher concentrations of hydrogen ions and is considered to be acidic, while values greater than 7 have lower hydrogen ion concentrations and are considered basic or alkaline. The pH scale is logarithmic; meaning that for every 1.0 pH unit the hydrogen ion concentration changes tenfold. The normal range for lake water pH in Wisconsin is about 5.2 to 8.4, though values lower than 5.2 can be observed in some acid bog lakes and higher than 8.4 in some marl lakes. In lakes with a pH of 6.5 and lower, the spawning of certain fish species such as walleye becomes inhibited (Shaw & Nimphius, 1985). The pH of the water in Chilton Millpond was found to be slightly alkaline with a value of 8.4, and falls within the normal range for Wisconsin Lakes (Figure 3.1-8).

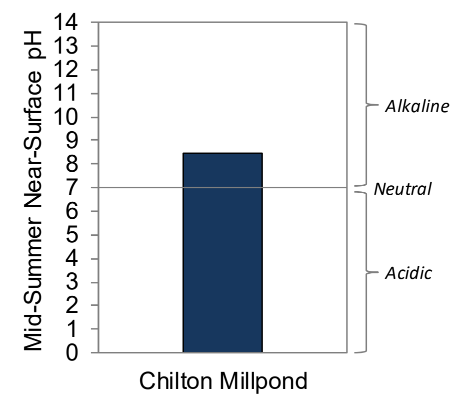


Figure 3.1-8. Chilton Millpond mid-summer near-surface pH value.

Alkalinity is a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. The main compounds that contribute to a lake's alkalinity in Wisconsin are bicarbonate (HCO_3^-) and carbonate (CO_3^-), which neutralize hydrogen ions from acidic inputs. These compounds are present in a lake if the groundwater entering it comes into contact with minerals such as calcite ($CaCO_3$) and/or dolomite ($(CaMgCO_3)_2$). A lake's pH is primarily determined by the amount of alkalinity. Rainwater in northern Wisconsin is slightly acidic naturally due to dissolved carbon dioxide from the atmosphere with a pH of around 5.0. Consequently, lakes with low alkalinity have lower pH due to their inability to buffer against acid inputs. The alkalinity in Chilton Millpond was measured at 303 mg/L as $CaCO_3$, indicating that the lake has a substantial capacity to resist fluctuations in pH and has a low sensitivity to acid rain (Figure 3.1-9).

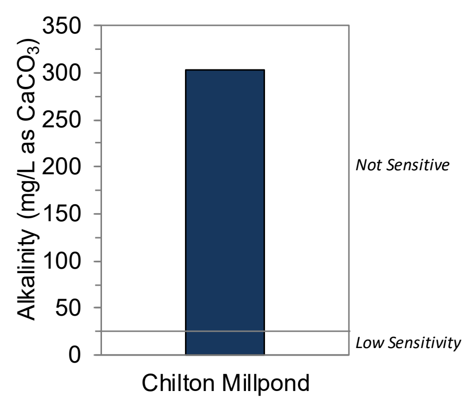


Figure 3.1-9. Chilton Millpond average growing season total alkalinity and sensitivity to acid rain. Samples collected from near-surface.

Like associated pH and alkalinity, the concentration of calcium within a lake's water depends on the geology of the lake's watershed. Recently, the combination of calcium concentration and pH has been used to determine what lakes can support zebra mussel populations if they are introduced. The commonly accepted pH range for zebra mussels is 7.0 to 9.0, so Chilton Millpond's pH of 8.4 falls inside of this range. Lakes with calcium concentrations of less than 12 mg/L are considered to have very low susceptibility to zebra mussel establishment. The calcium concentration of Chilton Millpond was found to be 75.1 mg/L, falling well within the optimal range for zebra mussels (Figure 3.1-10).

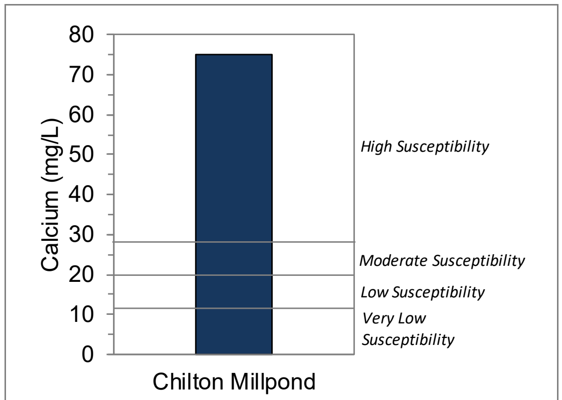


Figure 3.1-10. Chilton Millpond spring calcium concentration and zebra mussel susceptibility. Samples collected from the near-surface.

Zebra mussels (*Dreissena polymorpha*) are small bottom-dwelling mussels, native to Europe and Asia, that found their way to the Great Lakes region in the mid-1980s. They are thought to have come into the region through ballast water of ocean-going ships entering the Great Lakes, and they have the capacity to spread rapidly. Zebra mussels can attach themselves to boats, boat lifts, and docks, and can live for up to five days after being taken out of the water. These mussels can be identified by their small size, D-shaped shell and yellow-brown striped coloring. Once zebra mussels have entered and established in a waterway, they are nearly impossible to eradicate. Best practice methods for cleaning boats that have been in zebra mussel infested waters is inspecting and removing any attached mussels, spraying your boat down with diluted bleach, power-washing, and letting the watercraft dry for at least five days. Tows for zebra mussel veligers were completed by Onterra staff August 17, 2022. The veligers are a free-swimming, microscopic life stage of zebra mussels. The samples did not contain veligers, which is a good sign zebra mussels do not exist in the millpond.

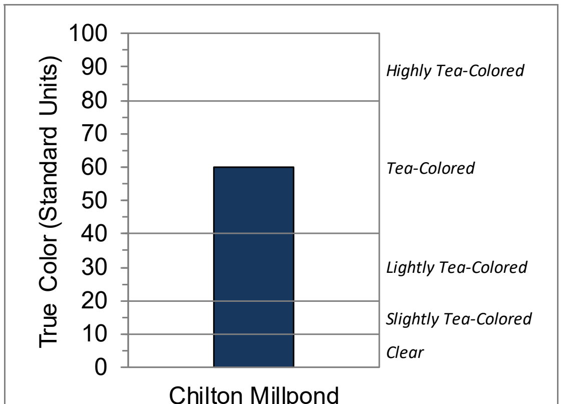


Figure 3.1-11. Chilton Millpond 2022 near-surface true color value.

A measure of water clarity once all of the suspended material (i.e., phytoplankton and sediments) have been removed, is termed *true color*, and measures how the clarity of the water is influenced by dissolved components. True color was measured at 60 SU (standard units) in July of 2022, indicating the lake's water was *tea-colored* in (Figure 3.1-11).

Stakeholder Survey Responses to Chilton Millpond Water Quality

As discussed in section 2.0, the stakeholder survey asks many questions pertaining to perception of the lake and how it may have changed over the years. Figures 3.1-12 and 3.1-13 display the responses of members of Chilton Millpond stakeholders to questions regarding water quality and how it has changed over their years visiting Chilton Millpond.

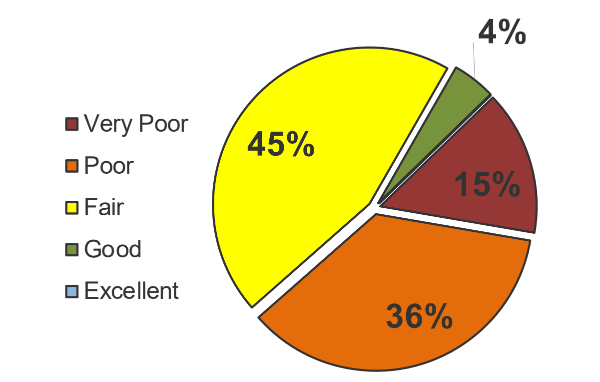


Figure 3.1-12. Stakeholder survey response Question #16. How would you describe the current water quality of Chilton Millpond?

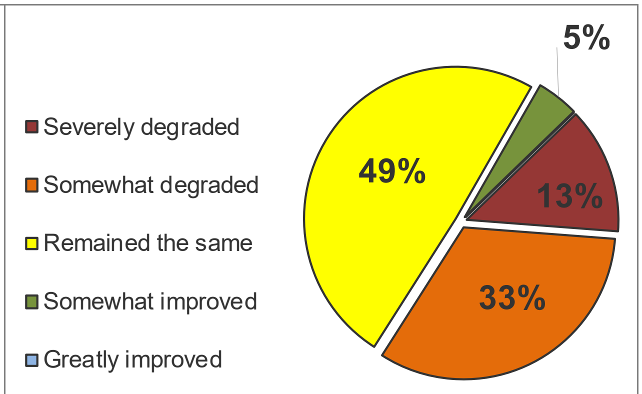


Figure 3.1-13. Stakeholder survey response Question #17. How has the water quality changed in Chilton Millpond since you first visited the lake?

3.2 Watershed Assessment

Watershed Modeling

A lake's **flushing rate** is simply a determination of the time required for the lake's water volume to be completely exchanged. **Residence time** describes how long a volume of water remains in the lake and is expressed in days, months, or years. The parameters are related and both determined by the volume of the lake and the amount of water entering the lake from its watershed. Greater flushing rates equal shorter residence times.

Two aspects of a lake's watershed are the key factors in determining the amount of phosphorus the watershed exports to the lake; 1) the size of the watershed, and 2) the land cover (land use) within the watershed. The impact of the watershed size is dependent on how large it is relative to the size of the lake. The watershed to lake area ratio (WS:LA) defines how many acres of watershed drains to each surface-acre of the lake. Larger ratios result in the watershed having a greater role in the lake's annual water budget and phosphorus load.

The type of land cover that exists in the watershed determines the amount of phosphorus (and sediment) that runs off the land and eventually makes its way to the lake. The actual amount of pollutants (nutrients, sediment, toxins, etc.) depends greatly on how the land within the watershed is used. Vegetated areas, such as forests, grasslands, and meadows, allow the water to permeate the ground and do not produce much surface runoff. On the other hand, agricultural areas, particularly row crops, along with residential/urban areas, minimize infiltration and increase surface runoff. The increased surface runoff associated with these land cover types leads to increased phosphorus and pollutant loading; which, in turn, can lead to nuisance algal blooms, increased sedimentation, and/or overabundant macrophyte populations. For these reasons, it is important to maintain as much natural land cover (forests, wetlands, etc.) as possible within a lake's watershed to minimize the amount runoff (nutrients, sediment, etc.) from entering the lake.

In systems with lower WS:LA ratios, land cover type plays a very important role in how much phosphorus is loaded to the lake from the watershed. In these systems, the occurrence of agriculture or urban development in even a small percentage of the watershed (less than 10%) can unnaturally elevate phosphorus inputs to the lake. If these land cover types are converted to a cover that does not export as much phosphorus, such as converting row crop areas to grass or forested areas, the phosphorus load and its impacts to the lake may be decreased. In fact, if the phosphorus load is reduced greatly, changes in lake water quality may be noticeable, (e.g. reduced algal abundance and better water clarity) and may even be enough to cause a shift in the lake's trophic state.

In systems with high WS:LA ratios, like those 10-15:1 or higher, the impact of land cover may be tempered by the sheer amount of land draining to the lake. Situations actually occur where lakes with completely forested watersheds have sufficient phosphorus loads to support high rates of plant production. In other systems with high ratios, the conversion of vast areas of row crops to vegetated areas (grasslands, meadows, forests, etc.) may not reduce phosphorus loads sufficiently to see a change in plant production. Both of these situations occur frequently in impoundments.

Regardless of the size of the watershed or the makeup of its land cover, it must be remembered that every lake is different and other factors, such as flushing rate, lake volume, sediment type, and many others, also influence how the lake will react to what is flowing into it. For instance, a deeper lake with a greater volume can dilute more phosphorus within its waters than a less voluminous lake and as a result, the production of a lake is kept low. However, in that same lake, because of its low flushing rate (a residence time of years), there may be a buildup of phosphorus in the sediments that may reach sufficient levels over time and lead to a problem such as internal nutrient loading. On the contrary, a lake with a higher flushing rate (low residence time, i.e., days or weeks) may be more productive early on, but the constant flushing of its waters may prevent a buildup of phosphorus and internal nutrient loading may never reach significant levels.

A reliable and cost-efficient method of creating a general picture of a watershed's effect on a lake can be obtained through modeling. The WDNR created a useful suite of modeling tools called the Wisconsin Lake Modeling Suite (WiLMS). Certain morphological attributes of a lake and its watershed are entered into WiLMS along with the acreages of different types of land cover within the watershed to produce useful information about the lake ecosystem. This information includes an estimate of annual phosphorus load and the partitioning of those loads between the watershed's different land cover types and atmospheric fallout entering through the lake's water surface. WiLMS also calculates the lake's flushing rate and residence times using county-specific average precipitation/evaporation values or values entered by the user. Predictive models are also included within WiLMS that are valuable in validating modeled phosphorus loads to the lake in question and modeling alternate land cover scenarios within the watershed. Although not needed for this particular project because of the Chilton Sanitary District, WiLMS will also estimate the the impact of shoreland septic systems.

Chilton Lake Watershed Assessment – Total Daily Maximum Load Project

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify waters within their boundaries that are not meeting water quality standards. For these waterbodies, which are defined as "impaired", Section 303(d) further requires EPA and states to develop a Total Maximum Daily Load (TMDL) for the pollutant(s) violating or causing violations of water quality standards. A TMDL defines the loading capacity which is the maximum amount of the pollutant that a waterbody can assimilate while continuing to meet water quality standards (WDNR 2022).

A TMDL also allocates the maximum allowable pollutant load between point and nonpoint sources of the pollutant. A TMDL provides a framework for EPA, states, and partner organizations to establish and implement pollution control and management plans, with the goal of achieving "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable (CWA § 101(a)(2)) (WDNR 2022)."

The Chilton Millpond watershed is part of the Northeast Lakeshore TMDL (Map 2), which was approved by the EPA in late-2023, and includes TMDLs for total phosphorus and sediment. The Chilton basin includes seven TMDL subwatersheds as a part of the project's Manitowoc River model. The TMDL is designed to both address impaired waters that are not meeting water quality standards and to protect waters from becoming impaired by establishing the loading capacity required to meet water quality standards for both listed and unlisted waters (WDNR 2022).

The Northeast Lakeshore TMDL includes the Sheboygan, Manitowoc, East and West Twin, and Kewaunee River watersheds and totals 1,964 sq.mi. The Chilton Millpond watershed is located in the South Branch Manitowoc River watershed which is on the upper end of the Manitowoc River basin. The South Branch Manitowoc River is considered a phosphorus impaired stream within the TMDL project.

The WDNR created the draft TMDL study report in early 2023 and it was approved by the EPA in November of that same year. As of December 2023, the WDNR was finalizing the document and will begin implementation immediately.

Chilton Millpond Watershed Assessment – WiLMS Model

Chilton Millpond's entire watershed encompasses an area of approximately 45,629 acres (71.29 sq.mi.) (Map 3). Considering the Chilton Millpond is 11 acres, this means that the watershed to lake area ratio is about 4,110:1. In other words, approximately 4,110 acres of land drains to each acre in the millpond. This is an incredibly high watershed to lake area ratio and exemplifies the fact that the millpond likely acts more like a river section than a lake.

Different types of landcover export varying amounts of phosphorus as water runs off the land and makes its way to a lake. Row crop agriculture and high-density development export the highest levels of phosphorus per acre, while forested areas and wetlands export the least. Figure 3.2-1 and Map 3 show the partitioning of landcover types within Chilton Millpond's watershed. Forest, pasture/grass, wetlands, and the surface area of the millpond itself, which are all considered relatively low contributors of phosphorus make up about 28% of the total watershed area. Landcover types such as urbanized areas and agricultural row crops occupy about 70% of the watershed area.

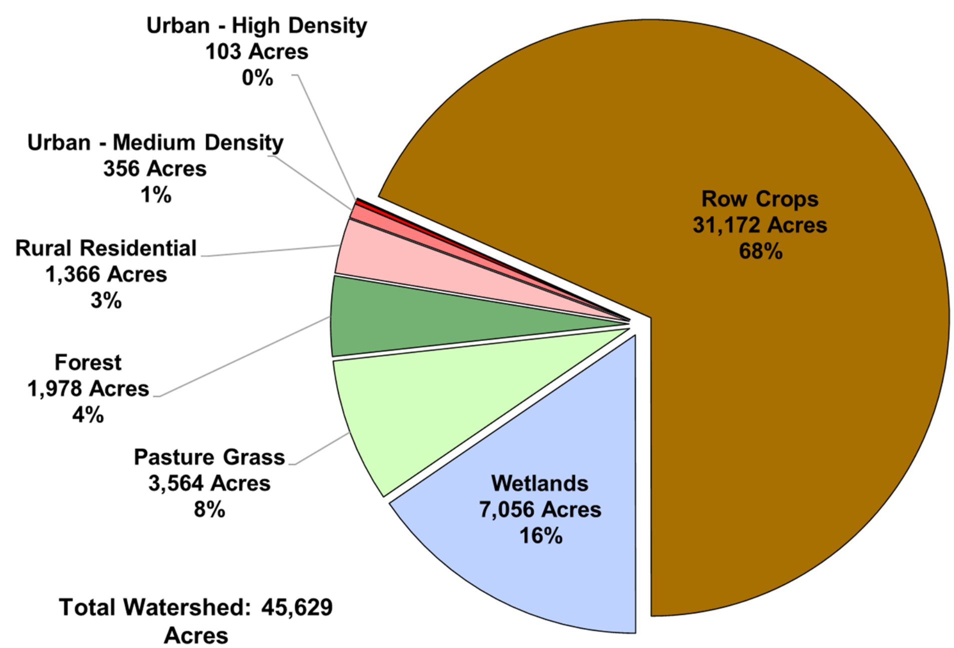


Figure 3.2-1. Chilton Millpond watershed land cover types in acres. Based upon National Land Cover Database .

WiLMS is a screening-level model and its accuracy wains with very large watersheds like that of Chilton Millpond. Utilizing an annual phosphorus load of 29,972 lbs, the model predicted an average growing season phosphorus concentration of 161-745 µg/L, with the most likely concentration being 299 µg/L. Considering the limited amount of historical phosphorus data, the wide fluctuations of the available data, and the fact that the growing season and summer month measured averages are 302 and 358 µg/L, respectively, the predicted value indicates the model is reasonably reflecting phosphorus loading to Chilton Millpond. As shown in Figure 3.2-2, the largest phosphorus contributing land cover type is row crop agriculture.

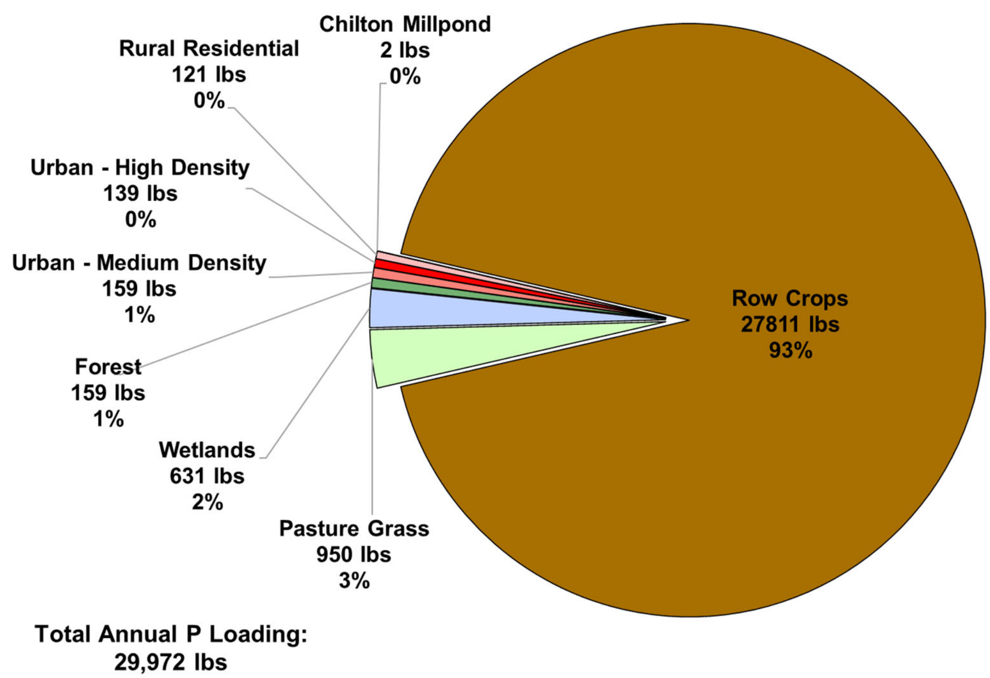


Figure 3.2-2. Chilton Millpond watershed phosphorus loading in pounds. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Once the model is set up and calibrated, it can be used to predict how the annual phosphorus load and resulting in-lake phosphorus concentrations may change with changes to watershed landcover types. For demonstrational purposes, three scenarios are shown in Table 3.2-1 below. The scenarios include replacing acreage of the highest phosphorus exporting landcover, row crops, with the lowest phosphorus exporting landcover, forested areas. Simply converting row crops to forests.

The development of scenario models demonstrates the large amount of change that would have to occur in Chilton Millpond's watershed to see a significant amount of change in the lake's phosphorus levels. Unrealistic changes, like converting 100% or 50% of row crop acreage to forests would lead to noticeable changes in the lake's phosphorus concentrations and algae blooms would likely be less frequent. However, converting 1000 acres, or 5% of the current acreage, from row crops to forests, a more reasonable plan, would produce a negligible change in the lake's phosphorus levels.

Table 3.2-1. Modeling scenarios for landcover changes in the Chilton Millpond watershed. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Scenario	Phosphorous Load from Row Crops (lbs/year)	Phosphorous Load from Forested Areas (lbs/year)	Predicted Growing Seasn Mean Phosphorous (µg/L)
Current	27811	159	161 - 745
50 % Row Crops to Forested Areas	13907	1411	98 - 448
100% Row Crops to Forested Areas	0	2661	31 - 92
1000 ac. (5%) Row Crops to Forested Areas	26921	238	158 - 727

While unfortunate, this is typical for man-made lakes with very large watersheds. As mentioned above, the watershed to lake area ratio for Chilton Millpond is 4,110:1. In this case, the sheer size of the watershed basically overrides the influence of landcover type in determining phosphorus loads to the lake. So, even if the watershed is dominated by forests and has no row crop acreage, the lake would still be eutrophic (highly productive). Fortunately, as described in Section 3.1 Lake Water Quality, the incredible flushing rate, which is brought on by that very large watershed, reduces the occurrence of nuisance algae blooms in the lake.

3.3 Shoreland Condition

Lake Shoreland Zone and its Importance

One of the most vulnerable areas of a lake's watershed is the immediate shoreland zone (approximately from the water's edge to at least 35 feet inland). When a lake's shoreland is developed, the increased impervious surface, removal of natural vegetation, and other human practices can severely increase pollutant loads to the lake while degrading important habitat. Limiting these anthropogenic (man-made) effects on the lake is important in maintaining the quality of the lake's water and habitat.

The intrinsic value of natural shorelands is found in numerous forms. Vegetated shorelands prevent polluted runoff from entering lakes by filtering this water or allowing it to slow to the point where particulates settle. The roots of shoreland plants stabilize the soil, thereby preventing shoreland erosion. Shorelands also provide habitat for both aquatic and terrestrial animal species. Many species rely on natural shorelands for all or part of their life cycle as a source of food, cover from predators, and as a place to raise their young. Shorelands and the nearby shallow waters serve as spawning grounds for fish and nesting sites for birds. Thus, both the removal of vegetation and the inclusion of development reduces many forms of habitat for wildlife.

Some forms of development may provide habitat for less than desirable species. Disturbed areas are often overtaken by invasive species, which are sometimes termed "pioneer species" for this reason. Some waterfowl, such as geese, prefer to linger upon open lawns near waterbodies because of the lack of cover for potential predators. The presence of geese on a lake resident's beach may not be an issue; however, the feces the geese leave are unsightly and pose a health risk. Geese feces may become a source of fecal coliforms as well as flatworms that can lead to swimmers' itch. Development such as rip rap or masonry, steel or wooden seawalls completely remove natural habitat for most animals, but may also create some habitat for snails; this is not desirable for lakes that experience problems with swimmers' itch, as the flatworms that cause this skin reaction utilize snails as a secondary host after waterfowl.

In the end, natural shorelines provide many ecological and other benefits. Between the abundant wildlife, the lush vegetation, and the presence of native flowers, shorelands also provide natural scenic beauty and a sense of tranquility for humans.

Shoreland Zone Regulations

Wisconsin has numerous regulations in place at the state level which aim to enhance and protect shorelands. Additionally, counties, townships and other municipalities have developed their own (often more comprehensive or stronger) policies. At the state level, the following shoreland regulations exist:

Wisconsin-NR 115: Wisconsin's Shoreland Protection Program

Wisconsin's shoreland zoning rule, NR 115, sets the minimum standards for shoreland development. First adopted in 1966, the code set a deadline for county adoption of January 1, 1968. By 1971, all counties in Wisconsin had adopted the code and were administering the shoreland ordinances it specified. Interestingly, in 2007 it was noted that many (27) counties had recognized inadequacies within the 1968 ordinance and had actually adopted stricter shoreland ordinances. Revised in February of 2010, and again in October of 2014, the finalized NR 115 allowed many standards to remain the same, such as lot sizes, shoreland setbacks and buffer sizes. However, several standards changed as a result of efforts to balance public rights to lake use with private property rights. The regulation sets minimum standards for the shoreland zone, and requires all counties in the state to adopt shoreland zoning ordinances. Counties were previously able to set their own, stricter, regulations to NR 115 but as of 2015, all counties have to abide by state regulations. Minimum requirements for each of these categories are described below.

- Vegetation Removal: For the first 35 feet of property (shoreland zone), no vegetation removal is permitted except for: sound forestry practices on larger pieces of land, access and viewing corridors (may not exceed 35 percent of the shoreline frontage), invasive species removal, or damaged, diseased, or dying vegetation. Vegetation removed must be replaced by replanting in the same area (native species only).

- Impervious surface standards: In general, the amount of impervious surface is restricted to 15% of the total lot size, on lots that are within 300 feet of the ordinary high-water mark of the waterbody. If a property owner treats their run off with some type of treatment system, they may be able to apply for an increase in their impervious surface limit, up to 30% for residential land use. Exceptions to this limit do exist if a county has designated highly-developed areas, so it is recommended to consult county-specific zoning regulations for this standard.

- Nonconforming structures: Nonconforming structures are structures that were lawfully placed when constructed, but do not comply with distance of water setback. Originally, structures within 75 ft of the shoreline had limitations on structural repair and expansion. Language in NR-115 allows construction projects on structures within 75 feet. Other specifications must be met as well, and local zoning regulations should be referenced.

Mitigation requirements: Language in NR-115 specifies mitigation techniques that may be incorporated on a property to offset the impacts of impervious surface, replacement of nonconforming structure, or other development projects. Practices such as buffer restorations along the shoreland zone, rain gardens, removal of fire pits, and beaches all may be acceptable mitigation methods. Mitigation requirements are county-specific and any such projects should be discussed with local zoning to determine the requirements.

Wisconsin Act 31

While not directly aimed at regulating shoreland practices, the State of Wisconsin passed Wisconsin Act 31 in 2009 in an effort to minimize watercraft impacts upon shorelines. This act prohibits a person from operating a watercraft (other than personal watercraft) at a speed in excess of slow-no-wake speed within 100 feet of a pier, raft, buoyed area or the shoreline of a lake. Additionally, personal watercraft must abide by slow-no-wake speeds while within 200 feet of these same areas. Act 31 was put into place to reduce wave action upon the sensitive shoreland zone of a lake. The legislation does state that pickup and drop off areas marked with regulatory markers and that are open to personal watercraft operators and motorboats engaged in waterskiing/a similar activity may be exempt from this distance restriction. Additionally, a city, village, town, public inland lake protection and rehabilitation district or town sanitary district may provide an exemption from the 100-foot requirement or may substitute a lesser number of feet.

Shoreland Research

Studies conducted on nutrient runoff from Wisconsin lake shorelands have produced interesting results. For example, a USGS study on several Northwoods Wisconsin lakes was conducted to determine the impact of shoreland development on nutrient (phosphorus and nitrogen) export to these lakes (Graczyk, Hunt, Greb, Buchwald, & Krohelski, 2003). During the study period, water samples were collected from surface runoff and ground water and analyzed for nutrients. These studies were conducted on several developed (lawn covered) and undeveloped (undisturbed forest) areas on each lake. The study found that nutrient yields were greater from lawns than from forested catchments, but also that runoff water volumes were the most important factor in determining whether lawns or wooded catchments contributed more nutrients to the lake. Groundwater inputs to the lake were found to be significant in terms of water flow and nutrient input. Nitrate plus nitrite nitrogen and total phosphorus yields to the ground-water system from a lawn catchment were three or sometimes four times greater than those from wooded catchments.

A separate USGS study was conducted on the Lauderdale Lakes in southern Wisconsin, looking at nutrient runoff from different types of developed shorelands – regular fertilizer application lawns (fertilizer with phosphorus), non-phosphorus fertilizer application sites, and unfertilized sites (Garn, 2002). One of the important findings stemming from this study was that the amount of dissolved phosphorus coming off of regular fertilizer application lawns was twice that of lawns with non-phosphorus or no fertilizer. Dissolved phosphorus is a form in which the phosphorus molecule is not bound to a particle of any kind; in this respect, it is readily available to algae. Therefore, these studies show us that it is a developed shoreland that is continuously maintained in an unnatural manner (receiving phosphorus rich fertilizer) that impacts lakes the greatest. This understanding led former Governor Jim Doyle into passing the Wisconsin Zero-Phosphorus Fertilizer Law (Wis Statue 94.643), which restricts the use, sale, and display of lawn and turf fertilizer which contains phosphorus. Certain exceptions apply, but after April 1 2010, use of this type of fertilizer is prohibited on lawns and turf in Wisconsin. The goal of this action is to reduce the impact of developed lawns, and is particularly helpful to developed lawns situated near Wisconsin waterbodies.

Shorelands provide much in terms of nutrient retention and mitigation, but also play an important role in wildlife habitat. Woodford and Meyer found that green frog density was negatively correlated with development density in Wisconsin lakes (Woodford & Meyer, 2003). As development increased, the habitat for green frogs decreased and thus populations became significantly lower. Common loons, a bird species notorious for its haunting call that echoes across Wisconsin lakes, are often associated more so with undeveloped lakes than developed lakes (Lindsay, Gillum, & Meyer, 2002). And studies on shoreland development and fish nests show that undeveloped shorelands are preferred as well. In a study conducted on three Minnesota lakes, researchers found that only 74 of 852 black crappie nests were found near shorelines that had any type of dwelling on it (Reed, 2001). The remaining nests were all located along undeveloped shoreland.

Photograph 3.3-1. Example of coarse woody habitat in a lake.

Emerging research in Wisconsin has shown that coarse woody habitat (sometimes called "coarse woody debris"), often stemming from natural or undeveloped shorelands, provides many ecosystem benefits in a lake. Coarse woody habitat describes habitat consisting of trees, limbs, branches, roots and wood fragments at least four inches in diameter that enter a lake by natural or human means (Photograph 3.3-1). Coarse woody habitat provides shoreland erosion control, a carbon source for the lake, prevents suspension of sediments and provides a surface for algal growth which is important for aquatic macroinvertebrates (Sass, 2009). While it impacts these aspects considerably, one of the greatest benefits coarse woody habitat provides is habitat for fish species.

Coarse woody habitat has shown to be advantageous for fisheries in terms of providing refuge, foraging area, as well as spawning habitat (Hanchin, Willis, & St. Stauver, 2003). In one study, researchers observed 16 different species occupying coarse woody habitat areas in a Wisconsin lake (Newbrey, Bozek, Jennings, & Cook, 2005). Bluegill and bass species in particular are attracted to this habitat type; largemouth bass stalk bluegill in these areas while the bluegill hide amongst the debris and often feed upon many macroinvertebrates found in these areas, who themselves are feeding upon algae and periphyton growing on the wood surface. Newbrey et al. 2005 found that some fish species prefer different complexity of branching on coarse woody habitat, though in general some degree of branching is preferred over coarse woody habitat that has no branching.

With development of a lake's shoreland zone, much of the coarse woody habitat that was once found in Wisconsin lakes has disappeared. Prior to human establishment and development on lakes (mid to late 1800's), the amount of coarse woody habitat in lakes was likely greater than under completely natural conditions due to logging practices. However, with changes in the logging industry and increasing development along lake shorelands, coarse woody habitat has decreased substantially. Shoreland residents are removing woody debris to improve aesthetics or for recreational opportunities such as boating, swimming, and ironically, fishing.

National Lakes Assessment

Unfortunately, along with Wisconsin's lakes, waterbodies within the entire United States have shown to have increasing amounts of developed shorelands. The National Lakes Assessment (NLA) is an Environmental Protection Agency sponsored assessment that has successfully pooled together resource managers from all 50 U.S. states in an effort to assess waterbodies, both natural and man-made, from each state. Through this collaborative effort, over 1,000 lakes were sampled in 2007, pooling together the first statistical analysis of the nation's lakes and reservoirs.

Through the National Lakes Assessment, a number of potential stressors were examined, including nutrient impairment, algal toxins, fish tissue contaminants, physical habitat, and others. The 2007 NLA report states that "*of the stressors examined, poor lakeshore habitat is the biggest problem* *in the nation's lakes; over one-third exhibit poor shoreline habitat condition*" (USEPA, 2009). Furthermore, the report states that "*poor biological health is three times more likely in lakes with poor lakeshore habitat.*" These results indicate that stronger management of shoreline development is absolutely necessary to preserve, protect, and restore lakes. Shoreland protection will become increasingly important as development pressure on lakes continues to grow.

Native Species Enhancement

The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects (Jennings, E., Hatzenbeler, Edwards, & Bozek, 2003). The maintenance of the newly created area helps to decrease water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreland. Removal of native plants and dead, fallen timbers from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving bottom and shoreland sediments vulnerable to wave action caused by boating and wind (Jennings, E., Hatzenbeler, Edwards, & Bozek, 2003) (Radomski & Goeman, Consequences of Human Lakeshore Development on Emergent and Floating-leaf Vegetation Abundance, 2001) (Elias & Meyer, 2003). Many homeowners significantly decrease the number of trees and shrubs along the water's edge in an effort to increase their view of the lake. However, this has been shown to locally increase water temperatures, and decrease infiltration rates of potentially harmful nutrients and pollutants. Furthermore, the dumping of sand to create beach areas destroys spawning, cover and feeding areas utilized by aquatic wildlife (Scheuerell & Schindler, 2004).

Photograph 3.3-2. Example of a biolog restoration site.

In recent years, many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic its unaltered state (Photograph 3.3-2). An area of shore restored to its natural condition, both in the water and on shore, is commonly called a shoreland buffer zone. The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Simply not mowing within the buffer zone does wonders to restore some of the shoreland's natural function.

Enhancement activities also include additions of submergent, emergent, and floating-leaf plants within the lake itself. These additions can provide greater species diversity and may compete against exotic species.

Wisconsin's Healthy Lakes & Rivers Action Plan

Starting in 2014, a program was enacted by the WDNR and UW-Extension to promote riparian landowners to implement relatively straight-forward shoreland restoration activities. This program provides education, guidance, and grant funding to promote installation of best management practices aimed to protect and restore lakes and rivers in Wisconsin. The program has identified five best practices aimed at improving habitat and water quality (Figure 3.3-1).

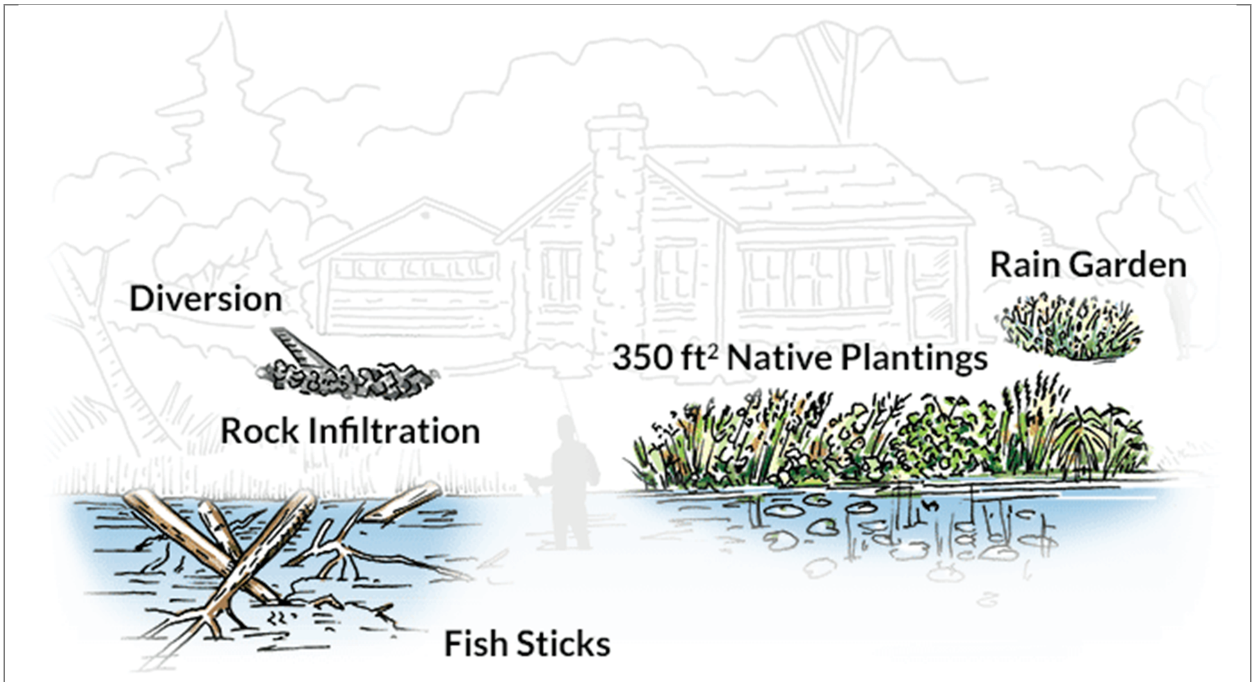


Figure 3.3-1. Healthy Lakes & Rivers 5 Best Practices. Illustration by Karen Engelbretson, extracted from healthylakeswi.com.

- Rain Gardens: This upland best practice consists of a landscaped and vegetated shallow depression aimed at capturing water runoff and allowing it to infiltrate into the soil.
- Rock Infiltration: This upland best practice is an excavated pit or trench, filled with rock, that encourages water to infiltrate into the soil. These practices are strategically placed at along a roof line or the downward sloping area of a driveway.
- Diversion: This best practice can occur in the transition or upland zone. These practices use berms, trenches, and/or treated lumber to redirect water that would otherwise move downhill into a lake. Water diversions may direct water into a Rock Infiltration or Rain Garden to provide the greatest reductions in runoff volumes.
- Native Plantings: This best practice aims to installing native plants within at least 350 square-foot shoreland transition area. This will slow runoff water and provide valuable habitat. One native planting per property per year is eligible.
- Fish Sticks: These in-lake best practices (not eligible for rivers) are woody habitat structures that provide feeding, breeding, and nesting areas for wildlife. Fish sticks consist of multiple whole trees grouped together and anchored to the shore. Trees are not felled from the shoreline, as existing trees are valuable in place, but brought from a short distance or dragged across the ice. In order for this practice to be eligible, an existing vegetated buffer or pledge to install one is required.

The Healthy Lakes and Rivers Grant Program allows partial cost coverage for implementing best practices. Competitive grants are available to eligible applicants such as lake associations and lake districts. The program allows a 75% state cost share up to $1,000 per practice. Multiple practices can be included per grant application, with a $25,000 maximum award per year. Eligible projects need to be on shoreland properties within 1,000 feet of a lake or 300 feet from a river. The landowner must sign a Conservation Commitment pledge to leave the practice in place and provide continued maintenance for 10 years. More information on this program can be found here:

https://healthylakeswi.com/

It is important to note that this grant program is intentionally designed for relatively simple, low-cost, and shovel-ready projects, limiting 10% of the grant award for technical assistance. Larger and more complex projects, especially those that require engineering design components may seek alternative funding sources potentially through the County. Small-Scale Lake Planning Grants can provide up to $3,000 to help build a Healthy Lakes and Rivers project. Eligible expenses in this grant program are surveys, planning, and design.

Chilton Millpond Shoreland Zone Condition

Shoreland Development

Photograph 3.3-3. Example of canopy, shrub and herbaceous layers.

The entire shoreline of Chilton Millpond was surveyed on May 23rd, 2022. A draft WDNR Lake Shoreland & Shallows Habitat Monitoring Field Protocol (WDNR, Lake Shoreland & Shallows Habitat Monitoring Field Protocol, 2020) was utilized to evaluate the shoreland zone on a parcel-by-parcel basis beginning at the estimated high-water level mark and extending inland 35 feet. The immediate shoreline was surveyed and classified based upon its potential to negatively impact the system due to development and other human impacts. Within the shoreland zone the natural vegetation (canopy cover, shrub/herbaceous) was given an estimate of the percentage of the plot which is dominated by each category (Photograph 3.3-3). Human disturbances (impervious surface, manicured lawn, agriculture, number of buildings, boats on shore, piers, boat lifts, sea wall length and other similar categories) were also recorded by number of occurrence or percentage during the survey.

For this management plan, the percent canopy cover, percent shrub/herbaceous, percent manicured lawn and percent impervious surfaces are primarily focused upon to assess the shoreline for development and determine a need for restoration. In general, developed shorelands impact a lake ecosystem in a negative manner, while definite benefits occur from shorelands that are left in their natural state or a near-natural state.

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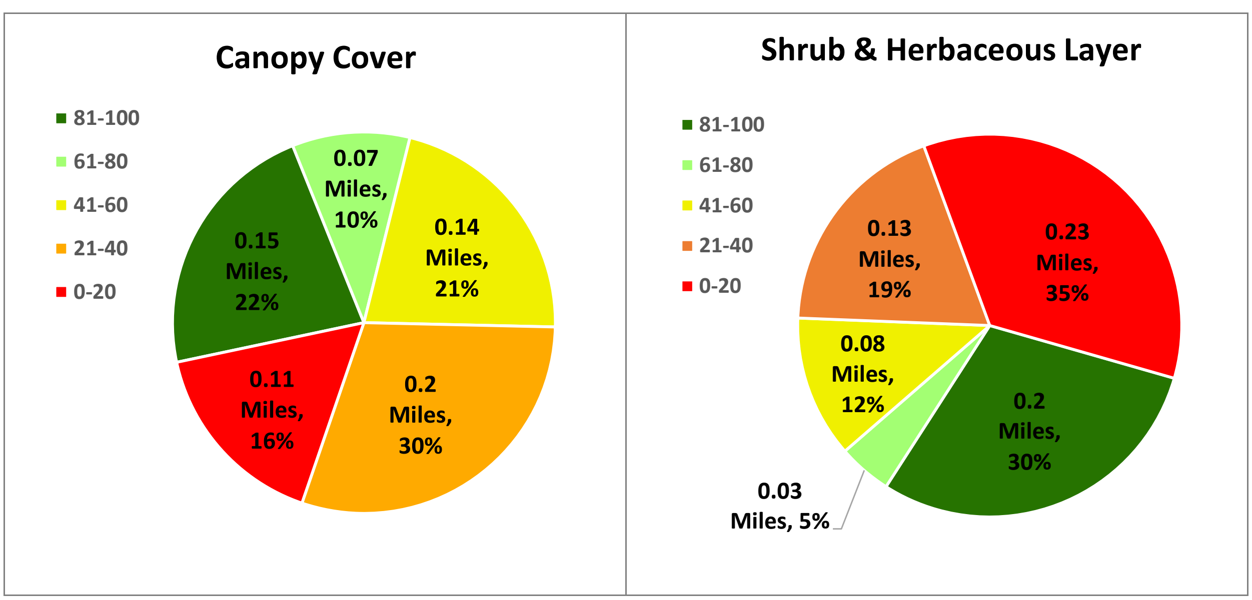
Canopy cover was defined as an area which is shaded by trees that are at least 16 feet tall (Photograph 3.3-3). The vast majority (67%) of Chilton Millpond's shoreline has less than 41% canopy cover (Figure 3.3-2). Undeveloped parcels, such as wetland areas, that naturally do not have a canopy present are also factored into this result (Map 4).

Shrub and herbaceous layers are small trees and plants without woody stems less than 16 feet tall (Photograph 3.3-3). The shoreland assessment survey indicates that 1.6 miles, or 30% Chilton Millpond's parcels contained between 81-100% shrub and herbaceous layers (Figure 3.3-2, Map 5). Another 0.6 miles (35%) only had between 0 and 20% shrub and herbaceous layer present on the parcel.

A manicured lawn is defined as grass that is mowed short and is direct evidence of urbanization. Having a manicured lawn poses a risk as runoff will carry pollutants, such as lawn fertilizers, into the lake. Approximately 7% of the parcels around the lake had no manicured lawn within the shoreland zone and another 32% of parcels had between 1-24% of the shoreland zone containing manicured lawn (Figure 3.3-2, Map 6). Approximately 30% of the shoreland parcels contained manicured lawn on 76% or greater of the shoreland zone.

Impervious surface is an area that releases all or a majority of the precipitation that falls onto it (e.g., rooftops, concrete, stairs, boulders and boats flipped over on shore). Approximately 91% of the shoreline had parcels with less than 24% of impervious surface within the shoreland zone (Figure 3.3-2, Map 7).



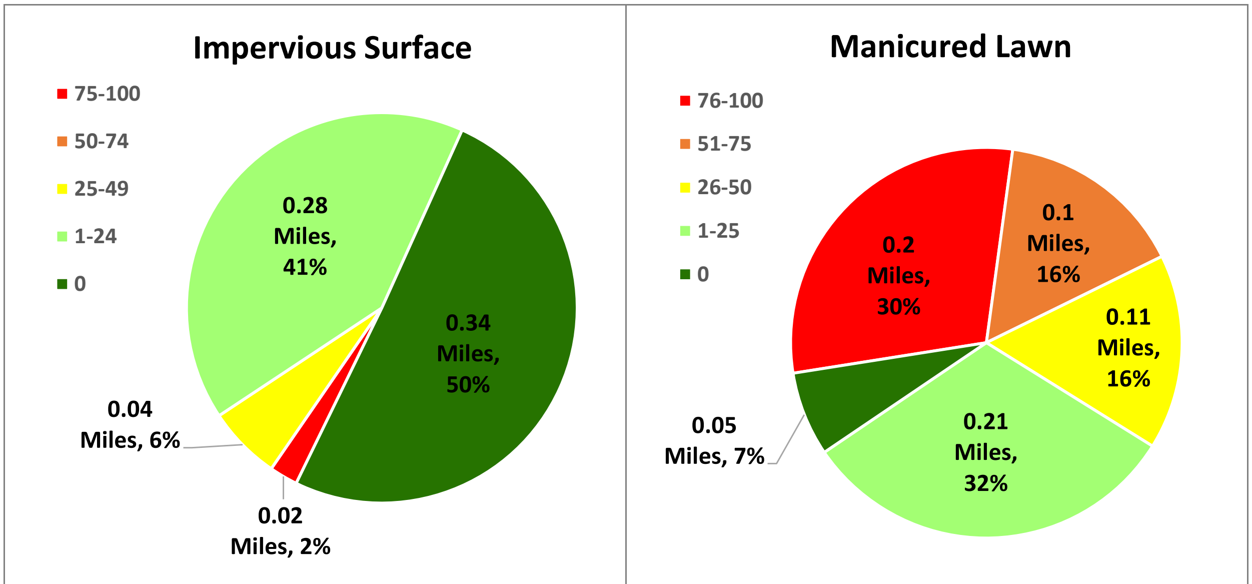


Figure 3.3-2. Chilton Millpond 2022 shoreland parcel canopy cover, shrub-herbaceous cover, impervious surface, and manicured lawn. Data from Onterra 2022 Survey.

While producing a completely natural shoreland is ideal for a lake ecosystem, it is not always practical from a human's perspective. However, riparian property owners can take small steps in ensuring their property's impact upon the lake is minimal. Choosing an appropriate landscape position for lawns is one option to consider. Placing lawns on flat, un-sloped areas or in areas that do not terminate at the lake's edge is one way to reduce the amount of runoff a lake receives from a developed site. And, allowing tree falls and other natural habitat features to remain along a shoreline may result not only in reducing shoreline erosion, but creating wildlife habitat also.

Coarse Woody Habitat

As part of the shoreland condition assessment, Chilton Millpond was also surveyed to determine the extent of its coarse woody habitat. Coarse woody habitat was identified, and classified in three size categories (2-8 inches in diameter, 8+ inches in diameter, or clusters of pieces) as well as four branching categories: no branches, minimal branches, moderate branches, and full canopy. As discussed earlier, research indicates that fish species prefer some branching as opposed to no branching on coarse woody habitat, and increasing complexity is positively correlated with higher fish species richness, diversity and abundance (Newbrey, Bozek, Jennings, & Cook, 2005).

During this survey, 33 total pieces of coarse woody habitat were observed along 0.81 miles of shoreline (Map 8), which gives Chilton Millpond a coarse woody habitat to shoreline mile ratio of 41:1 (Figure 3.4-4). The majority of these pieces did not cross the high-water level, meaning they were between the shoreline and the two-foot depth contour. No pieces were classified as a full canopy.

There has been 63 completed coarse woody habitat surveys utilizing the WDNR protocol throughout Wisconsin since 2017. The number of coarse woody habitat pieces per shoreline mile on Chilton Millpond falls at the 55th percentile for these lakes (Figure 3.4-4). To put this into perspective, Wisconsin researchers have found that in completely undeveloped lakes, an average of 345 coarse woody habitat structures may be found per mile (Christensen, Herwig, Schindler, &

Carpenter, 1996). Please note the methodologies between the surveys done on Chilton Millpond and those cited in this literature comparison are different, but still provide a valuable insight into what undisturbed shorelines may have in terms of coarse woody habitat.

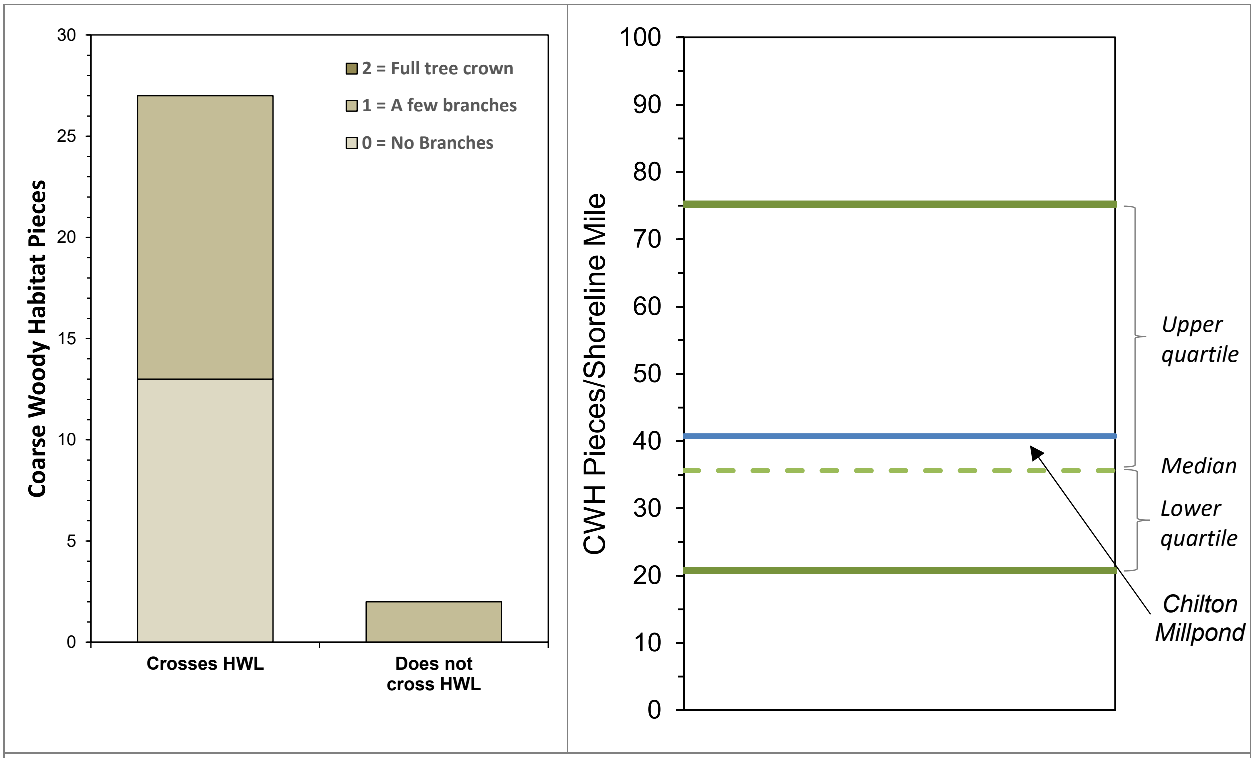


Figure 3.3-4. Chilton Millpond coarse woody habitat survey results. Based upon a Summer 2022 survey. Locations of the Chilton Millpond coarse woody habitat can be found on Map 8.

3.4 Aquatic Plants

Introduction

Although the occasional lake user may consider aquatic macrophytes to be "weeds" and a nuisance to the recreational use of the lake, the plants are actually an essential element in a healthy and functioning lake ecosystem. It is very important that lake stakeholders understand the importance of lake plants and the many functions they serve in maintaining and protecting a lake ecosystem. With increased understanding and awareness, most lake users will recognize the importance of the aquatic plant community and their potential negative effects on it.

Photograph 3.4-1. Example of emergent and floating-leaf communities.

Diverse aquatic vegetation provides habitat and food for many kinds of aquatic life, including fish, insects, amphibians, waterfowl, and even terrestrial wildlife. For instance, wild celery (*Vallisneria americana)* and wild rice (*Zizania aquatica* and *Z. palustris*) both serve as excellent food sources for ducks and geese. Emergent stands of vegetation (Photograph 3.4-1) provide necessary spawning habitat for fish such as northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*). In addition, many of the insects that are eaten by young fish rely heavily on aquatic plants and the periphyton attached to them as their primary food source. The plants also provide cover for feeder fish and zooplankton, stabilizing the predator-prey relationships within the system. Furthermore, rooted aquatic plants prevent shoreland erosion and the resuspension of sediments and nutrients by absorbing wave energy and locking sediments within their root masses. In areas where plants do not exist, waves can resuspend bottom sediments decreasing water clarity and increasing plant nutrient levels that may lead to algae blooms. Lake plants also produce oxygen through photosynthesis and use nutrients that may otherwise be used by phytoplankton, which helps to minimize nuisance algal blooms.

Under certain conditions, a few species may become a problem and require control measures. Excessive plant growth can limit recreational use by deterring navigation, swimming, and fishing activities. It can also lead to changes in fish population structure by providing too much cover for feeder fish resulting in reduced predation by predator fish, which could result in a stunted pan-fish population. Exotic plant species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) can also upset the delicate balance of a lake ecosystem by out competing native plants and reducing species diversity. These species will be discussed further in depth in the Aquatic Invasive Species section. These invasive plant species can form dense stands that are a nuisance to humans and provide low-value habitat for fish and other wildlife.

When plant abundance negatively affects the lake ecosystem and limits the use of the resource, plant management and control may be necessary. The management goals should always include the control of invasive species and restoration of native communities through environmentally sensitive and economically feasible methods. No aquatic plant management plan should only contain methods to control plants, they should also contain methods on how to protect and possibly enhance the important plant communities within the lake. Unfortunately, the latter is often neglected and the ecosystem suffers as a result.

Aquatic Plant Management and Protection

Important Note:
Even though most of these techniques are not applicable to Chilton Millpond, it is still important for lake users to have a basic understanding of all the techniques so they can better understand why particular methods are or are not applicable in their lake**.** The techniques applicable to Chilton Millpond are discussed in Summary and Conclusions section and the Implementation Plan found near the end of this document.

Many times, an aquatic plant management plan is aimed at only controlling nuisance plant growth that has limited the recreational use of the lake, usually navigation, fishing, and swimming. It is important to remember the vital benefits that native aquatic plants provide to lake users and the lake ecosystem, as described above. Therefore, all aquatic plant management plans also need to address the enhancement and protection of the aquatic plant community. Below are general descriptions of the many techniques that can be utilized to control and enhance aquatic plants. Each alternative has benefits and limitations that are explained in its description. Please note that only legal and commonly used methods are included. For instance, the herbivorous grass carp (*Ctenopharyngodon idella*) is illegal in Wisconsin and rotovation, a process by which the lake bottom is tilled, is not a commonly accepted practice. Unfortunately, there are no "silver bullets" that can completely cure all aquatic plant problems, which makes planning a crucial step in any aquatic plant management activity. Many of the plant management and protection techniques commonly used in Wisconsin are described below.

Permits

The signing of the 2001-2003 State Budget by Gov. McCallum enacted many aquatic plant management regulations. The rules for the regulations have been set forth by the WDNR as NR 107 and 109. A major change includes that all forms of aquatic plant management, even those that did not require a permit in the past, require a permit now, including manual and mechanical removal. Manual cutting and raking are exempt from the permit requirement if the area of plant removal is no more than 30 feet wide and any piers, boatlifts, swim rafts, and other recreational and water use devices are located within that 30 feet. This action can be conducted up to 150 feet from shore. Please note that a permit is needed in all instances if wild rice is to be removed. Furthermore, installation of aquatic plants, even natives, requires approval from the WDNR.

Permits are required for chemical and mechanical manipulation of native and non-native plant communities. Large-scale protocols have been established for chemical treatment projects covering >10 acres or areas greater than 10% of the lake littoral zone and more than 150 feet from shore. Different protocols are to be followed for whole-lake scale treatments (≥160 acres or ≥50% of the lake littoral area). Additionally, it is important to note that local permits and U.S. Army Corps of Engineers regulations may also apply. For more information on permit requirements, please contact the WDNR Regional Water Management Specialist or Aquatic Plant Management and Protection Specialist.

Manual Removal (Hand-Harvesting & DASH)

Manual removal methods include hand-pulling, raking, and hand-cutting. Hand-pulling involves the manual removal of whole plants, including roots, from the area of concern and disposing them out of the waterbody. Raking entails the removal of partial and whole plants from the lake by dragging a rake with a rope tied to it through plant beds. Specially designed rakes are available from commercial sources or an asphalt rake can be used. Hand-cutting differs from the other two manual methods because the entire plant is not removed, rather the plants are cut similar to mowing a lawn; however, Wisconsin law states that all plant fragments must be removed (Photograph 3.5-2).

Photograph 3.5-2. Example of aquatic plants that have been removed manually.

Manual removal or hand-harvesting of aquatic invasive species has gained favor in recent years as an alternative to herbicide control programs. Professional hand-harvesting firms can be contracted for these efforts and can either use basic snorkeling or scuba divers, whereas others might employ the use of a Diver Assisted Suction Harvest (DASH) which involves divers removing plants and feeding them into a suctioned hose for delivery to the deck of the harvesting vessel. The DASH methodology is considered a form of mechanical harvesting and thus requires a WDNR approved permit. DASH is thought to be more efficient in removing target plants than divers alone and is believed to limit fragmentation during the harvesting process.

Cost

Contracting aquatic invasive species removal by third-party firm can cost approximately $1,500 per day for traditional hand-harvesting methods whereas the costs can be closer to $2,500 when DASH technology is used. Additional disposal, travel, and permitting fees may also apply.

Advantages	*Disadvantages*
• Very cost effective for clearing areas around docks, piers, and swimming areas. • Relatively environmentally safe if treatment is conducted after June 15th. • Allows for selective removal of undesirable plant species. • Provides immediate relief in localized area. • Plant biomass is removed from waterbody.	• Labor intensive. • Impractical for larger areas or dense plant beds. • Subsequent treatments may be needed as plants recolonize and/or continue to grow. • Uprooting of plants stirs bottom sediments making it difficult to conduct action. • May disturb benthic organisms and fish-spawning areas. • Risk of spreading invasive species if fragments are not removed.

Bottom Screens

Bottom screens are very much like landscaping fabric used to block weed growth in flowerbeds. The gas-permeable screen is placed over the plant bed and anchored to the lake bottom by staking or weights. Only gas-permeable screen can be used or large pockets of gas will form under the mat as the result of plant decomposition. This could lead to portions of the screen becoming detached from the lake bottom, creating a navigational hazard. Normally the screens are removed and cleaned at the end of the growing season and then placed back in the lake the following spring. If they are not removed, sediments may build up on them and allow for plant colonization on top of the screen. Please note that depending on the size of the screen a Wisconsin Department of Natural Resources permit may be required.

Cost

Material costs range between $.20 and $1.25 per square-foot. Installation cost can vary largely, but may roughly cost $750 to have 1,000 square feet of bottom screen installed. Maintenance costs can also vary, but an estimate for a waterfront lot is about $120 each year.

Advantages	*Disadvantages*
• Immediate and sustainable control. • Long-term costs are low. • Excellent for small areas and around obstructions. • Materials are reusable. • Prevents fragmentation and subsequent spread of plants to other areas.	• Installation may be difficult over dense plant beds and in deep water. • Not species specific. • Disrupts benthic fauna. • May be navigational hazard in shallow water. • Initial costs are high. • Labor intensive due to the seasonal removal and reinstallation requirements. • Does not remove plant biomass from lake. • Not practical in large-scale situations.

Water Level Drawdown

The primary manner of plant control through water level drawdown is the exposure of sediments and plant roots/tubers to desiccation and either heating or freezing depending on the timing of the treatment. Winter drawdowns are more common in temperate climates like that of Wisconsin and usually occur in reservoirs because of the ease of water removal through the outlet structure. An important fact to remember when considering the use of this technique is that only certain species are controlled and that some species may even be enhanced. Furthermore, the process will likely need to be repeated every two or three years to keep target species in check.

Cost

The cost of this alternative is highly variable. If an outlet structure exists, the cost of lowering the water level would be minimal; however, if there is not an outlet, the cost of pumping water to the desirable level could be very expensive. If a hydro-electric facility is operating on the system, the costs associated with loss of production during the drawdown also need to be considered, as they are likely cost prohibitive to conducting the management action.

Advantages	*Disadvantages*
• Inexpensive if outlet structure exists. • May control populations of certain species, like Eurasian watermilfoil for a few years. • Allows some loose sediment to consolidate, increasing water depth. • May enhance growth of desirable emergent species. • Other work, like dock and pier repair may be completed more easily and at a lower cost while water levels are down.	• May be cost prohibitive if pumping is required to lower water levels. • Has the potential to upset the lake ecosystem and have significant effects on fish and other aquatic wildlife. • Adjacent wetlands may be altered due to lower water levels. • Disrupts recreational, hydroelectric, irrigation and water supply uses. • May enhance the spread of certain undesirable species, like common reed and reed canary grass. • Permitting process may require an environmental assessment that may take months to prepare. • Non-selective.

Mechanical Harvesting

Photograph 3.4-3. Mechanical harvester.

Aquatic plant harvesting is frequently used in Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. Harvesters are produced in many sizes that can cut to depths ranging from 3 to 6 feet with cutting widths of 4 to 10 feet (Photograph 3.4-3). Plant harvesting speeds vary with the size of the harvester, density and types of plants, and the distance to the off-loading area. Equipment requirements do not end with the harvester. In addition to the harvester, a shore-conveyor would be required to transfer plant material from the harvester to a dump truck for transport to a landfill or compost site. Furthermore, if off-loading sites are limited and/or the lake is large, a transport barge may be needed to move the harvested plants from the harvester to the shore in order to cut back on the time that the harvester spends traveling to the shore conveyor. Some lake organizations contract to have nuisance plants harvested, while others choose to purchase their own equipment. If the latter route is chosen, it is especially important for the lake group to be very organized and realize that there is a great deal of work and expense involved with the purchase, operation, maintenance, and storage of an aquatic plant harvester. In either case, planning is very important to minimize environmental effects and maximize benefits.

Cost

Equipment costs vary with the size and features of the harvester, but in general, standard harvesters range between $45,000 and $100,000. Larger harvesters or stainless steel models may cost as much as $200,000. Shore conveyors cost approximately $20,000 and trailers range from $7,000 to $20,000. Storage, maintenance, insurance, and operator salaries vary greatly.

Advantages	***Disadvantages***
• Immediate results. • Plant biomass and associated nutrients are removed from the lake. • Select areas can be treated, leaving sensitive areas intact. • Plants are not completely removed and can still provide some habitat benefits. • Opening of cruise lanes can increase predator pressure and reduce stunted fish populations. • Removal of plant biomass can improve the oxygen balance in the littoral zone. • Harvested plant materials produce excellent compost.	• Initial costs and maintenance are high if the lake organization intends to own and operate the equipment. • Multiple treatments are likely required. • Many small fish, amphibians and invertebrates may be harvested along with plants. • There is little or no reduction in plant density with harvesting. • Invasive and exotic species may spread because of plant fragmentation associated with harvester operation. • Bottom sediments may be re-suspended leading to increased turbidity and water column nutrient levels.

Herbicide Treatment

Photograph 3.4-4. Liquid herbicide application. Photo credit: Amy Kay, Clarke.

The use of herbicides to control aquatic plants and algae is a technique that is widely used by lake managers (Photo 3.4-4). Traditionally, herbicides were used to control nuisance levels of aquatic plants and algae that interfere with navigation and recreation. While this practice still takes place in many parts of Wisconsin, the use of herbicides to control aquatic invasive species is becoming more prevalent. Resource managers employ strategic management techniques towards aquatic invasive species, with the objective of reducing the target plant's population over time; and an overarching goal of attaining long-term ecological restoration. For submergent vegetation, this largely consists of implementing control strategies early in the growing season; either as spatially-targeted, small-scale spot treatments or low-dose, large-scale (whole lake) treatments. Treatments occurring roughly each year before June 1 and/or when water temperatures are below 60°F can be less impactful to many native plants, which have not emerged yet at this time of year. Emergent species are targeted with foliar applications at strategic times of the year when the target plant is more likely to absorb the herbicide.

While there are approximately 300 herbicides registered for terrestrial use in the United States, only 13 active ingredients can be applied into or near aquatic systems. All aquatic herbicides must be applied in accordance with the product's US Environmental Protection Agency (EPA) approved label. There are numerous formulations and brands of aquatic herbicides and an extensive list can be found in Appendix F of (Gettys, 2009).

Applying herbicides in the aquatic environment requires special considerations compared with terrestrial applications. WDNR administrative code states that a permit is required if, "you are standing in socks and they get wet." In these situations, the herbicide application needs to be completed by an applicator licensed with the Wisconsin Department of Agriculture, Trade and Consumer Protection. All herbicide applications conducted under the ordinary high-water mark require herbicides specifically labeled by the United States Environmental Protection Agency

Aquatic herbicides can be classified in many ways. Organization of this section follows Netherland (2009) in which mode of action (i.e., how the herbicide works) and application techniques (i.e., foliar or submersed treatment) group the aquatic herbicides. The table below provides a general list of commonly used aquatic herbicides in Wisconsin and is synthesized from (Netherland, 2009).

The arguably clearest division amongst aquatic herbicides is their general mode of action and fall into two basic categories:

1. Contact herbicides act by causing extensive cellular damage, but usually do not affect the areas that were not in contact with the chemical. This allows them to work much faster, but in some plants does not result in a sustained effect because the root crowns, roots, or rhizomes are not killed.
2. Systemic herbicides act slower than contact herbicides, being transported throughout the entire plant and disrupting biochemical pathways which often result in complete mortality.

Table 3.4-1. Common herbicides used for aquatic plant management.

General Mode of Action		Compound	Specific Mode of Action	Most Common Target Species in Wisconsin
Contact		Copper	plant cell toxicant	Algae, including macro-algae (i.e. muskgrasses & stoneworts)
		Endothall	Inhibits respiration & protein synthesis	Submersed species, largely for curly-leaf pondweed; invasive watermilfoil control when mixed with auxin herbicides
		Diquat	Inhibits photosynthesis & destroys cell membranes	Nusiance species including duckweeds, targeted AIS control when exposure times are low
		Flumioxazin	Inhibits photosynthesis & destroys cell membranes	Nusiance species, targeted AIS control when exposure times are low
Systemic	Auxin Mimics	2,4-D	auxin mimic, plant growth regulator	Submersed species, largely for invasive watermilfoil
		Triclopyr	auxin mimic, plant growth regulator	Submersed species, largely for invasive watermilfoil
		Florpyrauxifen-benzyl	arylpicolinate auxin mimic, growth regulator, different binding afinity than 2,4-D or triclopyr	Submersed species, largely for invasive watermilfoil
	In Water Use Only	Fluridone	Inhibits plant specific enzyme, new growth bleached	Submersed species, largely for invasive watermilfoil
	Enzyme Specific (ALS)	Penoxsulam	Inhibits plant-specific enzyme (ALS), new growth stunted	Emergent species with potential for submergent and floating-leaf species
		Imazamox	Inhibits plant-specific enzyme (ALS), new growth stunted	New to WI, potential for submergent and floating-leaf species
	Enzyme Specific (foliar use only)	Glyphosate	Inhibits plant-specific enzyme (ALS)	Emergent species, including purple loosestrife
		Imazapyr	Inhibits plant-specific enzyme (EPSP)	Hardy emergent species, including common reed

Both types are commonly used throughout Wisconsin with varying degrees of success. The use of herbicides is potentially hazardous to both the applicator and the environment, so all lake organizations should seek consultation and/or services from professional applicators with training and experience in aquatic herbicide use.

Herbicides that target submersed plant species are directly applied to the water, either as a liquid or an encapsulated granular formulation. Factors such as water depth, water flow, treatment area size, and plant density work to reduce herbicide concentration within aquatic systems. Understanding concentration and exposure times are important considerations for aquatic herbicides. Successful control of the target plant is achieved when it is exposed to a lethal concentration of the herbicide for a specific duration of time. Much information has been gathered in recent years, largely as a result of an ongoing cooperative research project between the Wisconsin Department of Natural Resources, US Army Corps of Engineers Research and Development Center, and private consultants (including Onterra). This research couples quantitative aquatic plant monitoring with field-collected herbicide concentration data to evaluate efficacy and selectivity of control strategies implemented on a subset of Wisconsin lakes and flowages. Based on their preliminary findings, lake managers have adopted two main treatment strategies: 1) whole-lake treatments, and 2) spot treatments.

Spot treatments are a type of control strategy where the herbicide is applied to a specific area (treatment site) such that when it dilutes from that area, its concentrations are insufficient to cause significant affects outside of that area. Spot treatments typically rely on a short exposure time (often hours) to cause mortality and therefore are applied at a much higher herbicide concentration than whole-lake treatments. This has been the strategy historically used on most Wisconsin systems.

Whole-lake treatments are those where the herbicide is applied to specific sites, but when the herbicide reaches equilibrium within the entire volume of water (entire lake, lake basin, or within the epilimnion of the lake or lake basin); it is at a concentration that is sufficient to cause mortality to the target plant within that entire lake or basin. The application rate of a whole-lake treatment is dictated by the volume of water in which the herbicide will reach equilibrium. Because exposure time is so much longer, target herbicide levels for whole-lake treatments are significantly less than for spot treatments.

Cost

Herbicide application charges vary greatly between $400 and $1,500 per acre depending on the chemical used, who applies it, permitting procedures, and the size/depth of the treatment area.

Advantages	***Disadvantages***
• Herbicides are easily applied in restricted areas, like around docks and boatlifts. • Herbicides can target large areas all at once. • If certain chemicals are applied at the correct dosages and at the right time of year, they can selectively control certain	• All herbicide use carries some degree of human health and ecological risk due to toxicity. • Fast-acting herbicides may cause fish kills due to rapid plant decomposition if not applied correctly. • Many people adamantly object to the use of herbicides in the aquatic environment;

invasive species, such as Eurasian watermilfoil. • Some herbicides can be used effectively in spot treatments. • Most herbicides are designed to target plant physiology and in general, have low toxicological effects on non-plant organisms (e.g., mammals, insects)	therefore, all stakeholders should be included in the decision to use them. • Many aquatic herbicides are nonselective. • Some herbicides have a combination of use restrictions that must be followed after their application. • Overuse of same herbicide may lead to plant resistance to that herbicide.

Biological Controls

There are many insects, fish and pathogens within the United States that are used as biological controls for aquatic macrophytes. For instance, the herbivorous grass carp has been used for years in many states to control aquatic plants with some success and some failures. However, it is illegal to possess grass carp within Wisconsin because their use can create problems worse than the plants that they were used to control. Other states have also used insects to battle invasive plants, such as water hyacinth weevils (*Neochetina spp.*) and hydrilla stem weevil (*Bagous spp.*) to control water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata)*, respectively.

However, Wisconsin, along with many other states, is currently experiencing the expansion of lakes infested with Eurasian watermilfoil and as a result has supported the experimentation and use of the milfoil weevil (*Euhrychiopsis lecontei*) within its lakes. The milfoil weevil is a native weevil that has shown promise in reducing Eurasian watermilfoil stands in Wisconsin, Washington, Vermont, and other states. Research is currently being conducted to discover the best situations for the use of the insect in battling Eurasian watermilfoil. Currently the milfoil weevil is not a WDNR grant-eligible method of controlling Eurasian watermilfoil.

Cost

Stocking with adult weevils costs about $1.20/weevil and they are usually stocked in lots of 1000 or more.

Advantages	***Disadvantages***
• Milfoil weevils occur naturally in Wisconsin. • Likely environmentally safe and little risk of unintended consequences.	• Stocking and monitoring costs are high. • This is an unproven and experimental treatment. • There is a chance that a large amount of money could be spent with little or no change in Eurasian watermilfoil density.

Wisconsin has approved the use of two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) to battle purple loosestrife. These beetles were imported from Europe and used as a biological control method for purple loosestrife. Many cooperators, such as county conservation departments or local UW-Extension locations, currently support large beetle rearing operations. Beetles are reared on live purple loosestrife plants growing in kiddy pools surrounded by insect netting. Beetles are collected with aspirators and then released onto the target wild population. For more information on beetle rearing, contact your local UW-Extension location.

In some instances, beetles may be collected from known locations (cella insectaries) or purchased through private sellers. Although no permits are required to purchase or release beetles within Wisconsin, application/authorization and release forms are required by the WDNR for tracking and monitoring purposes.

Cost

The cost of beetle release is very inexpensive, and in many cases is free.

Advantages	***Disadvantages***
• Extremely inexpensive control method. • Once released, considerably less effort than other control methods is required. • Augmenting populations may lead to long-term control.	• Although considered "safe," reservations about introducing one non-native species to control another exist. • Long range studies have not been completed on this technique.

Analysis of Current Aquatic Plant Data

Aquatic plants are an important element in every healthy lake. Changes in lake ecosystems are often first seen in the lake's plant community. Whether these changes are positive, such as variable water levels or negative, such as increased shoreland development or the introduction of an exotic species, the plant community will respond. Plant communities respond in a variety of ways. For example, there may be a loss of one or more species. Certain life forms, such as emergent or floating-leaf communities, may disappear from specific areas of the lake. A shift in plant dominance between species may also occur. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide very useful information for management decisions.

As described in more detail in the methods section, multiple aquatic plant surveys were completed on Chilton Millpond; the first looked strictly for the exotic plant, curly-leaf pondweed, while the others that followed assessed both native and non-native species. Combined, these surveys produce a great deal of information about the aquatic vegetation of the lake. These data are analyzed and presented in numerous ways; each is discussed in more detail below.

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the aquatic plant species, both native and non-native, that were located during the surveys completed in Chilton Millpond in 2016. The list also contains the growth-form of each plant found (e.g., submergent, emergent, etc.), its scientific name, common name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain aquatic plant species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of the whole-lake point-intercept survey completed on Chilton Millpond, plant samples were collected from plots laid out on a grid that covered the lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. The occurrence of aquatic plant species is displayed as the *littoral frequency of occurrence*. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are within the maximum depth of plant growth (littoral zone), and is displayed as a percentage.

Floristic Quality Assessment

The floristic quality of a lake's aquatic plant community is calculated using its native *species richness* and their *average conservatism*. Species richness is the number of native aquatic plant species that were physically encountered on the rake during the point-intercept survey. Average conservatism is calculated by taking the sum of the coefficients of conservatism (C-values) of the native species located and dividing it by species richness. Every plant in Wisconsin has been assigned a coefficient of conservatism, ranging from 1-10, which describes the likelihood of that species being found in an undisturbed environment. Species which are more specialized and require undisturbed habitat are given higher coefficients, while species which are more tolerant of environmental disturbance have lower coefficients.

For example, algal-leaf pondweed (*Potamogeton confervoides*) is only found in nutrient-poor, acid lakes in northern Wisconsin and is prone to decline if degradation of these lakes occurs. Because of algal-leaf pondweed's special requirements and sensitivity to disturbance, it has a C-value of 10. In contrast, sago pondweed (*Stuckenia pectinata*) with a C-value of 3, is tolerant of disturbance and is often found in greater abundance in degraded lakes that have higher nutrient concentrations and low water clarity. Higher average conservatism values generally indicate a healthier lake as it is able to support a greater number of environmentally-sensitive aquatic plant species. Low average conservatism values indicate a degraded environment, one that is only able to support disturbance-tolerant species.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept surveys (equation shown below). This assessment allows the aquatic plant community of Chilton Millpond to be compared to other lakes within the region and state.

FQI = Average Coefficient of Conservatism * √ Number of Native Species

Species Diversity

Species diversity is often confused with species richness. As defined previously, species richness is simply the number of species found within a given community. While species diversity utilizes species richness, it also takes into account evenness or the variation in abundance of the individual species within the community. For example, a lake with 10 aquatic plant species that had relatively similar abundances within the community would be more diverse than another lake with 10 aquatic plant species were 50% of the community was comprised of just one or two species.

An aquatic system with high species diversity is more stable than a system with a low diversity. This is analogous to a diverse financial portfolio in that a diverse aquatic plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. A lake with a diverse plant community is also better suited to compete against exotic infestations than a lake with a lower diversity. The diversity of a lake's aquatic plant community is determined using the Simpson's Diversity Index (1-D):

$$D = \sum (n/N)^2$$

where:
n = the total number of instances of a particular species
N = the total number of instances of all species and
D is a value between 0 and 1

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. The Simpson's Diversity Index value from Chilton Millpond is compared to data collected by Onterra and the WDNR Science Services on 77 lakes within the Southeast Wisconsin Till Plain ecoregion and on 392 lakes throughout Wisconsin.

Community Mapping

A key component of any aquatic plant community assessment is the delineation of the emergent and floating-leaf aquatic plant communities within each lake as these plants are often underrepresented during the point-intercept survey. This survey creates a snapshot of these important communities within each lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with future surveys. Examples of emergent plants include cattails, rushes, sedges, grasses, bur-reeds, and arrowheads, while examples of floating-leaf species include the water lilies. The emergent and floating-leaf aquatic plant communities in Chilton Millpond were mapped using a Trimble Global Positioning System (GPS) with sub-meter accuracy.

Exotic Plants

Because of their tendency to upset the natural balance of an aquatic ecosystem, exotic species are paid particular attention to during the aquatic plant surveys. Two exotics, curly-leaf pondweed and Eurasian watermilfoil are the primary targets of this extra attention.

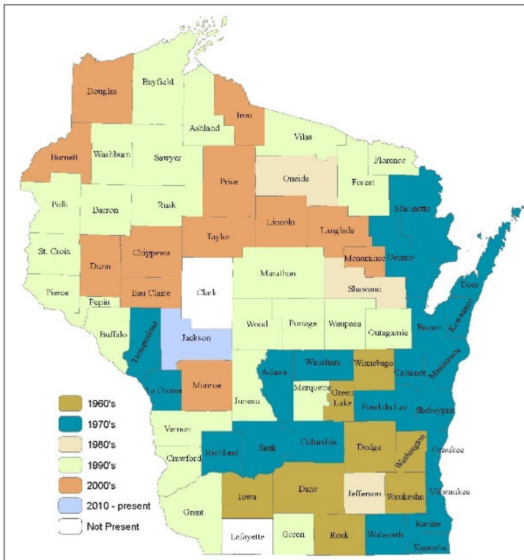


Figure 3.4-1. Spread of Eurasian watermilfoil within WI counties. WDNR Data 2022 mapped by Onterra.

Eurasian watermilfoil is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties (Figure 3.4-1). Eurasian watermilfoil is unique in that its primary mode of propagation is not by seed. It actually spreads by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, Eurasian watermilfoil has two other competitive advantages over native aquatic plants, 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian watermilfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly – leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced in early May, giving the plant a significant jump on native vegetation. Like Eurasian watermilfoil, curly-leaf pondweed can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.

Because of its odd life-cycle, a special survey is conducted early in the growing season to inventory and map curly-leaf pondweed occurrence within the lake. Although Eurasian watermilfoil starts to grow earlier than our native plants, it is at peak biomass during most of the summer, so it is inventoried during the comprehensive aquatic plant survey completed in mid to late summer. Aquatic invasive species mapping methodology is discussed in Section 6.0, Methods.

Chilton Millpond Aquatic Plant Survey Results

The whole-lake point-intercept and community mapping surveys were conducted on Chilton Millpond on July 15, 2022. The point-intercept survey utilized standard WDNR protocols (Hauxwell et al. 2010) at resolution of 20-meters, yielding 105 sampling points. During the 2022 surveys, a total of 14 aquatic plant species were located (Table 3.4-2). No non-native, or invasive species were found within Chilton Millpond. No other point-intercept surveys were completed in the past.

During the 2022 point-intercept survey, information regarding substrate type was collected at locations sampled with a pole-mounted rake. These data indicate that 92% of the point-intercept locations contained soft organic sediments, 6% contained sand, and 2% contained rock (Figure 3.4-2). Areas of soft organic substrate were the primary sediments found in the lake. The sediment within the entirety of Chilton Millpond is very conducive for supporting lush aquatic plant growth.

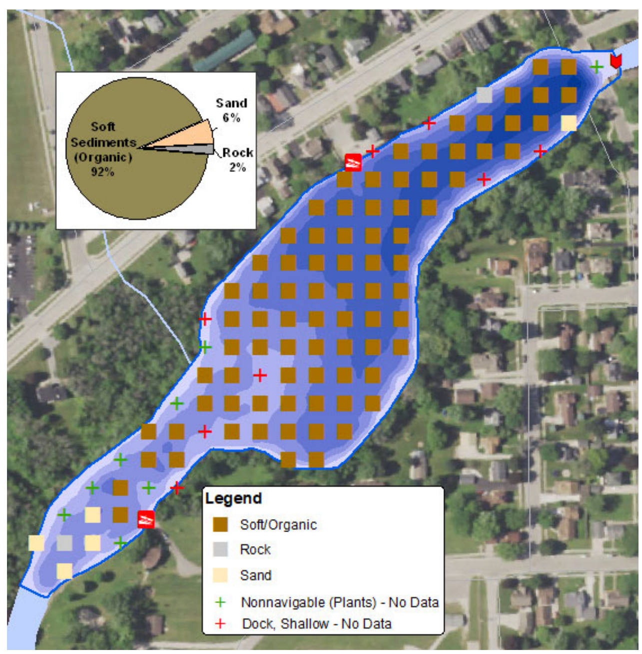


Figure 3.4-2. Chilton Millpond proportion of substrate types within littoral areas. Created using data from 2022 aquatic plant point-intercept survey.

Lakes in Wisconsin vary in their morphometry, water chemistry, water clarity, substrate composition, management, and recreational use, all factors which influence aquatic plant community composition. Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in soft substrates, others only in sandy/rocky areas, and some can be found growing in either. The combination of both soft sediments and areas of harder substrates creates different habitat types for aquatic plants, and generally leads to a higher number of aquatic plant species within the lake.

Table 3.4-2. Aquatic plant species located on Chilton Millpond from the 2022 surveys.

Growth Form	Scientific Name	Common Name	WI State Status	Coefficient of Conservatism	2022 (Onterra)
Emergent	*Iris versicolor*	Northern blue flag	Native	5	I
	Sagittaria latifolia	Common arrowhead	Native	3	X
	Sparganium eurycarpum	Common bur-reed	Native	5	I
FL	*Nymphaea odorata*	White water lily	Native	6	X
Submergent	*Ceratophyllum demersum*	Coontail	Native	3	X
	Elodea canadensis	Common waterweed	Native	3	X
	Elodea nuttallii	Slender waterweed	Native	7	X
	Nitella spp.	Stoneworts	Native	7	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	Native	8	X
	Potamogeton foliosus	Leafy pondweed	Native	6	X
	Potamogeton pusillus	Small pondweed	Native	7	X
	Potamogeton zosteriformis	Flat-stem pondweed	Native	6	X
S/E	*Sagittaria cuneata*	Arum-leaved arrowhead	Native	7	I
FF	*Lemna minor*	Lesser duckweed	Native	5	X

FL = Floating Leaf; FL/E = Floating Leaf and Emergent; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

Light is able to reach the deepest location within Chilton Millpond (6-7 feet) meaning aquatic vegetation have the capability to grow throughout the entire lake. Due to this, all reachable point-intercept sampling locations were visited during the survey and no locations were marked as "too deep". Approximately 76% of the point-intercept sampling locations contained aquatic vegetation in 2022 (Figure 3.4-3). Aquatic plant rake fullness data collected in 2022 indicates 44% of the 84 littoral sampling locations that contained vegetation with a total rake fullness rating (TRF) of 1, 11% had a TRF rating of 2, and 10% had a TRF rating of 3 indicating overall aquatic plant biomass in Chilton Millpond is moderate (Figure 3.4-3).

Whole-lake point-intercept surveys are used to quantify the abundance of individual species within the lake. Of the 14 aquatic plant species located in Chilton Millpond in 2022, 11 were encountered directly on the rake during the whole-lake point-intercept survey (Figure 3.4-4). The remaining 3 species were located incidentally, meaning they were observed by Onterra ecologists while on the lake but they were not directly sampled on the rake at any of the point-intercept sampling locations. Incidental species typically include emergent and floating-leaf species that are often found growing on the fringes of the lake and submersed species that are relatively rare within the plant community. Of the 11 species directly sampled with the rake during the point-intercept survey, common waterweed, coontail, and lesser duckweed were the three most frequently encountered species in 2022.

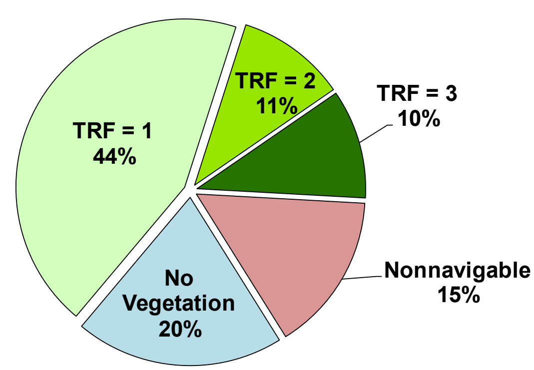


Figure 3.4-3. Chilton Millpond littoral frequency of occurrence of vegetation and total rake fullness (TRF) ratings. Created using data from the 2022 aquatic point-intercept survey.

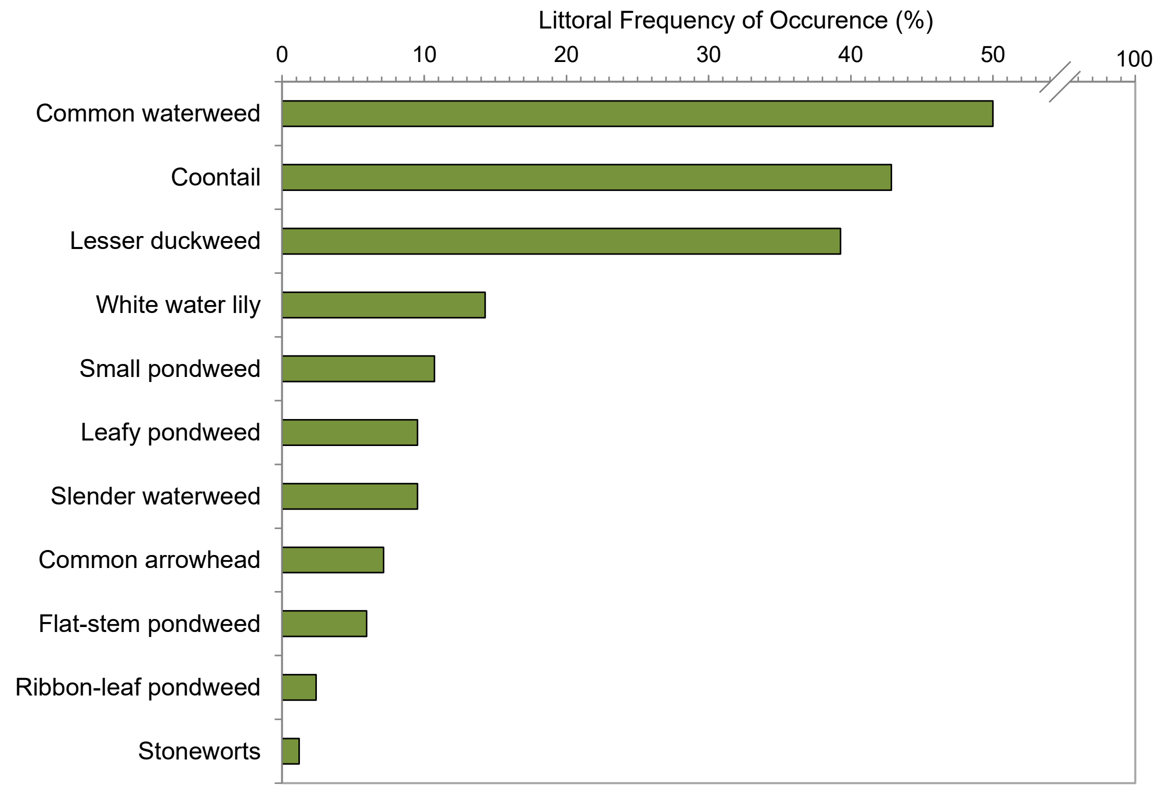


Figure 3.4-4. Chilton Millpond aquatic plant littoral frequency of occurrence. Created using data from 2022 point-intercept survey.

Common waterweed (Photo 3.4-5) was the most frequently encountered native aquatic plant species in Chilton Millpond in 2022 with a littoral frequency of occurrence of 50% (Figure 3.4-4). Common waterweed can be found in waterbodies across Wisconsin, is tolerant of high-nutrient, low-light conditions, and can grow to nuisance levels under ideal conditions. Common waterweed has blade-like leaves in whorls of three produced on long, slender stems. Like other submersed aquatic plants, common waterweed helps to stabilize bottom sediments and provides structural habitat and food for wildlife. In 2022, common waterweed was abundant throughout most littoral areas of Chilton Millpond being found at depths ranging from 1 and 5 feet of water.

Coontail (Photo 3.4-5) was the second most frequently encountered native aquatic plant species in Chilton Millpond 2022 with a littoral frequency of occurrence of 42.9% (Figure 3.4-4). Coontail possess whorls of leaves which fork into two to three segments, and provides ample surface area for the growth of periphyton and habitat for invertebrates. Unlike most of the submersed plants found in Wisconsin, coontail does not produce true roots and is often found growing entangled amongst other aquatic plants or matted at the surface. Because it lacks true roots, coontail derives most of its nutrients directly from the water (Gross, Erhard and Ivanyi 2003). Like common waterweed, this ability in combination with a tolerance for low-light conditions allows coontail to become more abundant in eutrophic waterbodies with higher nutrients and low water clarity. Coontail has the capacity to form dense beds that can float and mat on the water's surface. In 2022, coontail was abundant throughout all littoral areas of Chilton Millpond, and was most common between 1 and 6 feet of water.

Lesser duckweed (Photo 3.4-5) was the third most frequently encountered native aquatic plant species in Chilton Millpond 2022 with a littoral frequency of occurrence of 39.3% (Figure 3.4-4). Lesser duckweed is a free-floating aquatic plant, meaning it floats on the water's surface (not rooted in sediment) and its location is largely determined by wind and wave direction. This free-floating species is most commonly confused with turion duckweed which usually exhibits a reddish underside as well as papules on its surface. Since lesser duckweed is free floating, its location is primarily dependent on wind/wave direction and where floating leaf plants are where it can be contained. Its presence is often in association with high nitrogen concentrations in the water column. In 2022 lesser duckweed was primarily found growing in shallow near shore areas and where emergent and floating-leaf vegetation was also found.

Common waterweed (*Elodea canadensis*)	Coontail (*Ceratophyllum demersum*)	Lesser duckweed (*Lemna minor*)
		

Photograph 3.4-5. The three most common native plants in Chilton Millpond.

As explained above in the Primer on Data Analysis and Data Interpretation Section, the littoral frequency of occurrence analysis allows for an understanding of how often each of the plants is located during the point-intercept survey. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while common waterweed was found at 50% of the sampling locations in Chilton Millpond, its relative frequency of occurrence is 25.9%. Explained another way, if 100 plants were randomly sampled from Chilton Millpond, 26 of them would be common waterweed. Looking at relative frequency of occurrence (Figure 3.4-5), 11 species comprise 100% of the plant community in 2022 which is an indication of low diversity.

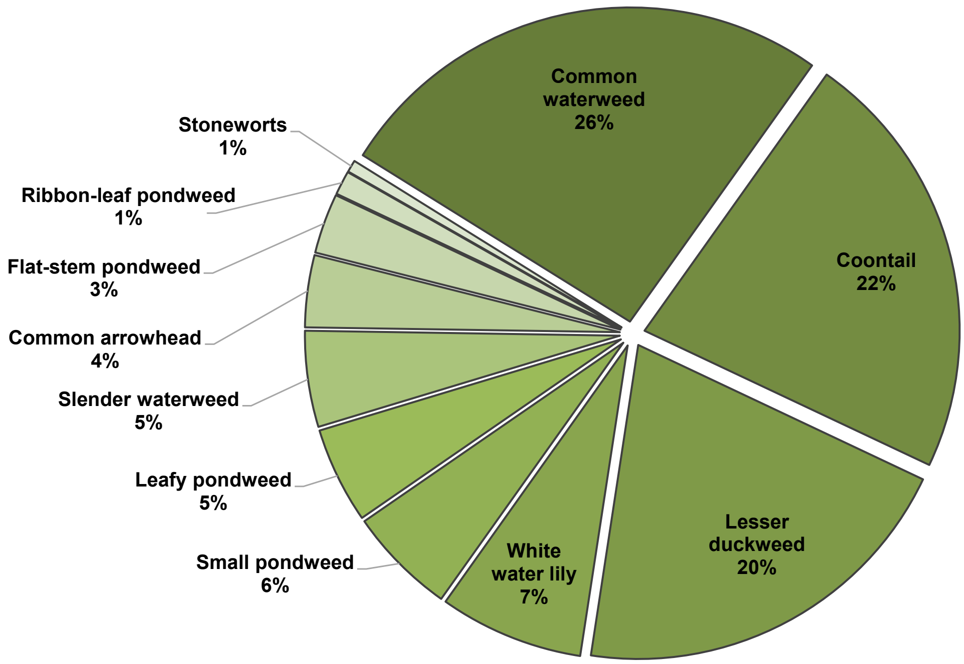


Figure 3.4-5. Chilton Millpond relative plant littoral frequency of occurrence. Created using data from the 2022 survey.

As discussed previously, the calculations used for the Floristic Quality Index (FQI) for a lake's aquatic plant community are based on the aquatic plant species that were encountered on the rake during the point-intercept survey and does not include incidental species. Figure 3.4-9 displays the native species richness (11) for Chilton Millpond is below the Southwestern Till Plains Ecoregion and Wisconsin State medians for 2022.

Data collected from the 2022 aquatic plant surveys show that the average conservatism value (5.5) is slightly above the Southwestern Till Plains Ecoregion and below the Wisconsin State medians (Figure 3.4-6), indicating that the majority of the plant species found in Chilton Millpond are considered resilient to environmental disturbance. The presence of these plants, and lack of sensitive species, signifies current environmental conditions can mainly support aquatic plants robust to disturbance.

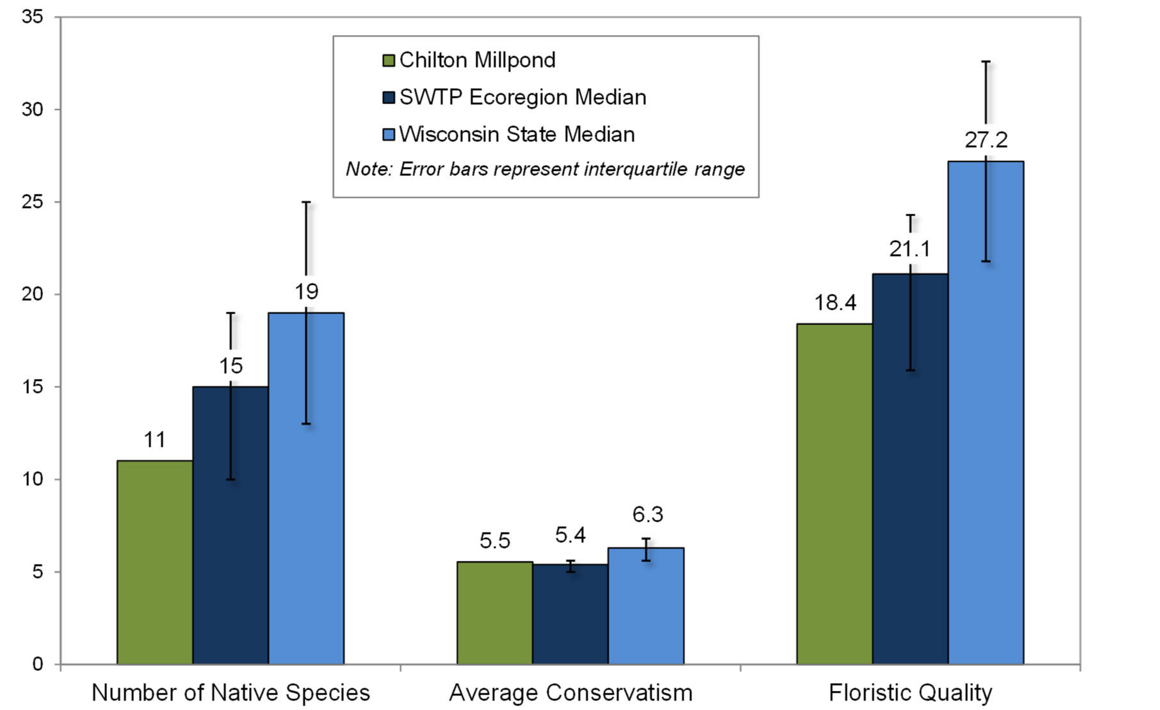


Figure 3.4-6. Chilton Millpond Floristic Quality Assessment. Created using data from 2022 surveys. Analysis following (Nichols, 1999) where SWTP = Southwestern Till Plains Ecoregion.

Combining Chilton Millpond's aquatic plant species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in a value of 18.4 (equation shown below); which is below the median values for the ecoregion and the state (Figure 3.4-6), and further illustrating Chilton Millpond's plant community contains species vigorous to disturbance and of low species richness.

$$\text{FQI} = \text{Average Coefficient of Conservatism (5.5)} * \sqrt{\text{Number of Native Species (11)}}$$
$$\text{FQI} = 18.4$$

The aquatic plant community in Chilton Millpond was found to be of low diversity, with a Simpson's diversity value of 0.83 in 2022 (Figure 3.4-7). This value for 2022, ranks at the ecoregion median and below the state median. A plant community with a mosaic of species with differing morphological attributes provides zooplankton, macroinvertebrates, fish and other wildlife with diverse structural habitat and various sources of food. The lack of diversity in Chilton Millpond will reduce the availability of good habitat for aquatic organisms.

Chilton Millpond supports a population of the non-native common carp (*Cyprinus carpio*). Numerous studies have documented the deleterious effects these fish have on lake ecosystems. Because of their ability to reach extreme densities, they are considered to be one of the most detrimental invasive species to waterbodies they inhabit (Weber & Brown, 2011). The low aquatic plant diversity is likely the result of a combination of factors such as common carp presence and poor water clarity.

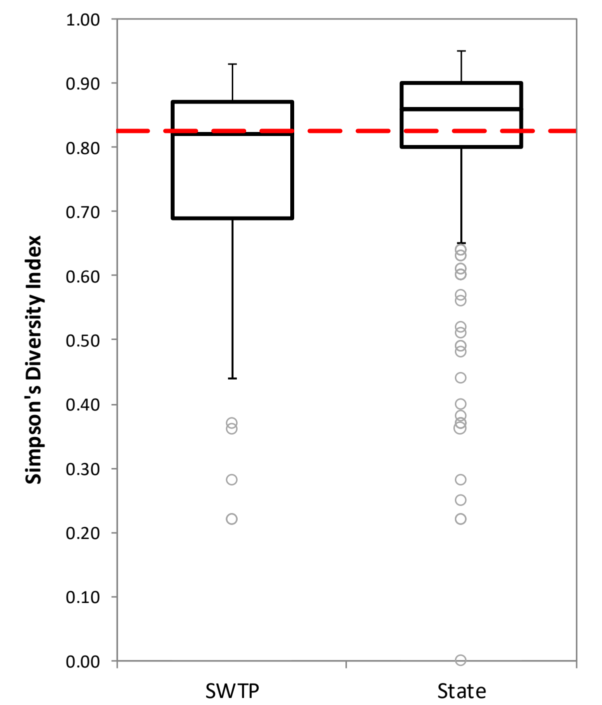


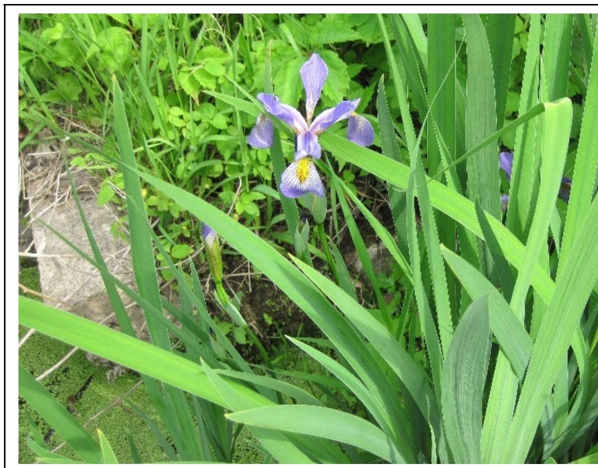
Figure 3.4-7. Chilton Millpond Simpson's Diversity index. Created using data from the 2022 aquatic plant survey. Ecoregion data provided by WDNR Science Services.

On Chilton Millpond, carp may be a contributor to limited vegetation in much of the lake and inhibit the proliferation of newly established vegetation by uprooting and disturbing the sediment. The carp population likely impacted the water quality in a negative way as well through frequent sediment disruptions and re-suspending sediment into the water column. For more information on carp and their population dynamics within Chilton Millpond, please refer to section *3.6 Fisheries Data Integration*.

On July 15, 2022, Onterra ecologists also conducted a community mapping survey aimed at mapping emergent and floating-leaved plant communities in Chilton Millpond (Photograph 3.4-6). The 2022 community map indicates that approximately 4.8 acres (43.6%) of the 11 acre-lake contain these types of plant communities (Map 9). Emergent and floating-leaf plant communities are a wetland community type dominated by species such as cattails, bulrushes, and water lilies. Like submersed aquatic plant communities, these communities also provide valuable habitat, shelter, and food sources for organisms that live in and around the lake.

In addition to those functions, floating-leaf and emergent plant communities provide other valuable services such as erosion control and nutrient filtration. These communities also lessen the force of wind and waves before they reach the shoreline which serves to lessen erosion. Their root systems also help stabilize bottom sediments and reduce sediment resuspension. In addition, because they often occur in near-shore areas, they act as a buffer against nutrients and other pollutants in runoff from upland areas.

This is important to note these communities are often negatively affected by recreational use and shoreland development. (Radomski & Goeman, Consequences of Human Lakeshore Development on Emergent and Floating-leaf Vegetation Abundance, 2001) found a 66% reduction in vegetation coverage on developed shorelands when compared to the undeveloped shorelands in Minnesota lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelands.



Photograph 3.4-6. Native northern blue flag iris located on Chilton Millpond.

3.5 Aquatic Invasive Species in Chilton Millpond

As is discussed in section 2.0 Stakeholder Participation, the lake stakeholders were asked about aquatic invasive species (AIS) and their presence in Chilton Millpond within the anonymous stakeholder survey. Onterra and the WDNR have confirmed that there is one AIS present (Table 3.5-1).

Table 3.5-1. AIS present within Chilton Millpond

Type	Common name	Scientific name	Location within the report
Fish	Common carp	*Cyprinus carpio*	Section 3.6 – Fisheries Data Integration

Figure 3.5-1 displays the aquatic invasive species that Chilton Millpond stakeholder survey respondents believe are in Chilton Millpond. Only the species known to be present in Chilton Millpond are discussed below or within their respective locations listed in Table 3.5-1. While it is important to recognize which species stakeholders believe to present within their lake, it is more important to share information on the species present and possible management options. More information on these invasive species or any other AIS can be found at the following links:

- http://dnr.wi.gov/topic/invasives/
- https://nas.er.usgs.gov/default.aspx
- https://www.epa.gov/greatlakes/invasive-species

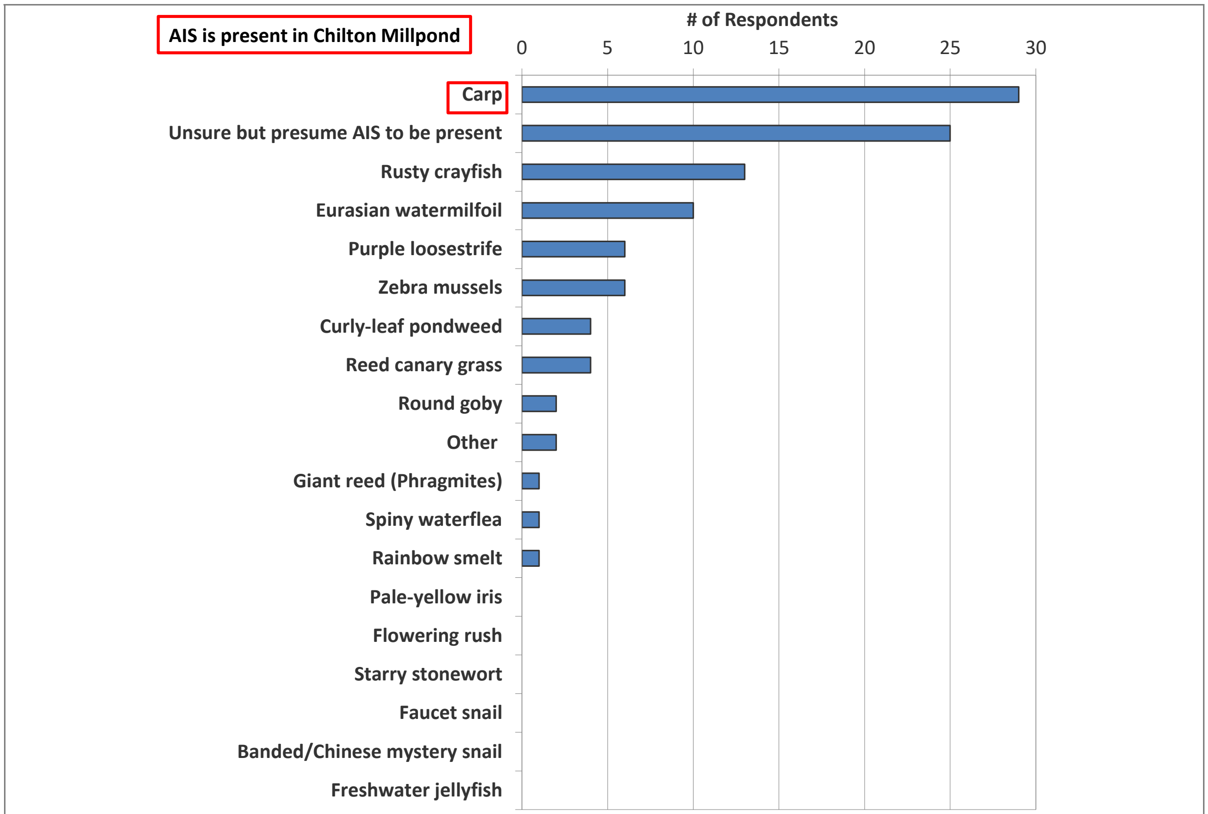


Figure 3.5-1. Stakeholder survey response Question #20. Which aquatic invasive species do you believe are in or immediately around Chilton Millpond?

3.6 Fisheries Data Integration

Fishery management is an important aspect in the comprehensive management of a lake ecosystem; therefore, a brief summary of available data is included here as a reference. The following section is not intended to be a comprehensive plan for the lake's fishery, as those aspects are currently being conducted by the fisheries biologists overseeing Chilton Millpond. The goal of this section is to provide an overview of some of the data that exists. Although current fish data were not collected as a part of this project, the following information was compiled based upon data available from the Wisconsin Department of Natural Resources (WDNR) and personal communications with DNR Fisheries Biologist Angelo Cozzola (WDNR 2023).

Chilton Millpond Fishery

Energy Flow of a Fishery

When examining the fishery of a lake, it is important to remember what drives that fishery, or what is responsible for determining its mass and composition. The gamefish in Chilton Millpond are supported by an underlying food chain. At the bottom of this food chain are the elements that fuel algae and plant growth – nutrients such as phosphorus and nitrogen, and sunlight. The next tier in the food chain belongs to zooplankton, which are tiny crustaceans that feed upon algae and plants, and insects. Smaller fish called planktivores feed upon zooplankton and insects, and in turn become food for larger fish species. The species at the top of the food chain are called piscivores, and are the larger gamefish that are often sought after by anglers, such as bass and walleye.

A concept called energy flow describes how the biomass of piscivores is determined within a lake. Because algae and plant matter are generally small in energy content, it takes an incredible amount of this food type to support a sufficient biomass of zooplankton and insects. In turn, it takes a large biomass of zooplankton and insects to support planktivorous fish species. And finally, there must be a large planktivorous fish community to support a modest piscivorous fish community. Studies have shown that in natural ecosystems, it is largely the amount of primary productivity (algae and plant matter) that drives the rest of the producers and consumers in the aquatic food chain. This relationship is illustrated in Figure 3.6-1.

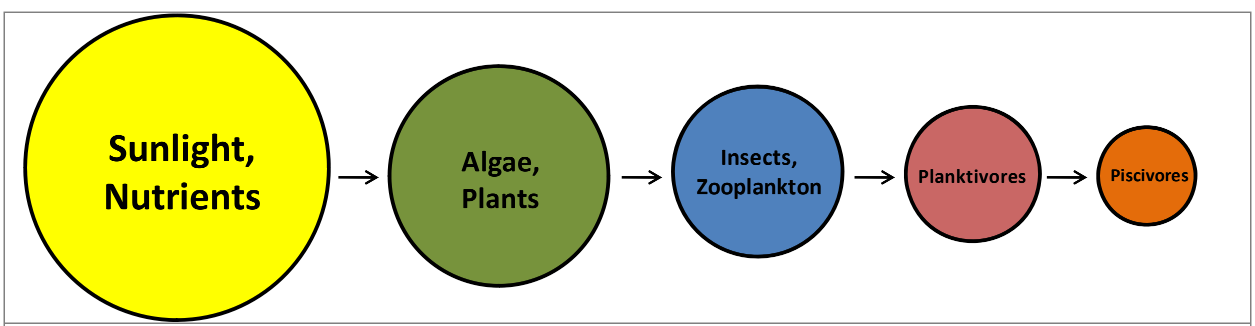


Figure 3.6-1. Aquatic food chain. Adapted from (Carpenter, Kitchell, & Hodgson, 1985)

As discussed in the Water Quality section, Chilton Millpond is a eutrophic system, meaning it has high nutrient content and thus relatively high primary productivity. Table 3.6-1 shows the game fish present in the system. Although not an exhaustive list of fish species in the lake, additional fish species found in past WDNR surveys of the Chilton Millpond include white sucker (*Catostomus commersonii*) and various redhorse species.

Table 3.6-1. Gamefish present in Chilton Millpond with corresponding biological information (Becker, 1983).

Black Bullhead (*Ameiurus melas*)	5	April - June	Matted vegetation, woody debris, overhanging banks	Amphipods, insect larvae and adults, fish, detritus, algae
Bluegill (*Lepomis macrochirus*)	11	Late May - Early August	Shallow water with sand or gravel bottom	Fish, crayfish, aquatic insects and other invertebrates
Largemouth Bass (*Micropterus salmo*	13	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Northern Pike (*Esox lucius*)	25	Late March - Early April	Shallow, flooded marshes with emergent vegetation with fine leaves	Fish including other pike, crayfish, small mammals, water fowl, frogs
Pumpkinseed (*Lepomis gibbosus*)	12	Early May - August	Shallow warm bays 0.3 - 0.8 m, with sand or gravel bottom	Crustaceans, rotifers, mollusks, flatworms, insect larvae (terrestrial and aquatic)
Rock Bass (*Ambloplites rupestris*)	13	Late May - Early June	Bottom of course sand or gravel, 1 cm - 1 m deep	Crustaceans, insect larvae, and other invertebrates
Smallmouth Bass (*Micropterus dolom*	13	Mid May - June	Nests more common on north and west shorelines over gravel	Small fish including other bass, crayfish, insects (aquatic and terrestrial)
Yellow Perch (*Perca flavescens*)	13	April - Early May	Sheltered areas, emergent and submergent veg	Small fish, aquatic invertebrates

Survey Methods

In order to keep the fishery of a lake healthy and stable, fisheries biologists must assess the current fish populations and trends. To begin this process, the correct sampling technique(s) must be selected to efficiently capture the desired fish species. A commonly used passive trap is a fyke net (Photograph 3.6-1). Fish swimming towards this net along the shore or bottom will encounter the lead of the net, be diverted into the trap and through a series of funnels which direct the fish further into the net. Once reaching the end, the fisheries technicians can open the net, record biological characteristics, mark (usually with a fin clip), and then release the captured fish.

The other commonly used sampling method is electrofishing (Photograph 3.6-1). This is done, often at night, by using a specialized boat fit with a generator and two electrodes installed on the front touching the water. Once a fish comes in contact with the electrical current produced, the fish involuntarily swims toward the electrodes. When the fish is in the vicinity of the electrodes, they become stunned making them easier to net and place into a livewell to recover. Contrary to what some may believe, electrofishing does not kill the fish and after being placed in the livewell fish generally recover within minutes. As with a fyke net survey, biological characteristics are recorded and any fish that has a mark (considered a recapture from the earlier fyke net survey) are also documented before the fish is released.

The mark-recapture data collected between these two surveys is placed into a statistical model to calculate the population estimate of a fish species. Fisheries biologists can then use this data to make recommendations and informed decisions on managing the future of the fishery.

A handful of surveys have taken place in the Chilton Millpond, but none in recent years. The most recent survey in DNR records was completed in 1991.

Photograph 3.6-1. Fyke net positioned in the littoral zone of a Wisconsin Lake (left) and an electroshocking boat (right).

Fish Stocking

Photograph 3.6-2. Northern pike fingerling.

To assist in meeting fisheries management goals, the WDNR may permit the stocking of fingerling or adult fish in a waterbody that were raised in permitted hatcheries (Photograph 3.6-2). Stocking a lake may be done to assist the population of a species due to a lack of natural reproduction in the system, or to otherwise enhance angling opportunities. Chilton Millpond was stocked from 1972 to 1992 with northern pike (Table 3.6-2) and largemouth bass (Table 3.6-3). Additionally, bluegill were stocked from 1974-1989 (Table 3.6-4) and yellow perch were stocked from 1980-1984 (Table 3.6-5).

Table 3.6-2. Stocking data available for northern pike in Chilton Millpond (1972-1992).

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1992	NORTHERN PIKE	FINGERLING	300	3.0
1982	NORTHERN PIKE	FINGERLING	200	9.0
1981	NORTHERN PIKE	ADULT	100	
1980	NORTHERN PIKE	YEARLING	100	
1980	NORTHERN PIKE	FRY	10,000	
1974	NORTHERN PIKE	YEARLING	100	15.0
1972	NORTHERN PIKE	YEARLING	100	13.0
1972	NORTHERN PIKE	ADULT	100	15.0

Table 3.6-3. Stocking data available for largemouth bass in Chilton Millpond (1975-1993).

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1975	LARGEMOUTH BASS	FINGERLING	2,000	1.0
1979	LARGEMOUTH BASS	FRY	2,000	2.0
1980	LARGEMOUTH BASS	FINGERLING	1,000	1.0
1981	LARGEMOUTH BASS	FINGERLING	500	1.0
1982	LARGEMOUTH BASS	FINGERLING	500	1.0
1983	LARGEMOUTH BASS	FINGERLING	1,500	2.0
1988	LARGEMOUTH BASS	FRY	1,800	
1993	LARGEMOUTH BASS	FINGERLING	1,500	3.0

Table 3.6-4. Stocking data available for bluegill in Chilton Millpond (1974-1989).

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1989	BLUEGILL	ADULT	300	4.0
1988	BLUEGILL	FRY	500	5.0
1985	BLUEGILL	ADULT	900	3.0
1984	BLUEGILL	ADULT	500	7.0
1983	BLUEGILL	ADULT	325	5.0
1980	BLUEGILL	FINGERLING	2,100	2.0
1974	BLUEGILL	ADULT	1,500	3.0

Table 3.6-5. Stocking data available for yellow perch in Chilton Millpond (1980-1984).

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1984	YELLOW PERCH	ADULT	500	11.0
1983	YELLOW PERCH	ADULT	500	7.0
1982	YELLOW PERCH	ADULT	500	
1981	YELLOW PERCH	YEARLING	1,000	
1980	YELLOW PERCH	ADULT	1,000	

Fishing Activity

Based on data collected from the stakeholder survey (Appendix B), fishing (open-water) was the fourth important reason for owning property on or near Chilton Millpond (Question #4). Figure 3.6-2 displays the fish that Chilton Millpond stakeholders target the most. Approximately 92% of these same respondents believed that the quality of fishing on the lake was somewhere between very poor and fair (Figure 3.6-3). Approximately 57% of respondents who fish Chilton Millpond believe the quality of fishing has gotten worse to some degree since they first started to fish the lake (Figure 3.6-4).

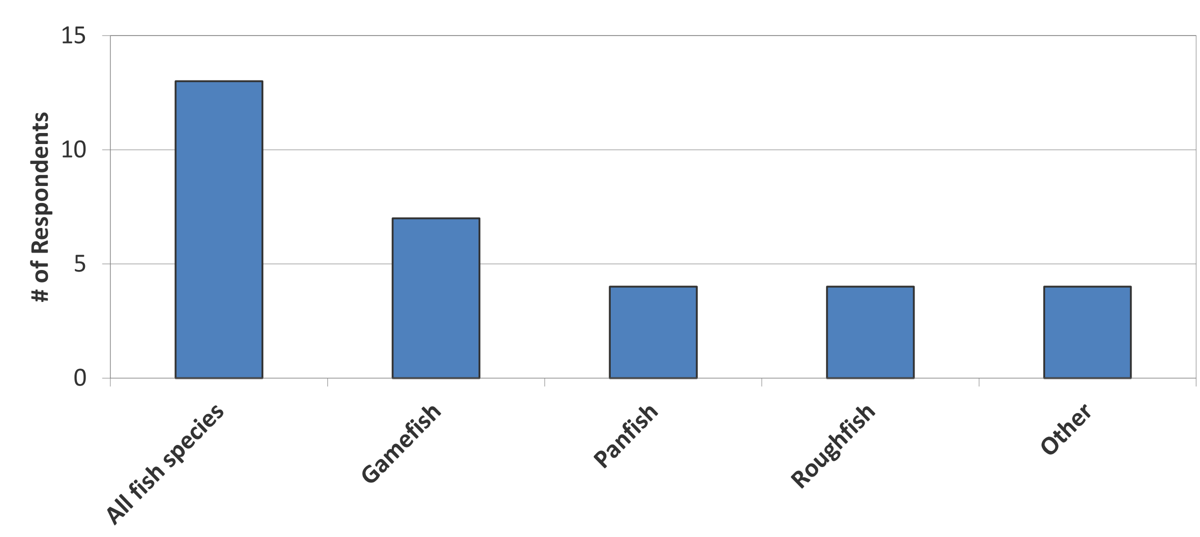


Figure 3.6-2. Stakeholder survey response Question #8. What species of fish do you like to catch on Chilton Millpond?

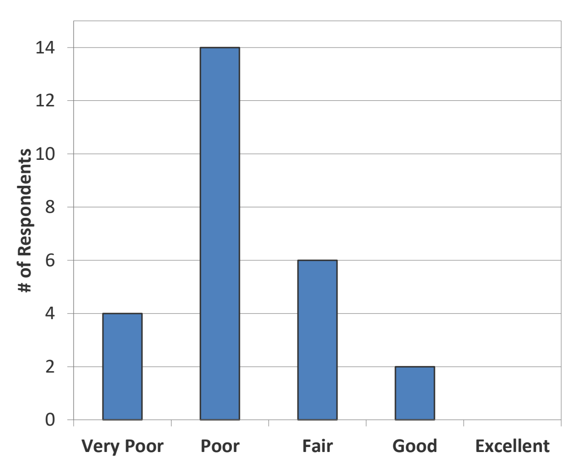


Figure 3.6-3. Stakeholder survey response Question #9. How would you describe the current quality of fishing on Chilton Millpond?

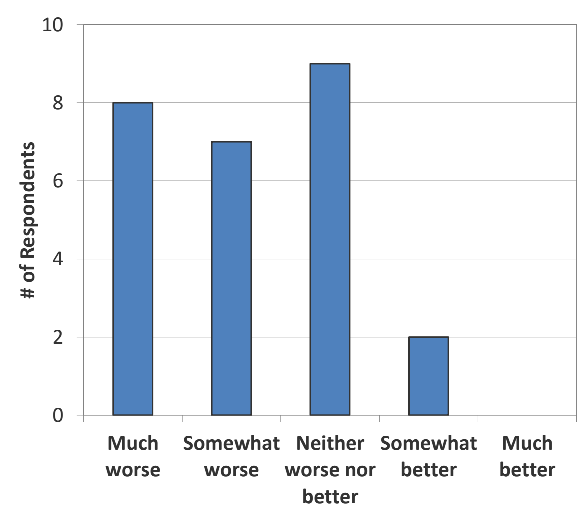


Figure 3.6-4. Stakeholder survey response Question #10. How has the quality of fishing changed on Chilton Millpond since you started fishing the lake?

Fish Populations and Trends

Utilizing the above-mentioned fish sampling techniques and specialized formulas, WDNR fisheries biologists can estimate populations and determine trends of captured fish species. These numbers provide a standardized way to compare fish caught in different sampling years depending on gear used (fyke net or electrofishing). Data is analyzed in many ways by fisheries biologists to better understand the fishery and how it should be managed.

Gamefish

Several gamefish species can be found within the Chilton Millpond; however overall gamefish populations are low. **Largemouth bass** and **northern pike** are the dominant game fish species, and have been commonly found in past surveys. The DNR website also lists **smallmouth bass** as present within the system as well. In total, 11,000 northern pike have been stocked in Chilton Millpond and 10,800 largemouth bass have been stocked.

Panfish

In past DNR surveys, the most commonly encountered panfish species include **bluegill**, **pumpkinseed**, and **yellow perch**. Multiple panfish stocking events occurred in the 1970's and 1980's. A total of 6,125 bluegill were stocked during these events and a total of 3,500 yellow perch were stocked.

Common Carp

Since the introduction of common carp (*Cyprinus carpio*), an invasive species which originates from Eurasia, to waterbodies in the United States and other countries around the world, numerous studies have documented the deleterious effects these fish have on lake ecosystems. Common carp can survive in a wide range of waterbody conditions, but they reach their greatest densities in shallow, eutrophic systems like Beaver Dam Lake (Weber & Brown, 2011). Because of their ability to reach extreme densities, they are considered to be one of the most detrimental invasive species to waterbodies they inhabit (Weber & Brown, 2011).

Following the introduction of common carp to a waterbody, studies have documented declines in submersed aquatic vegetation and increases in total phosphorus and suspended solids, and a shift from a clear, submersed aquatic plant-dominated state to a turbid, algae-dominated state (Bajer & Sorensen, 2015). Common carp directly increase nutrients within the water by physical resuspension of bottom sediments through foraging and spawning behavior as well as through excretion (Fischer & Krogman, 2013). Common carp foraging behavior also creates more flocculent sediments which are more prone to resuspension from wind. In addition, sediments are also more prone to wind-induced resuspension as aquatic vegetation declines through physical uprooting and decline in light availability due to increases in water turbidity (Lin & Wu, 2013). Zooplankton which feed on algae also decline as their refuge from predators within aquatic vegetation disappears. Common carp create a positive feedback mechanism: the direct physical resuspension and uprooting of vegetation indirectly increases the susceptibility of bottom sediments to wind-induced resuspension, and the increased turbidity further decreases aquatic vegetation. Carp have commonly been found in past surveys of the Chilton Millpond.

Chilton Millpond Fish Habitat

Substrate Composition

Just as forest wildlife require proper trees and understory growth to flourish, fish require certain substrates and habitat types to nest, spawn, escape predators, and search for prey. Lakes with primarily a silty/soft substrate, many aquatic plants, and coarse woody debris may produce a completely different fishery than lakes that are largely sandy/rocky, and contain few aquatic plant species or coarse woody habitat.

Substrate and habitat are critical to fish species that do not provide parental care to their eggs. Northern pike is one species that does not provide parental care to its eggs (Becker, 1983). Northern pike broadcast their eggs over woody debris and detritus, which can be found above sand or muck. This organic material suspends the eggs above the substrate, so the eggs are not buried in sediment and suffocate as a result. Walleye are another species that does not provide parental care to its eggs. Walleye preferentially spawn in areas with gravel or rock in places with moving water or wave action, which oxygenates the eggs and prevents them from getting buried in sediment. Fish that provide parental care are less selective of spawning substrates. Species such as bluegill tend to prefer a harder substrate such as rock, gravel or sandy areas if available, but have been found to spawn and care for their eggs in muck as well.

According to the point-intercept survey conducted by Onterra in 2022, 92% of the substrate sampled in the littoral zone of Chilton Millpond were soft, organic sediments, 6% was composed of sand sediments, and 2% were composed of rock.

Woody Habitat

As discussed in the Shoreland Condition Section, the presence of coarse woody habitat is important for many stages of a fish's life cycle, including nesting or spawning, escaping predation as a juvenile, and hunting insects or smaller fish as an adult. Unfortunately, as development has increased on Wisconsin lake shorelines in the past century, this beneficial habitat has often been the first to be removed from the natural shoreland zone. Leaving these shoreland zones barren of coarse woody habitat can lead to decreased abundances and slower growth rates in fish (Sass, 2009). A 2022 survey documented 33 pieces of coarse woody along the shores of Chilton Millpond, resulting in a ratio of approximately 41 pieces per mile of shoreline. Fisheries biologists do not suggest a specific number of fish sticks for a lake but rather highly encourage their installation wherever possible. To learn how Chilton Millpond's coarse woody habitat is compared to other lakes in its region please refer to section 3.3.

Fish Habitat Structures

Some fisheries managers may look to incorporate fish habitat structures on the lakebed or littoral areas extending to shore for the purpose of improving fish habitats and spawning areas. These projects are typically conducted on lakes lacking significant coarse woody habitat in the shoreland zone. The "Fish sticks" program, outlined in the WDNR best practices manual, adds trees to the shoreland zone restoring fish habitat to critical near shore areas. Typically, every site has 3 – 5 trees which are partially or fully submerged in the water and anchored to shore (Photograph 3.6-3). The WDNR recommends placement of the fish sticks during the winter on ice when possible to prevent adverse impacts on fish spawning or egg incubation periods. The program requires a WDNR permit and can be funded through many different sources including the WDNR, County Land & Water Conservation Departments or partner contributions.

Photograph 3.6-3. Examples of fish sticks (left) and half-log habitat structures. (Photos by WDNR)

Fish cribs are a type of fish habitat structure placed on the lakebed. These structures are more commonly utilized when there is not a suitable shoreline location for fish sticks. Installing fish cribs may also be cheaper than fish sticks; however, some concern exists that fish cribs can concentrate fish, which in turn leads to increased predation and angler pressure. Having multiple locations of fish cribs can help mitigate that issue.

Half-logs are another form of fish spawning habitat placed on the bottom of the lakebed (Photograph 3.6-3). Smallmouth bass specifically have shown an affinity for overhead cover when creating spawning nests, which half-logs provide (Wills, Bremigan, & Haynes, 2004). If the waterbody is exempt from a permit or a permit has been received, information related to the construction, placement and maintenance of half-log structures are available online.

An additional form of fish habitat structure is spawning reefs. Spawning reefs typically consist of small rubble in a shallow area near the shoreline for mainly walleye habitat. Rock reefs are sometimes utilized by fisheries managers when attempting to enhance spawning habitats for some fish species. However, a 2004 WDNR study of rock habitat projects on 20 northern Wisconsin lakes offers little hope the addition of rock substrate will improve walleye reproduction (Neuswanger & Bozek, 2004).

Placement of a fish habitat structure in a lake may be exempt from needing a permit if the project meets certain conditions outlined by the WDNR's checklists available online:

(https://dnr.wi.gov/topic/waterways/Permits/Exemptions.html)

If a project does not meet all of the conditions listed on the checklist, a permit application may be sent in to the WDNR and an exemption requested.

If interested, the Chilton Lake District, may work with the local WDNR fisheries biologist to determine if the installation of fish habitat structures should be considered in aiding fisheries management goals for Chilton Millpond.

Fishing Regulations

Regulations for Chilton Millpond fish species as of March 2023 are displayed in Table 3.6-6.

For specific fishing regulations on all fish species, anglers should visit the WDNR website (*www.http://dnr.wi.gov/topic/fishing/regulations/hookline.html)* or visit their local bait and tackle shop to receive a free fishing pamphlet that contains this information.

Table 3.6-6. WDNR fishing regulations for Chilton Millpond (As of March 2023).

Species	Daily bag limit	Length Restrictions	Season
Panfish (bluegill, pumpkinseed, sunfish, crappie and yellow perch)	25	None	Open All Year
Largemouth bass and smallmouth bass	5	14"	May 7, 2022 to March 5, 2023
Smallmouth bass	5	14"	May 7, 2022 to March 5, 2023
Largemouth bass	5	14"	May 7, 2022 to March 5, 2023
Muskellunge and hybrids	1	40"	May 7, 2022 to December 31, 2022
Northern pike	5	None	May 7, 2022 to March 5, 2023
Walleye, sauger, and hybrids	3	15"	May 7, 2022 to March 5, 2023
Bullheads	Unlimited	None	Open All Year

Mercury Contamination and Fish Consumption Advisories

Freshwater fish are amongst the healthiest of choices you can make for a home-cooked meal. Unfortunately, fish in some regions of Wisconsin are known to hold levels of contaminants that are harmful to human health when consumed in great abundance. The two most common contaminants are polychlorinated biphenyls (PCBs) and mercury. These contaminants may be found in very small amounts within a single fish, but their concentration may build up in your body over time if you consume many fish. Health concerns linked to these contaminants range from poor balance and problems with memory to more serious conditions such as diabetes or cancer. These contaminants, particularly mercury, may be found naturally to some degree. However, the majority of fish contamination has come from industrial practices such as coal-burning facilities, waste incinerators, paper industry effluent and others. Though environmental regulations have reduced emissions over the past few decades, these contaminants are greatly resistant to breakdown and may persist in the environment for a long time. Fortunately, the human body is able to eliminate contaminants that are consumed however this can take a long time depending upon the type of contaminant, rate of consumption, and overall diet. Therefore, guidelines are set upon the consumption of fish as a means of regulating how much contaminant could be consumed over time.

General fish consumption guidelines for Wisconsin inland waterways are presented in Figure 3.6-8. There is an elevated risk for children as they are in a stage of life where cognitive development is rapidly occurring. As mercury and PCB both locate to and impact the brain, there are greater restrictions on women who may have children or are nursing children, and also for children under 15. While the millpond currently does not have any fish consumption advisories, the DNR does not advise consumption of any fish species from the Manitowoc River downstream of the Chilton Dam due to PCB contamination.

Fish Consumption Guidelines for Most Wisconsin Inland Waterways		
	Women of childbearing age, nursing mothers and all children under 15	**Women beyond their childbearing years and men**
Unrestricted*	-	Bluegill, crappies, yellow perch, sunfish, bullhead and inland trout
1 meal per week	Bluegill, crappies, yellow perch, sunfish, bullhead and inland trout	Walleye, pike, bass, catfish and all other species
1 meal per month	Walleye, pike, bass, catfish and all other species	Muskellunge
Do not eat	Muskellunge	-

**Doctors suggest that eating 1-2 servings per week of low-contaminant fish or shellfish can benefit your health. Little additional benefit is obtained by consuming more than that amount, and you should rarely eat more than 4 servings of fish within a week.*

Figure 3.6-8. Wisconsin statewide safe fish consumption guidelines. Graphic displays consumption guidance for most Wisconsin waterways. Figure adapted from WDNR website graphic (http://dnr.wi.gov/topic/fishing/consumption/)

Fishery Management & Conclusions

The Chilton Millpond is a eutrophic system that supports low gamefish and panfish populations. Common carp and other rough fish species have commonly been documented as well. Because of the millpond's size, only a couple of DNR surveys have been completed to assess the fishery. Changes in water levels and water quality parameters, such as temperature and dissolved oxygen availability, likely affect fish movement and populations within the millpond.

4.0 SUMMARY AND CONCLUSIONS

The design of this project was intended to fulfill three objectives;

1) Collect baseline data to increase the general understanding of the Chilton Millpond ecosystem.
2) Collect sociological information from Chilton Millpond stakeholders regarding their use of the lake and their thoughts pertaining to the past and current condition of the lake and its management.
3) Create a realistic and implementable management plan for the millpond.

The three objectives were fulfilled during the project and have led to a good understanding of the Chilton Millpond ecosystem, the folks that care about the lakes, and what needs to be completed to protect and enhance them.

In spring 2022, the Chilton Lake District was awarded a Wisconsin DNR Surface Water Grant to develop a comprehensive management plan for Chilton Millpond. The planning project included two primary components; 1) the collection of information about the millpond itself, as well as the people who utilize and manage the waterbody, and 2) the development of a realistic and implementable management plan for the millpond. During 2022 and 2023, several studies were completed on Chilton Millpond, including three aquatic plant surveys, six water quality collections, and the development of a surface watershed model. Historical water quality and fishery information was also compiled. In addition, a user survey was initiated to collect information from Chilton Millpond stakeholders regarding their use of the millpond, how they believe it has changed over the years, and how they would like to see it managed.

During the spring and early-summer of 2023, a planning committee comprised of City officials and staff, citizens, and county staff, learned about the biological, physical, and chemical aspects of Chilton Millpond, the tremendous impact the millpond's large watershed has on the waterbody, and realistic options available to improve recreational opportunities on and around the millpond. The development of the plan began by creating a list of challenges facing the millpond and the lake district. Those challenges were converted to goals and a list of actions was created that would allow the district to achieve those goals.

While small at about 11 acres, the Chilton Millpond is a complicated waterbody. First and foremost, it is a manmade feature, so it does not function like a natural lake, and that is an important consideration because it cannot be managed like a natural lake either. When a natural lake is created, Mother Nature's goal is to fill it in. For the most part, a lake is not filled in by dirt arriving from the lake's drainage basin (watershed). It is actually the build-up of partially decomposed organic material the settles to the lake's bottom. Most of the organic material is developed within the lake when aquatic plants, both simple plants, like algae, and more complicated vascular plants utilize dissolved nutrients that originate in the lake's watershed to grow. In other words, dissolved ingredients from the watershed are made into biological solids (plants and animals) that eventually die, are partially decomposed, and then settle to the bottom of the lake. This process of filling in a natural lake takes thousands of years, but in a manmade lake, like a millpond, it may take only a lifetime. This is the case because in a flowage, like Chilton Millpond, the watershed is much bigger than would be able to occur naturally, and as a result, the inflow of those nutrients is unnaturally high. The higher levels of nutrients lead to higher plant production in the waterbody, which fills in the basin faster. Also, unlike a natural lake, the greater rate of inflow often allows for sediment from the watershed to be added to the flowage basin, so that too increases the rate at which the basin is filled. It is important to note that when a flowage basin "fills in" it doesn't completely fill in, the basin actually returns to more river-like conditions.

Chilton Millpond's surface watershed spans over 45,000 acres, yielding a watershed to lake area ratio of 4110:1. This means that each surface acre of the millpond has 4,110 acres of land draining to it. This is a tremendously large watershed draining to a small waterbody. The watershed's impact on the millpond is compounded by the fact that nearly 70% of the land in the watershed is used for agriculture, and as a result accounts for over 90% of the nearly 30,000 pounds of phosphorus estimated to enter Chilton Millpond annually. Wetlands, forests, and grasslands make up a little over 25% of the watershed and contribute much less to the millpond's annual nutrient load.
Unfortunately, little historical water quality data exists for Chilton Millpond. The data that does exist, in combination with the data collected as a part of this project, indicates that the millpond has high nutrient (phosphorus and nitrogen) levels that foster abundant plant growth in the millpond's basin. Fortunately, even with the high levels of nutrients, the flow rate through the millpond typically keeps algae from building up to nuisance levels. However, during drier summers with less flow and a lot of heat, algae levels can increase and cause issues, like fish kills, in the millpond.

The aquatic plant studies completed during the summer of 2022 documented that the plant community of Chilton Millpond is made up of 14 species with coontail and common waterweed being the most abundant. These two species, along with white water lily reach nuisance levels and hamper passive water sports, such as kayaking, canoeing, and fishing on the millpond. No aquatic invasive plant species were found in the millpond during the surveys, which is an incredible positive for waterbody.

As with most millponds in Wisconsin, the size of the watershed plays an important role in how much improvement can be realistically expected in the millpond's overall quality, even with significant changes watershed land use. For instance, scenarios developed as a part of the Chilton Millpond watershed modeling completed for this project show that converting all agricultural areas to forests would still allow enough phosphorus to reach the millpond to keep it highly productive with a high biomass of aquatic plants and occasional algae blooms. This is not to say that work in the watershed would not improve the health of the lake, it is that the improvements may not be seen in significantly better water quality. Instead, improvements may be seen in higher quality aquatic plants establishing in the millpond and reduced frequency of algae blooms.

The management plan developed for Chilton Millpond includes six goals focusing upon increasing recreational opportunities on and around the millpond, reducing nutrient and sediment pollution from the watershed, preventing the introduction of invasive species, reducing shoreline erosion, and developing a long-term water quality and aquatic plant database. The plan contains twelve management actions, that when implemented, will allow the district to meet its goals.

A large-scale dredging project was considered but removing nearly 25,800 cu.yd. of material would cost between $566,000 and $755,000 depending on the methods used. The scenario also included a possible drawdown of the millpond from September through May, prior to dredging, to move sediments downstream and likely reduce the volume of dredging required. Ultimately, district officials were concerned with the high costs of a dredging project and the potential negative impacts brought on by a drawdown to downstream areas. The current plan calls for a small-scale dredging project at the Hobart Park public landing and the possible purchase and operation of a mechanical harvester by the district, after a one- to two-year trial with contracted harvesting services. If these actions do not meet the goal of increasing recreational opportunities on the millpond, the large-scale dredging project will be reconsidered, and a feasibility study will be initiated.

5.0 IMPLEMENTATION PLAN

The Implementation Plan presented below was created through the collaborative efforts of the Chilton Lake District Planning Committee and ecologist/planners from Onterra. It represents the path the Chilton Lake District will follow in order to meet their lake management goals. The goals detailed within the plan are realistic and based upon the findings of the studies completed in conjunction with this planning project and the needs of the Chilton Millpond stakeholders as portrayed by the members of the Planning Committee, the returned stakeholder surveys, and numerous communications between Planning Committee members and the lake stakeholders. The Implementation Plan is a living document in that it will be under constant review and adjustment depending on the condition of the lake, the availability of funds, level of volunteer involvement, and the needs of the stakeholders.

Management Goal 1: Enhance Recreational Opportunities on Chilton Millpond

Management Action:	Determine feasibility of utilizing a district-owned mechanical harvester on Chilton Millpond to maintain navigation lanes and fishing access areas.
Timeframe:	Begin 2024
Facilitator:	District Board of Commissioners
Description:	Aquatic plant surveys completed in 2022 documented several areas on Chilton Millpond with abundant levels of native aquatic vegetation which during the summer months may hinder navigation, especially that of canoes and kayaks, and angler use at city parks. To enhance these opportunities, the Chilton Lake District will investigate the feasibility of purchasing, operating, and maintaining a small mechanical harvester. A small harvester, like a Truxor Amphibious Machine or an Eco Harvester with cutting bar, would be required to work in a small waterbody like Chilton Millpond. Before purchasing a harvester, the district may contract harvesting on the millpond for one or more years as a part of the feasibility determination. Map 10 displays 1.1 acres of harvest area consisting of 1.0 acre of 10-foot wide navigation lanes and a 0.1-acre harvest area near the Leahy-Lions Park shoreline for fishing access. Harvesting would not begin until June 1 and end before September 30, each season. Offload sites are located at the two public landings on the millpond. Plants would be disposed of at the City of Chilton Compost Site located at W2432 Short Road, Chilton, WI. Harvester operation and maintenance would be managed by the City of Chilton. Harvester operators would minimize direct impact to fish by returning captured fish to the lake, or by temporarily suspending operations if many gamefish are encountered. The harvester would also follow any conditions on the WDNR permit specific to this topic. Continued aquatic plant

	monitoring, which would be a requirement of subsequent mechanical harvesting permits, is discussed in the action associated with Goal 6.
Action Steps:	1. District Board of Commissioners gathers cost estimates for: • Harvester, offloading equipment, and transport of harvested material • Training of staff and operation of harvesting equipment • Maintenance and storage • Permitting 2. Obtain mechanical harvesting permit from WDNR. 3. Purchase equipment and train staff in its operation. 4. Complete harvest operation following plan and permit conditions.

Management Action:	Stabilize eroding streambanks to prevent continued erosion and maintain concentrated channel flow within Chilton Millpond.
Timeframe:	2024
Facilitator:	District Board of Commissioners
Potential Grant:	Wisconsin Healthy Lakes and Rivers Grant for restoration projects.
Description:	Planning committee members, city staff, and stakeholder survey respondents expressed concern that continued shoreline erosion is causing sedimentation within the millpond and flattening of the streambed, which in turn dissipates streamflow allowing for more deposition of watershed-derived sediments and greater nuisance native plant abundancies. To prevent continued shoreline erosion, the Chilton Lake District will determine the need for shoreline stabilization within the millpond and investigate a possible cost-share program between the district and riparian property owners. The district will also work with professionals to ease the environmental impact of the stabilization by incorporating native plants and other habitat features.
Action Steps:	1. Survey Chilton Millpond shoreline for erosion and the need for stabilization. 2. Determine estimated cost and cost-share program parameters. 3. Discuss shoreline stabilization needs and design with WDNR. 4. Apply for proper permits. 5. Implement stabilization project in phases.

Management Action:	Determine feasibility of small-scale mechanical dredging at Hobart Park boat landing to improve accessibility.
Timeframe:	2024
Facilitator:	District Board of Commissioners
Potential Grant:	Sport Fishing – Boat Access Grants

Description:	Sedimentation near the Hobart Park public boat launch has reduced water depth supported aquatic plant growth to the point that even passive watercraft have issues accessing the primary channel from the landing. The district will investigate the feasibility of mechanically dredging a narrow channel of approximately 10-feet wide from the landing to the primary channel in the millpond to facilitate better navigation for recreational watercraft and for the potential mechanical harvester described above. Chilton Millpond is on the WDNR's list for Riparian Navigational Dredging on Man-Made Impoundments General Permit list. The description states that riparians can obtain this permit to remove up to 50 cubic yards of sediment per year. This small-scale dredging project may be better implemented during a year in which a dam inspection is required, and the millpond is temporarily drawn down. Initial discussions with WDNR water regulations staff will provide guidance on the permit required and subsequent steps required to obtain the specific permit.
Action Steps:	See description above.

Management Action:	Complete large-scale dredging project feasibility study.
Timeframe:	If management actions above are found insufficient to meet Goal 1.
Facilitator:	District Board of Commissioners
Potential Grant:	WDNR Surface Water Planning Grant
Description:	During this management plan development project, several scenarios were developed to explore the possible costs associated with a large-scale dredging project. The scenario that would likely meet navigational needs, while possibly removing some nuisance native species, includes deepening the main basin to a minimum depth of 5 feet and the channel stretching along Hobart Park to approximately 4 feet. Nearly 25,800 cu.yd. of material would be removed with rough estimated costs varying between $566,000 and $755,000 depending on dredging and sediment disposal methods. The figure of nearly 25,800 cu.yd. was determined by calculating the difference between the current lake bathymetry (acoustic study completed by Onterra in April 2022) and the bathymetry described above and shown in the Example Dredging Project slides of the second planning meeting (Appendix A.) The scenario also included a possible drawdown from September through May prior to dredging to move sediments downstream and likely reduce the volume of dredging required. Additional information regarding a potential dredging project presented to the planning committee during the second planning meeting can be found in Appendix A.

	Ultimately, district officials were concerned with the high costs of a dredging project and the potential negative impacts brought on by a drawdown to downstream areas, especially the two ponds created by the low head dams that are within Chilton. However, both actions will be reconsidered if the implementation of the actions above fail to meet the goal of enhancing recreational opportunities on Chilton Millpond. If these actions are reconsidered by the district, a study would be completed to determine potential downstream impacts of a drawdown of the millpond, including characterizing the flow of the downstream ponds, and the determination of likely siltation areas. If dredging is reconsidered, a study would be completed to determine the volume of sediment arriving from the watershed and the impact that sediment would have on the longevity of the dredging project.
Action Steps:	See description above.

Management Goal 2: Enhance Recreational Opportunities around Chilton Millpond

Management Action:	Develop shoreline access plan including trails, sidewalks, fishing piers, and waterfront shelters.
Timeframe:	2024
Facilitator:	District Board of Commissioners in Partnership with City of Chilton
Potential Grant:	Knowles-Nelson Stewardship Grant
Description:	The City of Chilton is currently working on multi-family housing projects, a new fire station, and park improvements, including an all-inclusive playground area at Nennig Park. With improved recreational opportunities in Chilton Millpond, the city and district will work to also improve recreational activities around the pond as well, focusing primarily on Hobart and Leahy-Lions parks. The enhancements may include trails, fishing piers, sidewalks, kayak launches.
Action Steps:	See description above.

Management Goal 3: Increase the Public's Positive Perception and Understanding of Chilton Millpond

Management Action:	Separate Chilton Lake District communications from the City of Chilton Communications.
Timeframe:	2024
Facilitator:	District Board of Commissioners
Potential Grant:	WDNR Surface Water Education Grant
Description:	Currently, the Chilton Lake District does not have consistent, direct communications with its members, nor does it have a unique social media or internet presence. To better facilitate district communications with its members, the district will establish a web page accessible from the city's page and as the opportunity arise from the implementation of this plan, begin to create a social media presence. The initial web presence will be used to communicate district news, the results of continued monitoring on the millpond, and to provide educational information to district members and millpond riparians. Educational topics would include results of the planning project studies, information on riparian property maintenance for better water quality and aquatic habitat, and the results of continued monitoring conducted by the district.
Action Steps:	See description above.

Management Action:	Develop millpond-focused events on and around the millpond.
Timeframe:	Following successful implementation of actions aimed at enhancing recreational opportunities on and around Chilton Millpond.
Facilitator:	District Board of Commissioners in partnership with the City of Chilton and other community entities.
Potential Grant:	WDNR Surface Water Education Grant
Description:	Comments were received by planning committee members and via the stakeholder survey that some district members are not pleased with being included in the district tax levy because they do not utilize Chilton Millpond. Chilton Millpond is considered an asset to the City of Chilton and one of the primary objectives in initiating this planning project was to create a water feature the citizens of Chilton could enjoy and of which to be proud whether they own property on the millpond or not. The district will work the city, and other community partners, such as the Chamber of Commerce, fishing clubs, police and fire departments, and the school district to facilitate Chilton Millpond-focused events that will occur on or near it. For example, educational programs with schools, fishing events with local clubs, passive watercraft safety and enjoyment classes.
Action Steps:	See description above.

Management Goal 4: Prevent the Introduction of Aquatic Invasive Species

Management Action:	Inform Chilton Millpond riparians and users about aquatic invasive species.
Timeframe:	2023
Facilitator:	District Board of Commissioners
Potential Grant:	Wisconsin Surface Water Education Grant
Description:	No aquatic invasive plant species were located during the three plant surveys that were completed during the summer of 2022. Not having AIS plants is a tremendous positive for Chilton Millpond; therefore, the district must be diligent on preventing introductions of AIS. The most likely vector for introductions of AIS is human use of a waterbody, so educating millpond users regarding their role in preventing AIS transfers between waterbodies is critical. To meet this objective, the district will: 1. Update the AIS prevention signage at Hobart and Leahy-Lions parks. 2. Disburse AIS prevention information to district members via the district's website and social media. Excellent sources for AIS information and materials are the UW-Extension Lakes Program, WDNR, and the Great Lakes Restoration Initiative.
Action Steps:	See description above.

Management Action:	Rapid response plan for discovery of aquatic invasive species in Chilton Millpond
Timeframe:	Continuous
Facilitator:	District Board of Commissioners
Potential Grant:	Aquatic Invasive Species – Early Detection & Response Grant
Description:	Identifying exotic species soon after introduction often leads to better management of that species. Having a plan in place before the discovery assures the necessary steps will be taken to document the finding and leverage resources to manage it. If a suspected AIS is found in Chilton Millpond, a sample specimen should be collected and the sample location documented. This can be done by recording the latitude and longitude from a smart phone or GPS, placing a floating buoy at the location, or as a last resort, taking a screenshot of the position in a smart phone's map application. Proper identification is critical; therefore, the specimen should be provided to Dani Santry, Water Resource Specialist with Calumet County. If the specimen is confirmed as a new invasive species to Chilton Millpond, Mary Gansberg, Water Resource Specialist, WDNR should be contacted for guidance on the next steps.

Action Steps:	See description above.

Management Goal 5: Reduce Nutrient and Sediment Pollution Originating from Chilton Millpond Watershed

Management Action:	Support the creation and implementation of Nine-Key Elements Plan for South Branch Manitowoc River.
Timeframe:	2024
Facilitator:	District Board of Commissioners in partnership with Calumet County LWCD
Potential Grant:	Wisconsin Surface Water Planning Grant
Description:	Screening-level modeling of the Chilton Millpond surface watershed indicates that it is the source of the millpond's high nutrient levels. Studies completed as a part of the Northeast Lakeshore TMDL project confirm high nutrient as well as sediment loads occur within the regional watershed as well. Development of a 9 Key Element Watershed Plan for the South Branch Manitowoc watershed would document loading sources and determine measurable steps to reduce those loads. According to the WDNR, "Watershed plans consistent with EPA's nine key elements provide a framework for improving water quality in a holistic manner within a geographic watershed. The nine elements help assess the contributing causes and sources of nonpoint source pollution, involve key stakeholders, and prioritize restoration and protection strategies to address water quality problems." Completing a WDNR-approved 9 Key Element plan qualifies the watershed to receive specific funding, such as Targeted Runoff Management and WDNR Lake Protection Grants. The Calumet County LWCD has completed approved 9 Key Element Plans for several watersheds in Calumet County. The Chilton Lake District will partner with the county and financially support a project to create and implement a 9 Key Element Plan for the South Branch Manitowoc River.
Action Steps:	1. Contact Calumet County LWCD to discuss the development of a 9 Key Element Plan for the South Branch Manitowoc River. 2. Pass a resolution stating the district's level of financial support. 3. Work with the county to obtain a Wisconsin Surface Water Planning Grant to partially fund the development of the plan. 4. Work with the county to inform district members and watershed property owners about the project and its benefits to Chilton Millpond and other waterbodies in the watershed. 5. Continue partnership with the county to obtain additional funding to implement the 9 Key Element Plan.

Management Goal 6: Develop and Maintain a Long-Term Environmental Monitoring Program on Chilton Millpond

Management Action:	Monitor water quality through WDNR Citizens Lake Monitoring Network.
Timeframe:	2024
Facilitator:	District Board of Commissioners
Potential Grant:	N/A
Description:	Monitoring water quality is an important aspect of every lake management planning activity. Collection of water quality data at regular intervals aids in the management of the lake by building a database that can be used for long-term trend analysis. The lack of this type of historical information hampered the water quality analysis and watershed modeling during this project. Early discovery of negative trends may lead to the reason as to why the trend is developing. Stability will be added to the program by selecting an individual from the district to coordinate the district's volunteer efforts and to recruit additional volunteers to keep the program fresh. The WDNR will first require the district to collect Secchi disk transparencies during the first year, then, if openings exist, would let the group into the Advanced Water Quality Program, in which a volunteer collects water quality samples for processing by the Wisconsin State Laboratory of Hygiene (WSLH) once during the spring and three times during the summer months (June, July, and August). A distinct advantage of processing the samples through the WSLH is that the results are automatically loaded into the Surface Water Integrated Management System (SWIMS), the WDNR statewide database. Currently, the WDNR is allowing lake groups to participate in the Advanced Water Quality Program for three years out of every ten years. During the years that the district cannot participate in the WDNR-funded program, the district can continue to collect water quality samples for analysis by the WSLH, by utilizing the Chilton Lake District account number (357232) obtained as a part of this program. The samples would be shipped to the WSLH (2601 Agriculture Dr, Madison, WI 53718) with a completed Inorganic Test Form (4800-024), listing the Chilton Millpond's WBIC of 81200, and Station ID of 10007721. If the district plans to continue sampling from the South State Street bridge, the district should purchase a small Van dorn bottle to allow for water samples to be collected from approximately three feet below the water surface. An excellent source for a Van dorn sampler is www.wildco.com. As a part of the water quality monitoring program, the district should consider also collecting dissolved oxygen samples during the summer, and

	at least once, through the ice, each winter. Collection of these data will aid in determining the applicability of fish stocking in the millpond.
Action Steps:	1. District recruits volunteer(s) for water quality sample collection. 2. District contacts WDNR water resource specialist, Mary Gansberg to enroll in Citizen Lake Monitoring Network. 3. Volunteer collects water quality data and reports data to WDNR and Chilton Lake District.

Management Action:	Conduct periodic quantitative vegetation monitoring on Chilton Millpond.
Timeframe:	Point-Intercept Survey every 5 years, Community Mapping every 10 years, AIS surveys as deemed necessary by Chilton Lake District.
Facilitator:	District Board of Commissioners
Potential Grant:	Wisconsin Surface Water Planning Grant
Description:	As part of the ongoing AIS prevention and vegetation management program, a whole-lake point-intercept survey will be conducted at a minimum once every 5 years. This will allow a continued understanding of the submergent aquatic plant community dynamics within Chilton Millpond and allow for periodic, lakewide surveillance of the lake for new AIS. The first point-intercept survey was conducted on Chilton Millpond in 2022 as a part of this management planning project, therefore, the next anticipated point-intercept survey on the millpond would be in 2027. In order to understand the dynamics of the emergent and floating-leaf aquatic plant community in Chilton Millpond, a community mapping survey would be conducted approximately every 10 years. A community mapping survey was conducted on the millpond in 2022 as a part of this management planning effort. The next community mapping survey will be completed in 2032 to coincide with the point-intercept survey that would potentially occur 5 years after the 2027 point-intercept survey discussed above. Note that the community mapping survey should be done during the same summer as a point-intercept survey, so the schedule of point-intercept surveys, as laid out above, would be the determinant of the community mapping survey.
Action Steps:	See description above.

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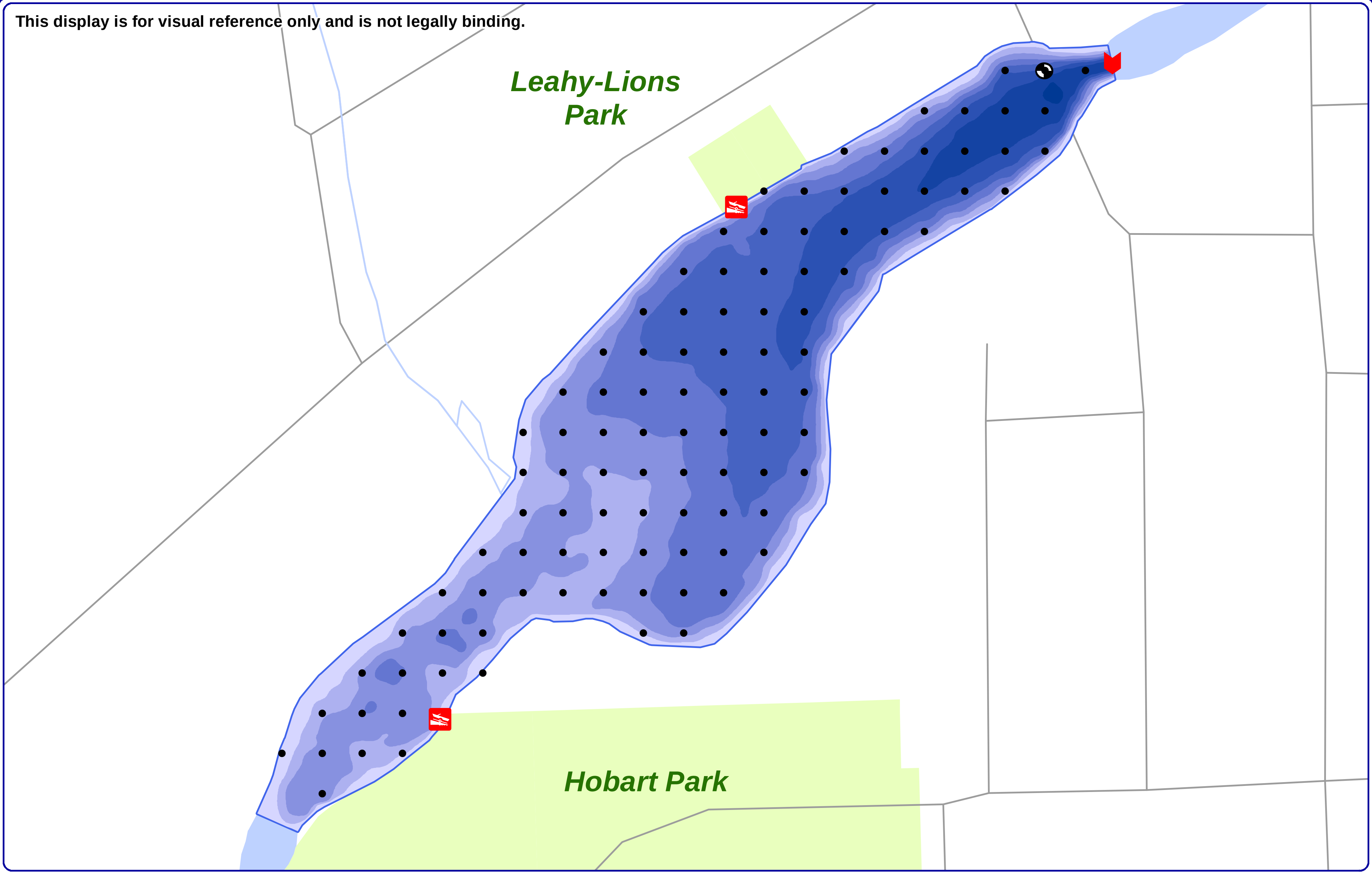

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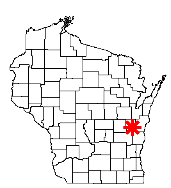
Sources:
Roads and Hydro: WDNR
Bathymetry: Onterra, 2022
Public Lands: WDNR
Map Date: May 18th, 2023 KLW
Filename: Map1_ChiltonMillpond_ProjectLocation.mxd



Project Location in Wisconsin

Legend

Chilton Millpond - 11.1 acres
Onterra Definition

Public Park

Point-intercept Sample Location
50 meter points, 150 points

Public Access

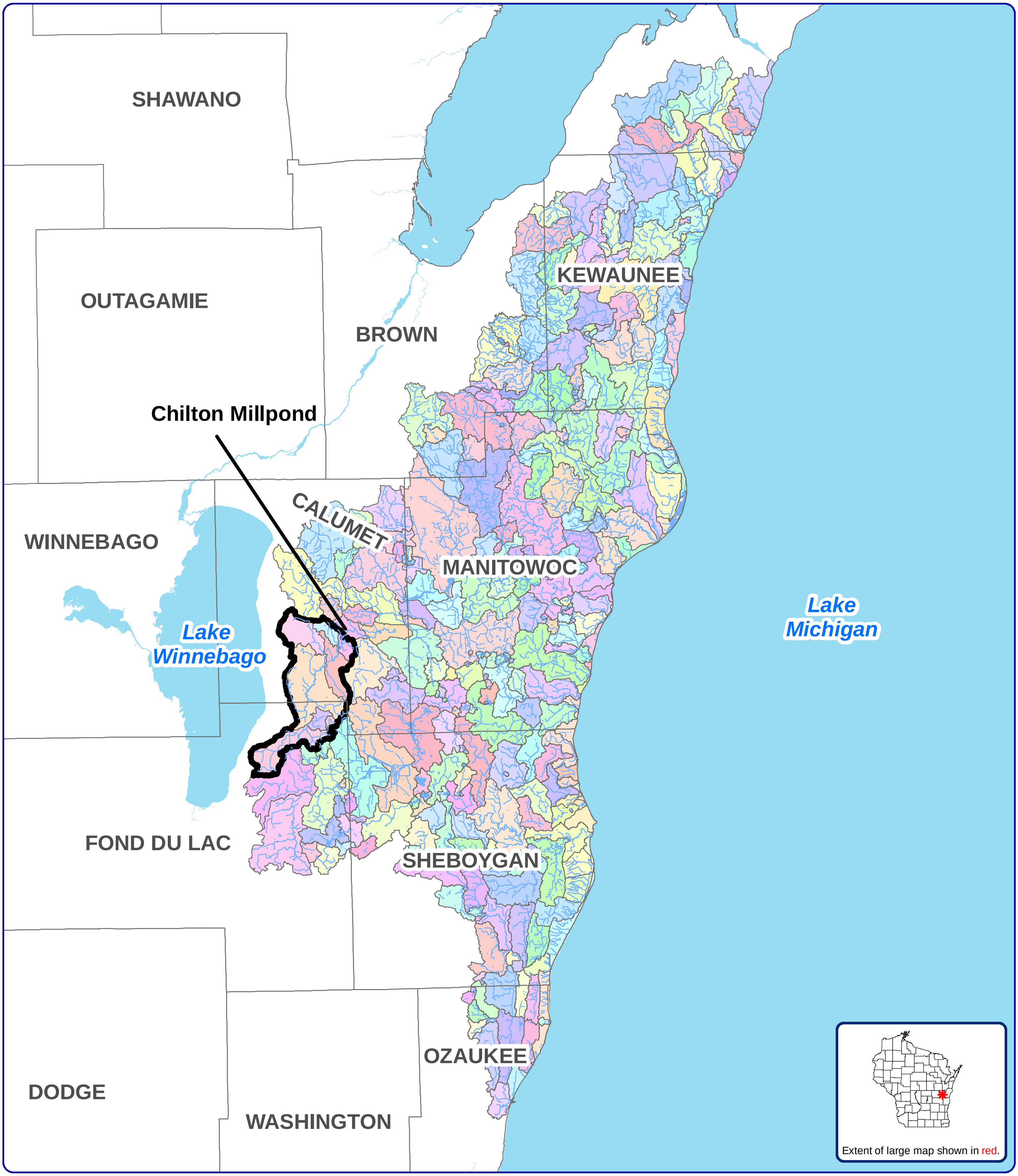
Dam

Map 1

Chilton Millpond

Calumet County, Wisconsin

Project Location & Lake Boundaries



N
W E
S

62,000
Feet

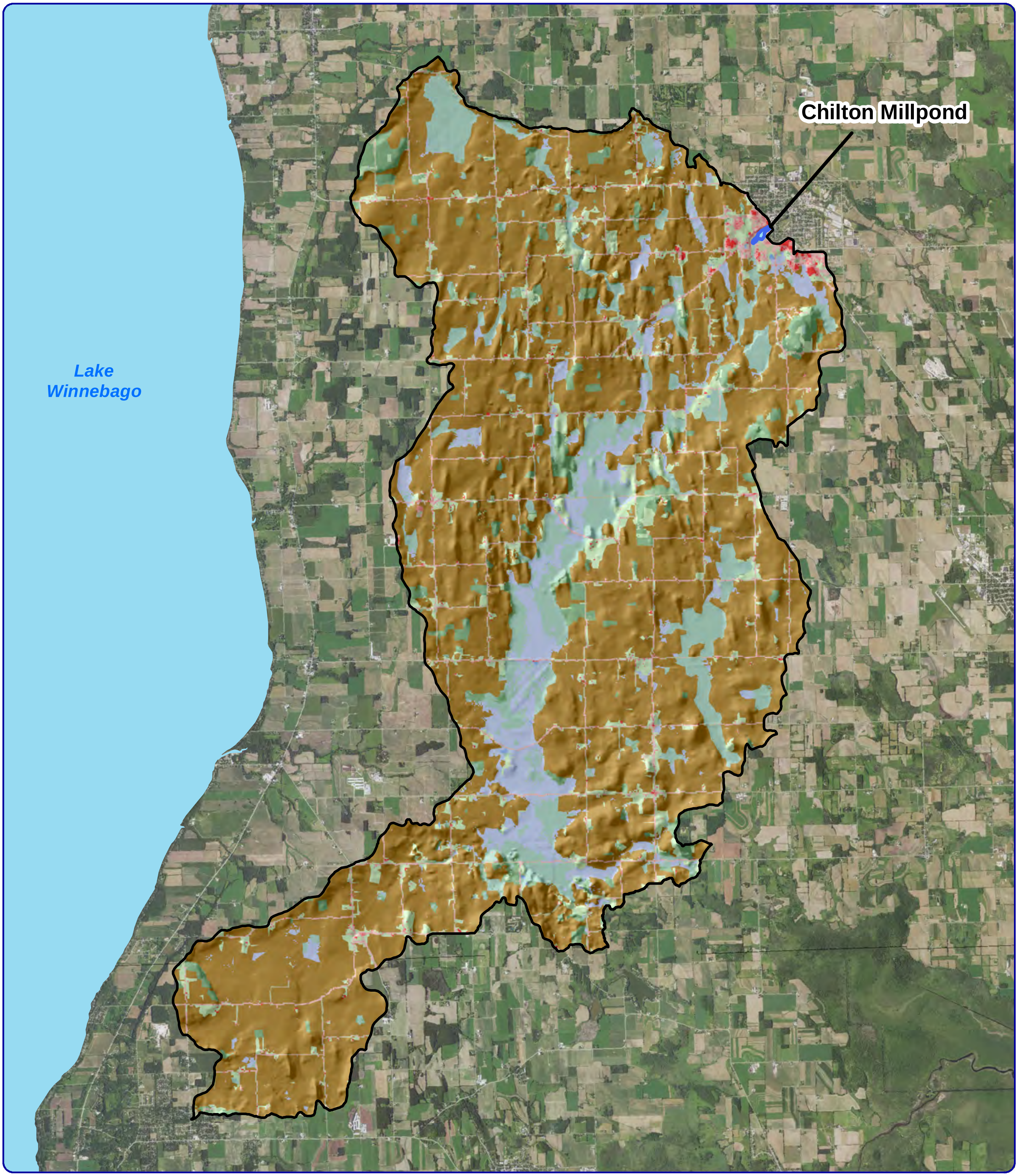
Legend

Chilton Millpond Watershed Boundary (45,629 Acres)

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Bathymetry: WDNR/Onterra, 2022
TMDL Boundary: WDNR, 2022
Watershed Boundaries: Onterra, 2023
Map Date: May 15th, 2023 KLW

Map 2
Chilton Millpond
Calumet, Wisconsin
Northeast Lakeshore TMDL Extent



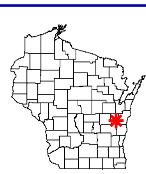
N
W E
S

8,200

Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro: WDNR
Bathymetry: WDNR/Onterra, 2022
Land Cover: NLCD, 2019
Watershed Boundaries: Onterra, 2023
Map Date: January 23, 2023 AMS



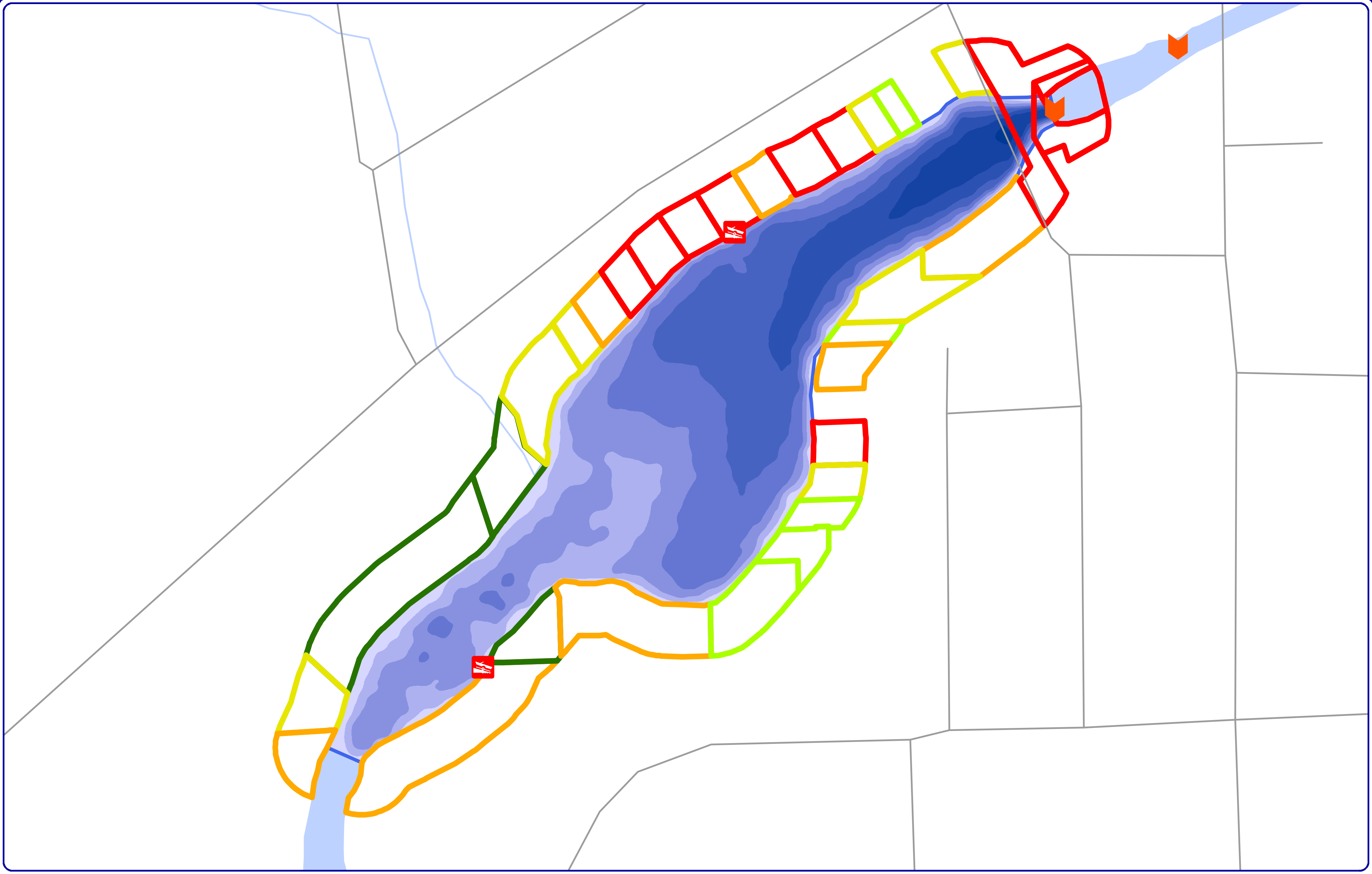
Extent of large map shown in red.

Legend

- Forest
- Forested Wetlands
- Pasture/Grass
- Open Water
- Wetland
- Row Crop Agriculture
- Rural Open Space
- Rural Residential
- Urban - High Density
- Urban - Medium Density
- Chilton Millpond Watershed Boundary

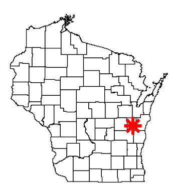
Map 3
Chilton Millpond
Calumet, Wisconsin

Watershed Boundaries & Land Cover Types



N
W E
S

250
Feet



Project Location in Wisconsin

Percent Layer

- 81 - 100%
- 61 - 80%
- 41 - 60%
- 21 - 40%
- 0 - 20%
- Local Road

Map 4

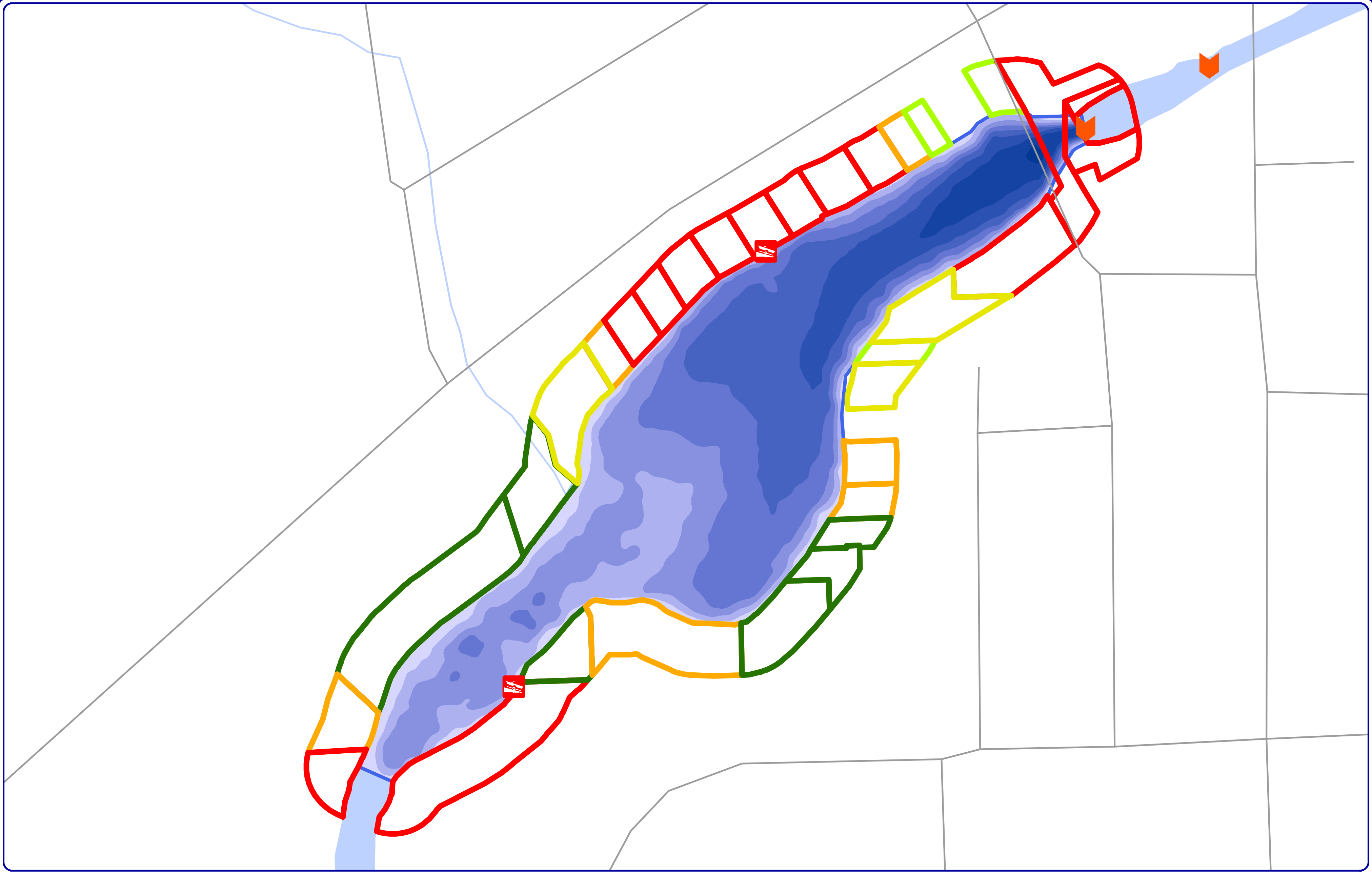
Chilton Millpond

Calumet County, Wisconsin

Percent Cover

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Bathymetry: Onterra, 2021
Parcel Delineation: Onterra 2022
Map Date: December 12th, 2022 AMS/KLW
Filename: ChiltonMillpond_SA_Canopy_2022.mxd



Map 5
Chilton Millpond
Calumet County, Wisconsin

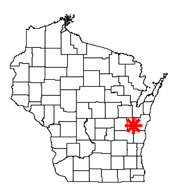
Percent Shrub and Herbaceous Cover

Percent Layer

- 81 - 100%
- 61 - 80%
- 41 - 60%
- 21 - 40%
- 0 - 20%
- Local Road

N / W / E / S

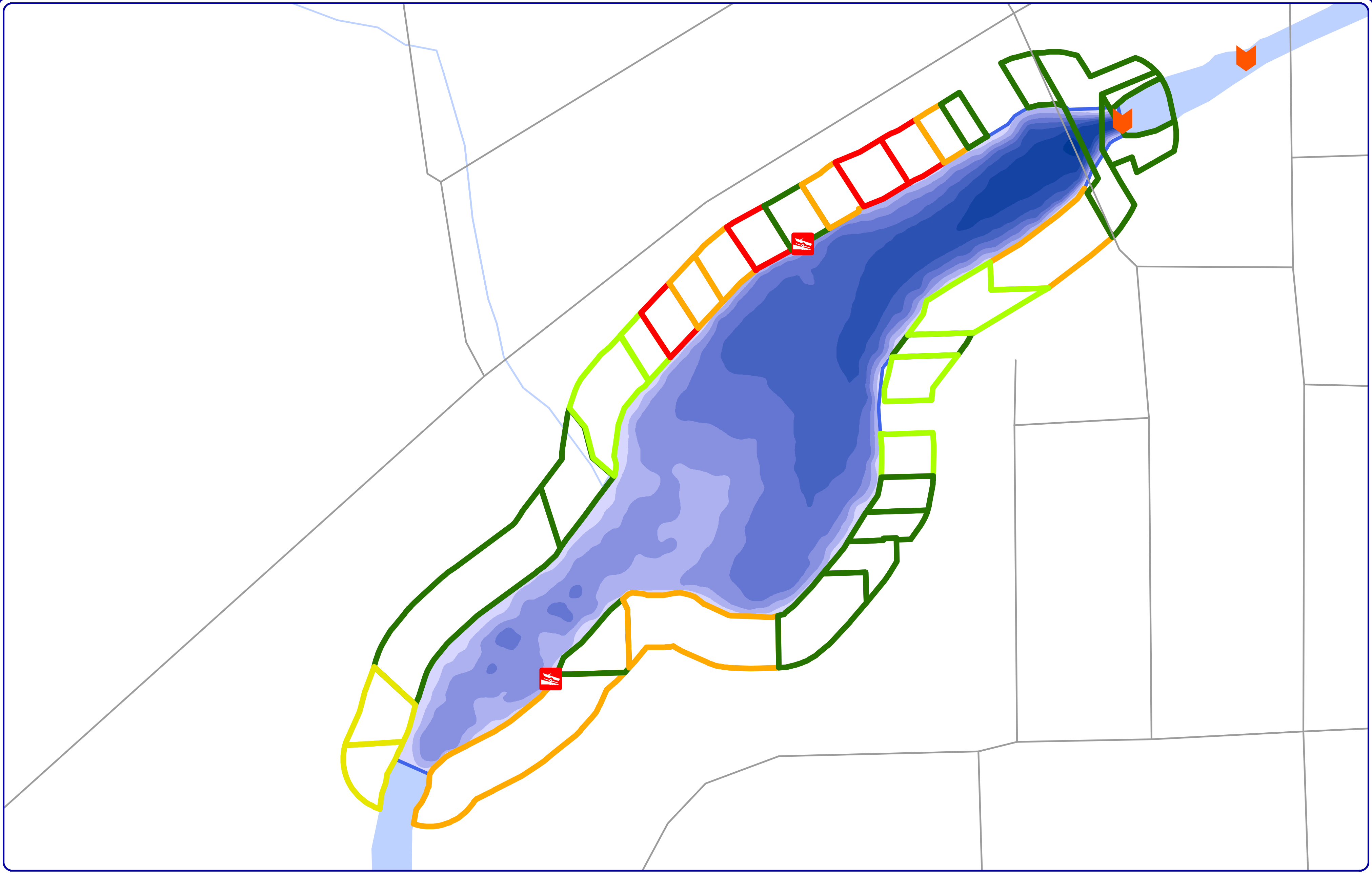
250 Feet



Project Location in Wisconsin

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Bathymetry: Onterra, 2021
Parcel Delineation: Onterra 2022
Map Date: December 12th, 2022 AMS/KLW
Filename: ChiltonMillpond_SA_shrubHerbaceous_2022.mxd

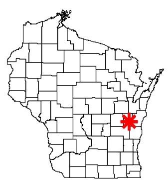


N
W E
S

250
Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Bathymetry: Onterra, 2021
Parcel Delineation: Onterra YEAR
Map Date: December 12th, 2022 AMS/KLW
Filename: ChiltonMillpond_SA_LAWN_2022.mxd

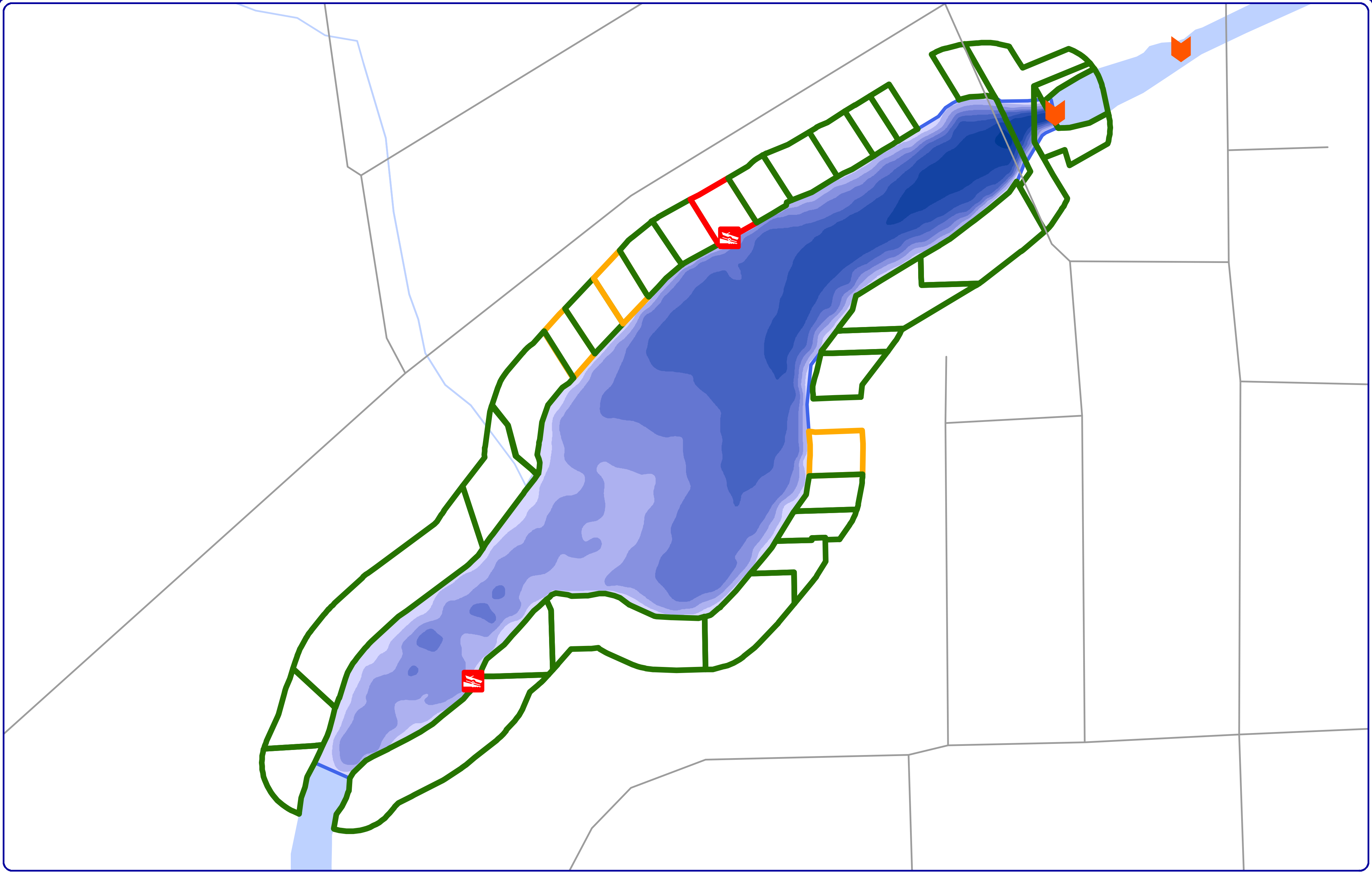


Project Location in Wisconsin

Percent Layer
- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- 0 - 20

Local Road

Map 6
Chilton Millpond
Calumet County, Wisconsin
Percent Manicured Lawn



N W E S

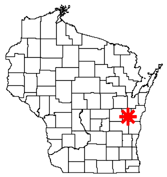
250

Feet

Onterra LLC
Lake Management Planning

815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Bathymetry: Onterra, 2021
Parcel Delineation: Onterra 2022
Map Date: December 12th, 2022 AMS/KLW
Filename: ChiltonMillpond_SA_ImpSurface_2022.mxd



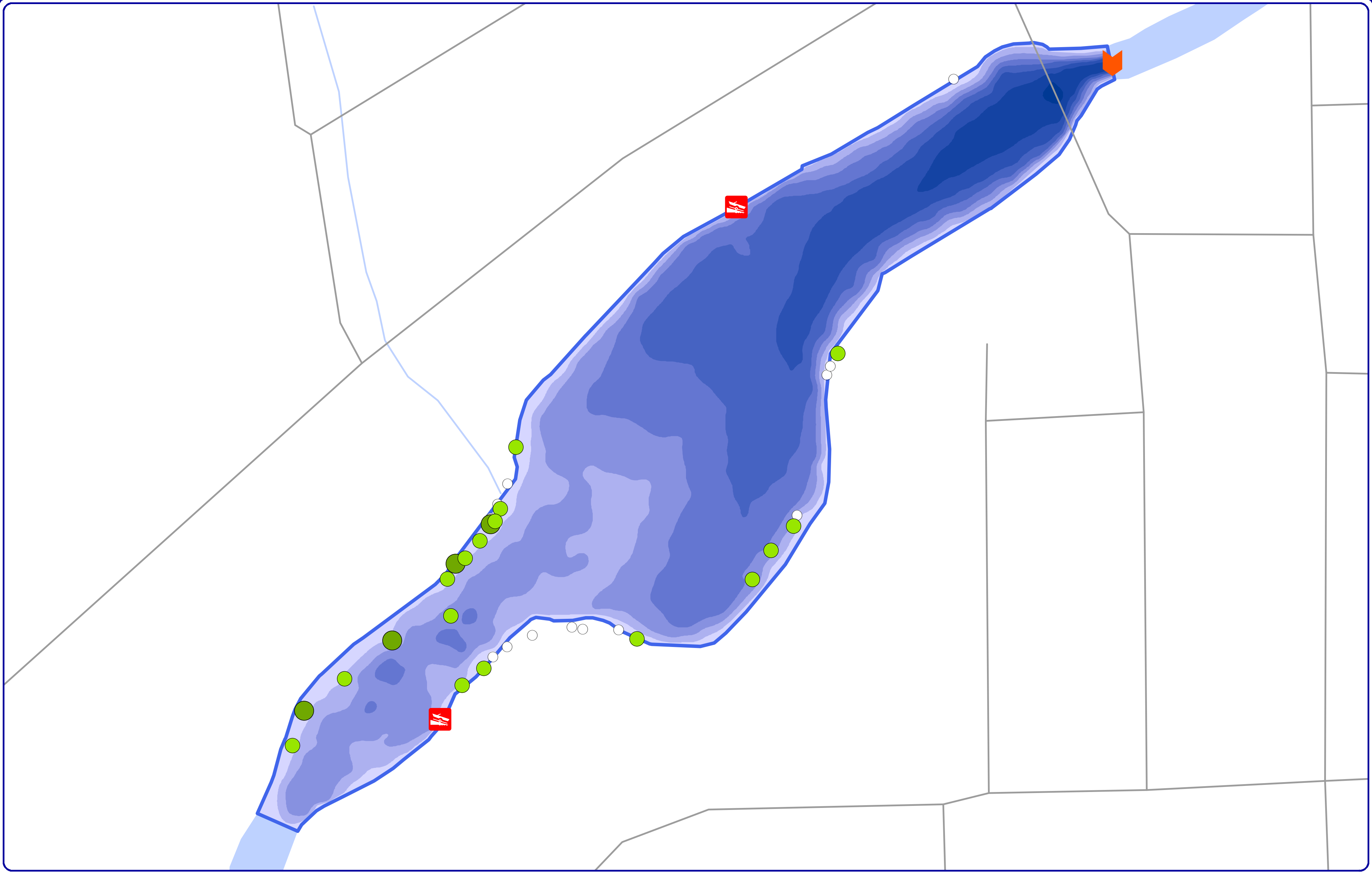
Project Location in Wisconsin

Percent Layer

- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- 0 - 20

Local Road

Map 7
Chilton Millpond
Calumet County, Wisconsin
Percent Impervious Surface



N
W E
S

210
Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Bathymetry: Onterra, 2021
Parcel Delineation: Onterra 2022
Map Date: May 18th, 2023 KLW
Filename: Map8_ChiltonMillpond_CWH_2022.mxd

Project Location in Wisconsin

Legend

- No Branches
- Some Branches
- Full Canopy

Map 8
Chilton Millpond
Calumet County, Wisconsin
Coarse Woody Habitat

180
Feet

Legend

- Emergent Plant Community
- Floating-Leaf Plant Community
- Emergent Plant Location
- Public Access
- Dam

Map 9
Chilton Millpond
Calumet County
Aquatic Plant Communities

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra 2022
Map Date: November 30th, 2022 AMS/KLW

N
W E
S

210
Feet

Legend

Emergent Plant Community (2022)

Floating-leaf Plant Community (2022)

Angling Harvesting Area *(0.1 acres)*

10' Harvesting Lane *(1.0 acres)*

Harvester Off-Loading Site

Public Access

Dam

Map 10

Chilton Millpond

Calumet County, Wisconsin

Mechanical Harvesting Strategy v1

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Bathymetry: Onterra, 2022
Aquatic Plants: Onterra, 2022
Public Lands: WDNR
Map Date: July 18, 2023 TWH