Final Report

Evaluation of the Forestville Millpond Following an Extended Drawdown

Project #LPL185623

*Drone **photo**, 06/16/2020*

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The Door County Soil & Water Conservation Department

2025

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INTRODUCTION

In 2016, the health of the millpond became a priority and concern led to a study through a Comprehensive Lake Management Planning Grant through the Wisconsin Department of Natural Resources (WDNR) Surface Water Grant Program. The information gathered in that 2017 study was used as a guide for stakeholders to vet management options to realistically address identified concerns. Examples of questions used in the survey included concerns regarding algal blooms, limited water clarity, poor water quality, low fish populations, too much aquatic vegetation, and more. Results of the survey did show concerns including limited capacity within the basin, elevated nutrient levels, low oxygen conditions, and the presence of aquatic invasive species. After years of gathering information, planning, several meetings with stakeholders, including the public, government officials, resource professionals, and local and state agencies a set of consensus-based goals were used to move forward with management options to address the identified concerns.

The stakeholders evaluated the pros, cons, costs, feasibility, effectiveness, and achievability of each management option. The stakeholders determined that the two final options were a drawdown of the pond, or dam removal. Dam removal was a very unpopular and costly option. Therefore, it was determined that a drawdown was the most cost effective and should be conducted and evaluated. Upon further planning and discussions with the WDNR, these plans changed into an extended drawdown of the pond. This meant a drawdown for two winters and two summers. This drawdown began November 2019 and concluded in September 2021.

Upon the conclusion of the drawdown, questions remained regarding the success of the drawdown to address the identified issues. As determined in the planning process, the millpond may require quite some time to stabilize, post-drawdown. In 2022, with an additional Surface Water Lake Planning Grant through the WDNR, a project was planned to duplicate data collections done prior to the drawdown to assess the same parameters and compare them to post drawdown conditions. These parameters include water chemistry to evaluate changes in nutrients levels, a bathymetric survey of basin to provide information on changes to depth and capacity, and finally, an aquatic plant inventory to identify and record plant populations at similar points collected previously to identify changes in species type and numbers present. Information gathered during this project will be added to the knowledge base of data vital to future decision making.

It is important to note that the system still may be stabilizing and it is important to monitor to better understand longevity of both positive & negative effects.

WATER CHEMISTRY

Site Selection

Upstream of the Forestville Millpond, water was sampled at four different sites. These sites were chosen based off the 2018 Forestville Millpond pre-drawdown report conducted by the Door County Soil and Water Conservation Department (SWCD). Sampling site #153161 is on the Ahnapee River at the County Hwy H intersection, roughly 4.4 miles upstream from the FMP dam. Site #10047671 is also located on County Hwy H, but on an unnamed tributary (WBIC 95820). The final two upstream sampling locations (sites #10047672 and #10047673) were located at both upstream and downstream of the confluence between the Ahnapee River and another unnamed tributary (WBIC 5013575), roughly 3.5 miles upstream from Millpond (Figure 1).

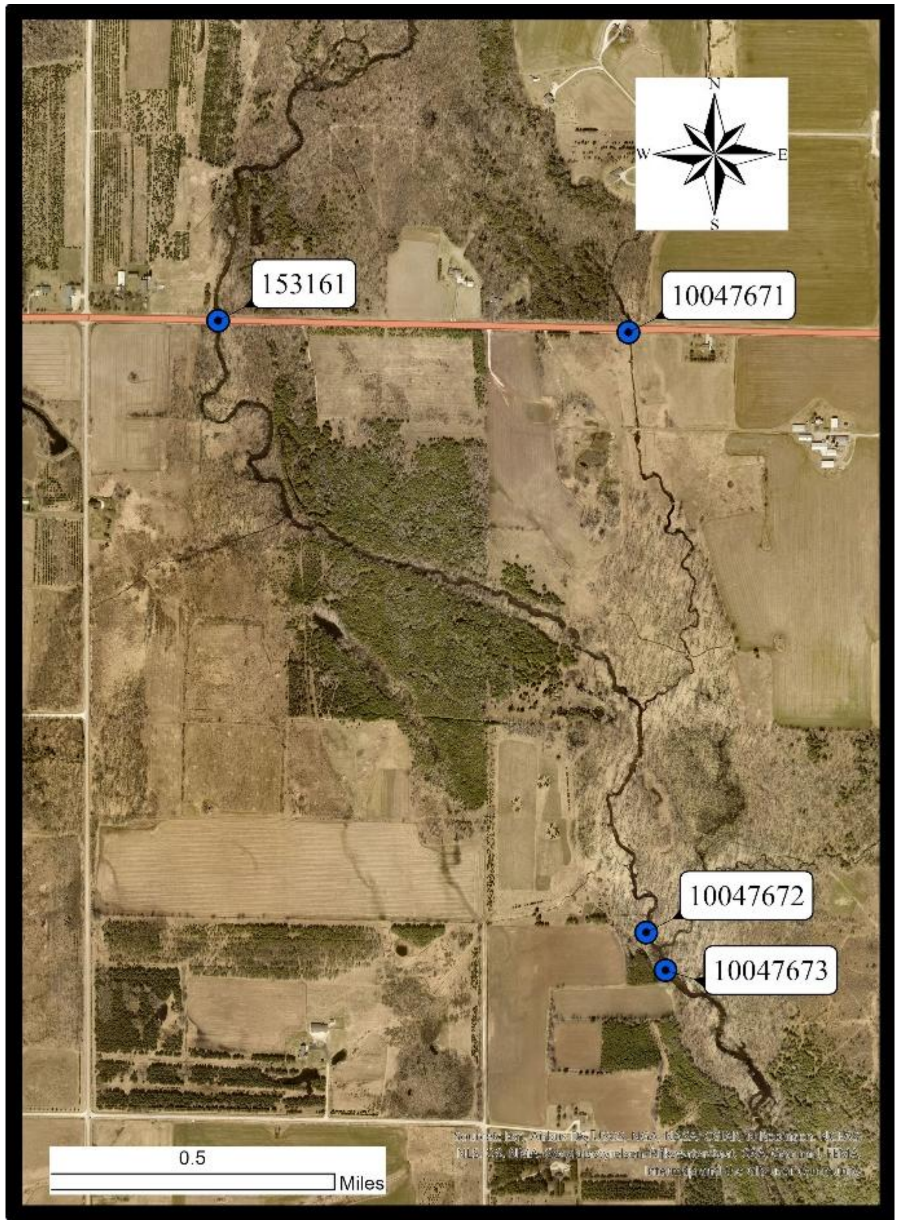


Figure 1*. Sampling sites on the Ahnapee River upstream from the Forestville Millpond.*

In addition to the upstream sampling locations, downstream samples were collected over the course of the sampling season at the intersection of County Hwy J and the Ahnapee River (sample #153027) (Figure 2). This sampling location is located roughly ¼ miles downstream of the FMP and was not sampled in prior study, however it was sampled in 2019 as part of a TMDL study, prior to the drawdown. Therefore, long term temporal comparisons can be made, but many conditions related to climate change should also be useful to compare stream samples upstream and downstream of the Millpond in post drawdown conditions.

These five stream locations were sampled on three different dates in 2023: 5/24, 6/19, and 7/18. On site measurements of temperature, total suspended solids (TSS), dissolved oxygen (DO), and pH were conducted by students and faculty from University of Wisconsin – Oshkosh (UWO), Environmental Research and Innovation Center. Water samples were also collected and were sent to the State of Wisconsin Laboratory of Hygiene to analyze total phosphorus (TP).

The sample location in the Millpond (site #153160) was located directly above the dam (Figure 2). This site was also sampled three times in 2023: 6/14, 7/17, 8/16. The same field measurements were conducted by the team from UWO, where they measured temperature, DO, pH, and TSS, in addition to turbidity during the sampling dates of 7/17 and 8/16. Water from this site in the Millpond was collected and sent to the Wisconsin State Lab of Hygiene for TP and chlorophyll-*a* analysis on all three sampling dates, along with Kjeldahl Nitrogen and Nitrate+Nitrite (as N) analysis on the sampling date of 6/14.

Figure 2. *Sampling sites at the Forestville Millpond and in the Ahnapee River below the Forestville Dam.*

Temperature

Temperature is an important measurement in streams because it is directly related to the health of fish and other aquatic organism populations. Stream temperature can be affected by land use, thermal pollution, and shade cover. Increased stream temperatures are directly related to decreased health and reproduction success in fish populations. This is due to fish thermoregulation and decreases in dissolved oxygen concentrations in water that accompanies the higher water temperatures. The Ahnapee River is a small, warm water sport fish community, and the Wisconsin DNR has established temperature thresholds for this type of stream habitat for both acute and sub-lethal temperatures. The acute temperature threshold is the temperature in which the stream cannot reach for any period of time without causing mass die-offs in the aquatic organism populations. The sub-lethal temperature threshold is the average temperature that would cause those die-offs if sustained for at least one week.

In the Ahnapee River and Forestville Millpond, the acute temperature threshold is between 79.9 and 85.1°F in the months between May and October. The sub-lethal temperature threshold ranges from 61 to 81.1°F. The highest measured temperature during the sampling season in the Ahnapee River was 77.7°F, and the measured temperature never exceeded the acute or sub-lethal temperature thresholds (Figure 3).

The ambient temperature is the typical temperature of small, warm water sport fish community outside of the direct influence of any point source discharge, which may lead to daily or seasonal temperature changes. The ambient temperature compares well with the stream measurements upstream of the FMP and those temperatures are what is to be expected (Figure 3). However, water measured in the FMP and directly below the FMP had slightly higher temperatures, but still below the acute and sub-lethal thermal thresholds. These temperature increases are likely due to increased exposure to direct sunlight while the water is retained in the Millpond.

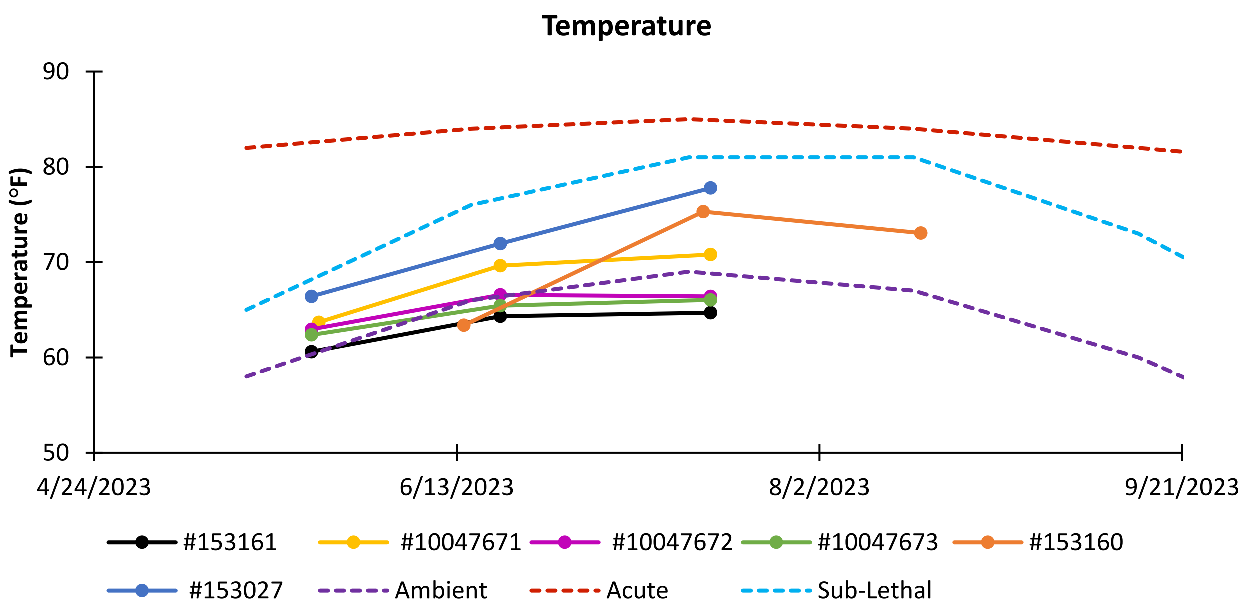


Figure 3. *Temperature at each site compared to the Ambient, Acute, and Sub-lethal temperature according to the Wisconsin DNR.*

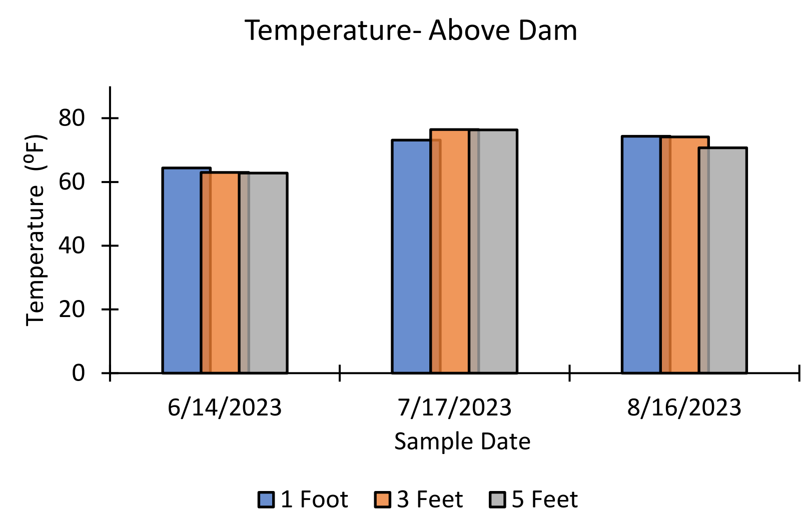


Figure 4. *Water temperature above the dam in the Forestville Millpond at three different sampling depths.*

Water in the Millpond is much deeper and more stagnant than water in the Ahnapee River, which means the sun heats the top layer of the pond and a smaller proportion of water is transferred between the groundwater and surface water. This process can be shown in the sampling months of June and August based off the temperature gradients in the Millpond above the dam. In June and August, the surface of the Millpond was significantly warmer than the bottom of the Millpond. This pattern did not hold on the sampling date of 7/17/2023. On this date, the surface water was coolest and the water progressively got warmer the deeper it was sampled. This was likely due to weather conditions directly prior to the sampling as it was unusually cold [low of 55^{o}F] the morning of July 17th, which was much cooler than the temperature of the water, possibly bringing down those surface water temperatures (Figure 4).

The highest temperatures were recorded directly below the dam at site #153027. Because the dam discharges water from the surface, this is typically the warmest water from the FMP. Even as these were the warmest temperatures recorded, they were still below the sub-lethal temperature thresholds. In general, the stream samples above the FMP were what would be expected for a small, warm water fish community stream. While in the FMP, the water warms up at the surface caused by higher air temperatures and sunlight, and that warm surface water is released to continue down the Ahnapee River, elevating the temperatures for at least ¼ mile downstream. Thermoclines are not expected in the FMP. This is a shallow system, where thermoclines typically occur in deep lakes and oceans. In general, the surface thermal layers can be anywhere from 1 to 66 feet deep. Thermoclines tend to be deeper in larger lake bodies because of greater wind action mixing the warmer water to a deeper level.

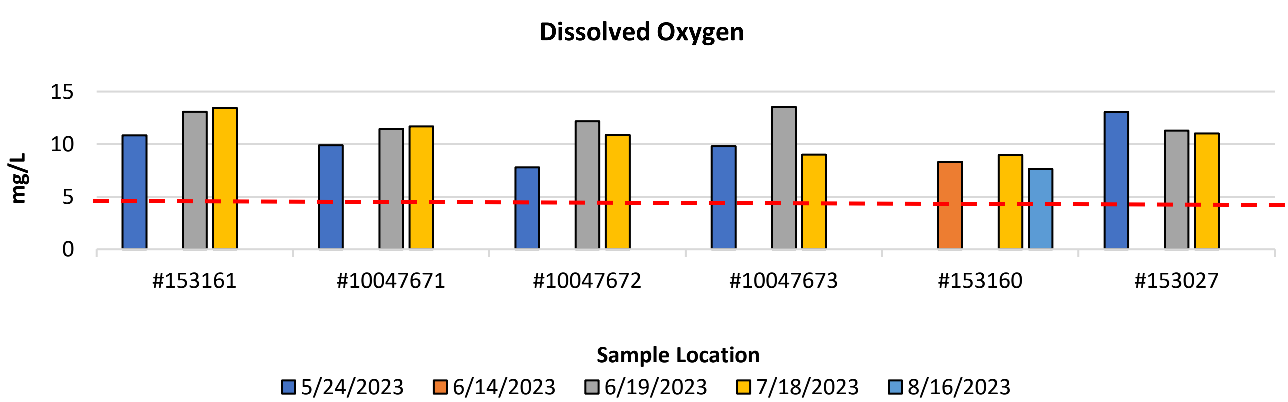


Figure 5. *Dissolved Oxygen levels in each of the sampling sites along the Ahnapee River and in the Forestville Millpond. Red dashed line shows the threshold of minimum oxygen levels to support healthy biological life.*

Dissolved Oxygen

Dissolved oxygen (DO) is the amount of gaseous oxygen that is in the water and it is essential for many biological organisms, especially aquatic animals. Oxygen is abundant in the atmosphere; however, it can be challenging for it to persist in water. Water in streams and lakes can become saturated with dissolved oxygen as a result of absorption from the atmosphere, aeration through rapid water movement, or through the respiration of aquatic plants through photosynthesis. DO also fluctuates with temperature as colder water can hold a higher concentration of oxygen gas than warm water.

To support healthy biological life in aquatic ecosystems, the state of Wisconsin has established the minimum concentration of DO to be 5 mg/L. This threshold was met on each date at every sample location in 2023. All the upstream, downstream and FMP samples at each depth had at least 5 mg/L of DO (Figure 5, 6).

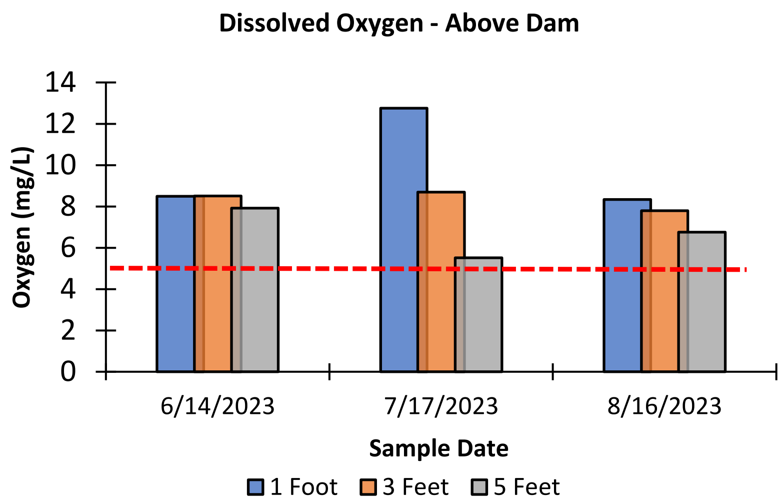


Figure 6. *Dissolved oxygen in the Forestville Millpond at the three sampling depths. Red dashed line shows the threshold of minimum oxygen levels to support healthy biological life.*

The time of year also affects DO concentrations. In winter there is lack of sunlight due to deep snow and decaying vegetation. In winter months, when water temperatures are low, the water can hold a greater amount of dissolved oxygen. As water temperatures rise in summer, its capacity to hold dissolved oxygen decreases, leading to potential oxygen depletion. Another reason for oxygen depletion is excess organic materials because of an overabundance of nutrients. When there are excessive nutrients available in the system, periphyton, phytoplankton, and other aquatic plants use those nutrients to increase their production and biomass. Eventually, these aquatic plants die and are decomposed by small microorganisms at the bottom of the stream or lake. These organisms typically consume oxygen and respire carbon dioxide (CO_2) or methane (CH_3), which can decrease the DO concentration near the bottom of the water column. This process appears to have taken place in the FMP throughout the summer of 2023. The highest concentration of oxygen was near the surface of the FMP, and the lowest was near the bottom of the FMP, likely due to the decomposition of organic matter in the benthos (Figure 6).

pH

pH is a measure of the hydrogen ion (H^+) concentration in a solution. Acids are defined as compounds that release hydrogen atoms (or protons), and bases are compounds that accept protons. Therefore, when there are more free protons in solution, the pH will be a lower number and the solution will be more acidic than if there are fewer free protons in solution. pH ranges on a scale from 0 to 14, with 7 being neutral, below 7 being acidic, and above 7 being basic.

Surface and groundwater have naturally occurring pH ranges and most organisms have adapted to specific pH ranges in their environment. Therefore, small changes to pH can have drastic effects on the aquatic life in the ecosystem, this is especially true for aquatic macroinvertebrates, fish eggs, and fry. The natural pH of a small stream or lake is most often determined by the surrounding geology. The makeup of the bedrock and soils that are in contact with the water influence the pH, which is why the pH is typically very consistent in an environment. However, there are instances where physical and biological factors can affect pH levels in the water. The chief natural cause of pH changes is the increase of carbonic acid to an environment. CO_2 dissolves in water and reacts with H_2O molecules to create carbonic acid (H_2CO_3). Depending on the pH of the water, carbonic acid can either release zero, one, or two hydrogen atoms, which create H_2CO_3, bicarbonate (HCO_3^-), and/or carbonate ions (CO_3^{2-}). When increased CO_2 dissolves in water, more H^+ ions are released and the pH decreases, creating a more acidic environment.

In the FMP and the upstream and downstream sampling locations, there appears to be consistent pH levels throughout the sampling season (Figure 7). The pH fell within the range of 7.9-8.9, which means that the water is slightly basic, but very close to neutral. This slightly basic environment is to be expected with the geology of the watershed, which is made up of dolomite bedrock.

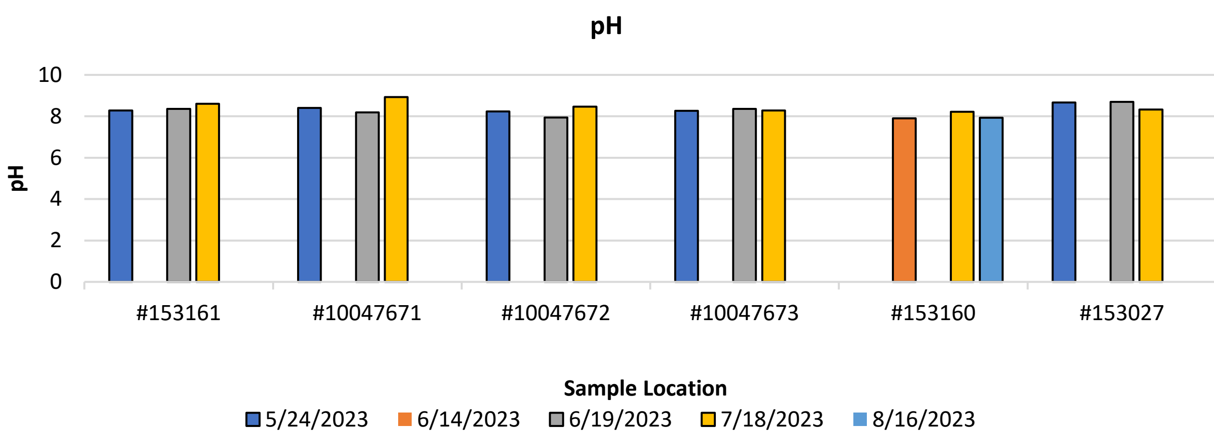


Figure 7. *pH levels in the Ahnapee River and Forestville Millpond.*

Total Suspended Solid (TSS)

Total Suspended Solids (TSS) are made up from a number of materials including silt, decaying plant and animal matter, industrial waste and sewage. These can be from a variety of sources including excess soil erosion, wastewater discharge, snowmelt and stormwater runoff. Carp, wind, and algae can also play a significant role in TSS, but in different ways. Particularly in shallow waters, such as the FMP, strong winds can resuspend sediment from the lake bottom. This causes increased turbidity and higher TSS levels. Free floating algae like phytoplankton is a vital part of the food chain in aquatic systems. They provide the food base for zooplankton that are eventually eaten by fish, ducks, and other animals. Too much phytoplankton and other algae can disrupt the natural balance of the lake ecosystem, make the lake unsightly, and contribute significantly to the TSS. Bottom feeding fish like carp stir up sediment from the lakebed while feeding, this increases the suspended solids in the water column, thus creating higher TSS levels.

High TSS concentrations can impact aquatic life in a number of ways. One of the most prevalent being the blocking of sunlight from reaching submerged vegetation, resulting in reduced rates of photosynthesis. As photosynthesis is reduced, plants release less DO into the water. If light is completely blocked, the death of aquatic vegetation and subsequent decomposition will follow, which further depletes DO concentrations.

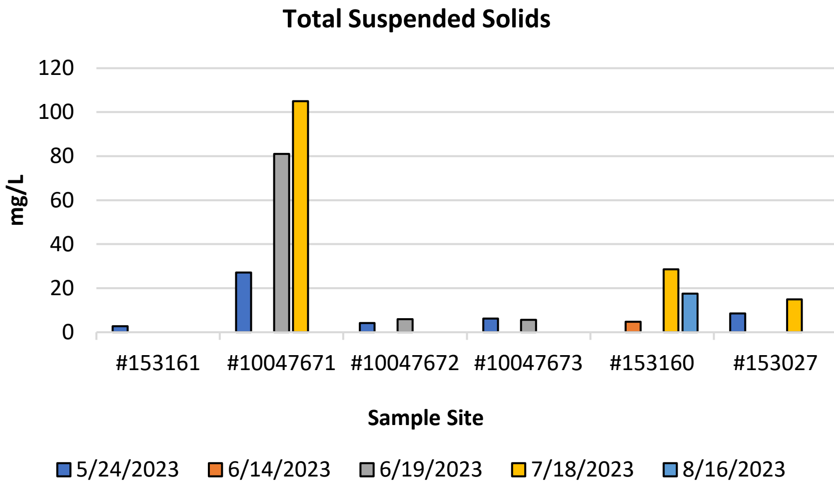


Figure 8. *Total suspended solids at the sampling sites in the Ahnapee River and the Forestville Millpond.*

These situations can lead to hypoxic or anoxic environments which may lead to large fish kills. Elevated TSS can also lead to decreased water quality and impact the ability of fish to see and catch prey. Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. There is not a specified threshold to evaluate TSS. As a general guide, permits issued to wastewater treatment plants outline a maximum of 20 mg/L as a monthly average and 30 mg/L as a weekly average. One site had elevated TSS levels over multiple sample dates (station #10047671). This site had suspended solids levels that exceeded 100 mg/L (Figure 8), which can have extremely harmful effects to the environment. However, the elevated TSS at this site did not seem to impact sampling sites further downstream, as the two sites before and after the confluence of the other unnamed tributary had lower TSS concentrations. Further observation is needed to determine the cause of the elevated TSS at sample #10047671, and to see if these levels are consistent through the sampling season.

Total Phosphorous

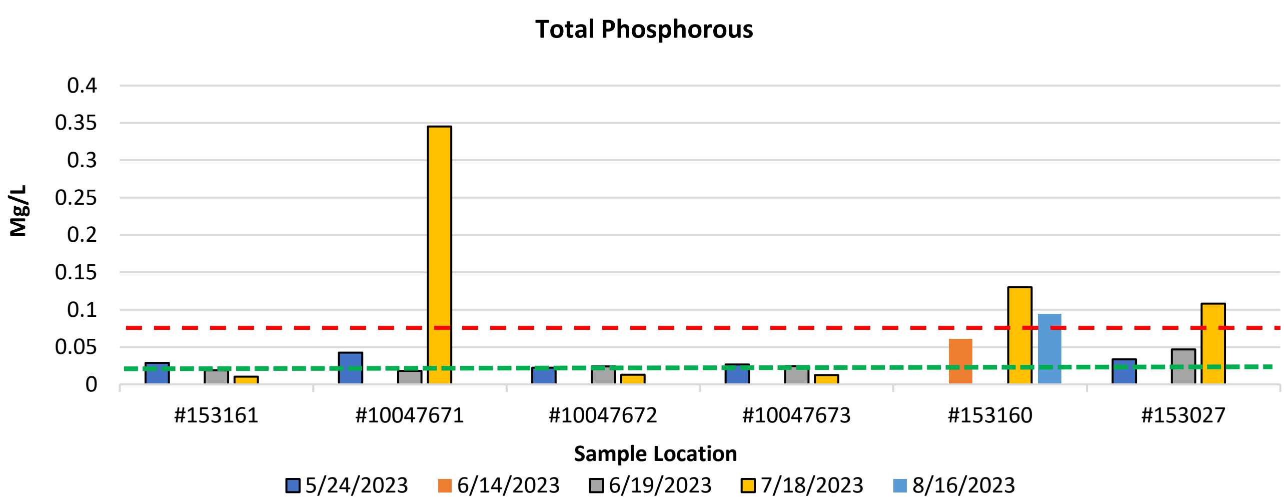


Figure 9. *Total Phosphorus in the Ahnapee River and Forestville Millpond. The red line shows the .075 mg/L threshold for impairment designated by the Wisconsin DNR. The green line shows the level of TP where algal blooms can start to grow at .02 mg/L.*

Phosphorus (P) is an essential nutrient for plants and animals and is often the limiting nutrient for plant growth in freshwater ecosystems. Therefore, increased P in water bodies is typically followed by increased algal growth. When there are excess nutrients such as P, the consequential excess algal growth is naturally followed by the death of large amounts of algae. The ensuing decay of dead algae creates higher oxygen consumption and potential hypoxic or anoxic conditions; conditions repeatedly seen in the lower portions of the bay of Green Bay. Both hypoxia and anoxia are harmful to fish populations and can potentially lead to fish kills when dissolved oxygen levels fall low enough.

Phosphorus is a common nutrient in agricultural fertilizers, manure, organic wastes in sewage, and industrial effluent. P is found in the environment in multiple forms, including particulate phosphorus and dissolved phosphorus; total phosphorus (TP) is the parameter that measures both forms together. The State of Wisconsin has established the maximum threshold for P levels in surface waters throughout the state. As outlined in NR 102.06(3)(b), the Ahnapee River is considered a stream and shall meet a total phosphorus criterion of .075 milligrams per liter (mg/L). Also outlined in NR 102 (4)(b)3, the Forestville Millpond is considered a drainage lake, but is not stratified, so it shall meet a total phosphorus criterion of .040 mg/L.

Algal blooms in surface waters can start to grow when phosphorus levels reach .020 mg/L. Most of the samples collected upstream from the Forestville Millpond (stations 153161, 10047671, 10047672, 10047673) had TP levels below the .075 mg/L threshold set by NR 102. However, there was one outlying spike in TP at site 10047671 sampled on 7/18/2023 with the TP measured at .345 mg/L. This spike in TP was a sample from an unnamed tributary of the Ahnapee at CTH H. All other sample locations had much lower TP levels on that same day (Figure 9). Note-This is the same sample site we saw a spike in the TSS. Further observation is needed to determine the cause of the elevated TP and TSS at sample #10047671, and to see if these levels are consistent during a sampling season. It is suspected that this elevated sample result was likely soil loss.

The Forestville Millpond had TP levels consistently above the threshold set by NR 102 (4)(b)3 of .040 mg/L. July had the highest TP levels with measurements greater than .100 mg/L (Figure 10). These TP levels in the Millpond may lead to excess algae growth and the potential for low oxygen conditions and subsequent fish kills. The Lower Ahnapee River, below the Forestville Dam, has been listed as a 303(d) Impaired Water, due to excessive TP concentrations. The link to this designation and the condition of the millpond and upper Ahnapee watersheds is unclear upon review of TP concentrations in this study.

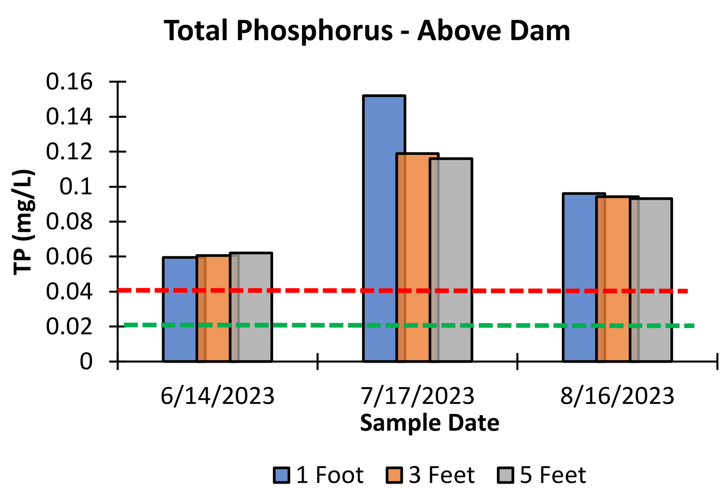


Figure 10. *Total Phosphorus levels in the Forestville Millpond at the three sampling depths. The red line shows the threshold for impairment in the Forestville Millpond of .04 mg/L, designated by WDNR. The green line shows the level of TP where algal blooms can start to grow at .02 mg/L.*

Chlorophyll-a

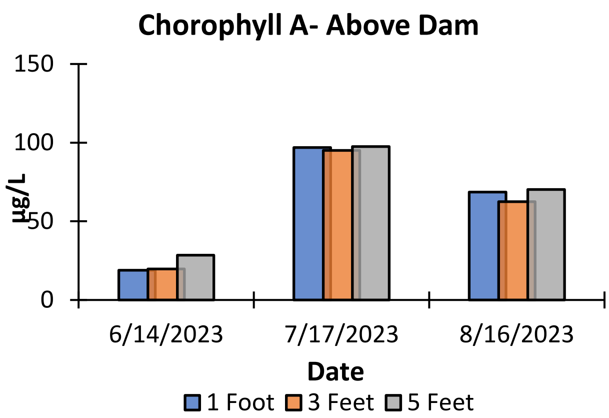


Figure 11. *Chlorophyll-a in the Forestville Millpond at three different depths above the dam.*

Chlorophyll allows photosynthesizing plants to use sunlight to convert light energy into chemical energy. Chlorophyll-*a* is the predominant type of chlorophyll found in green plants and algae and it can be used as a measure of the algal biomass in a waterbody. Excess algae can be a symptom of degraded water quality conditions because algae populations use excess nutrients to grow rapidly and form blooms which can have the potential to create health risks. Some water quality problems that arise from algae blooms are reduced light penetration which impacts aquatic plant populations, discoloration of water, taste and odor concerns, and reduced dissolved oxygen resulting in less available oxygen to plants and aquatic life. Development of blue-green algae blooms can bring about the production of naturally-occurring toxins that present a health risk to people, pets, livestock and wildlife. Chlorophyll-*a* is one of the measurements used to estimate a lake's Trophic State Index (TSI). The TSI will be discussed in a separate section of this chapter. The generally accepted chlorophyll-*a* threshold for fish & aquatic life impairment is 27 µg/L. All of the samples taken in July and August exceeded this threshold with average chlorophyll-*a* values of 96.5 µg/L and 67.1 µg/L, respectively. The samples taken in June at 1-foot and 3-foot depths were below the chlorophyll-*a* threshold with values of 18.8 µg/L and 19.8 µg/L, respectively, but the sample at a depth of 5 feet was above the threshold with a chlorophyll-*a* value of 28.5 µg/L (Figure 11). These high values of chlorophyll-*a* likely indicate excess nutrient loading and/or legacy nutrients into the Forestville Millpond, which is leading to excess algal growth and subsequent high chlorophyll-*a* measurements.

Nitrogen

Nitrate (NO_3^-) and Nitrite (NO_2^-) are naturally occurring, inorganic ions in the environment. As organic materials decompose, they release ammonia (NH_3), which can be oxidized to form both nitrates and nitrites. The primary sources of organic nitrates include human sewage, livestock manure, fertilizers, and erosion of natural deposits. Waterbodies with nitrogen concentrations in excess of 0.3 mg/L in the spring have sufficient levels to support summer algae blooms. All samples taken in the Millpond exceeded this value (Figure 12).

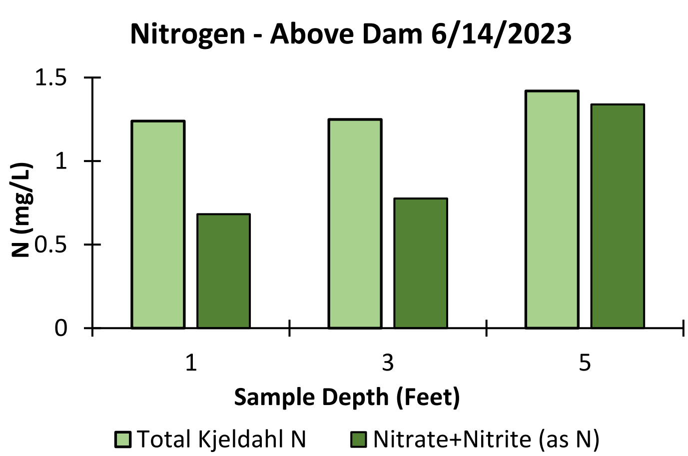


Figure 12. *Nitrogen samples in different forms above the dam in the Forestville Millpond on 6/14/2023 at three depths.*

Total Kjeldahl nitrogen is the sum of nitrogen bound in organic substances, nitrogen in ammonia, and nitrogen in ammonium (NH_4^+). Water with low dissolved oxygen may slow the rate at which ammonium is converted to nitrite and finally nitrate. Nitrite and ammonium are far more toxic than nitrate to aquatic life. The Wisconsin DNR currently regulates nitrogen as a toxic substance through implementation of the state's water quality standards for ammonia. The acute and chronic toxicity criteria is determined on a case-by-case basis, dependent on the appropriate aquatic life use category. Nitrogen levels in the Forestville Millpond were taken above the dam in June 2023 at various depths. Total Kjeldahl N was similar between depths, while Nitrate+Nitrite (as N) increased as the depth increased. Although oxygen was lower at a depth of 5 feet, which can inhibit the ammonium conversion to nitrate or nitrite, there are typically more aquatic plants near the bottom of the Millpond. These plants may explain the increased Nitrate and Nitrite concentrations in the benthos.

Trophic State

The Trophic State Index (TSI) is a classification system that rates lakes, ponds and reservoirs based on the biological activity, generally driven by nutrient loading. Classifications are as follows:

- Oligotrophic – Low nutrient levels. Low populations of aquatic plants, animals and algae.
- Mesotrophic – Moderate nutrient levels. Healthy and diverse populations of aquatic plants, fish and algae
- Eutrophic – High nutrient levels. Large populations of aquatic plants, fish and algae. Plants and algae populations often grow to nuisance levels. Fish species tolerant of warm temperatures and low dissolved oxygen concentrations.
- Hypereutrophic – Very high nutrient levels. Often exhibit large algae blooms. Fish populations are dominated by carp and other species that tolerate warm temperatures and low dissolved oxygen concentrations.

Based on the chemistry data collected in the 2023 season, the average summer Chlorophyll-*a* concentration was determined to be 62.0 µg/L. The summer Total Phosphorus average was .0947 mg/L.

Based on the average Chlorophyll-*a* concentration in the Millpond above the dam, the overall Trophic State Index was 71. The TSI suggests that the Forestville Millpond ranks as hypereutrophic. This TSI usually suggests blue-green algae become dominant and algal scums are possible. Extensive plant overgrowth problems also may occur.

By contrast, Chlorophyll-*a* concentration in 1994 was on average 25.4 µg/L and summer TP concentrations were on average .058 mg/L. This resulted in an overall TSI score of 62, based on the Chlorophyll-*a* concentration. In 2017, Chlorophyll-*a* was an average of 50.4 µg/L, TP was an average of .0136 mg/L, and the TSI score based on Chlorophyll-*a* was 69. These Chlorophyll-*a* based TSI scores in 1994 and 2017 indicate an environment that is increasingly eutrophic. This is typical of old impoundment systems.

Summary of 2023 Results

Water chemistry results from the post-drawdown Forestville Millpond show that there are both good and bad aspects of water quality during this sampling period. In 2023, there were nutrients above the DNR thresholds; parameters that were above the threshold of the DNR in the Millpond were Total Phosphorus, Chlorophyll-*a*, and Nitrogen. This indicates that there is an imbalance of nutrients coming into the system from the watershed and leaving the system via the lower Ahnapee River or through biological processes. Parameters that were at healthy levels were temperature, dissolved oxygen, and pH. This indicates that while there are excess nutrients in the Millpond during the sampling dates in 2023, the system seemed to be responding well and aquatic animals were still able to live in this environment.

While this may appear to be a good sign for the time being, there is a risk that if excess nutrients persist in the Millpond, it will again become degraded over time and parameters such as the temperature, DO, and pH levels will change. The Forestville Millpond is a unique environment as it is not a natural stream or lake and is artificially dammed with an outlet at the surface of waterbody. Because it is a unique environment, there are unique challenges when it comes to management. The Ahnapee river is a valuable resource in Northeast Wisconsin and continued monitoring and research should be conducted for the best understanding of how to most effectively manage the Forestville Millpond.

2024 BATHYMETRY

Accumulated sediments can impact capacity of the Forestville Millpond. This continues to be a concern for the Forestville Millpond.

Bathymetry is the study of the "bed" or "floor" of a waterbody, this can include everything from rivers and streams to lakes to oceans. A bathymetric study maps the depth of the waterbody relative to the water surface, and is compiled in a topographic map that represents the bottom of the waterbody (SWCD, 2018).

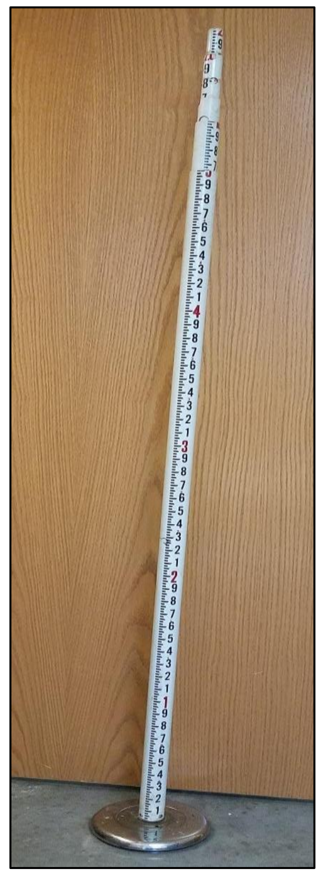


Figure 13. *Survey Rod with plate.*

Data was collected by SWCD staff in October 22, 2024. Survey points were collected on the shoreline to establish the existing benchmark elevation, as well as the surface elevation of the water at the time of surveying.

Survey points were collected using Carlson RT4 data collector, equipped with Carlson SurvPC data collection software, outfitted with Carlson BRx7 GNSS Receiver antennae. Coordinates were collected in Wisconsin State Plane-Central NAD 83(91) US foot horizontal datum and NAVD88 vertical datum.

A boat was used to traverse the surface of the Millpond, and 1029 points were recorded with coordinates and depth taken at each point (Figure 14).

Horizontal coordinates were captured and recorded in the Carlson data collector. Depth to the subsurface was collected through sonar readings at each position. Equipment used for sonar readings was an Eagle Supra ID marine sonar locator. Calibration was made using a survey rod with a plate attached to the bottom (Figure 19). Measurements were made and adjustments for the location of the transducer position relative to the boat were factored in. All depth measurements were based on a surface water elevation of 592.4.

A map was developed from the collected points, in which elevations were plotted and interpolated between collected points. This map illustrates an approximation of the bottom of the Millpond in October 2024 (Figure 16). This can be compared to the approximation of depths in 2017, prior to the drawdown (Figure 15).

Additional maps were produced for the millpond to help understand the depth even further. Contour lines can help better depict the depth of the millpond. Taking away colors and seeing a map on a grayscale can easily show the different depth ranges throughout the millpond (Figure 17). It was determined that approximately 52% of the pond has a 0-3' depth, and 48% of the pond has a depth of 3' and greater. Furthermore, to help show the percentage of millpond that is greater and less than 3 feet, a map was created to show this (Figure 18).

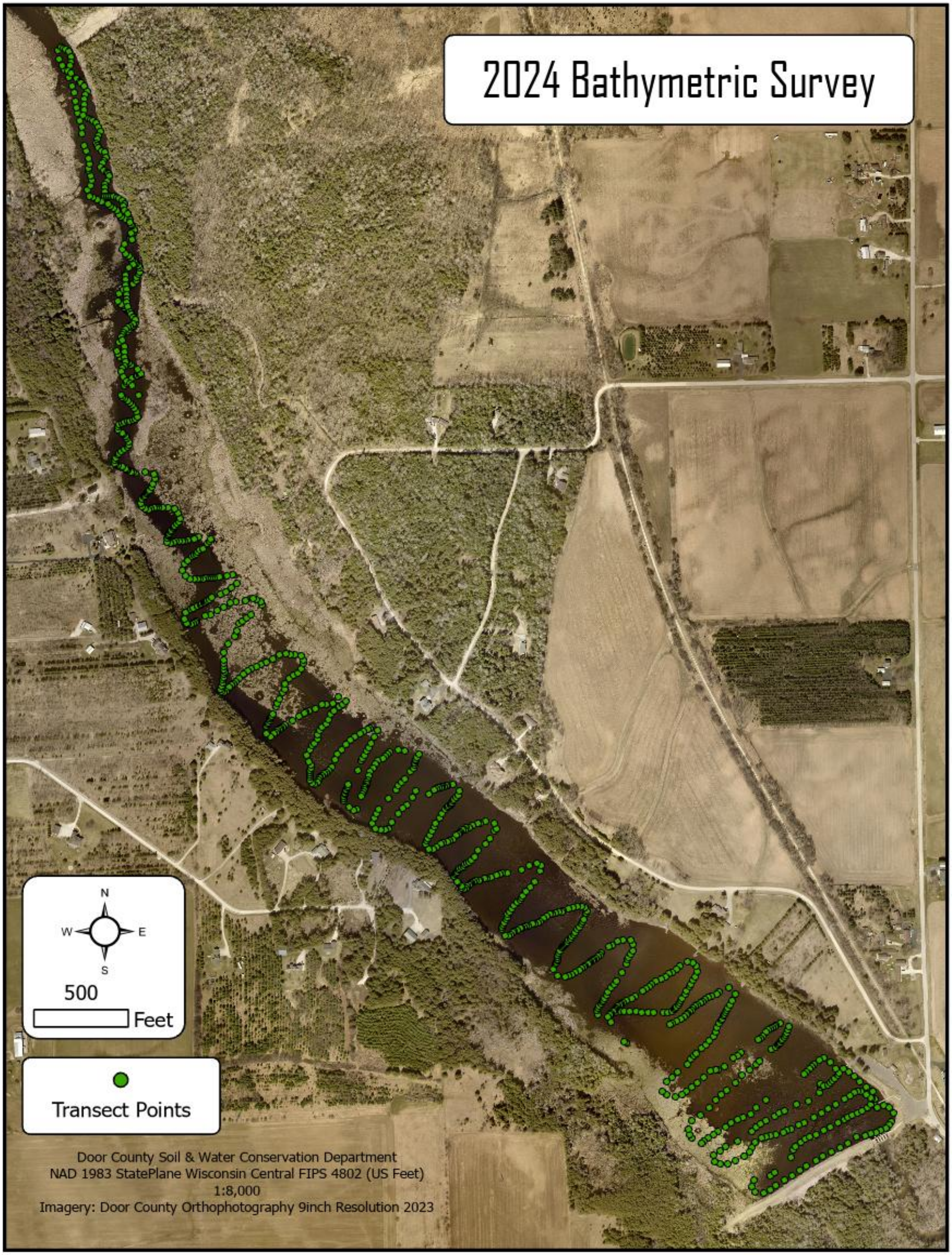


Figure 14. *October 22, 2024 Transect points.*

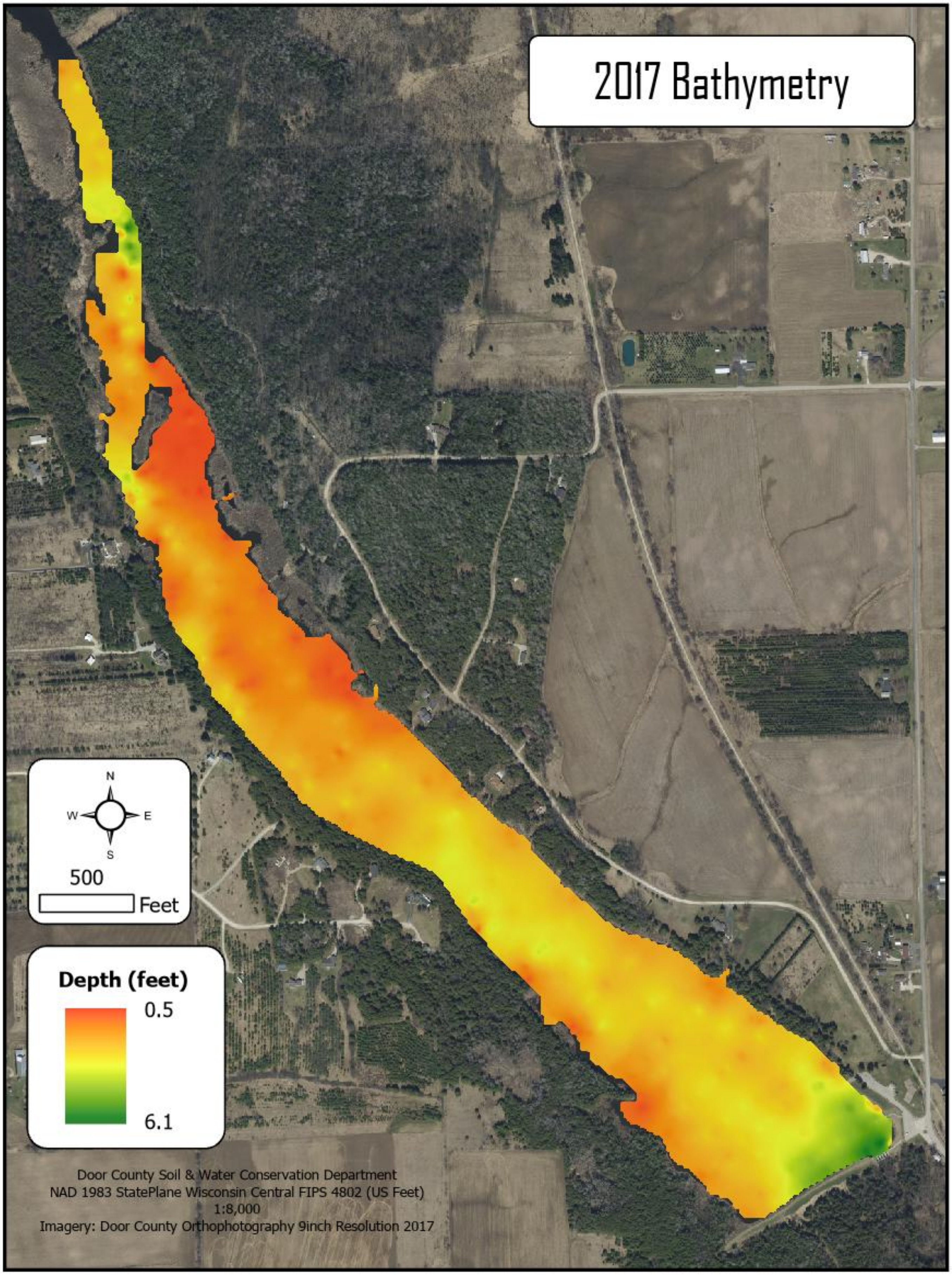


Figure 15. *Millpond depth, 2017.*

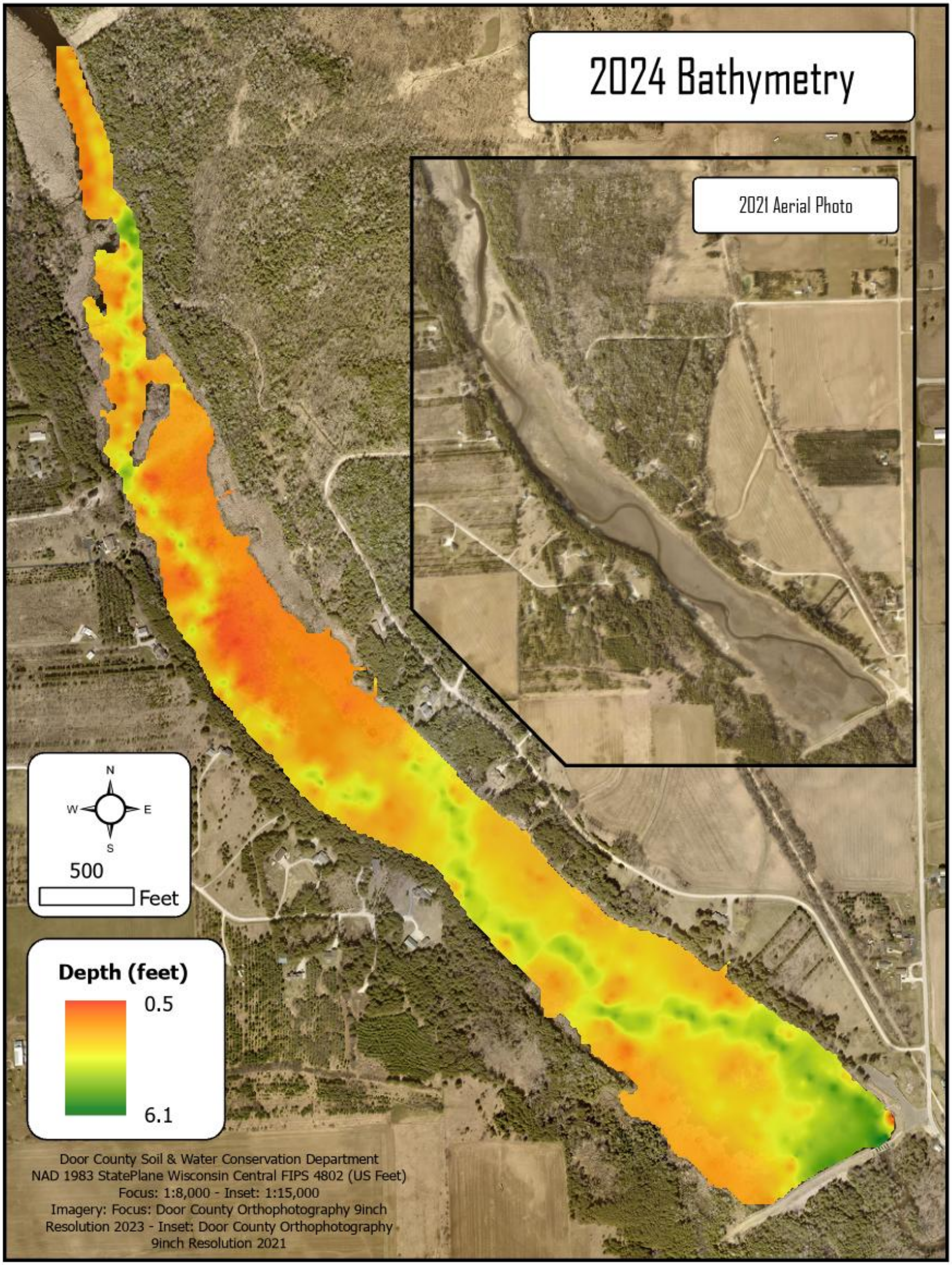


Figure 16. *Millpond Depth, 2024.*

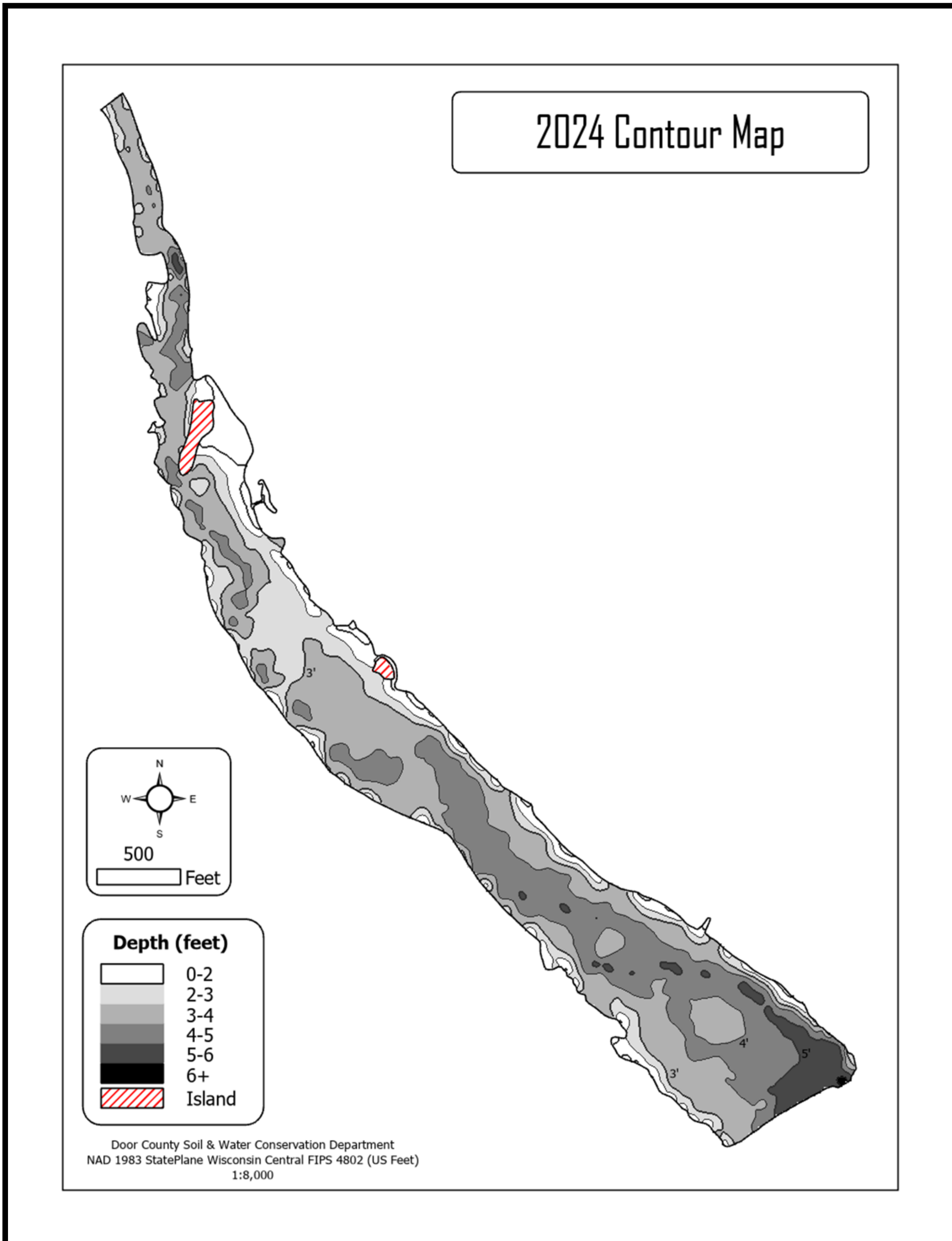


Figure 17. *Millpond Contours, 2024.*

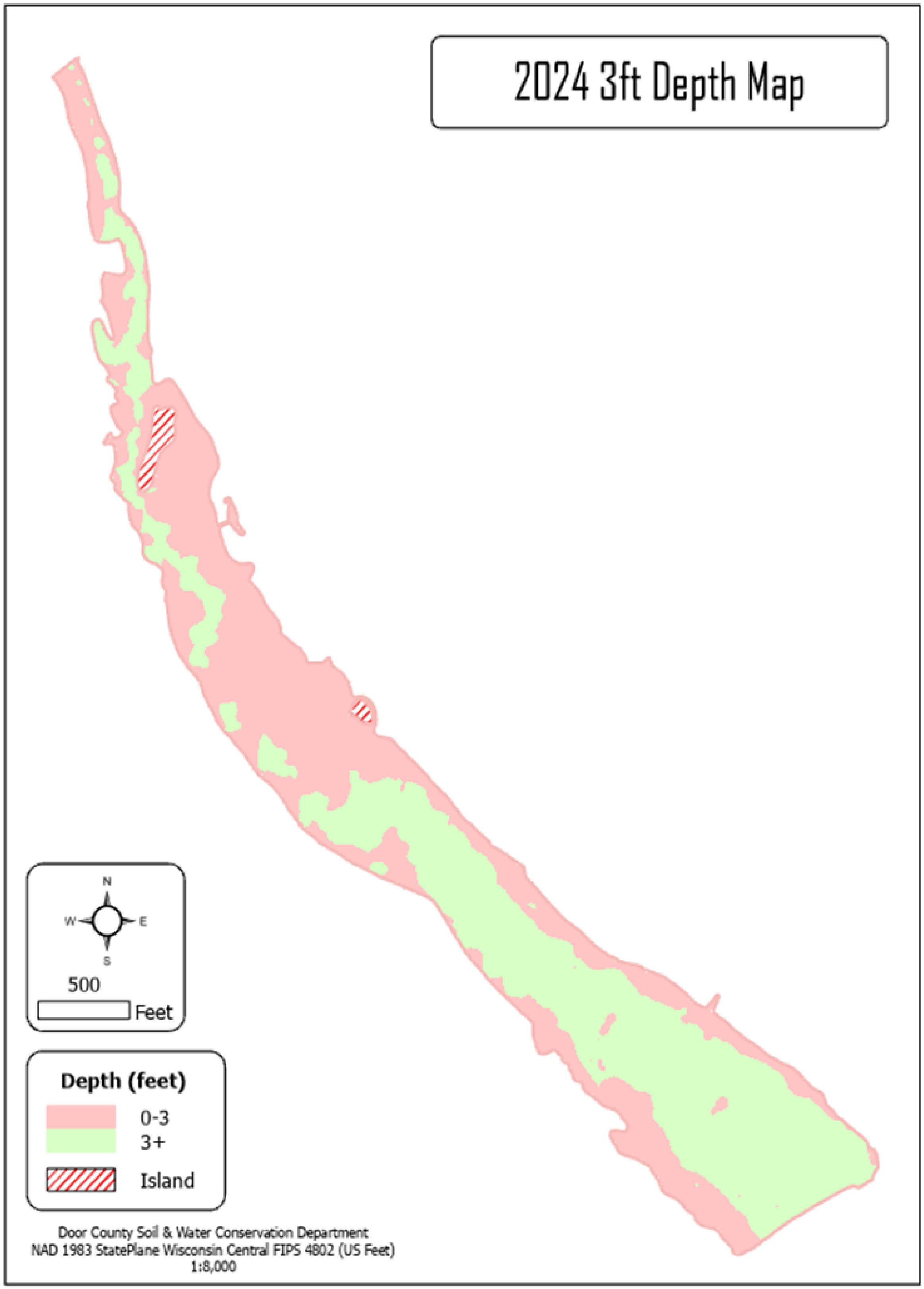


Figure 18. *Millpond 3ft depth map, 2024.*

AQUATIC PLANT COMMUNITY

The assessment of aquatic plant populations and overall plant communities is one way to determine the health of a lake ecosystem. This information can provide valuable insight about lake conditions and can play a role in future management decisions (Aron et al. 2010). In 2017, Door County Soil & Water Conservation Department (SWCD) explored the conditions of the Forestville Millpond and assembled a subsequent report in 2018. This report was used to help guide management decisions resulting in a drawdown starting in 2019 and ending in 2021 (SWCD, 2018). To evaluate post drawdown conditions, Door County SWCD based the post draw down aquatic plant inventory off the 2017 efforts.

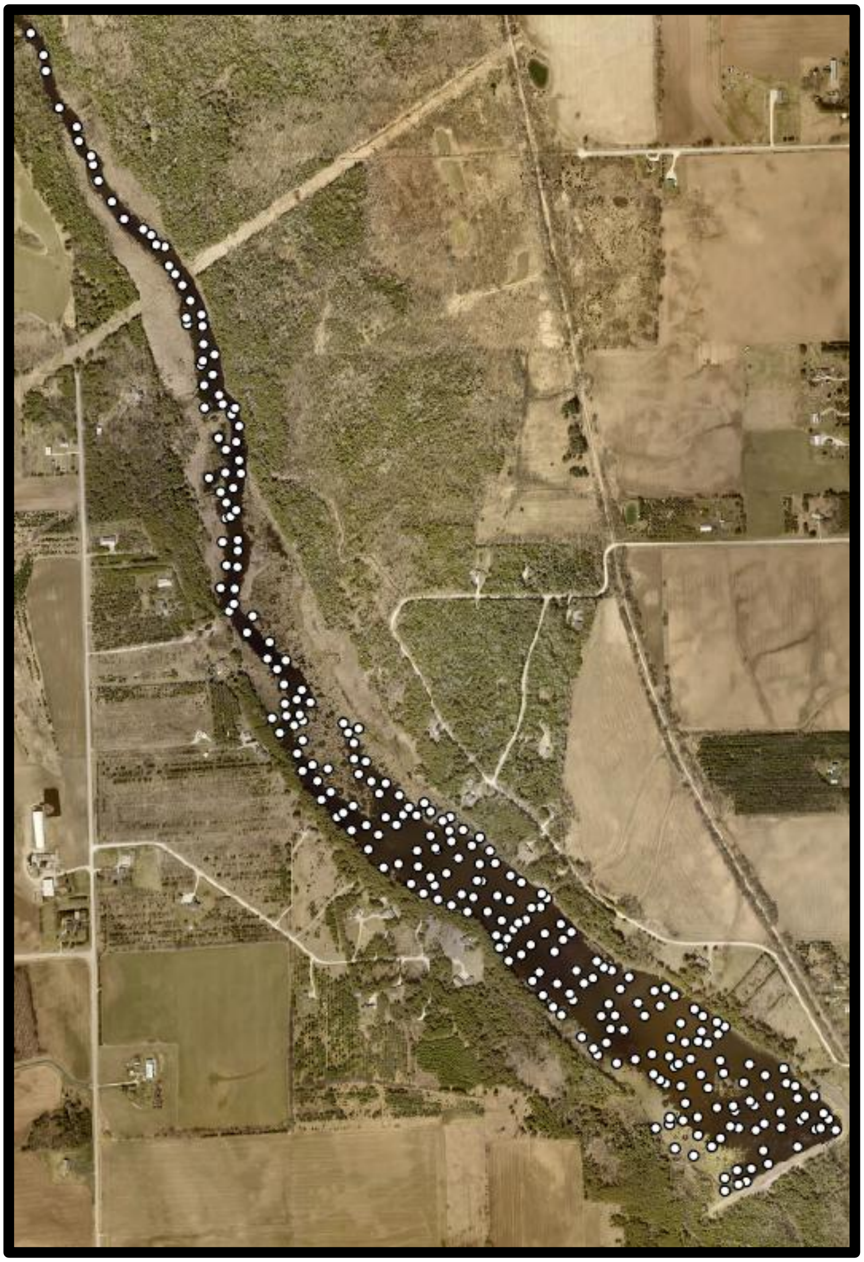


Figure 19. Aquatic vegetation sample points

SWCD utilized the methodology established in Wisconsin Department of Natural Resources (WDNR), *Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications* (Hauxwell, 2010). SWCD staff performed aquatic plant surveys on July 18th and July 19th of 2023.

The post drawdown survey was performed to evaluate current conditions. 2023 efforts utilized the 2017 point-intercept grid design, evenly distributing sample sites across the lake surface. These sample sites were uploaded to a Carlson Surveyor+ data collector and staff navigated to each sample site, then recorded a corresponding sample point with sub-centimeter accuracy (Figure 19).

During the two-day sampling period, 265 of the original 346 sample sites were visited due to extensive cattail populations creating inaccessible boating conditions. A double-sided sampling rake was used for the collection of vegetation at the sample sites. Data collected at each survey point included the site identification number, sample latitude and longitude, sample depth, dominant sediment type, collection apparatus type, rake fullness, a tally of each species that was observed, and a generalized abundance of each species collected on the rake. The quantitative data collected in the field surveys were entered into a templated spreadsheet created by the WDNR. Calculations were performed to develop statistical characteristics of the Millpond plant population to be able to compare with comparable habitat in the region. Other products generated by statistical analysis were the species richness, species frequency and the Floristic Quality Index value. The following tables summarize the results of the plant survey (Table 1, 2).

Total number of sites visited	265
Total number of sites with vegetation	213
Total number of sites shallower than maximum depth of plants	264
Frequency of occurrence at sites shallower than maximum depth of plants	80.68
Maximum depth of plants (ft)	5.7
Average number of all species per site (shallower than max depth)	2.64
Average number of all species per site (veg. sites only)	3.27
Average number of native species per site (shallower than max depth)	1.87
Average number of native species per site (veg. sites only)	2.47
Simpson Diversity Index	0.88
Overall Floristic Quality Index (FQI)	19.25
Overall Mean $\bar{C}$ (Average Conservatism – FQI)	4.8125
Species Number (Total)	22
Species Number (FQI)	16
Weighted Mean C ($\boldsymbol{w\bar{C}_n}$)	4.7

Table 1. Summary of field results. The total species include species observed within 6 feet of the sample sites. FQI results do not include observed species only those included in the rake sample and do not include invasive species. Invasive species are not included in the FQI calculations and therefore, do not have a coefficient of conservatism value.

Ecological Communities

Species	Sites Found	Relative Frequency	Coefficient of Conservatism
Cattail *(Typha* sp.)	13	1.9	1
Common arrowhead *(Sagittaria latifolia)*	2	0.3	3
Common bur-reed *(Sparganium eurycarpum)*	3	0.4	5
Common waterweed *(Elodea canadensis)*	126	18.1	3
Coontail *(Ceratophyllum demersum)*	100	14.3	3
Curly-leaf pondweed *(Potamogeton crispus)*	69	9.9	-
Eurasian water milfoil *(Myriophyllum spicatum)*	133	19.1	-
Muskgrasses *(Chara)*	6	0.9	7
Northern water-milfoil *(Myriophyllum sibiricum)*	65	9.3	6
White water lily (*Nymphaea odorata)*	-	-	5
Lady**'s** thumb (*Persicaria maculosa)*	-	-	1
Large-leaf pondweed *(Potamogeton amplifolius)*	-	-	7
Reed Canary Grass *(Phalaris arundinacea)*	1	0.1	-
Sago pondweed *(Stuckenia pectinate)*	11	1.6	3
Sandbar willow *(Salix interior*)	5	0.7	2
Slender waterweed *(Elodea nuttallii)*	57	8.2	7
Small duckweed *(Lemna minor)*	28	4.0	4
Softstem bulrush *(Schoenoplectus tabernaemontani)*	9	1.3	4
Spatterdock *(Nuphar variegate)*	2	0.3	6
Spiny hornwort (*Ceratophyllum echinatum)*	34	4.9	10
Water smartweed *(Polygonum amphibium)*	3	0.4	5
White water crowfoot *(Ranunculus aquatilis)*	30	4.3	8

Table 2. *Summary of plant species observed within pulled samples and accompanying coefficient of conservatism. This summary includes species observed within 6 feet of the sample site but were not found within the pulled sample. These species are noted by being included in the table and not being found at any sites. Invasive species are not included in the FQI calculations and therefore, do not have a coefficient of conservatism value.*

Two major ecological communities were observed at the Forestville Millpond during the vegetation survey: emergent marsh, and shallow open water (Figure 20). Emergent marsh communities typically occur in permanent standing water of less than 2 meters, and often are dominated by few clonal plant species. Common species which dominate emergent marsh environments include cattails, bulrushes, bur-reeds, etc. (Eggers and Reed, 2011; Epstein, 2017).

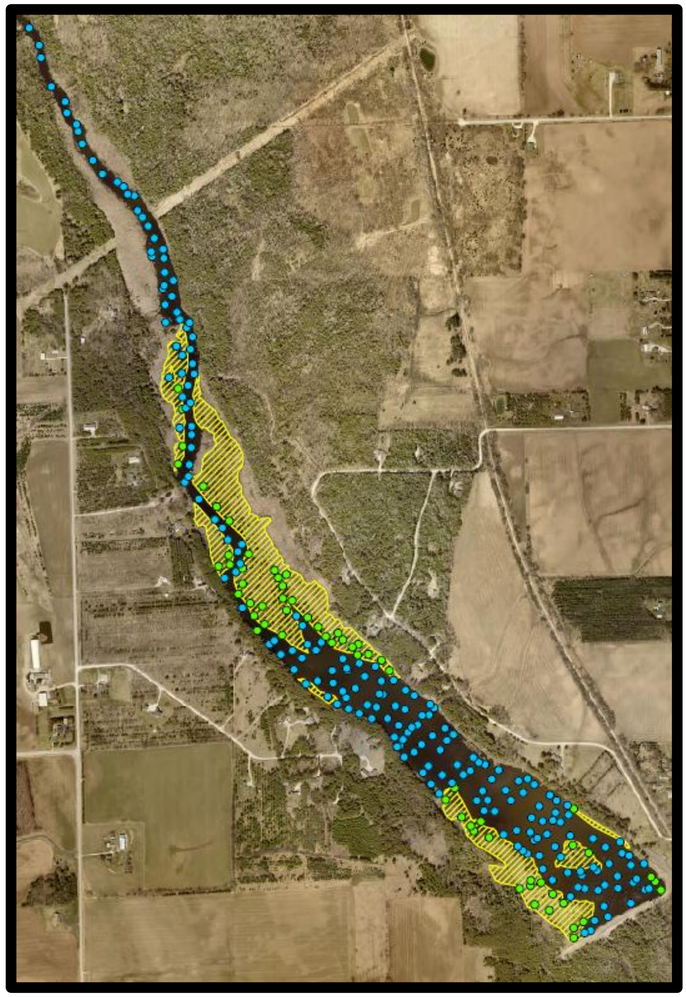


Figure 20. Locations of differing ecological communities and presence of cattail. Shaded yellow areas are Emergent Marsh communities. The non-shaded area in the Millpond is a shallow open water community. The green sample points relate to the presence (visual or sampled) of cattail. Blue sample points indicate the absence of cattail.

Shallow open water communities have less than 2 meters of water and are dominated by submergent, floating, and/or floating-leaved aquatic vegetation (Eggers and Reed, 2011). Some dominant aquatic vegetation in these communities are coontail, water-milfoils and common waterweed, with floating lilies found near the shoreline (MPCA, 2014).

Emergent marsh communities are ecologically important as they provide critical habitat for many birds including rails, herons, egrets, bitterns, grebes, terns, etc. Emergent marshes also support mammals such as muskrats and beavers, and many invertebrates that are critical to a healthy ecosystem (Epstein, 2017). Emergent marsh ecosystems can improve water quality by stabilizing sediment and removing excess nutrients through plant uptake (Barznji, 2014).

In Wisconsin, open water communities are good habitats for several fish species including northern pike, various shiner species, black and yellow bullhead, bluegill, largemouth bass, crappie, and Johnny darters (Eggers and Reed, 2011). Both of these deep-water wetland communities provide critical habitat for waterfowl during migration and for waterfowl in abnormally dry years due to the persistence of wet conditions compared to other wetland ecosystems (Eggers and Reed, 2011). Systems like the Forestville Millpond are ecotones: areas of transition between ecological communities. Ecotones are known for their exceptional plant and wildlife biodiversity and are potential locations for speciation (Eggers and Reed, 2011).

The open water and emergent marsh communities had many of the same plant species appear in each community, but were sampled at different frequencies. These communities were identified based on hydrologic regime and on dominate plant community. Eurasian water milfoil, common waterweed, and slender waterweed preferred the open water community, while cattail and small duckweed were sampled in higher frequencies in the emergent marsh community (Table 3, Figure 20). Although similar species were sampled, sampled vegetation was greater in the open water community compared to the emergent marsh community based on the frequency of occurrence of vegetation shallower than the maximum depth of plants (79.59 and 33.33, respectively) (Table 4). This brought the average number of species at each site down in the emergent marsh community, but when accounting for vegetated sites only, similar amounts of species were sampled in both communities. Simpson diversity index, FQI, and average $\bar{C}$ were also very similar between the ecological communities (Table 4). This is likely because of the similarities in which species were present in each community.

Scientific Name	Common Name	I.D. Code	Frequency of Occurrence		
			Total	Emergent Marsh	Open Water
Ceratophyllum demersum	Coontail	Cerde	14.3	15	14.2
Ceratophyllum echinatum	Spiny hornwart	Cerec	4.9	6.6	4.3
Chara sp.	Muskgrasses	Chara	0.9	1.8	0.6
Elodea canadensis	Common waterweed	Eloca	18.1	13.8	19.4
Elodea nuttallii	Slender waterweed	Elonu	8.2	4.2	9.4
Lemna minor	Small duckweed	Lemmi	4	11.4	1.7
Myriophyllum sibiricum	Northern water-milfoil	Myrsi	9.3	6	10.4
Myriophyllum spicatum	Eurasian water-milfoil	Myrsp	19.1	13.8	20.8
Nuphar variegate	Spatterdock	Nupva	0.3	0.6	0.2
Nymphaea odorata	White water lily	Nymod	0	0	0
Persicaria maculosa	Lady's thumb	Perma	0	0	0
Phalaris arundinacea	Reed canary grass	Phaar	0.1	0	0.2
Polygonum amphibium	Water smartweed	Polam	0.4	1.2	0.2
Potamogeton amplifolius	Large-leaf pondweed	Potam	0	0	0
Potamogeton crispus	Curly-leaf pondweed	Potcr	9.9	6.6	10.9
Ranunculus aquatilis	White water crowfoot	Ranaq	4.3	4.8	4.2
Sagittaria latifolia	Common arrowhead	Sagla	0.3	0	0.4
Salix interior	Sandbar willow	Salin	0.7	1.8	0.2
Schoenoplectus tabernaemontani	Softstem bulrush	Schta	1.3	3	0.8
Sparganium eurycarpum	Common bur-reed	Spaeu	0.4	0.6	0.4
Stuckenia pectinate	Saga pondweed	Stupe	1.6	1.8	1.5
Typha sp.	Cattail	Typha	1.9	7.2	0.2

Table 3. *Summary of observed species, separated by which community they were typically observed in. I.D. code consists of the first three letters of the genus and the first two letters of the species to create compressed labels utilized in Figure 27 the Relative Frequency of Occurrence of Species.*

	Emergent Marsh	Open Water
Total number of sites visited	68	197
Total number of sites with vegetation	23	156
Total number of sites shallower than maximum depth of plants	68	196
Frequency of occurrence at sites shallower than maximum depth of plants	33.33	79.59
Maximum depth of plants (ft)	3.4	5.7
Average number of all species per site (shallower than max depth)	0.65	2.7
Average number of all species per site (veg. sites only)	2.91	3.4
Average number of native species per site (shallower than max depth)	0.52	1.84
Average number of native species per site (veg. sites only)	2.39	2.49
Simpson Diversity Index	0.90	0.86
Overall Floristic Quality Index (FQI)	19.11	19.25
Overall Mean $\bar{C}$ (Average Conservatism – FQI)	4.933	4.8125
Species Number (Total)	20	21
Species Number (FQI)	15	16
Weighted Mean C ($w\bar{C}_n$)	4.5	4.8

Table 4. Summary of data comparing two different ecological communities: emergent marsh and open water in the Forestville Millpond

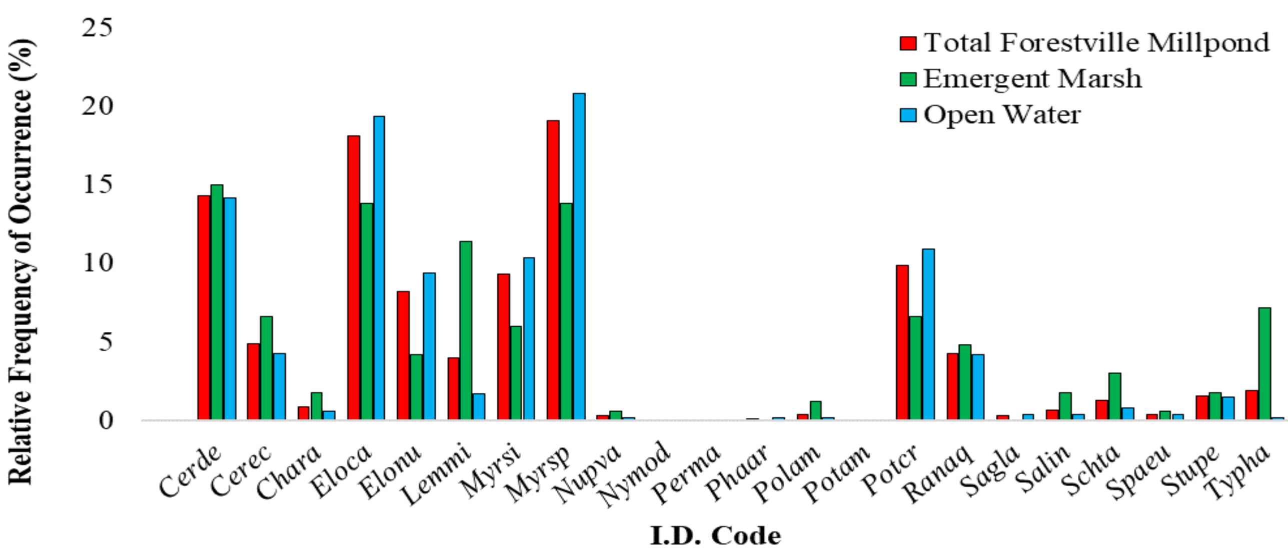


Figure 21. Relative frequency of occurrence of each observed species separated by the community they were sampled. This figure includes species observed within six feet of the sample point as well as species found within the sample pull.

Floristic Quality Index (FQI)

The Floristic Quality Index (FQI) is an assessment tool standardizing flora species presence for natural areas. This method was developed to replace subjective measures of quality, such as “high” or “low”, with a quantitative index. This index allows comparison of the floristic quality among many sites and tracking changes at the same site over time through evaluation of the closeness of the flora of an area to undisturbed conditions. The value developed for the index incorporates the number of floristically significant species and designates a coefficient of conservatism ($\bar{C}$), a reflection of sensitivity to disturbance, to each (Table 2). This gives weight to both high populations of particular species but also recognizes those with a greater relative conservation benefit. These results can be put into perspective when compared to lakes and flowages within the same and neighboring ecoregions; Door County is located within the North Central Hardwood Forests (NCHF) region (Figure 22) and results are compared to a combination of that region and the Southeastern Wisconsin Till Plains (SWTP) region (Marti and Bernthal, 2019). When compared to the other regions, the total Millpond FQI value of 19.25 is below the statewide value of 22.2 and the ecoregion value of 20.9 (Figure 23). The number of species making up the FQI, 16, is greater than the statewide and ecoregion median values (Figure 24), and the mean value of the coefficient of conservatism of 4.8125 is lower than the statewide value of 6 and the ecoregion value of 5.6 (Figure 25) (Marti and Bernthal, 2019). Although there are more species present in the Millpond than observed in this ecoregion, the average species has less ecological value than the average species found elsewhere in the ecoregion and state. One possible explanation for the high number of species may be the drawdown itself. During the drawdown, the Millpond experienced high levels of disturbance and the ecosystem changed drastically in a very short time. These changes to the Millpond likely caused large changes to the plant and animal community – changes that may not have had time to come to equilibrium at the time of the 2023 vegetation survey.

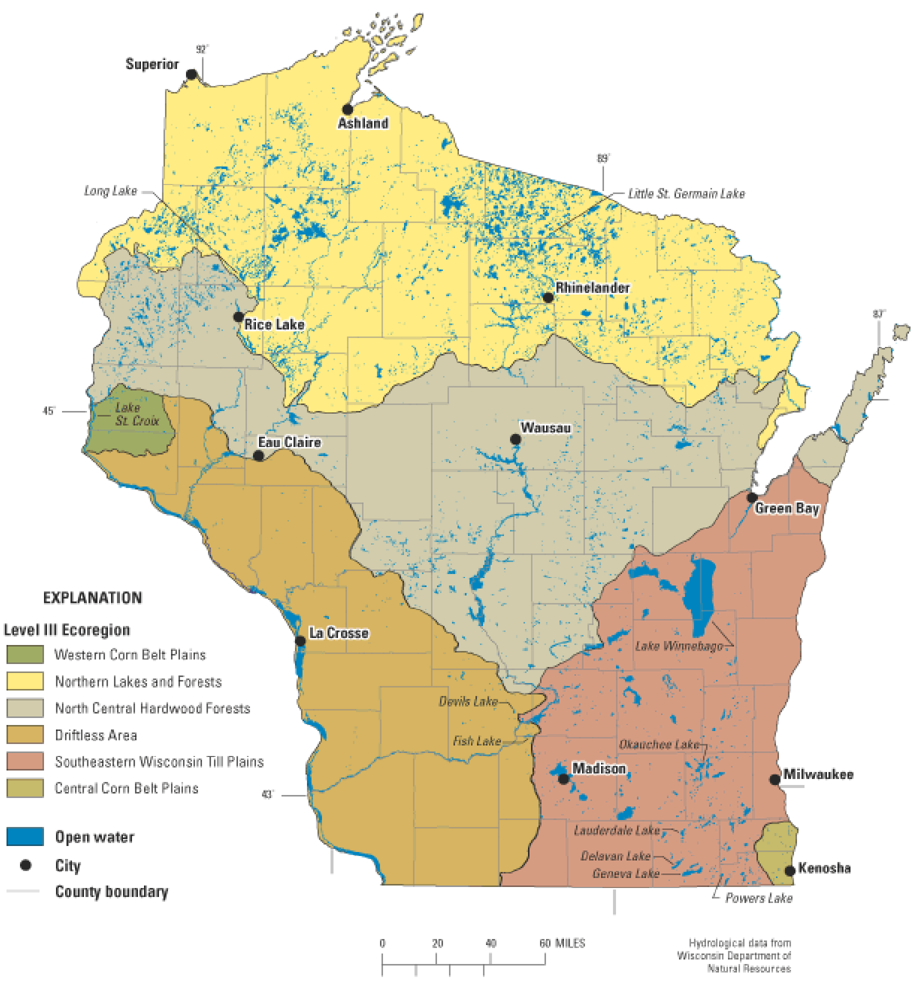


Figure 22. Wisconsin Ecoregions. From United States Geological Service.

According to the 2023 vegetation survey and corresponding FQI and mean $\bar{C}$, the Forestville Millpond has lower ecological value than other locations in the NCHF and SWTP. However, these ecoregions have many different habitats within them which are lumped together to calculate both the statewide averages and individual ecoregion averages for FQI, number of species, and mean $\bar{C}$. In order to clarify results, weighted mean $\bar{C}$ ($w\bar{C}_n$) was utilized to compare community types to similar communities in the region.

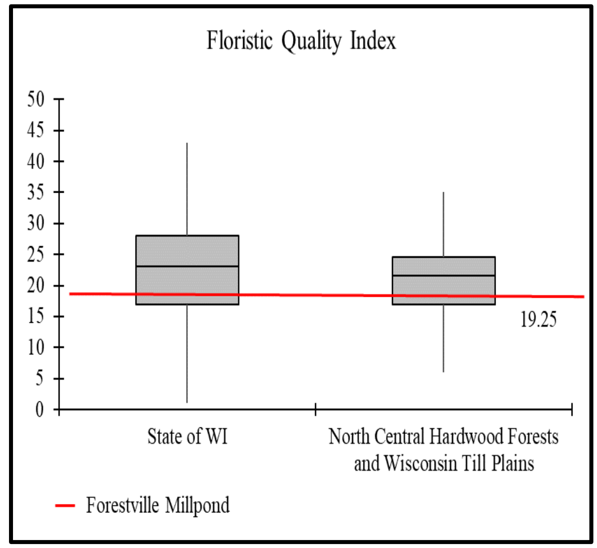


Figure 23. Comparison of Floristic Quality Index of the Forestville Millpond and other areas of the state.

Weighted mean $\bar{C}$ ($w\bar{C}_n$) is used to evaluate the value of an ecosystem. $w\bar{C}_n$ is a version of the mean $\bar{C}$ of the vegetative population, but considers the abundance of each plant species. When the emergent marsh and open water communities are separated and then compared to the other similar habitats in the NCHF. Standards used for the shallow open water community were established by the Minnesota Pollution Control Agency (MPCA). They determined two classifications on the health and value for these communities. $w\bar{C}_n$ was the metric used for this evaluation. The two categories are "good" and "fair" with the $w\bar{C}_n$ separating these categories set at 5 (MPCA, 2014). The open water community in the Millpond had a $w\bar{C}_n$ of 4.8, putting this community in the "fair" category, (Figure 26).

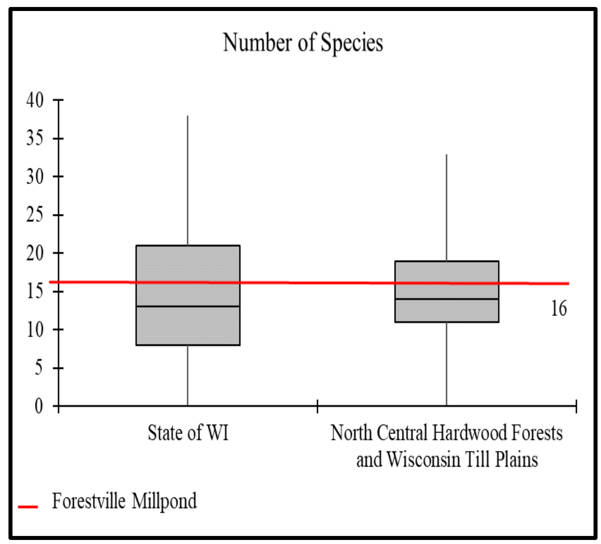


Figure 24. Comparison of Number of Species excluding invasive species.

Similarly, the Wisconsin DNR assessed the $w\bar{C}_n$ compared to the level of disturbance in emergent marsh ecosystems in the NCHF. Disturbance levels were separated into two groups: most disturbed and least disturbed. Comparisons between these two groups and the observed $w\bar{C}_n$ from the Millpond show that the Millpond fell between the most disturbed category and least disturbed category of emergent marshes (Figure 27). Both the open water and emergent marsh communities are comparatively average against other like ecosystems in the region (MPCA, 2014; Marti and Bernthal, 2019).

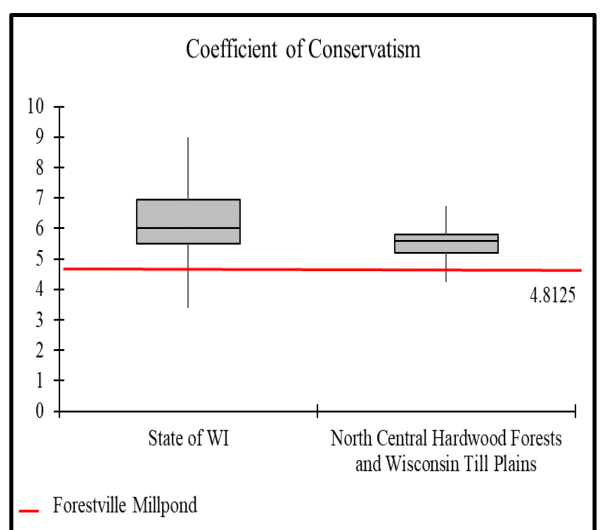


Figure 25. Comparison of Coefficient of Conservatism for native species sampled in with the rake.

Visually Identified Aquatic Vegetation

While this survey focused on vegetation which was collected with the double-sided rake, those species may not tell the whole story about the aquatic vegetation community. Three species were visually identified in the Millpond, but were not collected by the surveying team: white water lily (*Nymphaea odorata*), large-leaf pondweed (*Potamogeton amplifolius*), and lady's thumb (*Persicaria maculosa*). When visually identified species are included in the FQI, FQI increased from 19.25 to 20.88. However, when visually identified species are included into the calculations for mean coefficient of conservatism, the mean slightly reduces from 4.8125 to 4.79 (Table 5).

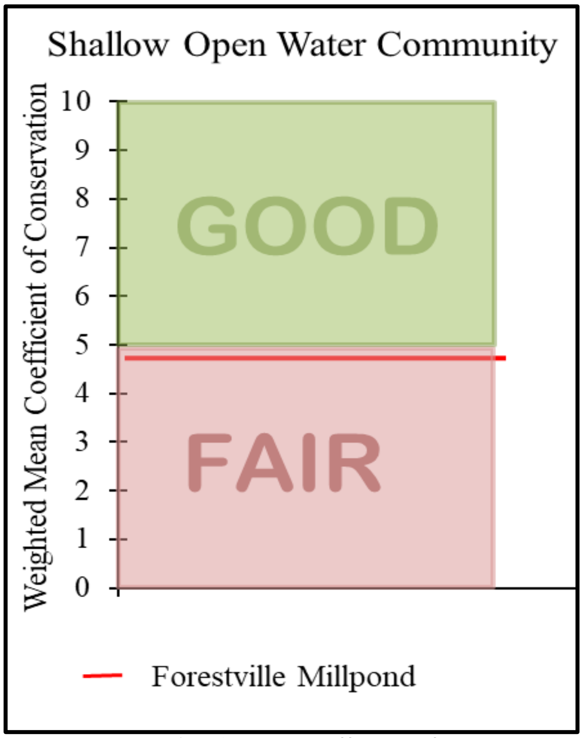


Figure 26. *Weighted mean coefficient of conservatism ($w\bar{C}_n$) for the shallow open water ecological community in the Forestville Millpond compared to community assessments of a "good" or "fair" shallow open water community designated by the Minnesota Pollution Control Agency*

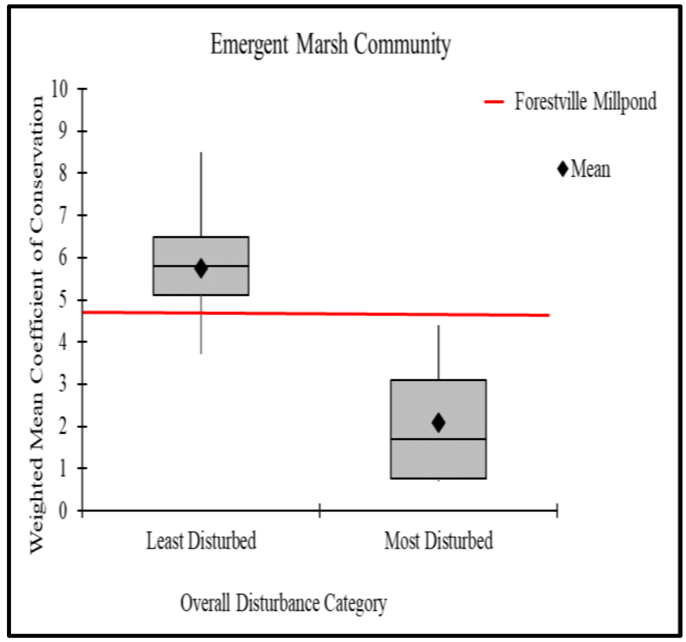


Figure 27. *Comparison of weighted mean coefficient of conservatism ($w\bar{C}_n$) in different levels of disturbance in emergent marsh communities in the North Central Hardwood Forest ecoregion of Wisconsin. Boxes represent the 75th and 25th percentiles of score distributions and lines represent 95% confidence intervals for the least disturbed and most disturbed sites. The Forestville Millpond $w\bar{C}_n$ falls below the 25th percentile but within the 95% confidence interval for least disturbed and above 95% confidence interval for most disturbed.*

When the communities in the Forestville Millpond are broken up into emergent marsh and open water communities, the visually identified plants affect the communities differently in regard to the FQI and mean $\bar{C}$. In the open water community, white water lily (*Nymphaea odorata*) and large-leaf pondweed (*Potamogeton amplifolius*) were only visually identified within 6ft of the sample sites without collecting them with the rake. The addition of these species increased both FQI from 19.25 to 21.21 and the mean $\bar{C}$ from 4.1825 to 5. Those same two species were visually identified in the emergent marsh community, along with lady's thumb (*Persicaria maculosa*), which was observed on a muskrat hut within 6 ft of a sample site. The addition of these three species increased the FQI from 19.1 to 19.8 and decreased the mean $\bar{C}$ from 4.93 to 4.67 (Table 5).

Community		Number of Species	FQI	Mean $\overline{C}$
ALL	Sampled	16	19.25	4.8125
	Visuals Included	19	20.88	4.79
OPEN WATER	Sampled	16	19.25	4.8125
	Visuals Included	18	21.21	5
EMERGENT MARSH	Sampled	15	19.11	4.93
	Visuals Included	18	19.8	4.67

Table 5. *Comparison of FQI and mean $\overline{C}$ in the different ecosystems in the Millpond with and without visually identified species.*

In each case of including the visually identified aquatic vegetation, the FQI increased, even though the mean $\overline{C}$ didn't always follow suit. This may be because the FQI calculation considers the number of species, while the mean $\overline{C}$ only considers the "quality" of the species found. Furthermore, many of these species are considered "pioneer" species, which means they are the first to colonize an ecosystem after a major disturbance. Pioneer species are often very hardy and can withstand harsh conditions, allowing them to be among the first colonizers, but this also means that some may have very low coefficient of conservatism values, which may be a reason why the mean $\overline{C}$ at the Millpond is lower than the state average.

Simpson Diversity Index (SDI)

The Simpson Diversity Index (SDI) is used to quantify biodiversity of an ecological community based on a calculation of the number of each species surveyed (abundance) and the number of individuals per sample point. The SDI utilizes a decimal scale, with values closer to zero representing a lack of diversity and those closer to one representing a higher degree of biodiversity. The data collected in the survey of the Forestville Millpond as a whole resulted in an SDI of 0.88. The emergent marsh community has an SDI of 0.90 and the open water community has an SDI of 0.86. The median SDI value for Wisconsin lakes is 0.80, as established by the 2012 National Lakes Assessment. This places the total millpond, and both separate ecological communities' SDI above the state average, which can be anticipated by the species count and abundance of vegetation in the survey results. Again, the abundance of species sampled at the Millpond in 2023 may be due to the recent disturbance of the ecosystem. There may be residual species present from when the Millpond was drawn down and an equilibrium may not yet be established. To understand a true understanding of the post drawdown ecosystem, successive vegetation surveys would need to occur.

Non-Native Aquatic Species

Three non-native plant species were definitively identified in the Millpond: Eurasian water milfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), and reed canary grass (*Phalaris arundinacea*). Both Eurasian water milfoil (EWM) and curly-leaf pondweed (CLP) are native to Europe, Asia and North Africa, and are thought to have been introduced to the United States near the turn of the 20th century. Known for growing in soft sediments, these aggressive invasive species will crowd out native species as well as impact natural habitats and impede recreation.

EWM was the most abundant plant species sampled in the Millpond. It was consistently observed throughout the Millpond and was found in high abundance near the main impoundment area (Figure 34). CLP was also identified throughout the Millpond; however, it was observed in much lower abundance than EWM (Figure 28). It should be noted that the peak growing season for CLP was passed at the time of this survey, so a survey earlier in the season might more accurately show the population. Reed canary grass was only sampled at one location in the Millpond and was not observed to be wide-spread, within the Millpond. However, reed canary populations are well established within the Ahnapee watershed. Reed canary grass is very aggressive and grows in thick, dense mats which prevents native wetland plants from growing.

Cattails (*Typha sp*.) were abundant around the edge of the Millpond (Figure 29). These cattails were accompanied by bur-reed (*Sparganium eurycarpum*), softstem bulrush (*Schoenoplectus tabernaemontani*), spatterdock (*Nuphar variegate*), and small duckweed (*Lemna minor*), which all made up large portions of the emergent marsh habitat (Figure 21). While all these species may potentially be native, many cattail species are invasive in Door County. In this survey, cattail species were identified only to genus. Identification to species would require genetic testing to be absolute. Meaning populations identified may be invasive, hybrid, and/or native.

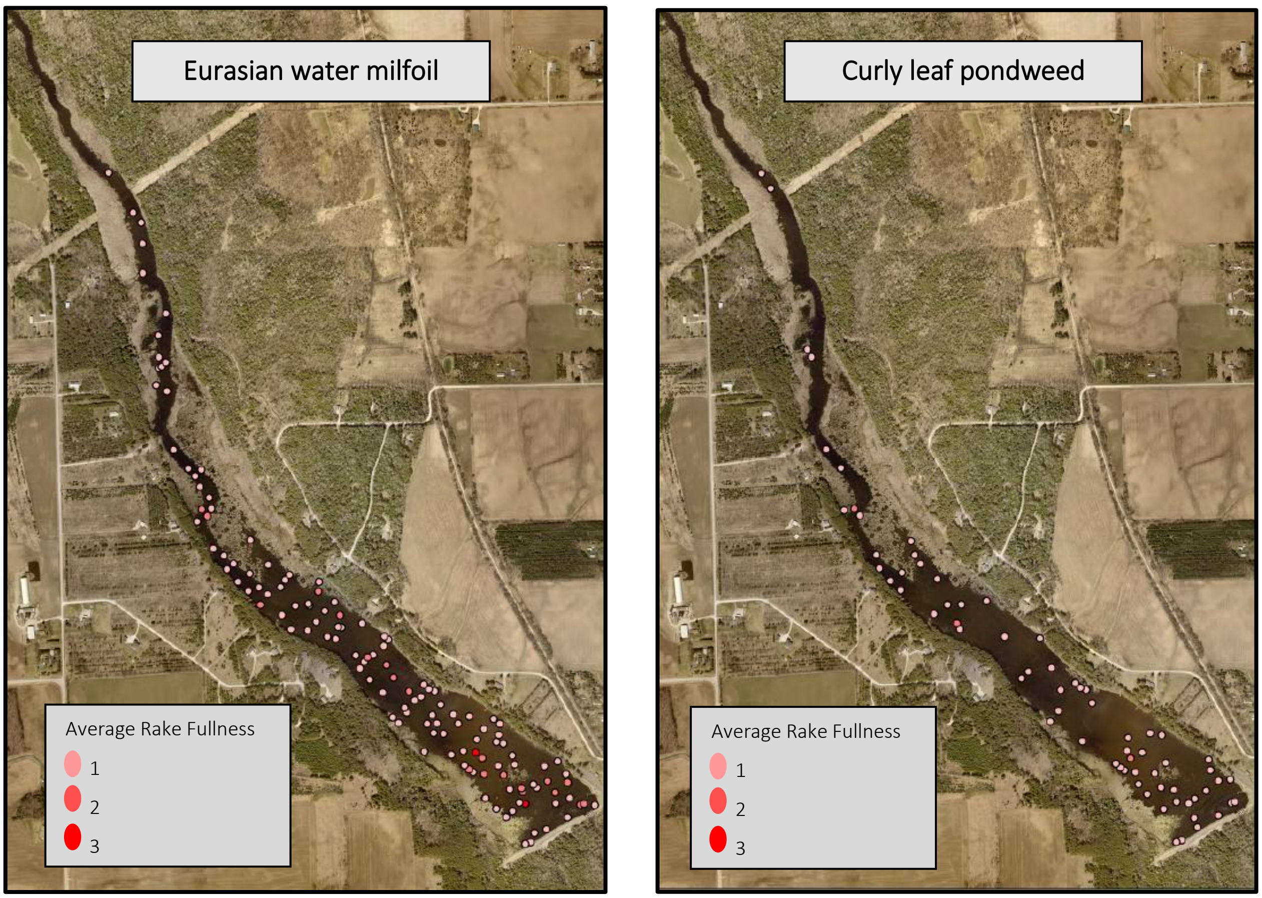


Figure 28. *Distribution and average rake fullness of invasive species Eurasian water milfoil (left), and Curly leaf pondweed (right).*

Summary of 2023 Aquatic Plant Survey

The Forestville Millpond is a very shallow system with a dominantly muck bottom. There were two main ecological communities: emergent marsh and open water. These communities had similar species present, however, the abundance greatly varied in one community or another. The maximum depth found to contain plants was 5.7 feet. Just over 80% of the sampled sites contained any type of vegetation, but species components varied based on ecological community. The most abundant species was invasive, Eurasian water milfoil (*Myriophyllum spicatum*), which was observed at 19% of the sites visited. The most abundant native plant was the common waterweed (*Elodea canadensis*), which was observed at 18% of the sites visited. Four more species were observed at least in 8% of the sample sites. In the emergent marsh ecological community, cattail (*Typha sp*.) and small duckweed (*Lemna minor*) were the most observed species. While having lower FQI and mean $\bar{C}$ values compared to the state as a whole, the Forestville Millpond is currently comprised of two distinct ecosystems and has a diverse population of aquatic vegetation.

Figure 29. *Photo of the convergence of the two observed ecological communities: open water and emergent marsh.*

PRECIPITATION

The drawdown of the FMP was scheduled for two winters and two summers to maximize lakebed exposure to freezing winter conditions and dry sunny conditions. Unfortunately, mother nature did not cooperate. Accumulating precipitation was consistently higher than normal for the two-year period (Figure 30). At the end of the drawdown the Forestville weather station recorded an approximate total of 74 inches of precipitation which is about 9 inches above the normal range.

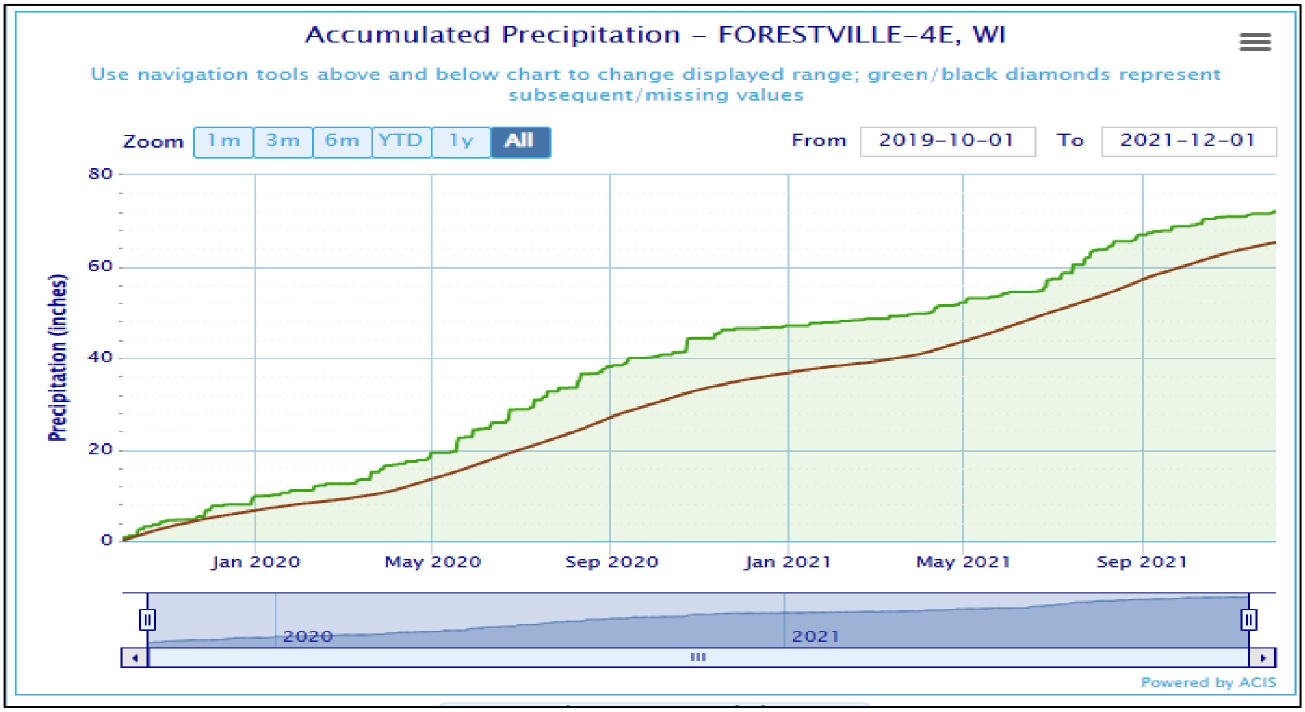


Figure 30. *Accumulated Precipitation in Forestville, WI from 10/1/2019 to 12/01/2021 (green). Brown indicates normal accumulation.*

Another analysis to evaluate precipitation during the drawdown is WETS analysis. This is a Natural Resource Conservation Service (NRCS) climate analysis for wetlands. The WETS analysis focuses on monthly or 30-day precipitation accumulations to identify the physical characteristics of wetlands. Figure 31 illustrates the 30-day accumulations with the blue bars on the graph, with the normal range boxed in red. The green areas indicate time periods that SWCD took pictures of the flowage when the majority of the lakebed was exposed to the open air.

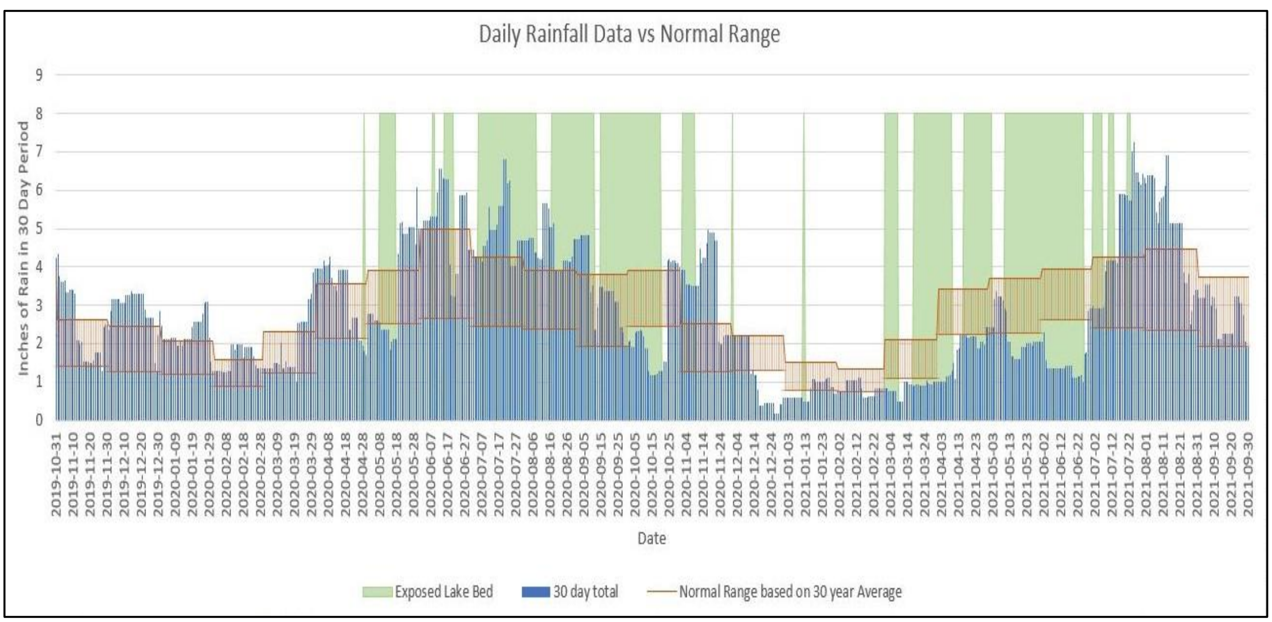


Figure 31. *Daily Rainfall vs. Normal Range for Forestville, WI from 10/1/2019 to 12/01/2021.*

Higher than average and long precipitation events during the drawdown time period unfortunately did not result in a continual exposure of the lakebed. Not having continual exposure to the open air during the summer and winter months likely reduced expected benefits, especially with invasive plant species.

Rain Event Photos

5/20/20. Extreme heavy rains. Water spilling over dam.

5/18/20. Extreme heavy rains. Water spilling over dam.

5/18/20. Extreme heavy rains. Field washouts.

Fish Stocking

During the Fall of 2021 and 2022, the Wisconsin Department of Natural Resource (WDNR) stocked largemouth bass and bluegill into the millpond in an effort to restore the fishery. A summary of the fish stocking at the Forestville Millpond from 1983-2022 is shown in Table 6.

YEAR	SPECIES	AGE CLASS	# FISH STOCKED	AVERAGE LENGTH (in.)
2022	BLUEGILL	LARGE FINGERLING	66830	1
2022	LARGEMOUTH BASS	LARGE FINGERLING	2339	2.7
2021	BLUEGILL	LARGE FINGERLING	46960	0.75
2021	LARGEMOUTH BASS	LARGE FINGERLING	2350	3.3
1993	LARGEMOUTH BASS	FINGERLING	7000	1
1992	NORTHERN PIKE	FINGERLING	2830	5.5
1992	LARGEMOUTH BASS	FINGERLING	3250	1
1991	LARGEMOUTH BASS	FINGERLING	7000	2
1991	NORTHERN PIKE	FINGERLING	360	7.9
1990	NORTHERN PIKE	FRY	100000	1
1987	NORTHERN PIKE	FINGERLING	975	9
1986	NORTHERN PIKE	FINGERLING	325	9
1986	SMALLMOUTH BASS	FINGERLING	2000	3
1985	MUSKELLUNGE	FRY	65000	1
1985	LARGEMOUTH BASS	ADULT	20	12
1985	NORTHERN PIKE	FINGERLING	325	9
1983	NORTHERN PIKE	FINGERLING	375	11

Table 6. Fish stocked by year, showing species, age class, # stocked, and average length.

Electrofishing Survey

On May 8, 2024, the Wisconsin Department of Natural Resources (WDNR) conducted an electrofishing survey on the Forestville Millpond. Shocking began around 11:15pm and was completed approximately 52 minutes later. The total distance shocked was 2 miles counter clockwise starting at the boat launch headed north, turning south once the flowage narrowed and finally ended back at the launch. All fish were netted and measured besides common carp which had numbers “encountered” estimated after shocking run.

Species	Total #	CPE (no./hr.)	CPE (no./mi)	Mean Length (in.)	Length Range (in)
Large Mouth Bass	34	39.2	17	13	11.2-15
Bluegill	11	12.7	5.5	7.2	6.4-7.9
Northern Pike	8	9.2	4	20.5	18.6-24
Pumpkinseed	1	1.15	0.5	5.8	5.8
Common Shiner	1	1.15	0.5		
Total	55	63.5	27.5		

Table 7. *2024 Electrofishing Survey results.*

Largemouth bass dominated the catch with bluegill, northern pike, and pumpkinseed rounding out the catch. Total number, catch per effort, and sizes caught can be seen in the Table 7. A cause for concern would be the number juvenile common carp under ~15 in. seen. Estimates of common carp were over 100 fish seen in the 2 miles of shocking. Common carp were prevalent in shallow marsh areas in the northern reach of the flowage while most other species were caught in the southern portion of the flowage where submergent vegetation and rock was present. Rain events days prior to the survey increased turbidity in the flowage making it difficult for effective sampling of fish difficult.

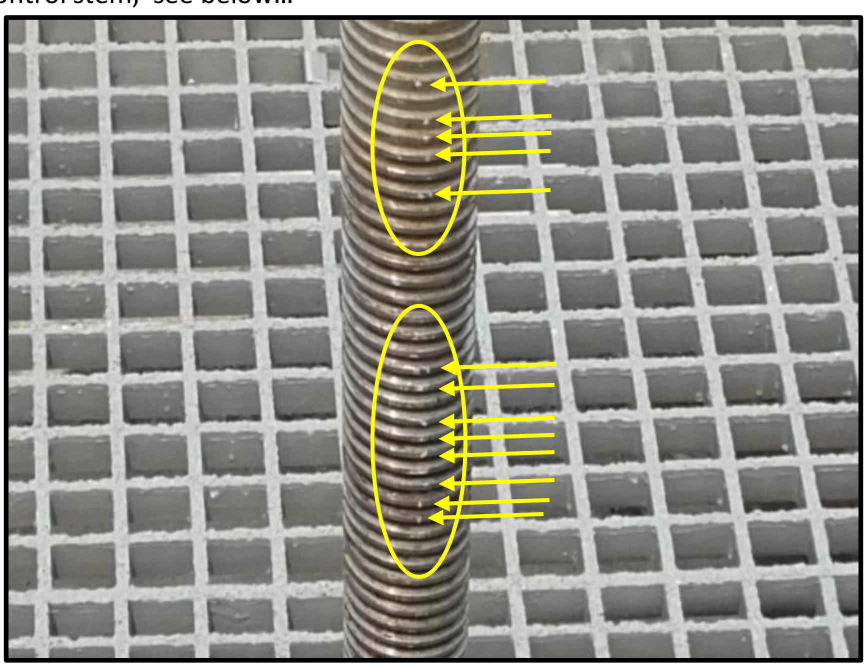
Further information can be found in Appendix C, *Wisconsin Department of Natural Resources 2024 Forestville Millpond Survey Summary, Door County.*

Drawdown Challenges & Lessons Learned

The physical drawdown of the FMP was the responsibility of Door County Facility & Parks Department (F&P) and their staff. Several months prior to commencing the drawdown the SWCD , Door County Parks, and the WDNR developed a working plan in preparation of the drawdown (Figure 32). This plan covered four primary time periods that spanned over a five-year period. For each time period activities were delegated primarily to F&P and then secondarily to SWCD and DNR activities.

The first time period was the summer and Fall of 2019. This time period was categorized as Prep & Start of the Drawdown. A couple of activities that should be re-evaluated if future drawdowns are considered include:

1.) Initial plans were to keep or maintain the existing carp barrier even though it was removed after commencing a drawdown. This barrier collected debris initially and then fish and turtles. The barrier was permanently dismantled on July 20, 2020.
2.) A wild game/security camera was installed at the site to document daily photos. Relying on remote camera was a mistake as cold weather took a toll on the batteries. Ideally primary and secondary staff should have taken daily pictures from several pre-designated vantage points. In August 2021, it appeared that the pond was quite slow at drawing down. Upon a site visit, it was discovered that the sluice valve was partially closed, and there were suspicious “pipe wrench type teeth” marks on the sluice valve control stem, see below…



8/4/21. Mysterious “teeth” marks on valve. *After it was discovered that the sluice valve was partially closed after large rain events.*

Several weeks after the drawdown commenced the lead staff from the F&P department left Door County employment. Daily photo recording was reassigned to SWCD staff in April of 2020.

3.) One of the unpredictable variables during this time period was the COVID 19 pandemic. The virus was first detected in early February 2020 and by March 25th 2020 a stay-at-home order was issued. This further emphasized the need to have primary and secondary staff available to complete priority activities.

The second time period was focused on maintaining the drawdown. During this time period the sluice valve was to remain fully open. Primary activities were to document monthly with photos however daily or multiple times per week became the preferred documentation. Also, the sluice valve should be monitored daily to ensure driftwood or cattail mats are not plugging up the sluice opening, and to verify that the sluice valve is fully opened and exercised occasionally. Several maintenance and safety measures were conducted during this time period in addition to the new dry hydrant for the Southern Door Fire Department. Fish restocking plans were initiated by the DNR however carp control measures were dropped as a low priority and/or lacking feasibility.

The third time period was the refilling of the flowage starting September 1, 2021 and concluded on October 7, 2021 when the water again over-topped the spillway as the primary discharge. At this point the sluice valve was closed entirely. Precipitation was in the normal range during this time period and maintaining flow downstream was a DNR priority that required gradual closing of the sluice valve. Vegetation assessments were also conducted prior to refilling to assess with DNR staff any issues with woody or herbaceous plan establishments prior to refilling and stocking of fish.

The Fourth and final time period on the drawdown plan focused on the post refill activities which primarily included fish stocking, monitoring for riparian invasive plants, and continued water quality monitoring. This report of course, is the result of the initial monitoring, post refill.

In Summary, any future drawdowns would need to address the previous challenges or lessons learned. For example, if we continue to have large rain events or wetter years, should the sluice valve be re-evaluated to release more water and maximize exposed lakebed days?? The biggest lesson learned is a project of this magnitude requires daily inspection, multiple agency cooperation and a great deal of patience.

DISCUSSIONS & CONCLUSIONS

Prior to the drawdown of the Forestville Millpond the expected benefits included: an increase in water depth; an improvement in water quality; a reduction in invasive plants, an increase in native plants, and an improved fishery.

Starting with water depth the theory was that the silt and mucky bottom would be exposed to the air, dry-out, mineralize, and compact. Sediment core analysis showed that the silt/muck layer ranged from 1 ‘ 2” to 2‘ 3”. It’s nearly impossible to guess what percent of gain in depth can occur due to all the environmental factors that have been called out in this report. Several methods and figures have been included in this report to illustrate the changes in depth, and the conclusions would be that depth in channel that formed gained depths in the magnitude of a foot or two, and the rest of the basin the gain in depth was typically less than a foot and likely averages in the neighborhood of 4-6”. What is notable is that the 1974 bathymetry data indicated that 73% of the pond was less than 3’ in depth, and in the 2018 report the area less than 3’ was at 92%. When measuring this statistical area from figure 18 the area less than 3’ in depth has dropped dramatically to 48%.

Water quality improvement was the next area the benefits were expected. These benefits could include less total suspended solids (TSS), lower phosphorus and nitrogen levels, increased oxygen levels and lower chlorophyll levels. Suspended solids in theory would decrease as the silt and muck would be compacted after a drawdown and would be less susceptible to resuspension from wind or adult carp activities. The results show that after the draw down 1/3 of the TSS samples exceeded the 20 mg/l threshold and prior to the drawdown 2/3 of the TSS samples exceeded the threshold. By no means is this statistic earth shattering, but it is an improvement. Phosphorus and nitrogen levels are likely to remain the same or greater unless legacy nutrients are removed through some type of large-scale dredging activities. The results from this study show phosphorus and nitrogen levels remain high enough to sustain annual algal blooms. Oxygen levels showed the greatest response to the drawdown with all 9 samples being above the threshold for fish impairment. In the 2018 report, 5 of the 9 samples had levels below the threshold and likely cause stress within the fish populations. The likely cause of higher oxygen is the increase in aquatic plants and the reduction of oxygen eating organic material at the bottom of the pond. Chlorophyll levels increased and again is not unexpected as nutrient levels did not decrease and shallow water impoundments are known for these impairments.

Aquatic plant benefits included a reduction in Curly leaf pondweed and Eurasian water milfoil and the increase in native vegetation. The plant survey was performed approximately 22 months after the pond was refilled and there was a definite challenge with accessing points as there were surviving populations of flooded and emergent cattails preventing boat access. This living population was temporary and was not an issue the following year when the bathymetry survey was conducted. The survey indicated that reductions in invasive plants did not occur and is likely due the pond not being fully drawn down for the entire time period. Repeated flooding of the basin is the likely explanation for Curly leaf pond weed and Eurasian water milfoil survival. On the plus side more sites had aquatic vegetation and more native species were inventoried. The increase in all species and sites is likely due to sediments being compacted for better rooting and increased clarity due to reduced suspended solids. Having a reduced adult carp population is also a likely contributor to the increase in plant life.

An improved fishery was goal and a huge concern for local residents. Prior to the drawdown the WDNR last stocked fish in the pond in 1993. The DNR discontinued the stocking efforts due to poor water quality and periodic fish kills. During pre-drawdown discussions the DNR made a commitment to restock fish as part of this waterbody improvement project. The data in the draft report is very promising for the largemouth bass and bluegill but as feared the carp in the system remain and will likely remain due to limited resources and methods to eliminate them. There is no conclusion on the fishery at this point as it will take at least another year or two, along with additional surveys to fully evaluate the longer-term effects to the fishery.

The drawdown was an option that had not been tried previously. It was not a popular option with a number of individuals; however, the drawdown was determined to be the most cost effective and least disruptive option. If the County wishes to maintain this flowage, maintaining the dam structures annually will be critical. At some point in the future (estimated 50+years) the structures longevity will near its end. Future planning with the County should be considered in order to be fiscally prepared for maintenance, replacement, removal, or catastrophic failure.

REFERENCES

Aron, K., J. Bode, H. Bunk, J. Cahow, G. Dauffenbach, j. Dauffenbach, M. Gansberg, S. Graham, J. Hauxwell, L. Herman, J. Jereczek, S. Knight, D. Konkel, R. Korth, F. Koshere, A. Kowalski, T. Lyden, J. Madsen, S. Provost, C. Schaal, M. Sesing, B. Sorge, J. Thornton, P. Toshner, J Wudi. 2010. *Aquatic Plant Management in Wisconsin*. University of Wisconsin-Stevens Point.

Barznji, D.A.M., 2014. Role of Aquatic Plants in Improving Water Quality. Unique Journal of Pharmaceutical and Biological Sciences 2, 12–16.

Door County Soil and Water Conservation Department (SWCD), 2018. *Final Report for Comprehensive Lake Management Planning Grant project #LPL162317*

Eggers, S.D. and D.M. Reed. 2011. *Wetland Plants and Plant Communities of Minnesota and Wisconsin (3rd Ed).* US. Army Corps of Engineers, St. Paul District, St. Paul, Minnesota.

Epstein, E.E. *Natural communities, aquatic features, and selected habitats of Wisconsin*. *Chapter 7 in The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management.* Wisconsin Department of Natural Resources, PUB-SS-1131H 2017, Madison

Hauxwell, J., S. Knight, K. Wagner, A. Mikulyuk, M. Nault, M. Porzky and S. Chase. 2010. *Recommended baseline monitoring of aquatic plants in Wisconsin: sampling design, field and laboratory procedures, data entry and analysis, and applications*. Wisconsin Department of Natural Resources Bureau of Science Services, PUB-SS

Marti, A.M. and T.W. Bernthal, 2019. *Provisional wetland Floristic Quality Benchmarks for wetland monitoring and assessment in Wisconsin. Final Report to US EPA Region V, Grants # CD00E01576 and #CD00E02075.* Wisconsin Department of Natural Resources. EGAD # 3200-2020-01.

Minnesota Pollution Control Agency (MPCA). 2014. *Rapid Floristic Quality Assessment Manual.* wq-bwm2-02b. Minnesota Pollution Control Agency, St. Paul, MN

Nichols, Stanley A., 1999. *Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications, Lake and Reservoir Management*. 15:2, 133-141, DOI: 10.1080/07438149909353957

Wisconsin State Legislature. Chapter NR 102. 2024. *Water Quality Standards For Wisconsin Surface Waters. Subchapter 1, NR 102.04.*

APPENDIX A: Water Chemistry Raw Data

Station #153161 Ahnapee River at CTH H			
Date Sampled	5/24/2023	6/19/2023	7/18/2023
Temperature (°F)	60.602	64.31	64.688
DO (mg/L)	10.84	13.07	13.46
pH	8.28	8.36	8.6
TSS (mg/L)	2.8	ND	ND
TP (mg/L)	0.0288	0.019	0.0105

Station #10047671 Unnamed Tributary at CTH H			
Date Sampled	5/24/2023	6/19/2023	7/18/2023
Temperature (°F)	63.698	69.62	70.79
DO (mg/L)	9.89	11.43	11.69
pH	8.4	8.19	8.93
TSS (mg/L)	27.2	81	105
TP (mg/L)	0.0427	0.0182	0.345

Station #10047672 Ahnapee River upstream of WBIC 5013575			
Date Sampled	5/24/2023	6/19/2023	7/18/2023
Temperature (°F)	62.96	66.56	66.3988
DO (mg/L)	7.79	12.17	10.85
pH	8.24	7.94	8.47
TSS (mg/L)	4.2	6	ND
TP (mg/L)	0.0222	0.0239	0.013

Station #10047673 Ahnapee River downstream of WBIC 5013575			
Date Sampled	5/24/2023	6/19/2023	7/18/2023
Temperature (°F)	62.366	65.444	66.038
DO (mg/L)	9.79	13.54	9.02
pH	8.26	8.36	8.28
TSS (mg/L)	6.2	5.6	ND
TP (mg/L)	0.0267	0.0246	0.0124

Station #153160 FMP 1-Foot			
Date Sampled	6/14/2023	7/17/2023	8/16/2023
Temperature (°F	64.4	73.13	74.336
DO (mg/L)	8.49	12.75	8.34
pH	7.7	8.22	8.2
TSS (mg/L)	4	26.8	16
TP (mg/L)	0.0595	0.152	0.096
Chlorophyll-*a* (µg/L)	18.8	96.9	68.5
Total Kjeldahl N (mg/L)	1.24	-	-
Nitrate + Nitrite (mg/L)	0.682	-	-

Station #153160 FMP 3-Feet			
Date Sampled	6/14/2023	7/17/2023	8/16/2023
Temperature (°F)	62.96	76.46	74.084
DO (mg/L)	8.51	8.69	7.79
pH	8	8.24	8.16
TSS (mg/L)	4	24.0	16.6
TP (mg/L)	0.0606	0.119	0.0943
Chlorophyll-*a* (µg/L)	19.8	95.1	62.4
Total Kjeldahl N (mg/L)	1.25	-	-
Nitrate + Nitrite (mg/L)	0.776	-	-

Station #153160 FMP 5-Feet			
Date Sampled	6/14/2023	7/17/2023	8/16/2023
Temperature (°F)	62.78	76.30	70.7
DO (mg/L)	7.91	5.52	6.75
pH	8	8.19	7.43
TSS (mg/L)	6.2	34.8	20
TP (mg/L)	0.062	0.116	0.0931
Chlorophyll-*a* (µg/L)	28.5	97.5	70.3
Total Kjeldahl N (mg/L)	1.42	-	-
Nitrate + Nitrite (mg/L)	1.34	-	-

Station #153027 Ahnapee River at CTH J			
Date Sampled	5/24/2023	6/19/2023	7/18/2023
Temperature (°F)	66.56	71.96	77.774
DO (mg/L)	13.04	11.28	11
pH	8.66	8.69	8.33
TSS (mg/L)	8.6	ND	15
TP (mg/L)	0.0335	0.0467	0.108

APPENDIX B: Field Observations

5/4/20. Driftwood/Gate Issues. *Carp barrier should have been removed prior to drawdown. Drift wood plugged. Fish & Turtles were trapped, several fatalities.*

6/22/20. Driftwood/Gate Issues. *Gate to prevent turtle and fish issues with spillway carp guard. After approximately 4 days determined this was a bad idea as grass and algae accumulated and reduced the flow noticeably.*

7/17/20 & 7/20/20. Driftwood/Gate Issues. *Because a gate was not an option, carp barrier rebars removed.*

8/17/20. Driftwood/Gate Issues. *Driftwood needed daily inspections to maintain flow.*

8/21/20, 8/3/20. Maintenance. *Muck on rock light colored vs. adjacent muck. Prior to this, access to the basin was treacherous. After these dates, foot travel improved.*

3/8/21, 4/9/21. Maintenance & Community. *Dry Hydrant installed for fire assistance.*

5/13/20. The Unpleasant. *One of the first visuals of the cuttings of the stream channels.*

6/8/20. The Unpleasant. *Continued views of stream channels forming and abundant algae.*

6/17/20. The Unpleasant. *Continued views of stream channels forming and abundant algae.*

8/12/20 & 11/5/20. The Unpleasant. *Dead panfish and Salmon in spillway.*

3/19/21 & 3/26/21. The Unpleasant. *Young pike trapped below and dead pike in spillway.*

9/25/20 & 4/2/21. The Unpleasant. *Algae growth and a bare millpond.*

7/13/20. The Good. *Large flock of pelicans.*

7/13/20. The Good. *Caspian Terns.*

8/3/20. The Good. *Shore birds.*

8/17/20. The Good. *Heron, Snapping turtle.*

8/19/20. The Good. *Ducks*

8/26/20. The Good. *Bald Eagle.*

8/28/20. The Good. *Shorebird, Turtle.*

4/2/21. The Good. *Rainbow Trout.*

8/28/20. The Good. *Blue Heron.*

9/14/20. The Good. *Ducks.*

4/9/21. The Good. *Suckers.*

4/7/21. The Good. *Trout, suckers.*

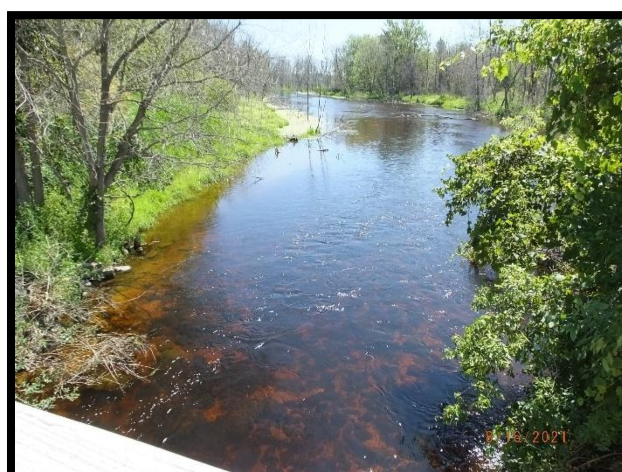
9/21/20. The Good. *Salmon.*

4/28/21. The Good. *Sandhill Cranes.*

6/2/21. The Good. *Trout above dam.*

6/7/21. The Good. *Compacted sediment*

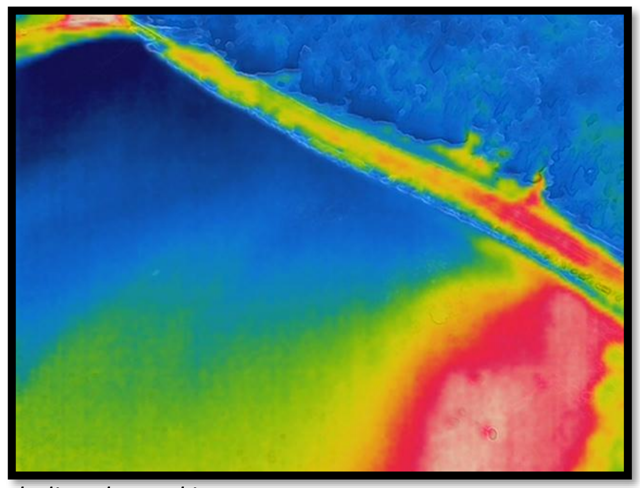
5/19/21. The Good. *Large Snapper.*



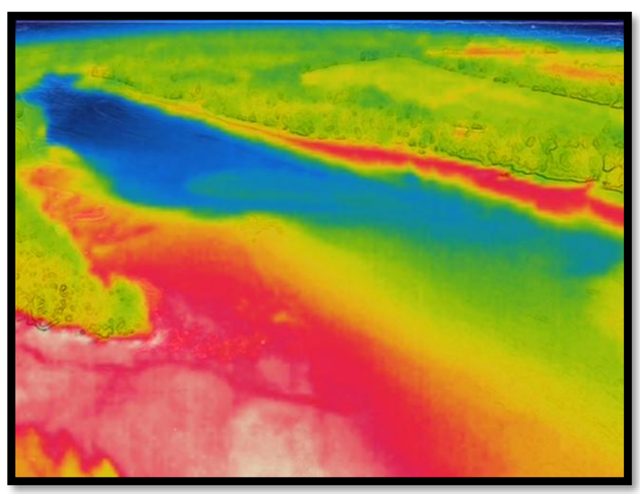
8/16/21. The Good. *Downstream at CTH J*

Drone Photos

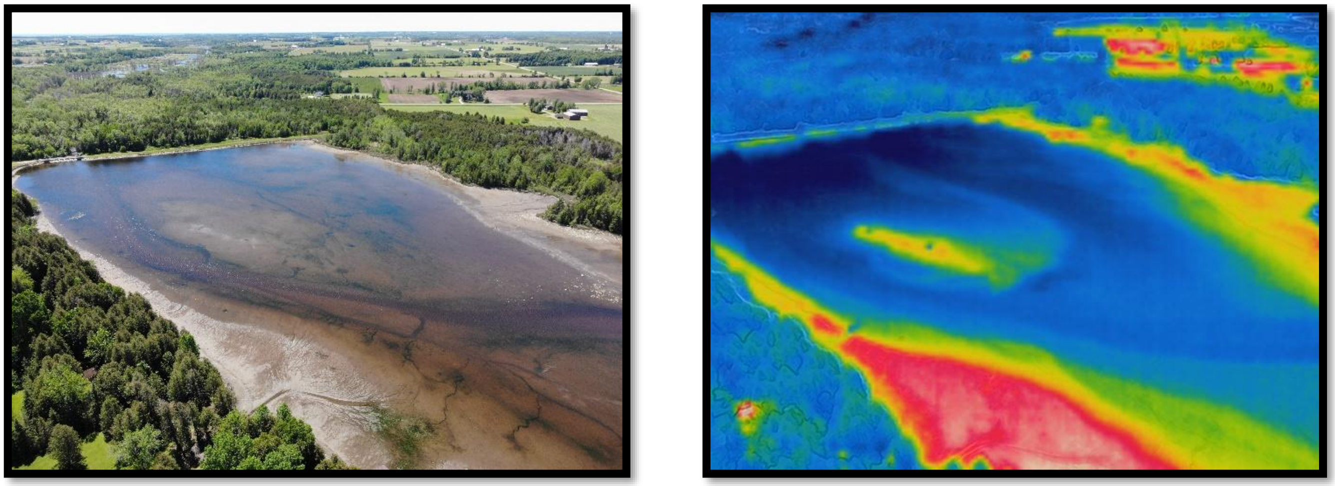
6/14/20. *Drone photo looking South towards the Dam.*



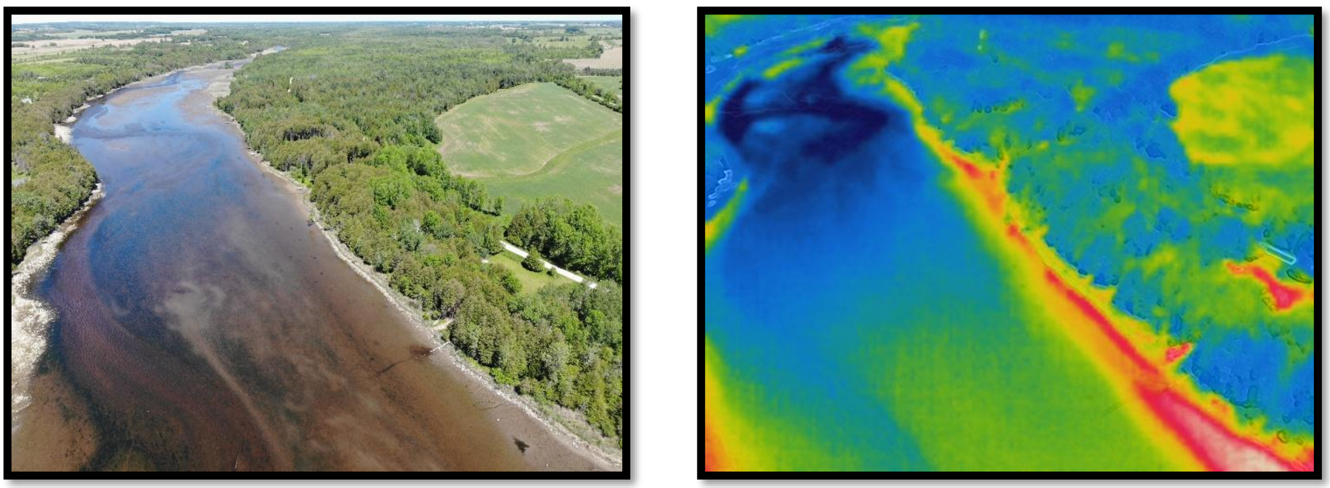
6/14/20. *Drone photo looking Southeast towards the Dam, including thermal imagery.*



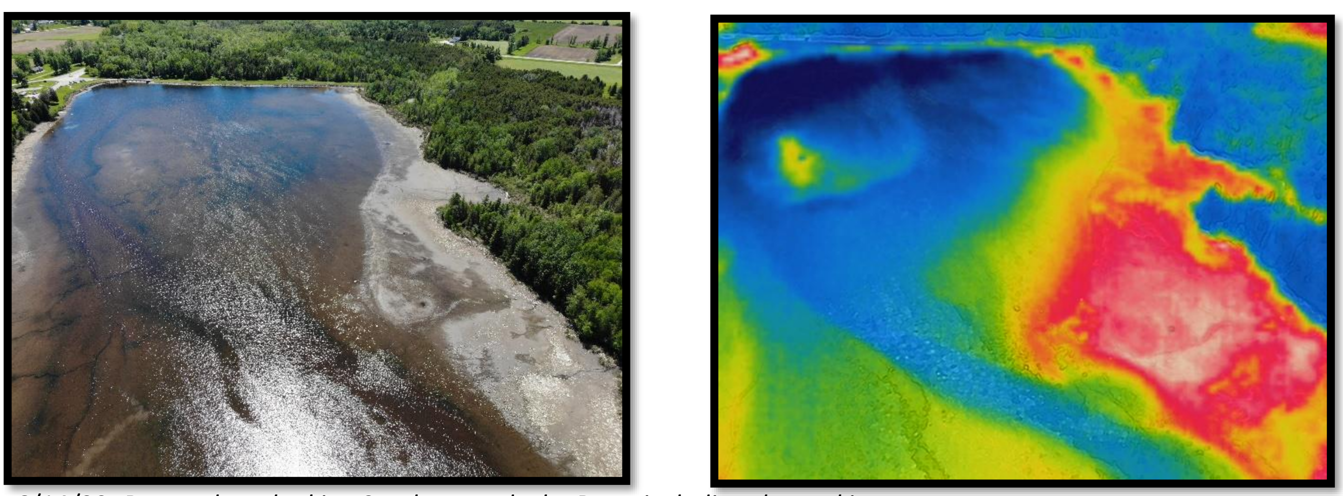
6/14/20. *Drone photo looking Northeast from the West end of the Dam, including thermal imagery.*



6/14/20. *Drone photo looking Southwest toward the Dam, including thermal imagery.*



6/14/20. *Drone photo looking North, including thermal imagery.*



6/14/20. *Drone photo looking South towards the Dam, including thermal imagery.*

6/14/20. *Drone imagery looking Northeast.*

6/14/20. *Drone imagery looking West/Northwest.*

APPENDIX C:

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

2024 Forestville Millpond Survey Summary, Door County

Draft Report Completed January 2025

Forestville Millpond (WBIC 95700) is a 65-acre impoundment of the Ahnapee River located in southern Door County. The Millpond has a maximum depth of 6 feet, an average depth of 2 feet and is in an agriculture dominated watershed (Door County SWCD 2018). Historically the fishery found in the Millpond has altered between a fishery dominated by northern pike, largemouth bass, yellow perch, black crappie, and bluegill to one dominated by bullhead and common carp (Lychwick 1984).

Records indicate that the first dam creating the Forestville Millpond was constructed in 1877 and the dam in its current form was reconstructed in 1982 (Door County SWCD 1996). Following reconstruction of the dam in 1982, WDNR chemically treated the millpond using rotenone to remove undesirable fish species and stock more desirable gamefish species (Lychwick 1984). Following the rotenone treatment, the millpond was restocked with largemouth Bass, smallmouth bass, muskellunge, and northern pike (Table 1). Initially the efforts appeared to be successful but high nutrient loads coupled with the shallow nature of the Millpond led to poor water quality and frequent winterkills affecting the fish community (Door County SWCD 1996). WDNR electrofishing surveys done in 2008 and 2016 indicated that largemouth bass, northern pike, and panfish were present but the fishery was dominated by common carp indicating that water quality may still have been an issue (Hogler 2008; Hogler 2016).

Table 1. Stocking summary for the Forestville Flowage, Door County from 1983 to 2024.

Stocking Year	Species	Age Class	No. Stocked	Avg. Length (in)
2022	BLUEGILL	LARGE FINGERLING	66,830	1
2022	LARGEMOUTH BASS	LARGE FINGERLING	2,339	2.7
2021	BLUEGILL	LARGE FINGERLING	46,960	0.75
2021	LARGEMOUTH BASS	LARGE FINGERLING	2,350	3.3
1993	LARGEMOUTH BASS	FINGERLING	7,000	1
1992	NORTHERN PIKE	FINGERLING	2,830	5.5
1992	LARGEMOUTH BASS	FINGERLING	3,250	1
1991	LARGEMOUTH BASS	FINGERLING	7,000	2
1991	NORTHERN PIKE	FINGERLING	360	7.9
1990	NORTHERN PIKE	FRY	100,000	1
1987	NORTHERN PIKE	FINGERLING	975	9
1986	NORTHERN PIKE	FINGERLING	325	9
1986	SMALLMOUTH BASS	FINGERLING	2,000	3
1985	MUSKELLUNGE	FRY	65,000	1
1985	LARGEMOUTH BASS	ADULT	20	12
1985	NORTHERN PIKE	FINGERLING	325	9
1983	NORTHERN PIKE	FINGERLING	375	11

In November 2019, a drawdown of the Forestville Millpond was initiated in an effort to increase water depth, control aquatic invasive plants, improve water quality, and reduce the common carp population. The Millpond was gradually filled beginning in September 2021.

During the falls of 2021 and 2022, the WDNR stocked largemouth bass and bluegill into the millpond in an effort to restore the fishery.

On May 8, 2024, the WDNR conducted an SE2 (spring electrofishing) survey on the Forestville Millpond. The goal of the survey was to assess the fish populations in the millpond with the primary objective of assessing bass and panfish populations. Using a boomshocker electrofishing boat the survey we surveyed 2 miles of shoreline at night. All fish that were encountered were netted except for common carp which were counted if the netters could touch the fish.

Largemouth Bass

Largemouth Bass were the most abundant gamefish species sampled from the Forestville Millpond in the 2024 survey. A total of 34 Largemouth Bass were captured (17.0/mi), ranging in length from 11.2 to 15.0 inches and averaging 13.0 inches (Figure 1). Nine of the bass sampled were greater than the 14-inch minimum size limit (26.5%). The 2024 catch rate (17.0/mi) increased from the 2016 survey (12.4/mi) but was less than the 2008 survey (24.4/mi) (Hogler 2008; Hogler 2016). The average length in the 2024 survey (13.0 inches) was less than the 2008 and 2016 surveys (14.2, 14.4 inches, respectively) (Hogler 2008; Hogler 2016). No largemouth bass recruitment was detected during the 2024 survey and the population is likely comprised of age-2 and age-3 fish that were stocked in 2021 and 2022 following the drawdown. The surveys in 2008 and 2016 also did a poor job of detecting largemouth bass recruitment in the Forestville Millpond but sampled bass from age-2 to age-8 (Hogler 2008; Hogler 2016). In this survey, the lack of recruitment may be a function of the relatively young population as age at maturity varies by waterbody, resource availability, and sex, however, previous surveys suggest that there may be bottleneck limiting largemouth bass recruitment in the Millpond (Hogler 2008; Hogler 2016). The stocked largemouth bass seem to be growing quite well. Future surveys will likely be a better index of recruitment and evaluation of the stocking efforts.

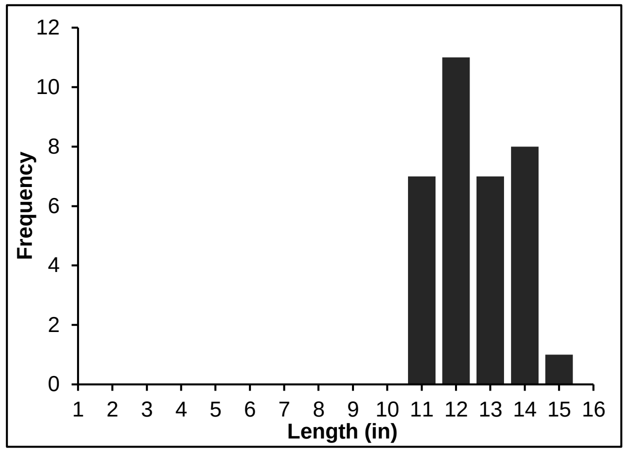


Figure 1. Length frequency of Largemouth Bass sampled from the Forestville Millpond in 2024.

Bluegill

Bluegill were the most abundant panfish species sampled from the Forestville Millpond. A total of 11 bluegills were captured (5.5/mi). Sampled bluegills ranged in length from 6.4 to 7.9 inches and averaged 7.3 inches (Figure 2). Of the Bluegills sampled, 100% were greater than 6.0 inches, and 64% were greater than 7.0 inches. The 2024 catch rate (5.5/mi) decreased from the 2016 survey (8.1/mi) but higher than the 2008 survey (2.1/mi) (Hogler 2008; Hogler 2016). The average length in the 2024 survey (7.3 in) was higher than the 2008 and 2016 surveys (4.7, 5.4 inches, respectively) (Hogler 2008; Hogler 2016). No bluegill recruitment was detected during the 2024 survey and the population is likely comprised of age-2 and age-3 fish that were stocked in 2021 and 2022 following the drawdown. While in low numbers, the surveys in 2008 and 2016 did indicate some level of recruitment with small fish being sampled (Hogler 2008; Hogler 2016). In this survey, the lack of recruitment may be a function of the relatively young population as age at maturity varies by waterbody, resource availability, and sex, however, previous surveys suggest that there may be bottleneck limiting bluegill recruitment in the Millpond (Hogler 2008; Hogler 2016). Bluegills were observed going through the spawning process in the Forestville Millpond in 2023. The stocked bluegills seem to be growing quite well. Future surveys will likely be a better index of recruitment and evaluation of the stocking efforts.

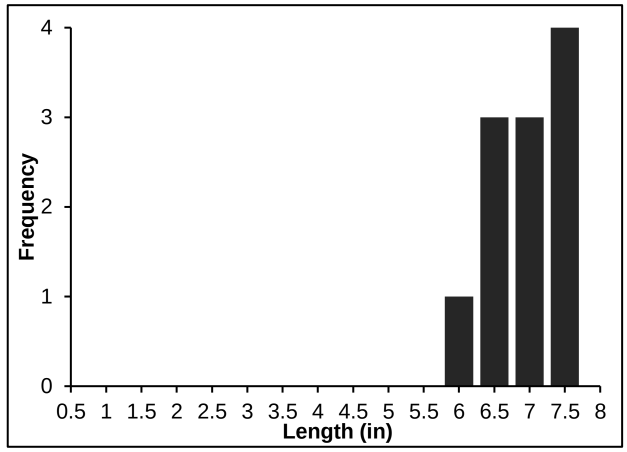


Figure 2. Length frequency of bluegills sampled from the Forestville Millpond in 2024.

Northen Pike

A total of 8 northern pike were sampled during the survey on the Forestville Millpond (4.0/mi). Sampled pike ranged in length from 18.7 to 24.0 inches and averaged 20.6 inches (Figure 2). There is no minimum length regulation for northern pike in the Forestville Millpond. The 2024 catch rate (4.0/mi) increased from the 2008 and 2016 surveys (1.7/mi, 1.7/mi, respectively) (Hogler 2008; Hogler 2016). The average length in the 2024 survey (20.6 inches) was less than the 2008 survey (22.2 inches) but higher than the 2016 survey (18.6 inches) and the length ranges sampled were similar among surveys (Hogler 2008; Hogler 2016). No northern pike were stocked in the Forestville Millpond following the drawdown.

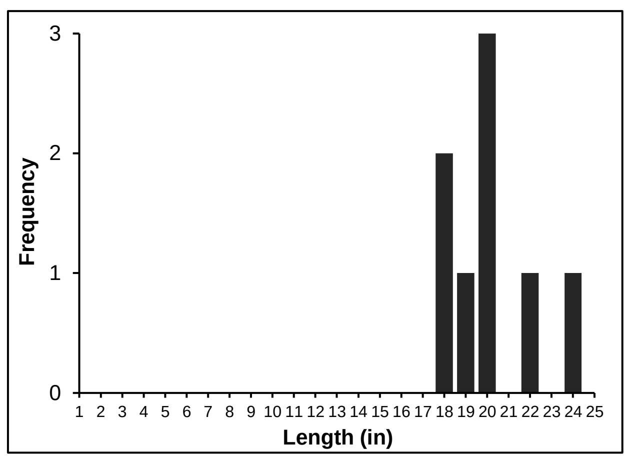


Figure 2. Length frequency of northern pike sampled from the Forestville Millpond in 2024.

Other Species
Like previous surveys that have been done on the Forestville Millpond, common carp continue to dominate the fish community (Hogler 2008; Hogler 2016). Common carp were not netted during the survey but were counted if netters could touch the fish. With >115 fish encountered (57.5/mi) and many more seen common carp were the most abundant species detected in our survey. Nearly all common carp encountered were relatively small with most ranging from 8 to 16 inches. No common carp were stocked in the Forestville Millpond following the drawdown.

One pumpkinseed and one common shiner were sampled during the 2024 survey.

References:
Door County SWCD. 1996. Final Report to the Wisconsin Lake Management Planning Grant for the Forestville Millpond. Door County Soil and Water Conservation Department. Sturgeon Bay, Wisconsin. 28 pages.

Door County SWCD. 2018. Final Report for Comprehensive Lake Management Planning Grant Project #LPL162317 Forestville Millpond. Door County Soil and Water Conservation Department. Sturgeon Bay, Wisconsin. 89 pages.

Hogler, S and S. Surendonk, 2008. 2008 Forestville Millpond Fish Survey Memo. Unpublished. Wisconsin Department of Natural Resources. Madison, WI. 6 pages.

Hogler, S and S. Surendonk, 2016. 2016 Forestville Millpond Fish Survey Memo. Unpublished. Wisconsin Department of Natural Resources. Madison, WI. 6 pages.

Lychwick, T. 1984. Chemical Rehabilitation of Forestville Millpond. Unpublished. Wisconsin Department of Natural Resources. Madison, WI. 10 pages.

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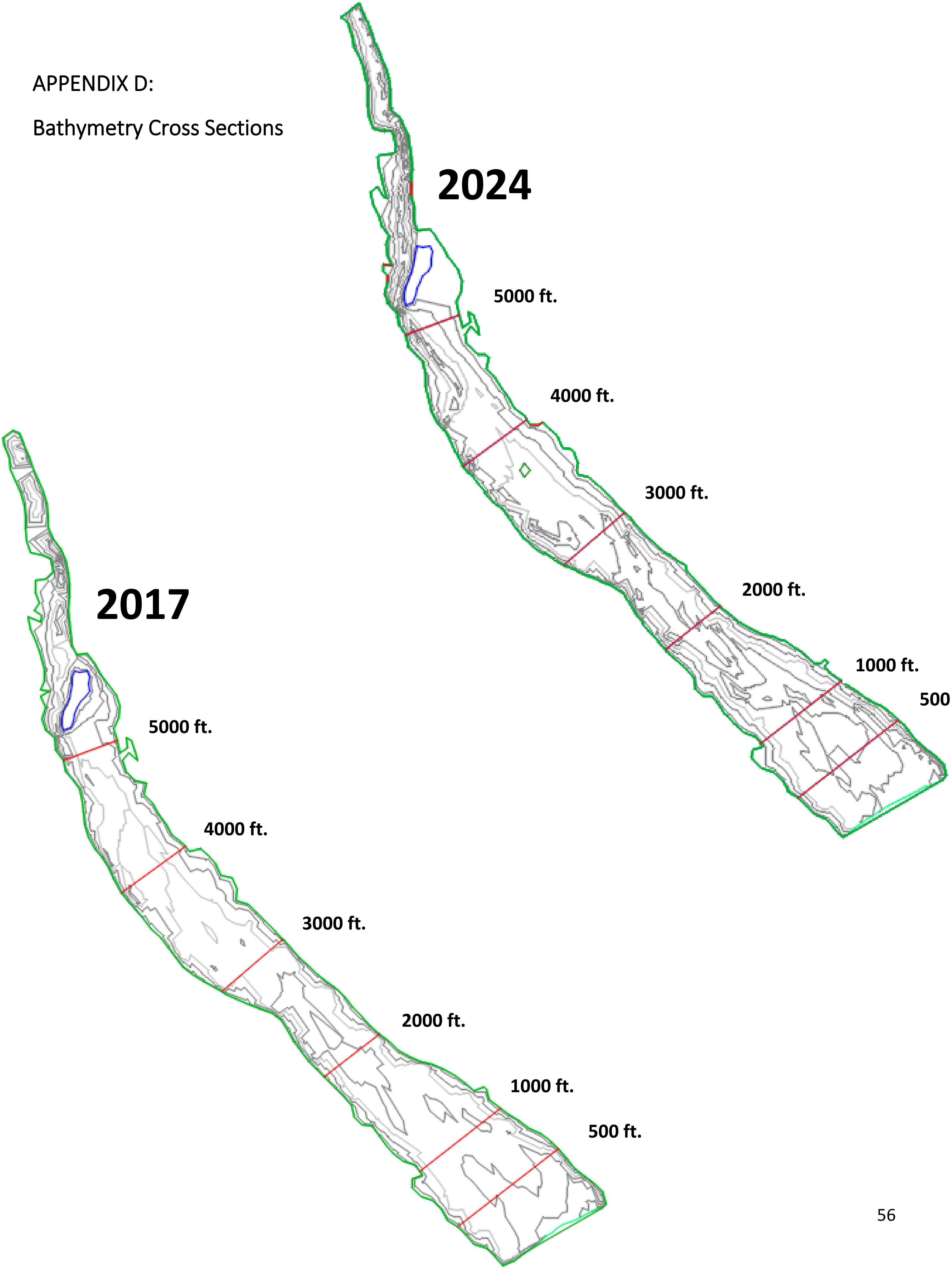
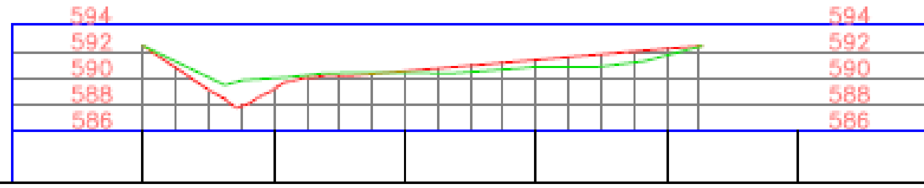
APPENDIX D:

Bathymetry Cross Sections



5000ft PROFILE



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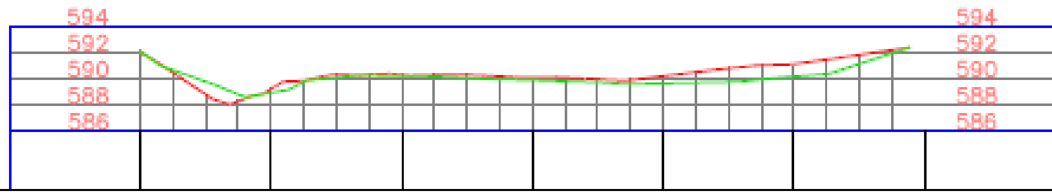

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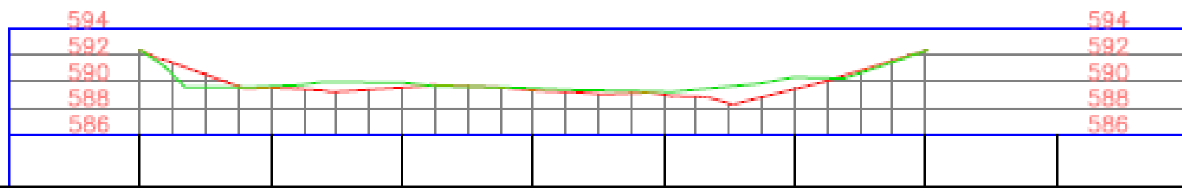

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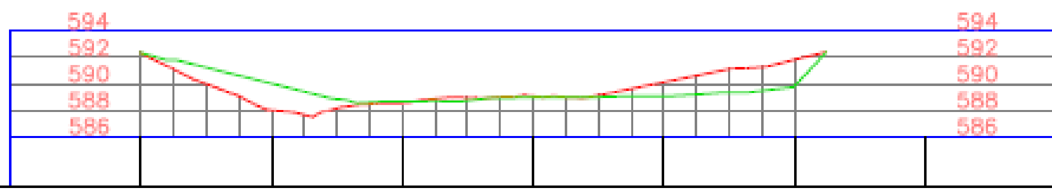

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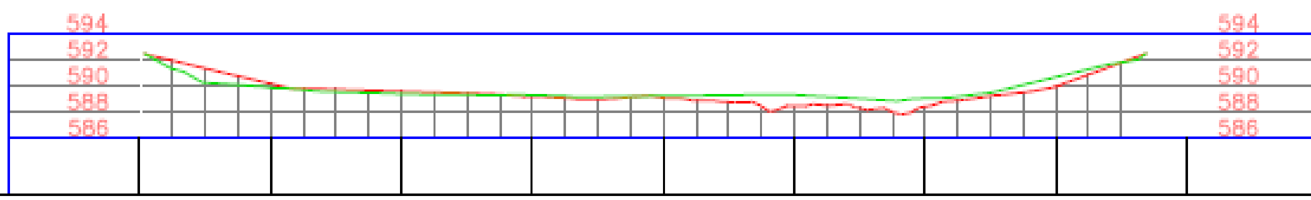
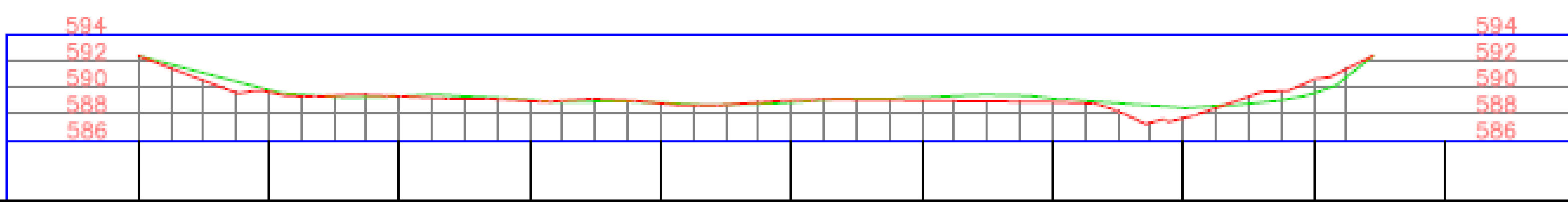
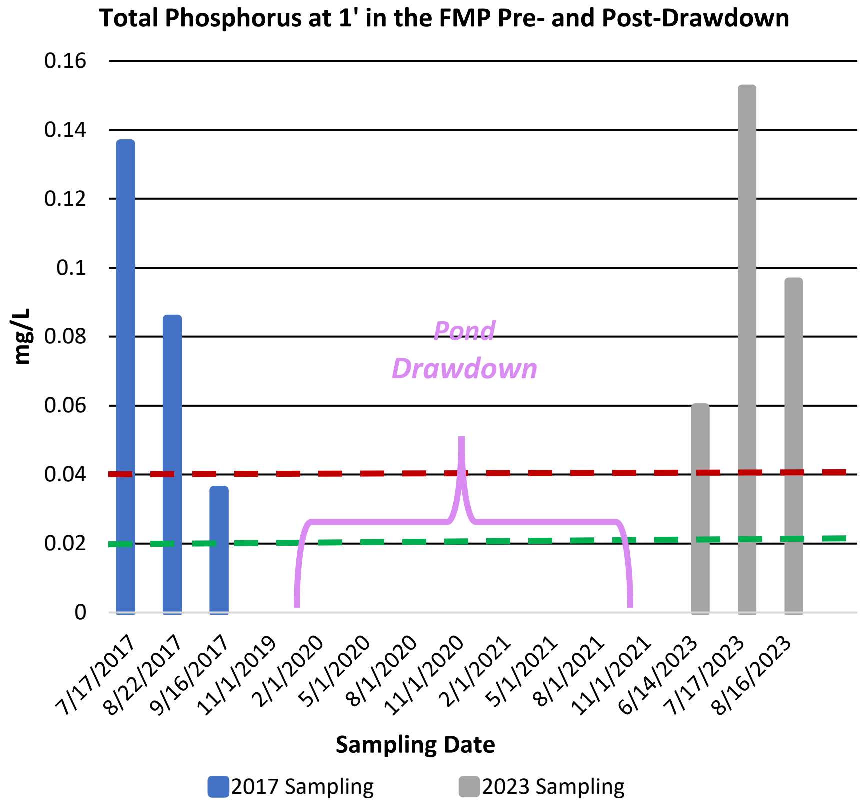
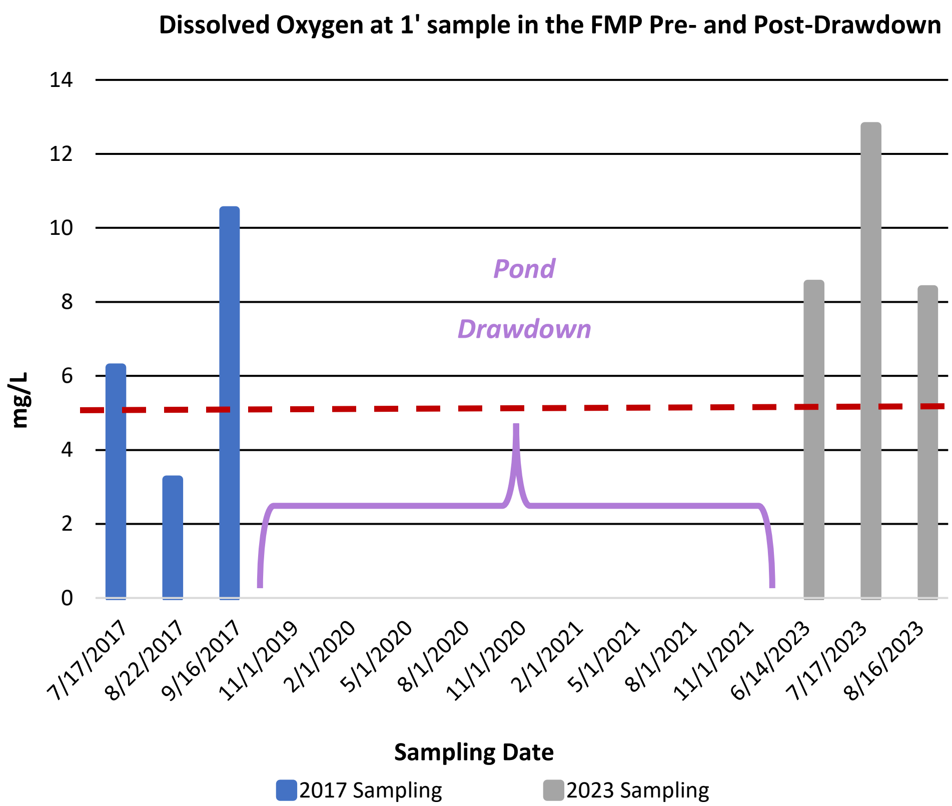


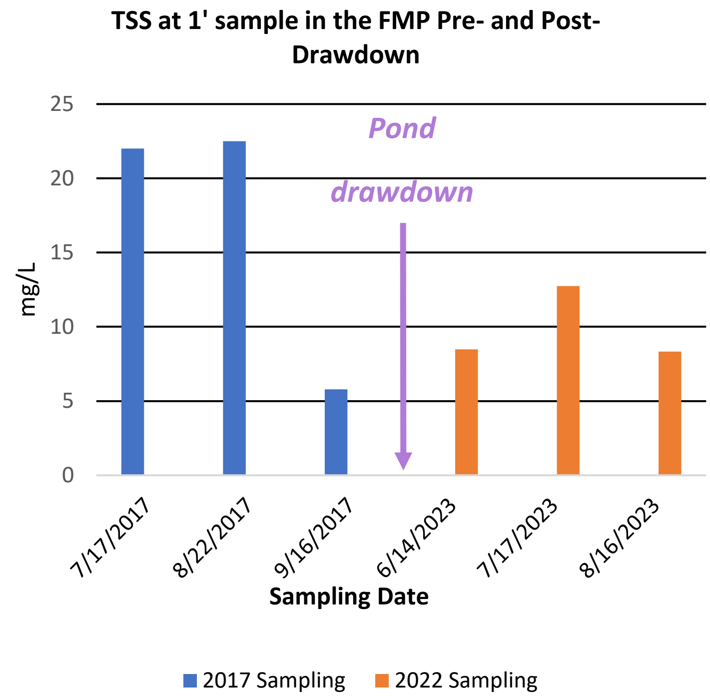
500ft PROFILE

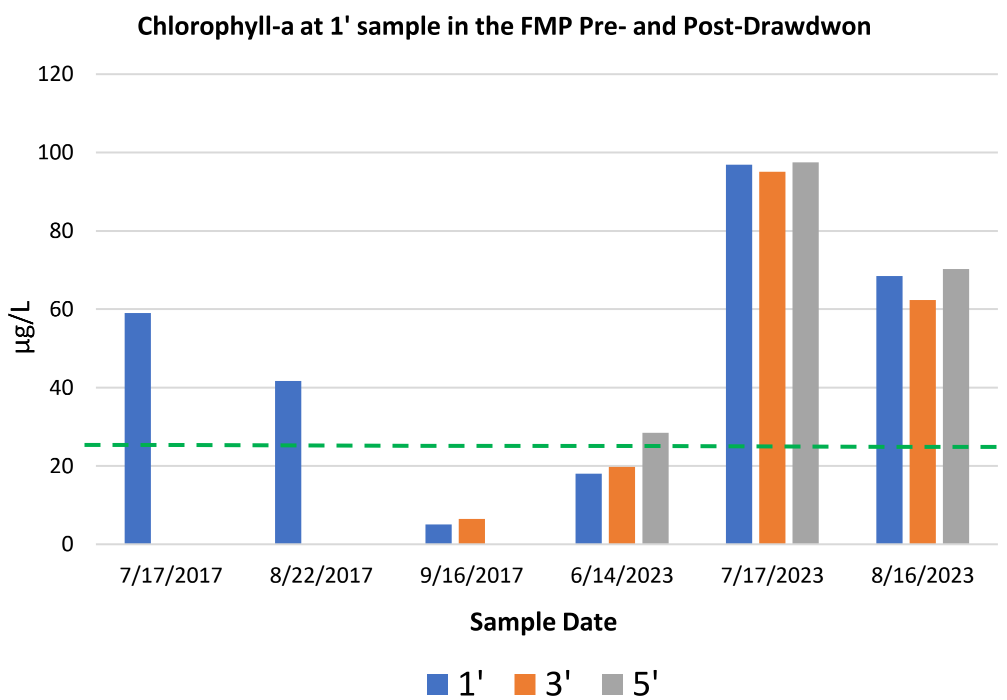


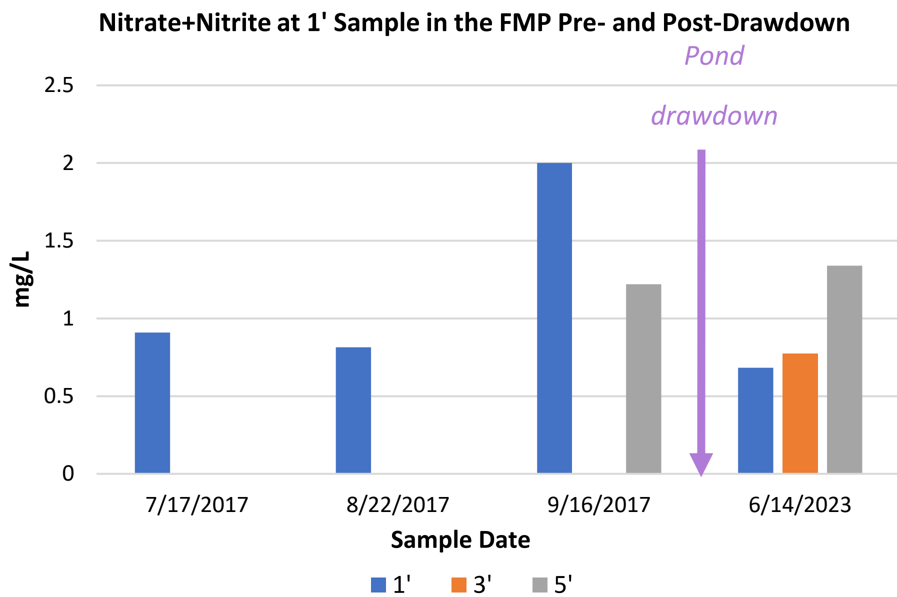
APPENDIX E: Data Comparisons



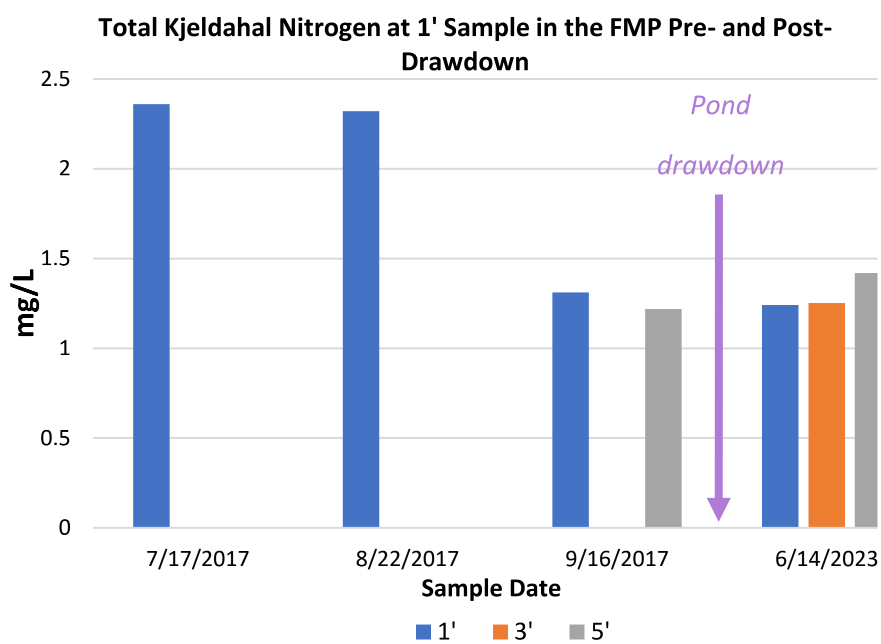



TSS at 1' sample in the FMP Pre- and Post-Drawdown
25
20
15
10
5
0
mg/L
Pond
drawdown
7/17/2017
8/22/2017
9/16/2017
6/14/2023
7/17/2023
8/16/2023
Sampling Date
2017 Sampling
2022 Sampling


Chlorophyll-a at 1' sample in the FMP Pre- and Post-Drawdwon
120
100
80
60
40
20
0
µg/L
7/17/2017
8/22/2017
9/16/2017
6/14/2023
7/17/2023
8/16/2023
Sample Date
1'
3'
5'



Nitrate+Nitrite at 1' Sample in the FMP Pre- and Post-Drawdown
Pond
drawdown
2.5
2
1.5
1
0.5
0
mg/L
7/17/2017
8/22/2017
9/16/2017
6/14/2023
Sample Date
1'
3'
5'



Total Kjeldahal Nitrogen at 1' Sample in the FMP Pre- and Post-Drawdown
Pond
drawdown
2.5
2
1.5
1
0.5
0
mg/L
7/17/2017
8/22/2017
9/16/2017
6/14/2023
Sample Date
1'
3'
5'

APPENDIX F: Forestville Millpond Drawdown Plan

Forestville Millpond Drawdown Plan

	Prep & Drawdown Summer/Fall 2019	Maintain Drawdown Fall 2019 to Fall 2021	Millpond Refill Fall 2021	Post Refill Activities 2021-2023
F&P Activities	Public communications - coordinate with Public Health, SWCD and DNR as necessary to ensure consistent and accurate messages	Public communications	Public communications	Public communications
	Sluice valve & safety preparations	Monitor sluice valve, at a minimum weekly	Refill per DNR recommendation to maintain at least 25% of the natural low flow of water downstream (Q7,10)	Funding for fish restocking (DNR &/or Private Hatcheries)
	Contact Miles Winkler, DNR prior to starting drawdown	Documentation: monthly photos	Contact Miles Winkler, DNR prior to starting refill	
	Commence drawdown November 1st at a rate not to exceed 3" per day	Document extent of pooling behind dam after large storm events	Target date to fill to capacity (October 1st) ~ Start September 1st per DNR recommendation	
	Photo and water level documentation daily until drawdown is complete	Construct any necessary dam improvements or repairs (e.g. safety cat walk)	Documentation: photo and water levels daily until refill is complete	
	Consider security camera	I.D. potential funding for private fish stocking		
	Coordinate with DNR Fisheries & Water Reg staff for carp barriers/control & permits			
SWCD/DNR Activitites	Install temporary carp barrier prior to drawdown - DNR Fisheries (Nick Legler) to develop plan for carp barrier & control and stocking recommendations	Carp control follow-up plan (nets, electro shock, barriers, etc). Request quotas for fish restocking in 2020 - DNR	Carp control efforts - DNR	Fish restocking species schedule - DNR
	Monitor each summer for riparian invasives and control (mechanical or herbicides) - SWCD	Monitor each summer for riparian invasives and control (mechanical or herbicides) - SWCD	Vegetation assessment by July 15 & identify preferred control method (spray, mow, burn or do nothing) and timing - SWCD	Monitor each summer for riparian invasives and control (mechanical or herbicides) - SWCD
	Visual monitoring of discharge water at beginning of drawdown - DNR	Identify funding for repeat monitoring of Millpond following refill - SWCD		Repeat monitoring of Millpond to evaluate changes since 2017. Bathymetric survey (2022 & 2023), Aquatic vegetation (2023), and Water Quality (2022 & 2023)
				Recommendation on native aquatic plantings (2022) - DNR