1.0 INTRODUCTION

The Tomahawk Lake System is a drainage system in Oneida County and are designated as a Statewide AIS Source Water (Figure 1.0-1). Tomahawk Lake and Little Tomahawk Lake are designated as Outstanding Resource Waters (ORW) by the Wisconsin Department of Natural Resources (WDNR). Over 900 waterfront parcels exist on these lakes and the system is an integral part of Oneida County's tourism trade.

The primary citizen-based organization leading management activities on the Tomahawk System is the Tomahawk Lake Association (TLA). EWM was first documented in 2003, with the TLA being formed in 2005 to lead management efforts towards this species.

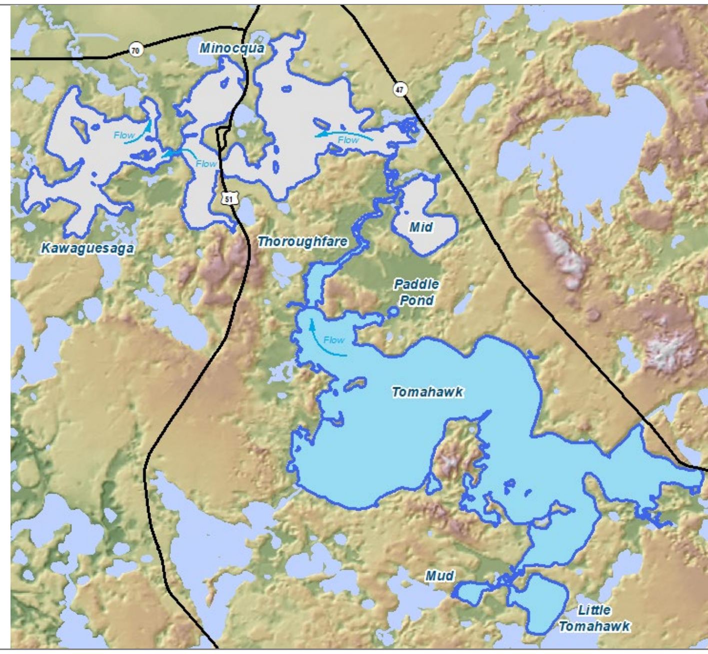


Figure 1.0-1. Tomahawk Lake System, Oneida County, Wisconsin.

1.1 Historic EWM Management & Planning

Targeted 2,4-D spot treatments occurred on the system from 2006-2016. In 2009, the TLA created a Hydraulic Conveyor System (HCS) which now falls into what is commonly called Diver Assisted Suction Harvesting (DASH). The HCS system has been operated on the Tomahawk Lake System from 2009 to 2021.

With changes in technologies and what is considered a *Best Management Practice* (BMP) for EWM management, the TLA investigated options outside of herbicide and manual removal efforts that may have more direct benefit with fewer potential unknown risks, such as targeted mechanical harvesting. During the spring of 2019, the TLA applied for a WDNR permit to conduct a mechanical harvesting trial in select parts of the system including Thoroughfare. The 2019 season was met with mechanical failures such that the TLA opted to rerun the trial again in 2020. Two days of mechanical harvesting were conducted in July 2020 on roughly 19 acres with monitoring showing that the EWM population within the site returned to pre-harvested levels by mid-September.

During the later-summer of 2021, the TLA worked with the local WDNR biologist (Scott Van Egeren) and Onterra to develop an adaptive management strategy that may be worthy of WDNR Control Grant funding. The TLA secured the maximum WDNR grant award allowed ($150,000) to fund a trial mechanical harvesting project in 2022 and 2023. Slightly larger equipment would be used as part of the 2022-2023 effort in which over 100 acres was preliminarily estimated to be targeted and monitored. This report is the second and final deliverable for the 2-year grant-funded project (ACEI-293-22).

During 2021-2022, the TLA created an updated *Aquatic Plant Management* (APM) Plan. While this project was focused on revisiting the TLA's aquatic plant management-related goals and actions, this document also incorporates aspects of shoreland condition and lake stewardship. The *APM Plan* was accepted by the WDNR in December 2022.

The *APM Plan* outlined several management goals, with specific actions outlined to assist with reaching each goal. In regards to EWM management, the TLA's defined goal is to:

Actively manage EWM to keep the population from negatively impacting recreation, navigation, and aesthetics

In order to reach this objective, the TLA has developed a multi-pronged approach as part of this Integrated Pest Management (IPM) Program.

- ***Mechanical Harvesting*** will be the primary EWM management tool. Much of the EWM footprint of EWM in the Tomahawk Lake System is in offshore and exposed areas where herbicide treatment is not likely to be effective. Building off what was learned in previous attempts, a more robust trial mechanical harvesting program started in 2022-2023 to continue to learn how to best implement this tool and develop success expectations.
- ***Herbicide Treatment*** will be integrated into the IPM Program after trials document its effectiveness. The first trial was designed to occur in spring 2023, occurring in areas of high likelihood of success and areas that are less compatible for mechanical harvesting, as they contain shallow water and/or docks and other obstacles.
- ***Hand-Harvesting*** using HCS/DASH will be reserved for requesting riparian at a local scale. The costs of the action will be the responsibility of the requesting riparian, with assistance on permitting from the TLA.

In addition to the 2022-2023 mechanical harvesting grant (ACEI-293-22), the TLA also secured a grant to fund a 2023 trial herbicide treatment (ACEI-312-23). These projects were designed to dovetail together, including having a single report of the project results to be released in quarter one of 2024. Therefore, this report satisfies the final deliverable of the 2-year mechanical harvesting project as well as the 2023 herbicide monitoring project.

1.2 2023 EWM Management Strategy

IPM Strategy: Mechanical Harvesting

Areas targeted for mechanical harvesting include areas within high riparian footprint and areas of local importance for recreation. During the winter prior to the 2022 field season, the TLA worked with Onterra and Aquatic Plant Management LLC to create a mechanical harvesting strategy based of the 2021 late-season EWM mapping survey, with attention to the development of a prioritization and efficiency strategy (Map 1). During 2022, Aquatic Plant Management completed around 90 days of mechanical harvesting between June and October, removing approximately 123,000 cubic feet of EWM from 36 predefined and prioritized locations. The 2023 mechanical harvesting strategy was planned to largely mirror the 2022 strategy, with a few modifications to the work areas based on proposed herbicide management and other factors influencing the prioritization of sites. An intentional aspect of the harvesting plan was to conduct significant amounts of harvesting time in late-summer as a means of achieving overall EWM reductions with potential benefits extending into the following spring.

IPM Strategy: Herbicide Spot Treatment

The mechanical harvesting contractor noted that the biggest obstacle to productivity was a few select colonies required a large amount of effort both for harvesting and for off-loading times. In order to make the mechanical harvesting program more productive, the TLA investigated adding herbicide management into their Integrated Pest Management (IPM) Program.

The TLA's preliminary herbicide treatment strategy for 2023 was to conduct ProcellaCOR spot treatments in two sites of the lake, consistent with what was outlined within the TLA's fall 2022 grant application (Map 2). Upon submitting the required WDNR permit application, WDNR fisheries managers raised concerns about treating areas of the lake that are important for walleye spawning. The WDNR offered the following commentary when denying approval of treatment site B-23 located within Pickeral Bay. The WDNR permitted site C-23 near the Lake Tomahawk boat landing.

> *DNR is taking the precautionary approach and has determined that treating area B-23 could potentially be detrimental to ongoing efforts to rehabilitate the lake walleye populations due to the treatment site proximity to known walleye spawning areas.*
>
> *Area B-23 has been denied this year given the poor status of walleye recruitment in the chain overall, the uncertainty about interactions between the herbicide and walleye larvae, and the potential for young of the year walleye to be predated after reduction or removal of their plant refuges. Other management techniques such as DASH and Mechanical harvesting could be utilized in place of herbicide to allow riparian access to open water.*

1.3 Pretreatment Confirmation and Refinement Survey

On June 12, an Onterra field survey crew completed the Pretreatment Confirmation and Refinement Survey within the single permitted 2023 treatment area on Tomahawk Lake. The main objective of the survey was to collect quantitative data within the site to document pretreatment native aquatic plant populations. Other tasks were to confirm active growth of EWM, evaluate the average depth of the site, and record pH and water temperatures. Water temperatures were 65.5°F throughout the water column, and pH was 8.4 at mid depth in the treatment area. The EWM population was largely present in the same areas documented in past mapping surveys and was green with plenty of active growth (Photo 1.3-1).

Photograph 1.3-1. EWM observed during 2023 Pre-Treatment Survey on Tomahawk Lake. Photo credit Onterra.

During the subsample point-intercept survey, EWM was present at 46/100 sampling points (46%). Common native plants included fern pondweed, coontail, common waterweed, and other pondweeds. The average depth of all 100 sampling points was determined to be 8.5 feet and was believed to be a more accurate reflection of the average depth of the treatment area compared to the 6. foot depth used in the preliminary strategy. Therefore, the final dosing strategy was adjusted, requiring additional herbicide product to meet the dosing target of 3.5 PDU's per acre-ft compared to the preliminary strategy. No changes were made to the application area extents. Map 2 displays the final strategy including the dosing on the embedded table.

With help from staff at Great Lakes Indian Fish & Wildlife Commission (GLIFWC) conveying when walleye were likely spawning on the system during the spring of 2023, it was extrapolated as to when walleye were likely to be largely past their most vulnerable life stage (first 14 day of larval stage) to extended exposure auxin use rates (Figure 1.3-1). With this information, the scheduled treatment date was planned to occur after June 11, 2023, the conservative date of when most of the hatched walleye would have progressed passed their most sensitive stages to auxin herbicides.

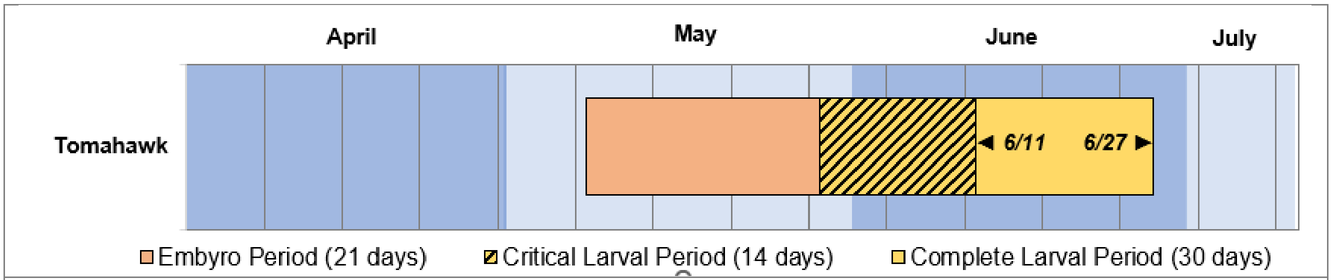


Figure 1.3-1. Sensitive stages of walleye to auxin herbicide exposure.

2.0 2023 AQUATIC PLANT MANAGEMENT ACTIVITIES

Herbicide Treatment:

The ProcellaCOR herbicide application were completed by Aquatic Plant Management, LLC on June 14, 2023. The application was completed under the supervision of representatives of WDNR and the Department of Agriculture, Trade and Consumer Protection (DATCP). The application was completed without issue and with ideal conditions present including modest winds of less than 3 mph.

Mechanical Harvesting:

The mechanical harvesting operations that took place during 2023 were similar to the 2022 program. A report issued by the harvesting contractor, Aquatic Plant Management, LLC, offers a summary of the 2023 activities including amount of time spent at each site, total number of harvesting cuts, and amount of EWM harvested (Appendix A).

Hand Harvesting/Diver Assisted Suction Harvest (DASH):

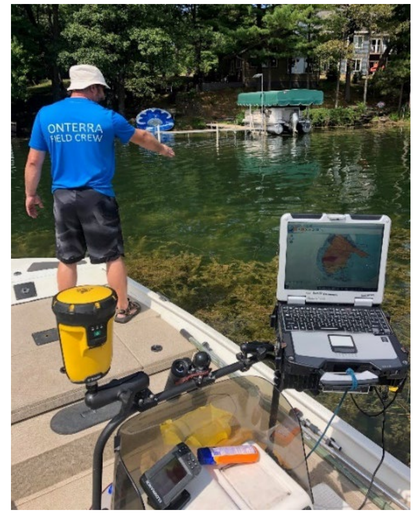
Nine riparian property owners utilized the DASH program during 2023 with the focus on removing EWM from near private piers, swim areas, and boat lifts. Additional use of DASH took place within shallow water and near shore locations within the mechanical harvesting site AF-22 where the mechanical harvester was not able to be used. In total, 897 cubic feet of EWM was harvested through the use of DASH during 2023. Additional details of the 2023 DASH operations are available within Appendix A.

3.0 2023 AQUATIC PLANT MONITORING RESULTS

It is important to note that two types of surveys are discussed in the subsequent materials: 1) point-intercept surveys and 2) EWM mapping surveys. The point-intercept survey provides a standardized way to gain quantitative information about a lake's aquatic plant population through visiting predetermined locations and using a rake sampler to identify all the plants at each location. The survey methodology allows comparisons to be made over time, as well as between lakes. The point-intercept survey can be applied at various scales. The point-intercept survey is most often applied at the whole-lake scale. The whole-lake point-intercept survey has been conducted Tomahawk Lake in 2007, 2014, and 2021.

If a smaller area is being studied, a modified and finer-scale point-intercept sampling grid may be needed to produce a sufficient number of sampling points for comparison purposes. The subsample point-intercept survey methodology is often applied over management areas such as herbicide application sites. This type of sampling is used within this project as a part of the mechanical harvesting and herbicide spot treatment pre/post monitoring.

While the point-intercept survey is a valuable tool to understand the overall plant population of a lake, it does not offer a full account (census) of where a particular species exists in the lake. During the EWM mapping survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photograph 3.0-1). Field crews supplement the visual survey by deploying a submersible camera along with periodically doing rake tows. The EWM population is mapped using sub-meter GPS technology by using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and are qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques were applied to AIS locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.



Photograph 3.0-1. EWM mapping survey. Photo credit Onterra.

Overall, each survey has its strengths and weaknesses, which is why both are utilized in different ways as part of this project.

3.1 Herbicide Concentration Monitoring

The herbicide concentration monitoring plan associated with the treatment was developed by Onterra and the WDNR, with the intent of gaining sufficient data to aid in understanding the concentrations of florpyrauxifen-benzyl and florpyrauxifen acid that were achieved in the hours and days after treatment. A copy of the final herbicide concentration monitoring plan is included as Appendix B. Water samples were collected by volunteer members of the TLA and upon completion of the sampling, were shipped to EPL Bio Analytical Services in Illinois for analysis. This lab was identified by the WDNR as being able to detect florpyrauxifen-benzyl at below 1 part per billion (ppb). The EPL Lab reports the concentration in parts per billion (ppb) of the initial parent active ingredient in ProcellaCOR™ (florpyrauxifen-benzyl), as well as an acid metabolite (florpyrauxifen acid) which is the immediate by-product that it breaks down into.

The measured concentrations of florpyrauxifen-benzyl were higher in site T2 compared to T1, but both contained concentrations of the active ingredient in ProcellaCOR at sufficient concentrations and exposure times to kill EWM. While both sampling locations were within the direct herbicide application area, site T2 was placed in a broader section of the site compared to a comparatively narrower portion of the application area at site T1 which may have been a factor the resulted in higher measured concentrations from the site in a broader area of the treated site. The highest measured concentration was recorded at 3 HAT from site T2 and was near 3.1 ppb. For reference, the herbicide application rate in the site of 3.5 PDU's equates to approximately 6.741 ppb. It is typical for measured concentrations to fall below application rates as the herbicide dissipates out of the site, as well as being absorbed by aquatic plants and converted to florpyrauxifen acid.

Site T3 was placed approximately 600 meters west of the application area near the center of the large semi-defined basin of the lake in an effort to understand whether herbicide mixed within a larger area of the lake after treatment. It as anticipated that EWM control would expend outward from the application area, but it was unclear if that would be limited to the small bay where the treatment took place, or the larger bay where T3 was placed in the center of. Of the four sampling intervals during which samples were collected at site T3, only the 4 DAT interval contained detectable levels of florpyrauxifen-benzyl (0.104 ppb). At 4 DAT, the levels measured at T3 were approaching, but slightly lower than, the concentrations measured from samples located in the application area. This indicates that herbicide likely did not mix uniformly through this relatively large area of the lake, but was present within a portion of the lake outside of the application area. Florpyrauxifen-benzyl was below detection limits in the application area by 7 DAT, and was not detected from samples collected at 14 DAT or 21 DAT at site T3.

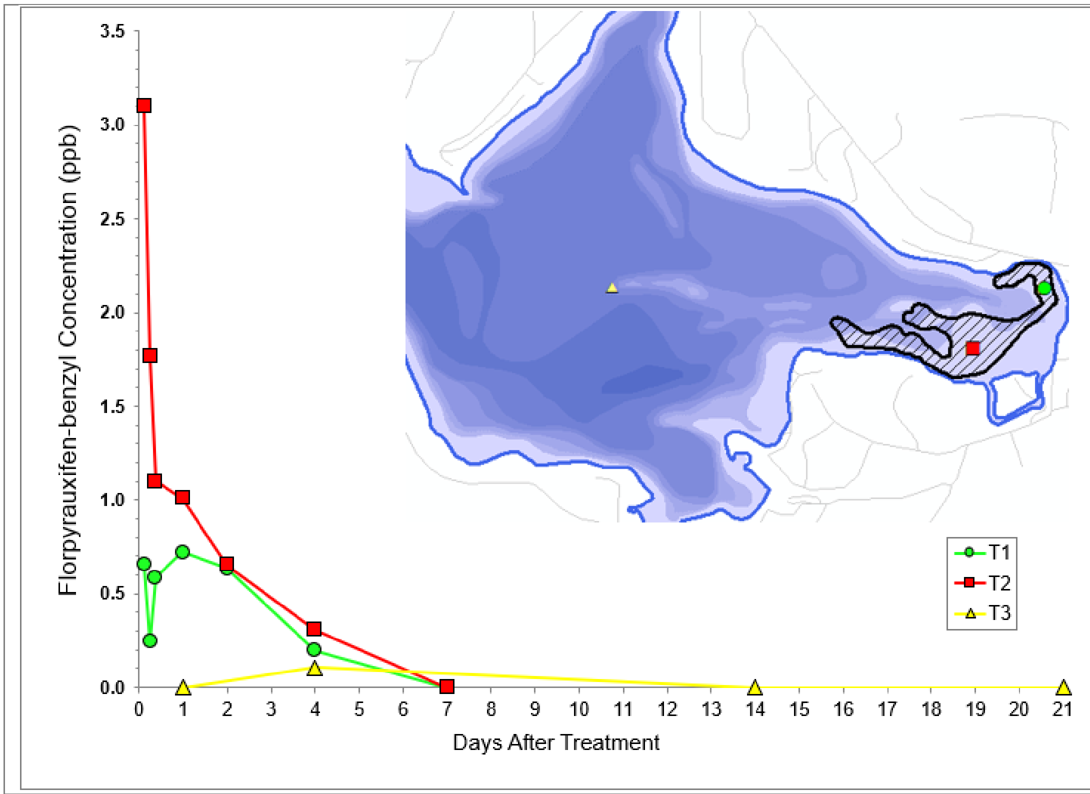


Figure 3.1-1. Florpyrauxifen-benzyl concentrations associated with a 2023 treatment in Tomahawk Lake. Herbicide application area shown in black hashed area.

Figure 3.1-2 displays the concentrations of acid metabolite of ProcellaCOR, florpyrauxifen acid. Note that the y-axis differs compared to the previous figure in order to display the values. Florpyrauxifen acid concentrations were also initially higher at site T2 compared to T1 in samples collected through 1 DAT. By 2 DAT, concentrations were similar between T1 and T2 at approximately 0.3-0.4 ppb and were each between 0.2-0.3 ppb by 4 DAT. Florpyrauxifen acid was detectable at 7 DAT from site T2 but was not detected in T1. Similar to the florpyrauxifen-benzyl concentrations, acid was only detected at site T3 during one sampling interval at 4 DAT with a concentration of approximately 0.1 ppb. With the concentration measuring lower at T3 at 4 DAT compared to samples from the application area, uniform mixing may not have occurred within a larger portion of the lake. Concentrations were below detection limits in samples collected at 14 DAT and 21 DAT from site T3.

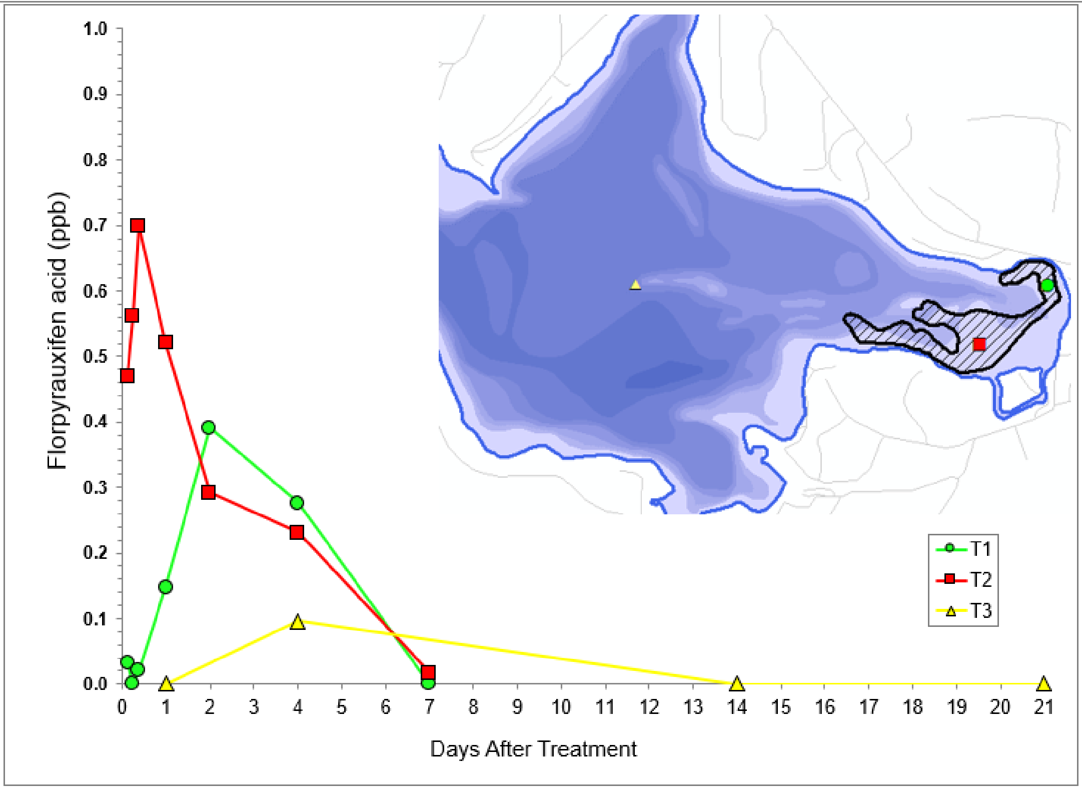


Figure 3.1-2. Florpyrauxifen acid concentrations after a 2023 treatment in Tomahawk Lake. Herbicide application area shown in black hashed area.

3.2 Subsample Point-Intercept Survey

Mechanical Harvesting Sites

A quantitative monitoring plan was created for this project in which a total of 342 sub-sample point-intercept sampling locations were contained within six of the mechanical harvest areas and 45 were placed within an un-targeted control site (Map 3). The quantitative assessment would be completed through the comparison of the sub point-intercept survey from June 2022 (*prior to harvesting*), late-season 2022 (*after 1 harvest season*), and late-season 2023 (*after 2 harvest seasons*). This will allow an understanding of how native and non-native plant populations are impacted by the mechanical harvesting effort. It is acknowledged that the timing of the first survey in this dataset was such that some native species may not have fully emerged from winter dormancy and may be underrepresented. Wild celery (*Vallisneria americana*) is amongst the species likely underrepresented in a June survey, while almost any other species including EWM, would also be expected to increase in occurrence as the growing season progresses beyond the month of June.

The results of the entire aquatic plant populations within each of the six harvested sites and the control site are shown in the subsequent figures.

Control Site: Within the control site, the occurrence of EWM increased between each of the three surveys with the September 2023 occurrence being statistically greater than the June 2022 survey (Figure 3.2-1). The occurrence of southern naiad and wild celery were statistically higher than the June 2022 survey in both of the September surveys. No species showed a statistically valid decrease in occurrence in the control site when comparing either of the September surveys to the June 2022 survey.

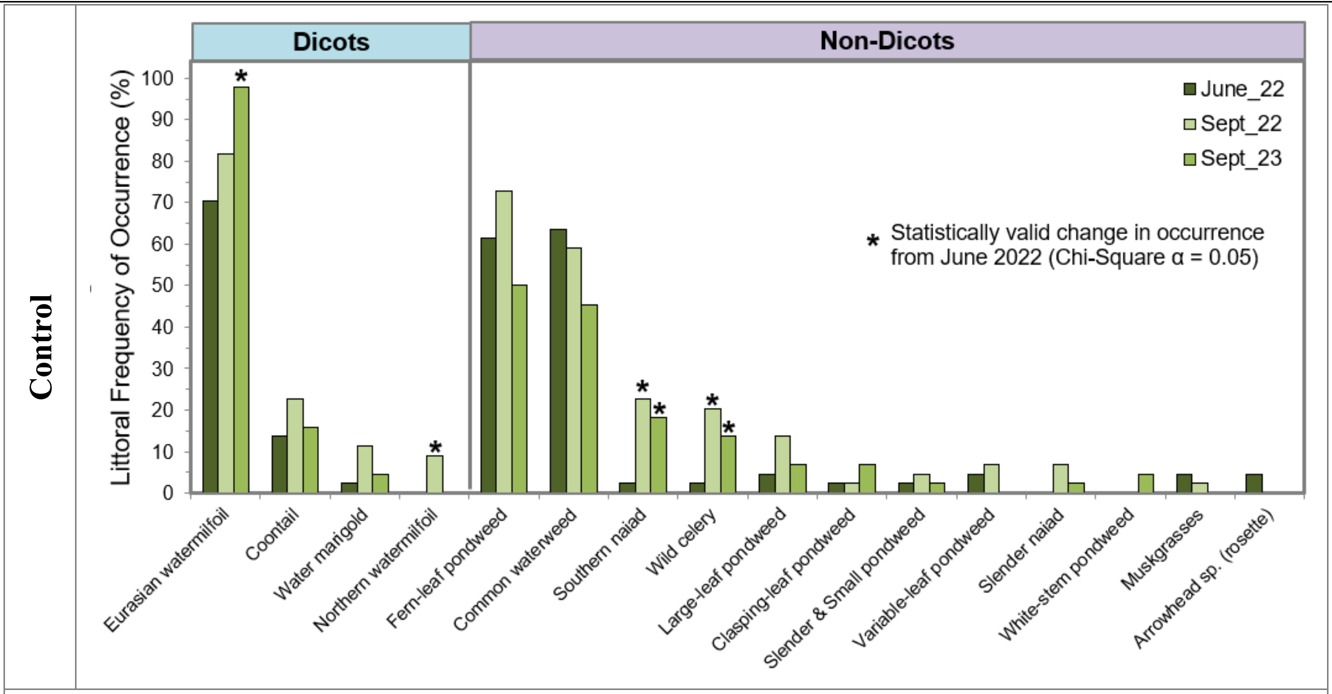


Figure 3.2-1. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in Control Site in Tomahawk Lake. n=45.

<u>Site AB-22:</u> Within site AB-22, seven native aquatic plant species showed statistically valid increases in occurrence compared to the pre-harvesting survey conducted in June 2022 (Figure 3.2-2). The occurrence of EWM was not statistically different during the study period with all surveys indicating an occurrence of over 70%. Northern watermilfoil was the only species that showed a statistically valid decrease in occurrence when comparing the September 2023 survey to the June 2022 survey.

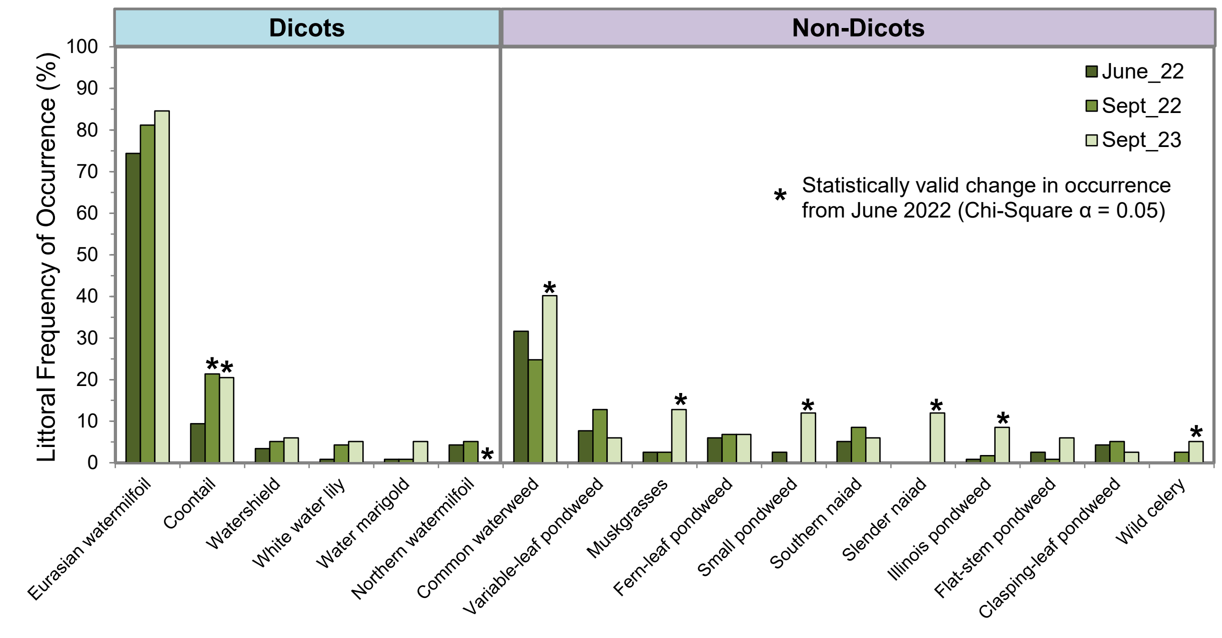
<u>Site AC-22:</u> In site AC-22, southern naiad was the only native species to show a valid increase in occurrence while most species did not exhibit valid changes in occurrence (Figure 3.2-2). Coontail and northern watermilfoil each showed statistically valid decreases in occurrence when comparing the September surveys to the pre-harvesting survey from June 2022. The occurrence of EWM was statistically higher in both September surveys when compared to the pre-harvesting survey.

<u>Site AE-22:</u> In site AE-22, four native species exhibited statistically valid decreases in occurrence during the study period including northern watermilfoil, common waterweed, wild celery, and variable-leaf pondweed (Figure 3.2-3). Three native species showed statistically valid increases in occurrence during the same timeframe including southern naiad, flat-stem pondweed, and fern-leaf pondweed. Several other species present in the site did not show valid changes in occurrence.

<u>Site AH-22:</u> From site AH-22, two native species showed statistically valid decreases in occurrence during the period of study including northern watermilfoil and water stargrass. Similar to the control site, both wild celery and southern naiad were statistically higher in each September survey when compared to the pre-harvesting survey from June 2022. Most of the native species present in the site did not show statistically valid changes in occurrence over the study period.

<u>Site I-22:</u> In site I-22, variable-leaf pondweed and common waterweed exhibited statistically valid increases in occurrence while no species showed valid decreases in occurrence. The occurrence of EWM remained above 90% in each survey.

AB-22



AC-22

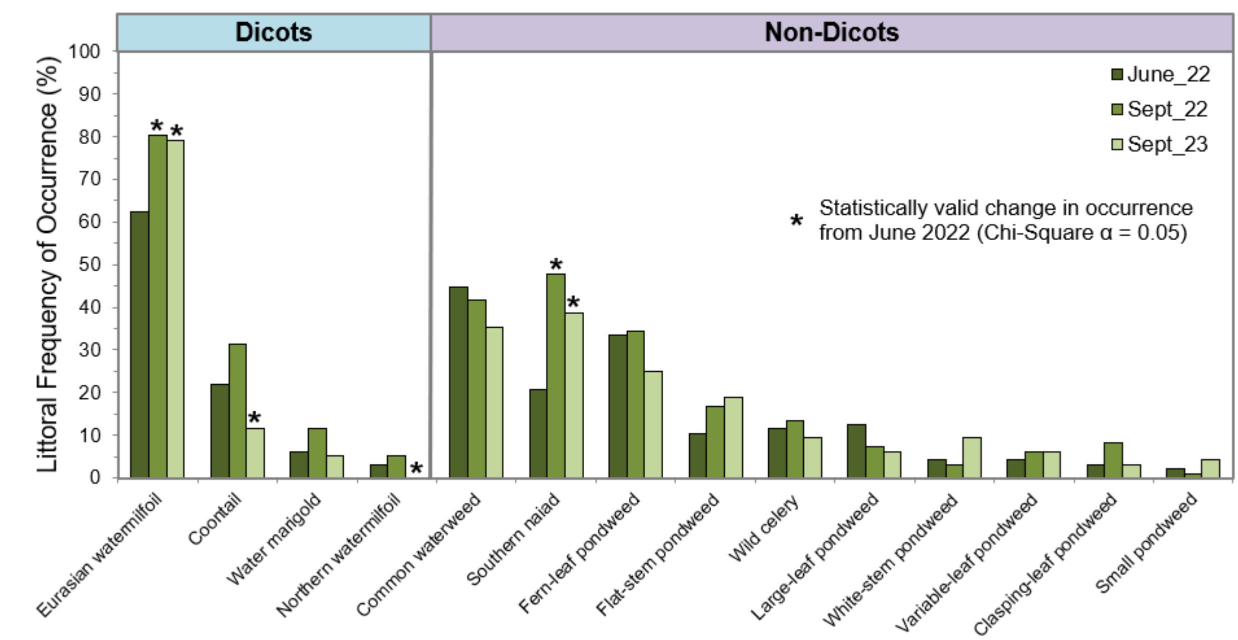
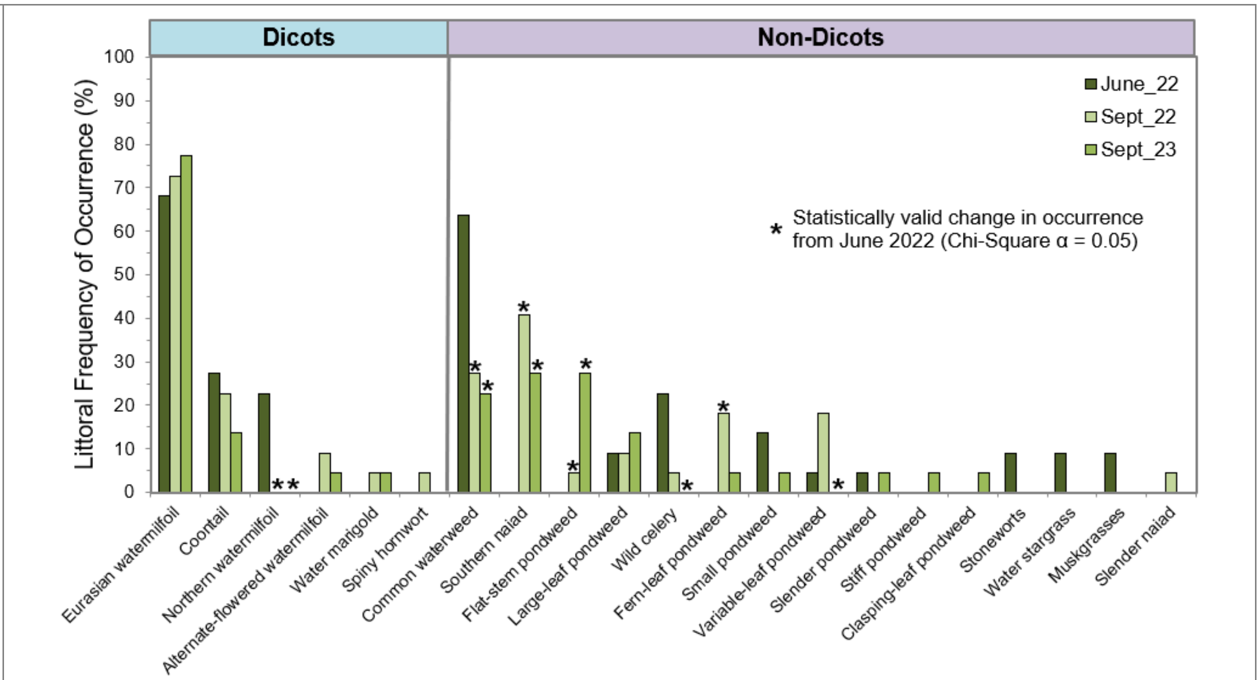


Figure 3.2-2. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in Tomahawk Lake. AB-22 n=125, EC-22 n=97.

AE-22



AH-22

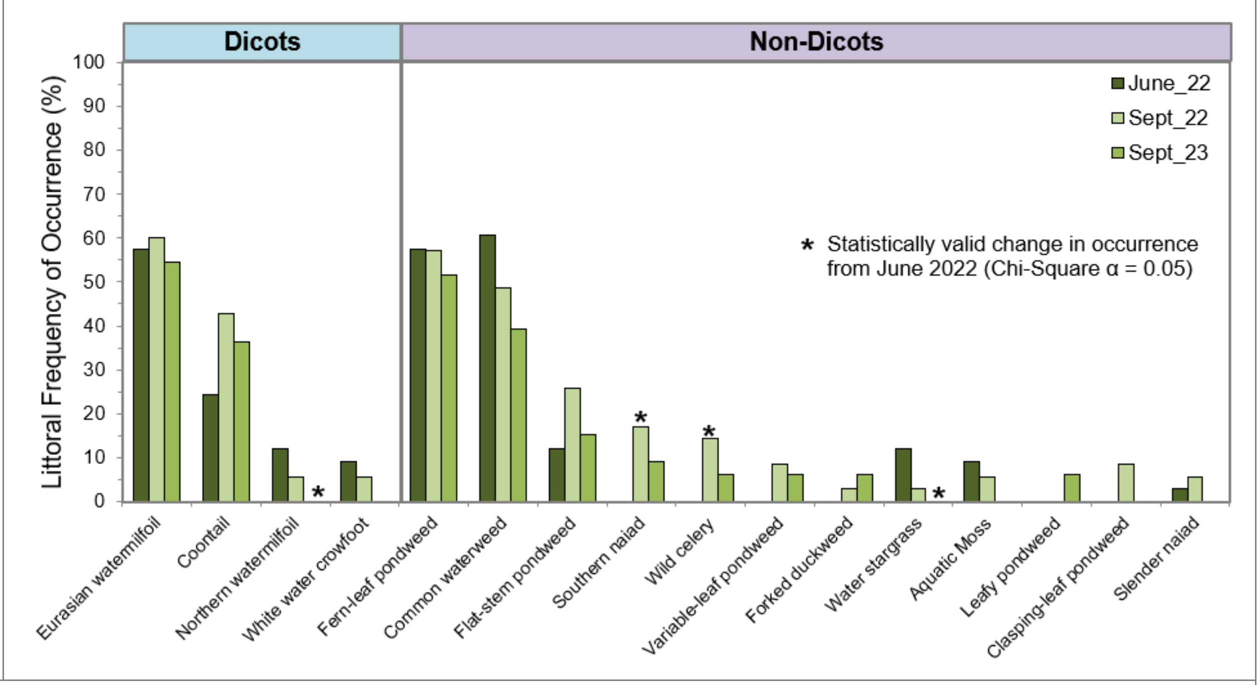


Figure 3.2-3. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in Tomahawk Lake. AE-22 n=22, AH-22 n=35.

I-22

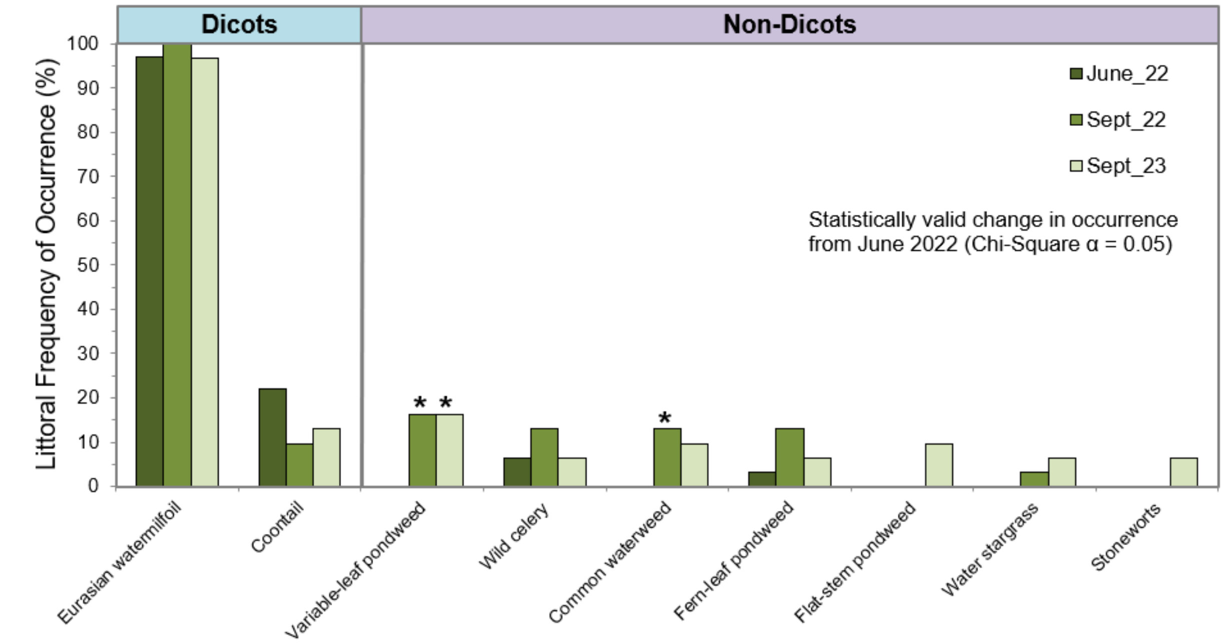


Figure 3.2-4. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in site I-22 in Tomahawk Lake.

Figure 3.2-5 explores the total rake fullness ratings and littoral frequency of occurrence of EWM from each of the mechanical harvesting sites. The control site indicated an increasing trend in EWM occurrence over time with a fairly consistent ratio of each of the three rake fullness ratings. Site AB-22 showed consistent total rake fullness ratings in each survey with approximately the same ratio of each rake fullness rating and largely mirrored the control site. This site saw 12.4 hours of mechanical harvesting during August 2023.

Interestingly, sites AC-22, AE-22, AH-22 and I-22 showed fewer rake fullness ratings of 3 in the September 2023 survey as compared to the September 2022 survey. This would indicate that less EWM biomass may have been present in these sites in 2023, although EWM was still present at around the same occurrence. Site M-22 was not assessed in the same manner during 2023 as the site was located within the direct 2023 herbicide application area.

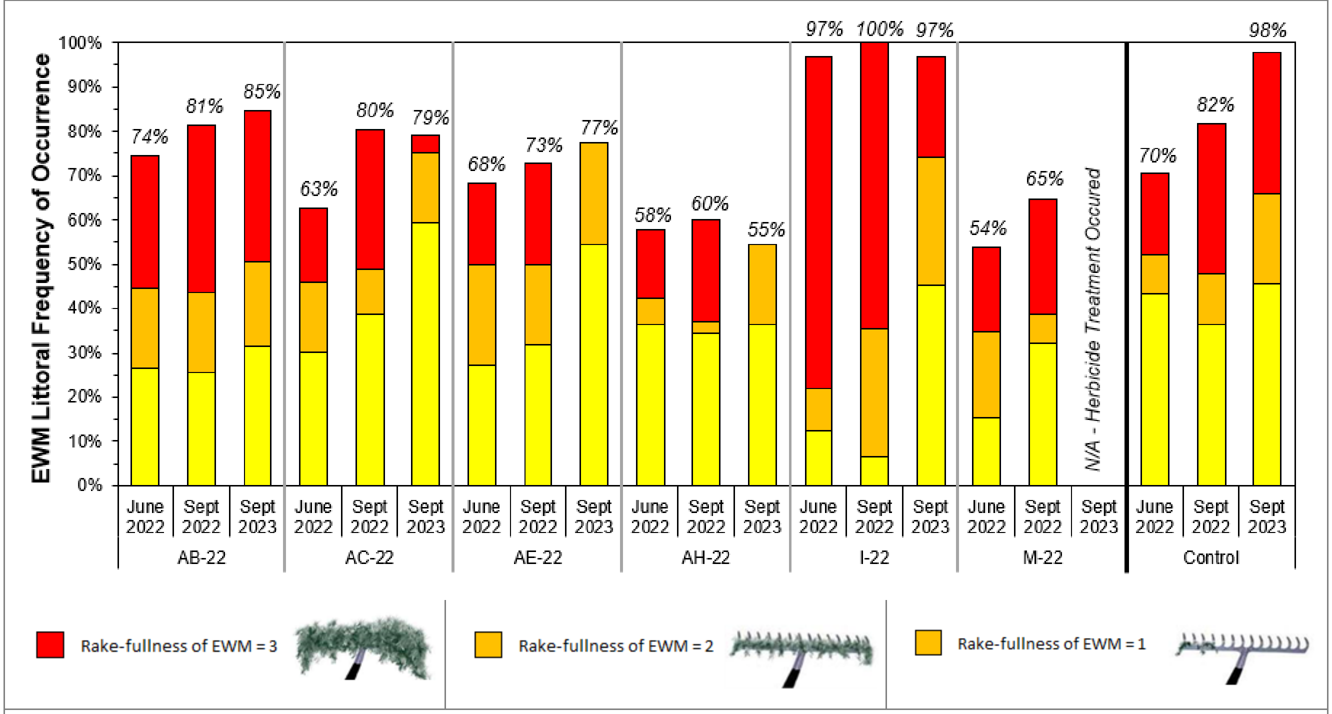


Figure 3.2-5. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in site I-22 in Tomahawk Lake.

Volunteer-Based EWM Regrowth Monitoring

A pilot program was initiated in 2021, where volunteers were provided a 6-ft graduated PVC pipe to measure the distance from the top of the EWM plants to the surface of the lake. During this project, volunteers would collect data from multiple predefined sites per harvesting plot at different time intervals. The logistics of implementing this monitoring were challenging for the TLA. Recently cut plants were difficult to measure, especially those that were cut to 6 feet deep.

Ultimately, the data that was collected in 2022 allowed an understanding of EWM re-growth over time at five locations in roughly mid-July. The data indicate that EWM grew an average of just over a foot a week. Additional efforts in 2023 were aimed at gathering more overall data, perhaps allowing the ability to query aspects such as time of year, impacts of multiple cut events, etc.

During the 2023 monitoring, a volunteer collected data approximately weekly from two sites during mid-June through early-August. One site that was studied was identified as site N-22 and was located just west of the 2023 ProcellaCOR treatment area. The volunteer noted that the EWM was 4-feet below the surface on June 19, and none could be found one week later on June 26. This corresponds with the timing of the herbicide application which took place on June 14. This site was subsequently removed from the regrowth monitoring study.

The other site that was monitored in this way (O-22) showed progressive growth over the course of time with the colony measuring 3 feet below the water surface on June 19, 2 feet below on June 26, 1.5 feet below on July 6, 0.5-1.0 below the surface on July 17, 0.5 or less feet below surface on July 25, and surface matted on August 5. The site was harvested on August 8, and no subsequent measurements were recorded after that date while visual observations indicated the colony remained well below the surface until another harvesting session occurred in early-October.

ProcellaCOR Herbicide Treatment Site C-23

The quantitative monitoring plan associated with the 2023 ProcellaCOR treatment site consists of replicate subsample point-intercept surveys collected before (June 2023) and after (September 2023) treatment. Another replication is planned for the *year after treatment* for approximately September 2024. A total of 100 sampling locations were included in the study with a spacing of 25 meters apart. All points were located within the direct herbicide application area (Figure 3.2-6). The pretreatment survey documented EWM on 46/100 points or 46%, while EWM was present at 1 point in the post-treatment survey, which represents a statistically valid 97.8% decrease in occurrence.

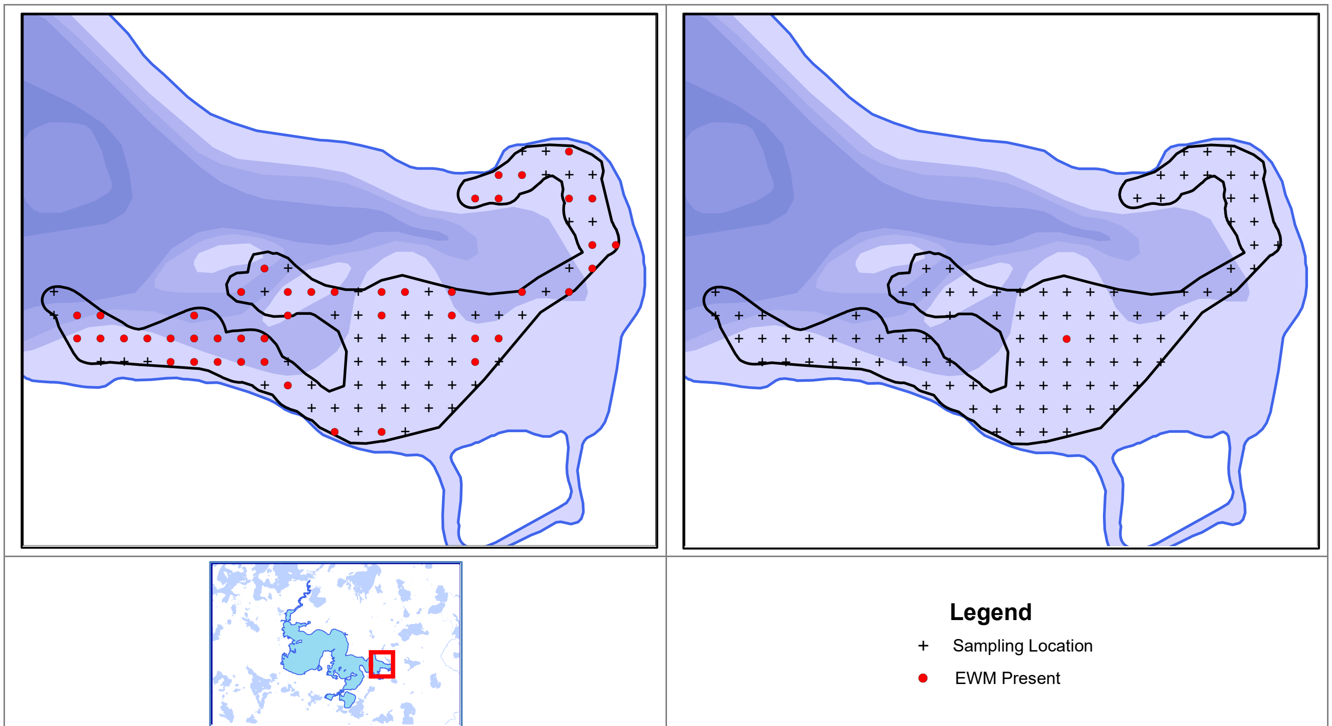


Figure 3.2-6. Subsample point-intercept survey results from June 2023 (Pre-Treatment) and September 2023 (Post-Treatment)

Four native species exhibited a statistically valid decrease in occurrence between the two surveys, while one species showed a valid increase and most species did not have a significant change in occurrence (Figure 3.2-7). The occurrence of coontail was reduced by 87.2% and water marigold was reduced by 100%. Both of these species have shown to be susceptible to ProcellaCOR treatments. The occurrence of fern-leaf pondweed was reduced by 23.2%, which was a statistically valid decrease. Fern-leaf pondweed was still very common within the site in the post-treatment survey with an occurrence of 53%. Forked duckweed is a free-floating species that is a little bigger than a thumb-nail, which becomes entangled on plants in the middle of the water column. Forked duckweed showed a statistically valid 81.8% decline in occurrence between the two surveys. Fern-leaf pondweed and forked duckweed are not known to be particularly sensitive to ProcellaCOR treatments, although continued studies like this help better understand aquatic plant response to this chemical. Continued monitoring in 2024 will serve to understand the aquatic plant population dynamics including whether the species that declined will show signs of recovery.

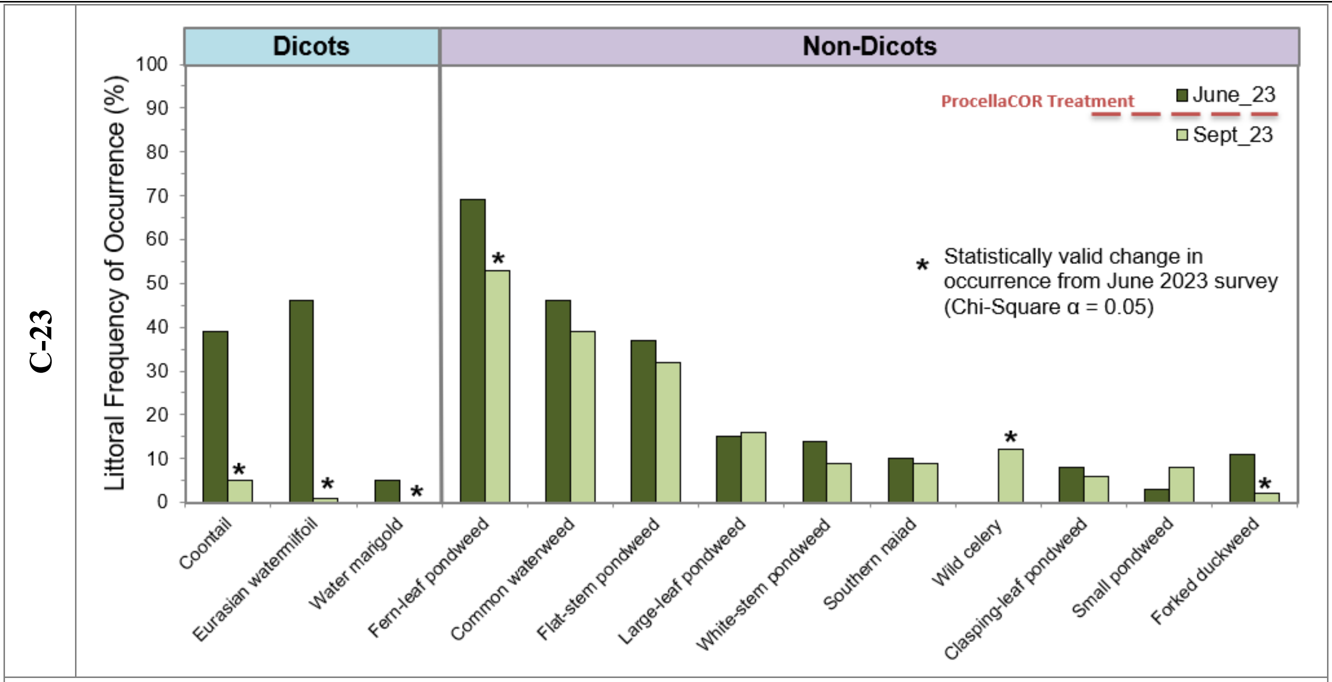


Figure 3.2-6. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept survey in site C-23 in Tomahawk Lake.

3.3 Late-Summer EWM Mapping Survey

Onterra ecologists conducted the Late-Summer EWM Mapping Survey on the system on September 18-20, 2023. The results of the late-summer 2023 mapping survey are displayed on a series of Maps 4-10. Eurasian watermilfoil is widespread in the system with many large contiguous colonies. A total of 269.6 acres of colonized EWM was mapped throughout the system of which over half (138.4 acres) was given a *highly dominant* density rating. *Surface matting* conditions covered 7.9 acres, another 35.5 acres was *dominant* density, and 87.8 additional acres were comprised of either *highly scattered* or *scattered* densities (Figure 3.3-1 – left frame).

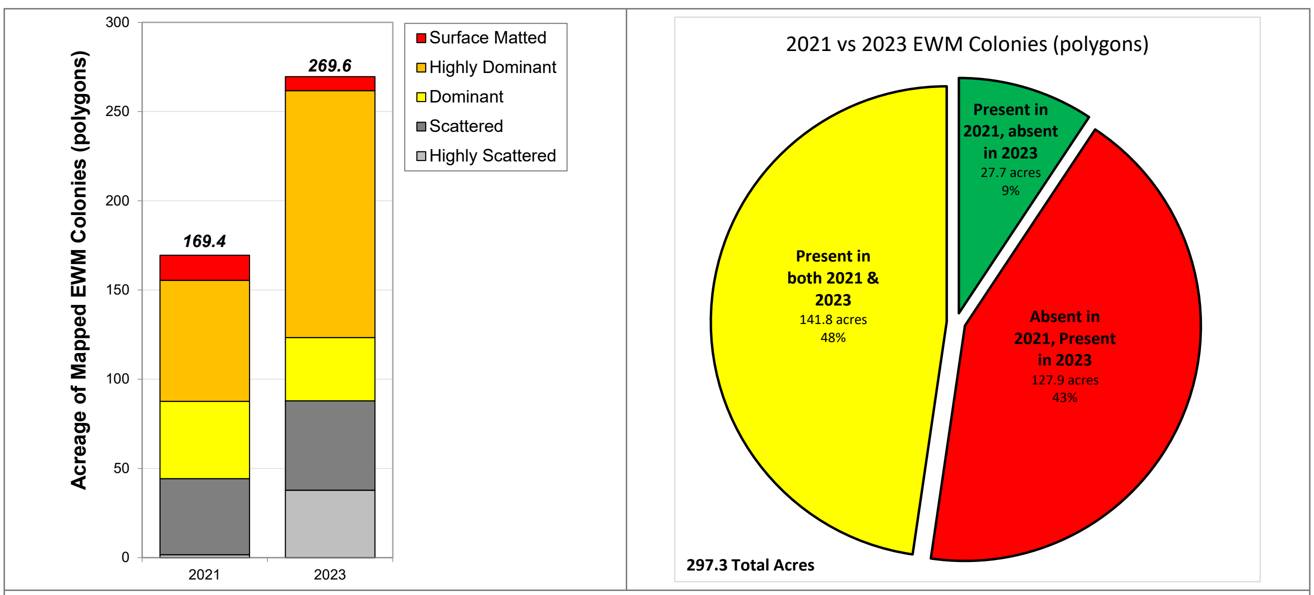


Figure 3.3-1. Acreage comparison of colonized EWM in Tomahawk Lake from 2021 & 2023 surveys. Created using data from Onterra late-season AIS mapping surveys.

In an effort to increase the flow of information between lake stakeholders and project planners, the TLA has built an interactive web map application for the system, allowing users to see the late-season EWM mapping survey and management areas as they relate to their property or favorite recreation and fishing spots. To directly access this interactive map:

https://onterra.maps.arcgis.com/apps/webappviewer/index.html?id=5ce67c25fc7049c7bf75f4b06e113050

The EWM population was mapped throughout the system most recently during the late-summer of 2021. A comparison of these two surveys shows colonized acreage of EWM was approximately 100 acres larger in 2023 vs 2021 (Map 11). Some of the expansion in colonial area stems from areas that were mapped with point-based methods in 2021 that were better represented with low-density polygons in 2023. For example, 37.7 acres of *highly scattered* density colonies were delineated in 2023 compared to just 1.6 acres in 2021 (Figure 3.3-1, right frame). Additional acreage in 2023 is a result of new populations not identified in the earlier survey. Much of the EWM acreage that was present in 2021 and absent in 2023 can be attributed to the colonies that were impacting by the 2023 ProcellaCOR treatment.

The 2023 ProcellaCOR treatment resulted in a substantial decrease in the EWM population within the application area with relatively few single plants present in the northern end of the site in the post-treatment survey (Figure 3.3-2). Reductions in EWM were observed somewhat beyond the application area as well when comparing the pre- and post-treatment EWM mapping surveys. For reference, a pink hatched line is placed on both map figures to reference approximately the line where EWM was controlled from the treatment. The initial results look promising for the *year of treatment*, especially in the application area. The success criteria for this treatment are that EWM reductions would last through the *year after treatment*, therefore, monitoring during 2024 will determine if expectations are met.

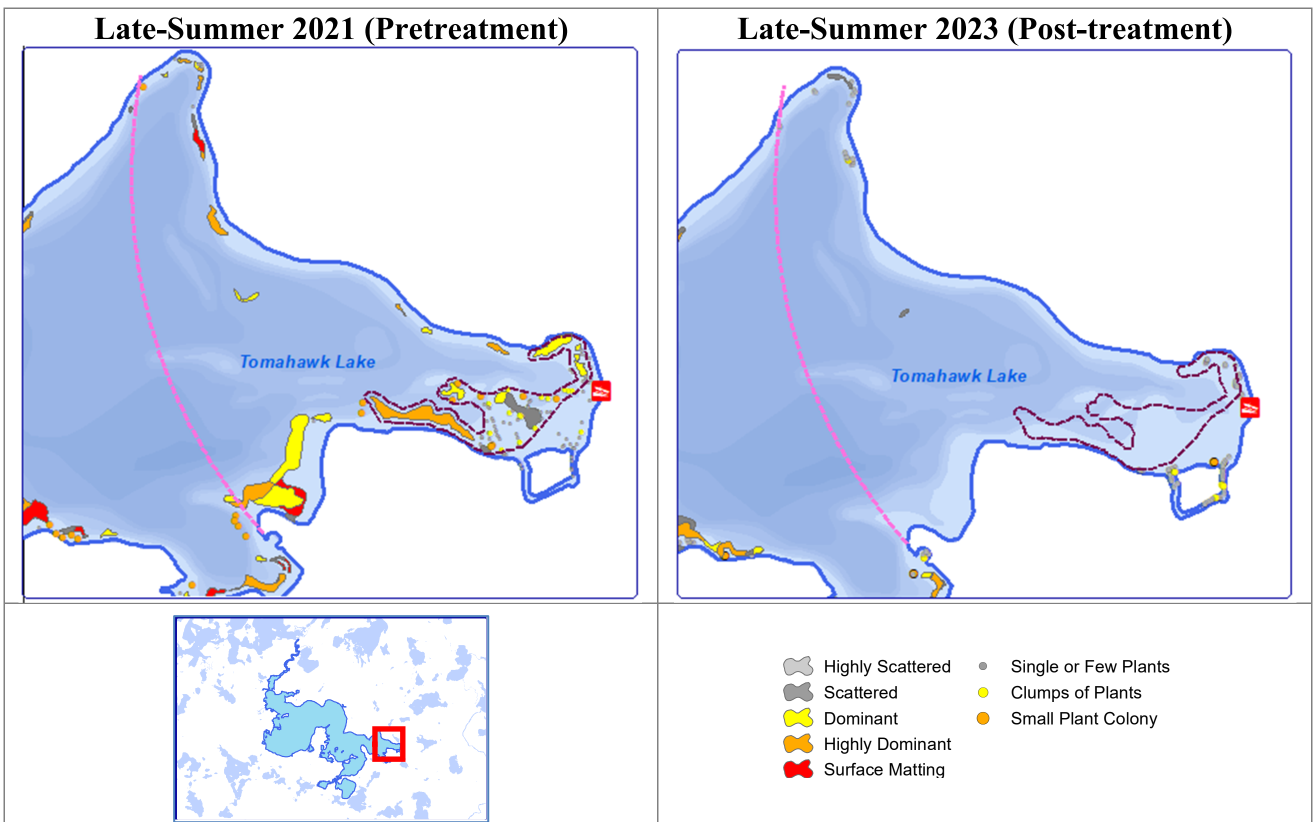


Figure 3.3-2. EWM population before (2021) and after (2023) a ProcellaCOR herbicide treatment in Tomahawk Lake. Herbicide application area displayed in dashed purple outline.

4.0 CONCLUSIONS & DISCUSSION

Positive strides have been made in 2022 and 2023 towards meeting the TLA's EWM management goal of keeping the EWM population from negatively impacting recreation, navigation, and aesthetics. The mechanical harvesting project is not attempting to manage the overall EWM population of the system, but to restore at least a large portion of use and aesthetics of the lake. The TLA feels that the two-year trial (2022-2023) has provided evidence that this plan is meeting many of their goals, but two years is not enough to fully understand the longer term implications of the program. The TLA is also testing early and late-season harvesting to understand if greater reductions in EWM impacts can be achieved than simply short-term nuisance relief.

The purpose of the 2023 herbicide treatment program was to remove EWM in heavily-used locations that they were currently spending a lot of time mechanical harvesting. Without the need for mechanical harvesting in this area, they can direct those harvesting efforts elsewhere and be overall more productive. The results of the treatment of the Lake Tomahawk landing bay appear highly successful, but continued monitoring in 2024 and beyond is warranted to fully evaluate this management event. The TLA understands the importance of continued dialogue with the WDNR lakes and fisheries program as it relates to their future EWM management program, especially when herbicide treatments are being discussed.

4.1 2024 EWM Management & Monitoring Strategy

Mechanical Harvesting Program:

The TLA successfully applied for a WDNR grant during the fall 2023 cycle that provides funding assistance related to a continuation of a 2-year mechanical harvesting trial program. The TLA will continue with another 2-years of its trial program (4-year total program) that utilizes mechanical harvesting to suppress dense EWM colonies that exist in high-traffic areas of the lake. The newly awarded grant project would continue that effort in 2024-2025, with continued aquatic plant and harvest longevity monitoring and adding a removed nutrient analysis study component discussed below.

The TLA is proposing this 2-year extension of its trial project to better understand the role mechanical harvesting can play as part of their Integrated Pest Management program. It is currently unclear the amount of mechanical harvesting required to alleviate the nuisance conditions caused by EWM, so one of the goals is quantifying the length of impact that mechanical harvesting can have. It is highly likely that the TLA will have to fully fund their mechanical harvesting program in 2026 and beyond without grant funds, so understanding that level of mechanical harvesting needed to reach goals is important when setting annual budgets and conducting fundraising efforts.

Some research indicates that multiple years of consecutive mechanical harvesting may lead to changes in certain plant abundances, including EWM. The TLA will continue to monitor for changes in aquatic plants in select mechanical harvesting sites.

New for 2024-2025, this project would estimate the amount of nutrients that are removed from the system from mechanical harvesting each year. Very little information exists about the quantity of nutrients (nitrogen and phosphorus) that are removed from targeted EWM removal in northern Wisconsin. Other studies have looked at eutrophic systems in southern Wisconsin with much different parameters than Oneida County. In general, TLA volunteers will collect plant samples from harvested materials at 4 locations around the lake at 5 mid-month intervals. The samples will be provided to the

UW Soils & Forage Analysis Laboratory in Madison for analysis, including dry weight, total nitrogen, and total phosphorus. Plant communities vary by location and time of growing season, which may indicate different nutrient removal constants per month. The constants would be multiplied by the unit of removed material per area to model the overall nutrients removed.

To determine the amount of phosphorus and nitrogen removed per unit of weight, the TLA will facilitate the collection of a composite sample made up of 3 grab samples throughout a single day at each location (4) and interval (5 mid-month). The samples would be properly prepared and shipped overnight (UPS Ground) to the UW Soil Forage Lab.

The laboratory will report percent dry matter in the sample as well as each of the element weights as percent of the dry matter. These constants will be multiplied by the amount of harvested material removed as reported by the contracted mechanical harvester.

Herbicide Spot-Treatment:

The TLA continues to be interested in making their mechanical harvesting program more efficient by integrating herbicide management of key areas into their overall plan. As can be observed on page 11 of Appendix A, the bay containing the Clearwater Camp for Girls required one third of the TLA's cutting hours in 2023. Additionally, this site was a far distance from the nearest offload location at the Kemp Station ramp, taking additional time away from the management of other areas. During a joint meeting with the Minocqua-Kawaguesaga Lakes Protection Association (MKLPA), the WDNR lakes and fisheries departments, and Onterra (represents both the TLA and MKLPA) in mid-December 2023, discussions about possibly targeting Clearwater Bay (sometimes referred to as Echo Bay) with aquatic herbicides occurred. The WDNR conveyed that they still opposed the treatment of Pickerel Bay, which was denied in 2023, but would be amenable to targeting Clearwater Bay in 2024.

Map 13 shows the preliminary treatment design which includes direct application to 17.3 acres at 4.0 PDU/acre-ft. This is more acreage and a higher rate than a 2019 ProcellaCOR treatment of this bay that did not meet success expectations. Following WDNR fisheries request, the design attempted to avoid overlap of direct application with the critical habitat areas, which are largely a rock/gravel walleye spawning location. When the herbicide mixes out from the application area into Clearwater Bay, the calculated concentration (3.3 ppb) would be approximately double of what was calculated as the potential in 2019, which should produce better efficacy than the previous treatment. Onterra predicts some of the EWM outside of this bay to the North and Northeast may also be impacted by the treatment, but less certain as you extend outward and around the island. Remaining funds from the 2023 trial herbicide treatment grant (ACEI-312-23) will provide some state assistance for this control and monitoring component.

Pretreatment Confirmation and Refinement Survey

Onterra ecologists will conduct a *Pretreatment Confirmation and Refinement Survey* prior to the early-season herbicide application to verify application area extents and inspect the condition of the EWM colonies targeted for treatment through the use of a combination of surface surveys, rake tows, and submersible video monitoring. This approximately late-May meander-based survey would investigate for EWM colonial expansion, growth stage of the EWM (and native plants), application area specifies (e.g. average depth & extents), and other aspects that could warrant a modification to the treatment plan. Water temperature and pH data would be collected during the survey to assist with projecting ideal treatment timing. During this visit, Onterra staff would provide supplies and training to volunteers for conducting herbicide concentration monitoring.

Following the *Pretreatment Confirmation & Refinement Survey*, an email-style report with map(s) of the survey results and finalized treatment plan would be provided to the TLA, WDNR, and other project partners for review prior to the treatment. Spatial data would be provided to the herbicide applicator in appropriate format. The chosen contractor, in conjunction with the TLA, will be responsible for completing appropriate permit-related documentation and deliverables to the WDNR. As occurred during 2023, Onterra would work with GLIFWC and other fisheries managers to predict when sensitive fish species of concern, like walleye, have outgrown their most-sensitive life stage to herbicide exposure. Therefore this treatment is likely to occur in mid- to late-June 2024.

Herbicide Concentration Monitoring

TLA volunteers would conduct herbicide concentration monitoring during the hours/days following treatment following a sampling regime that will be created through collaborative efforts of the WDNR and Onterra. Samples would be collected at specified time intervals and locations within and outside the application area. Sample collection would be focused on understanding the quantity and longevity of the herbicide active ingredient and the acid metabolite (primary degradation product). Properly preserved samples would be overnight-delivered to EPL Bio Analytical Services where the herbicide analysis is conducted.

Quantitative Aquatic Plant Monitoring

Aquatic plant monitoring is planned in 2024 through the replication of a sub-sample point-intercept survey. These data were largely collected during the summer of 2023 as a part of the mechanical harvesting monitoring projects. The post treatment data will be compared to previous surveys to understand how native and non-native aquatic plant populations may be impacted by the 2023 management strategy. Continued discussion with WDNR will determine whether a new sampling grid would be created that provides complete coverage of the area of interest, with understanding that the pre-treatment collection of the data would then need to occur just before treatment in 2024 (early/mid-June).

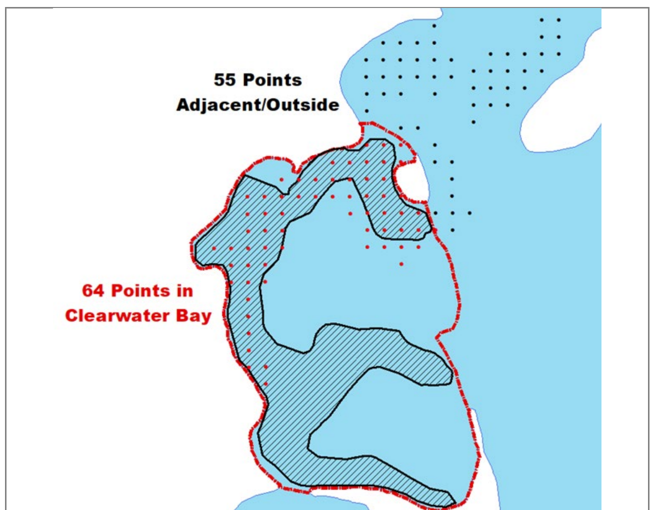
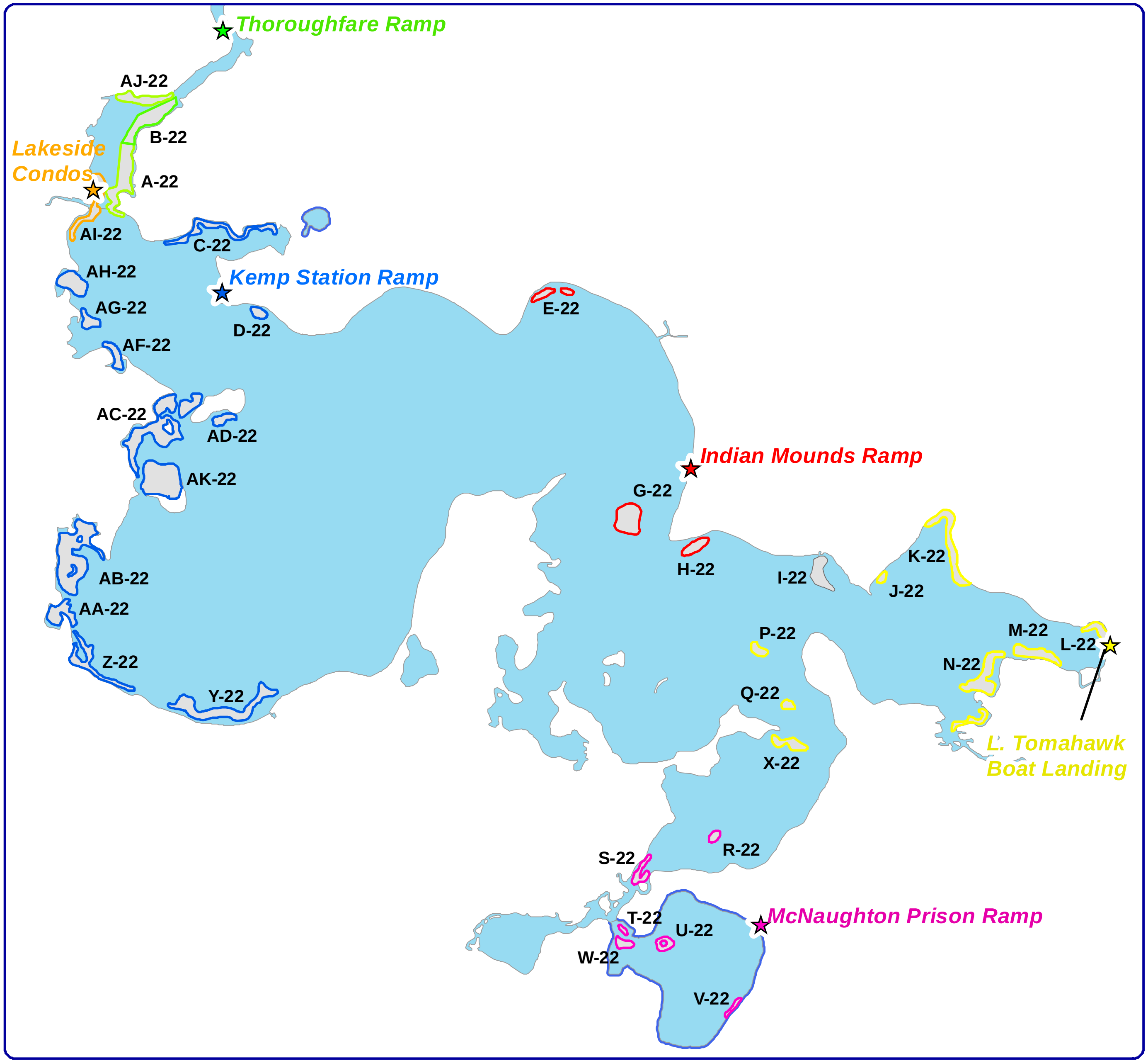


Figure 4.1-1. Preliminary quantitative monitoring strategy for proposed 2024 herbicide treatment

Qualitative EWM Monitoring

A focused Late Season 2024 EWM Mapping Survey will be conducted in the vicinity of the 2024 treatment at the perceived peak growth stage. Comparing these data to the 2023 late-season EWM mapping survey will help lake stakeholders understand management outcomes. The herbicide treatment would meet control expectations if little to no EWM is present in the application areas during the late-summer 2024 survey. Many treatment impacts during the *year of treatment* may be short-lived, so understanding how populations stabilize during the *year after treatment* is important within evaluations. EWM reductions would be expected to extend into 2025 for the treatment to be deemed successful.



2022 Final Mechanical Harvesting Strategy

Site	Acres	Off-load Location
A-22	10.6	Thoroughfare ramp or Lakeside Condos
B-22	8.5	Thoroughfare ramp or Lakeside Condos
C-22	7.1	Kemp Station ramp
D-22	1.6	Kemp Station ramp
E-22	1.6	Indian Mounds ramp
F-22	0.7	Indian Mounds ramp
G-22	7.5	Indian Mounds ramp
H-22	2.9	Indian Mounds ramp
I-22	7.4	Lake Tomahawk boat landing
I1-22	0.9	Lake Tomahawk boat landing
J-22	0.9	Lake Tomahawk boat landing
K-22	8.1	Lake Tomahawk boat landing
L-22	2.4	Lake Tomahawk boat landing
M-22	4.7	Lake Tomahawk boat landing
N-22	7.8	Lake Tomahawk boat landing
O-22	2.3	Lake Tomahawk boat landing
P-22	1.7	Lake Tomahawk boat landing
Q-22	1.2	Lake Tomahawk boat landing
R-22	1.1	McNaughton Prison Landing
S-22	2.6	McNaughton Prison Landing
T-22	0.5	McNaughton Prison Landing
U-22	2.0	McNaughton Prison Landing
V-22	0.9	McNaughton Prison Landing
W-22	1.6	McNaughton Prison Landing
X-22	3.2	Lake Tomahawk boat landing
Y-22	13.3	Kemp Station ramp
Y1-22	1.3	Kemp Station ramp
Y2-22	1.2	Kemp Station ramp
Z-22	7.1	Kemp Station ramp
Z1-22	2.9	Kemp Station ramp
AA-22	2.7	Kemp Station ramp
AB-22	18.9	Kemp Station ramp
AB1-22	4.2	Kemp Station ramp
AC-22	16.1	Kemp Station ramp
AD-22	2.1	Kemp Station ramp
AE-22	3.5	Kemp Station ramp
AF-22	2.7	Kemp Station ramp
AG-22	2.5	Kemp Station ramp
AH-22	5.7	Kemp Station ramp
AI-22	5.8	Lakeside Condos or Kemp Station ramp
AJ-22	4.8	Thoroughfare ramp or Lakeside Condos
AK-22	13.8	Kemp Station ramp
Total	***198.7***	

N
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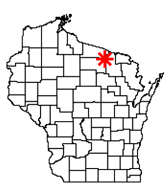
350
feet

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

Sources:
Roads and Hydro: WDNR
Bathymetry: Onterra
Aquatic Plants: Onterra, 2021
Orthophtography: NAIP, 2020
Map Date: July 1, 2022 - EJH

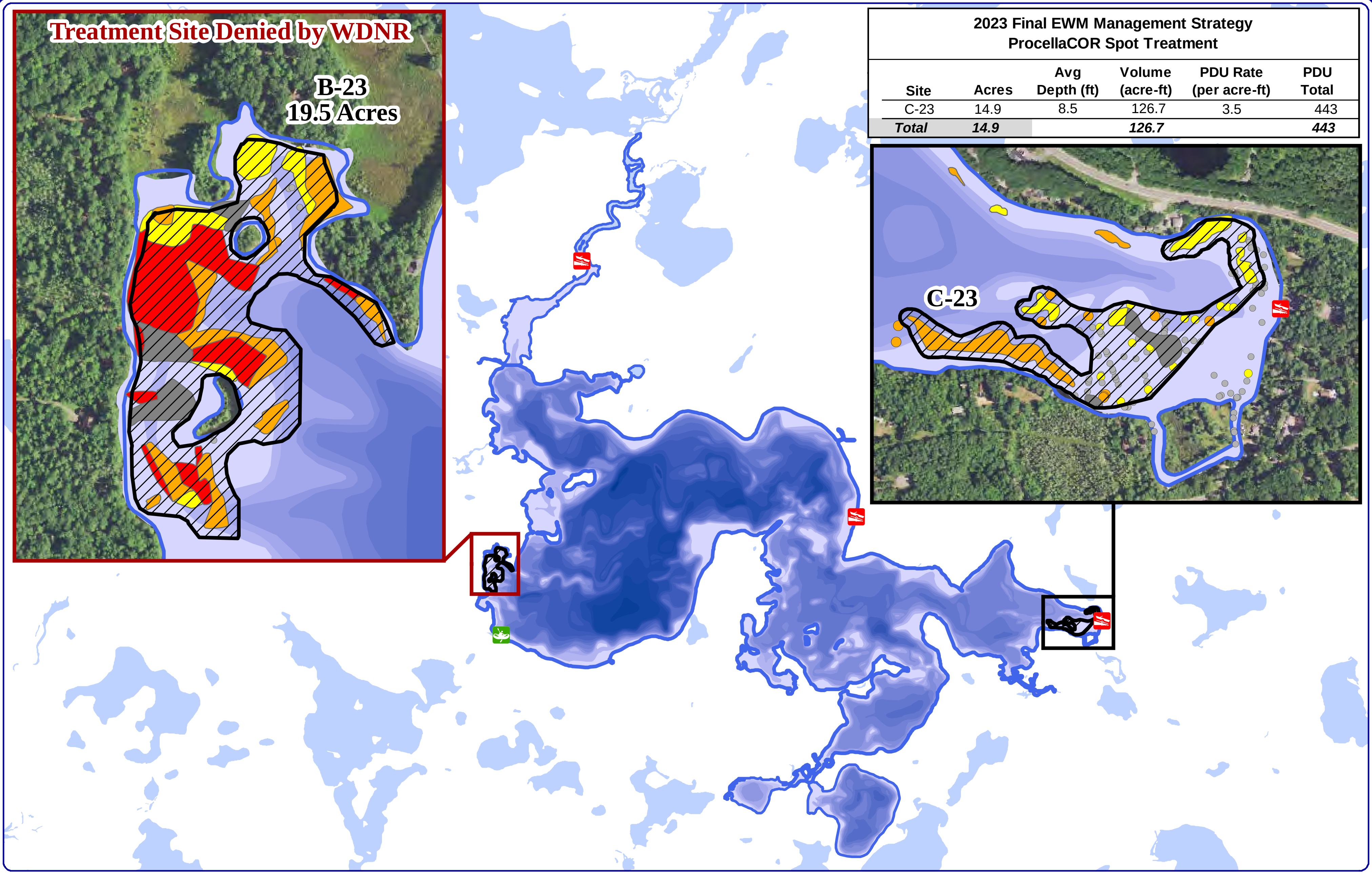


Project Location in Wisconsin

Off-Load Location

Indian Mounds Ramp
Kemps Station Ramp
Lake Tomahawk Ramp
Lakeside Condos or Kemps Station Ramp
McNaughton Prison Ramp
Thoroughfare Ramp or Lakeside Condos

Map 1
Tomahawk System
Oneida County, Wisconsin
2022-2023 Mechanical Harvesting Plan



Site	Acres	Avg Depth (ft)	Volume (acre-ft)	PDU Rate (per acre-ft)	PDU Total
C-23	14.9	8.5	126.7	3.5	443
Total	***14.9***		***126.7***		***443***

2023 Final EWM Management Strategy
ProcellaCOR Spot Treatment

N W E S

5,100
Feet

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De Pere, WI 54115
920.338.8860
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Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2021
Orthophotography: NAIP, 2020
Map Date: Nov 2, 2022 TWH
Filename:Tomahawk_EWMPB_2021.mxd

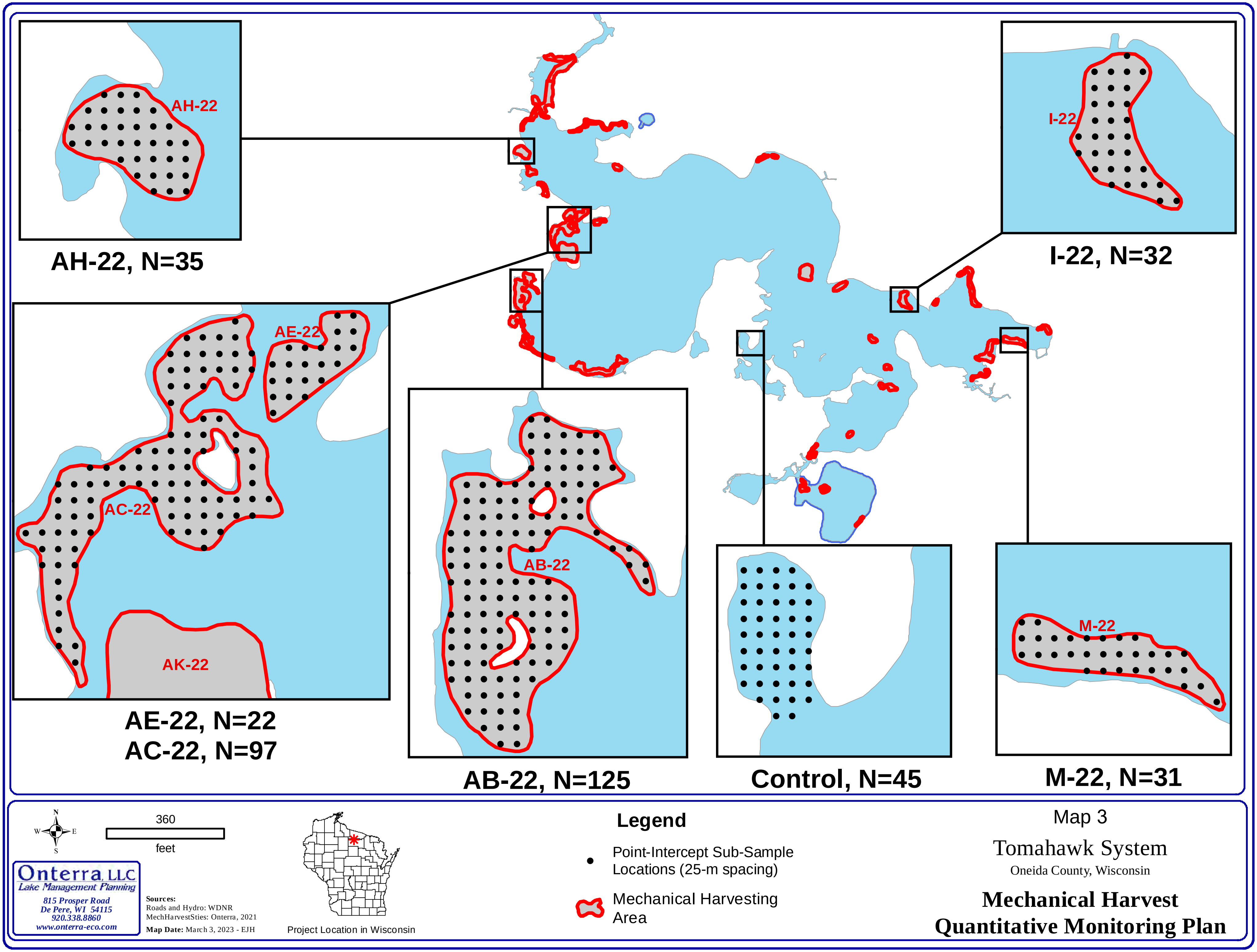
Project Location in Wisconsin

Legend

Eurasian watermilfoil (August 3-5, 2021)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting *(None)*
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2023 Herbicide Application Area

Map 2
Tomahawk Lake
Oneida Co, Wisconsin
Final 2023 EWM Herbicide Treatment Area


AH-22
AH-22, N=35
I-22
I-22, N=32
AE-22
AC-22
AK-22
AE-22, N=22
AC-22, N=97
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AB-22, N=125
Control, N=45
M-22
M-22, N=31
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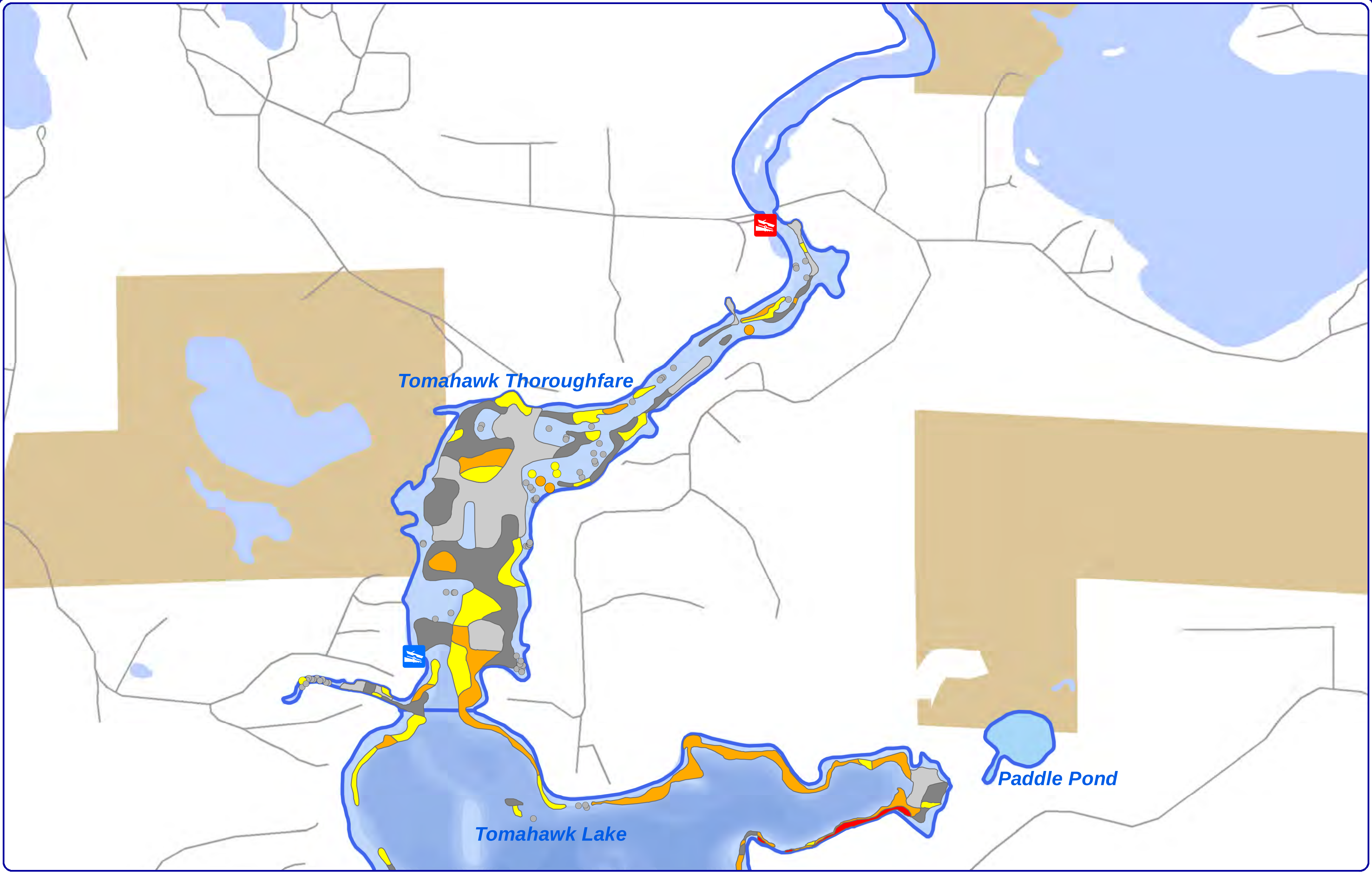
feet
Onterra, LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com
Sources:
Roads and Hydro: WDNR
MechHarvestSties: Onterra, 2021
Map Date: March 3, 2023 - EJH
Project Location in Wisconsin
Legend
Point-Intercept Sub-Sample Locations (25-m spacing)
Mechanical Harvesting Area
Map 3
Tomahawk System
Oneida County, Wisconsin
Mechanical Harvest
Quantitative Monitoring Plan



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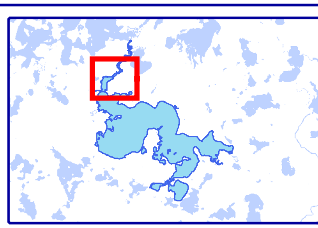

Legend

Eurasian watermilfoil (September 18-20, 2023)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony

- Public Boat Landing
- Private Boat Landing
- Carry-In
- American Legion State Forest

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920.338.8860
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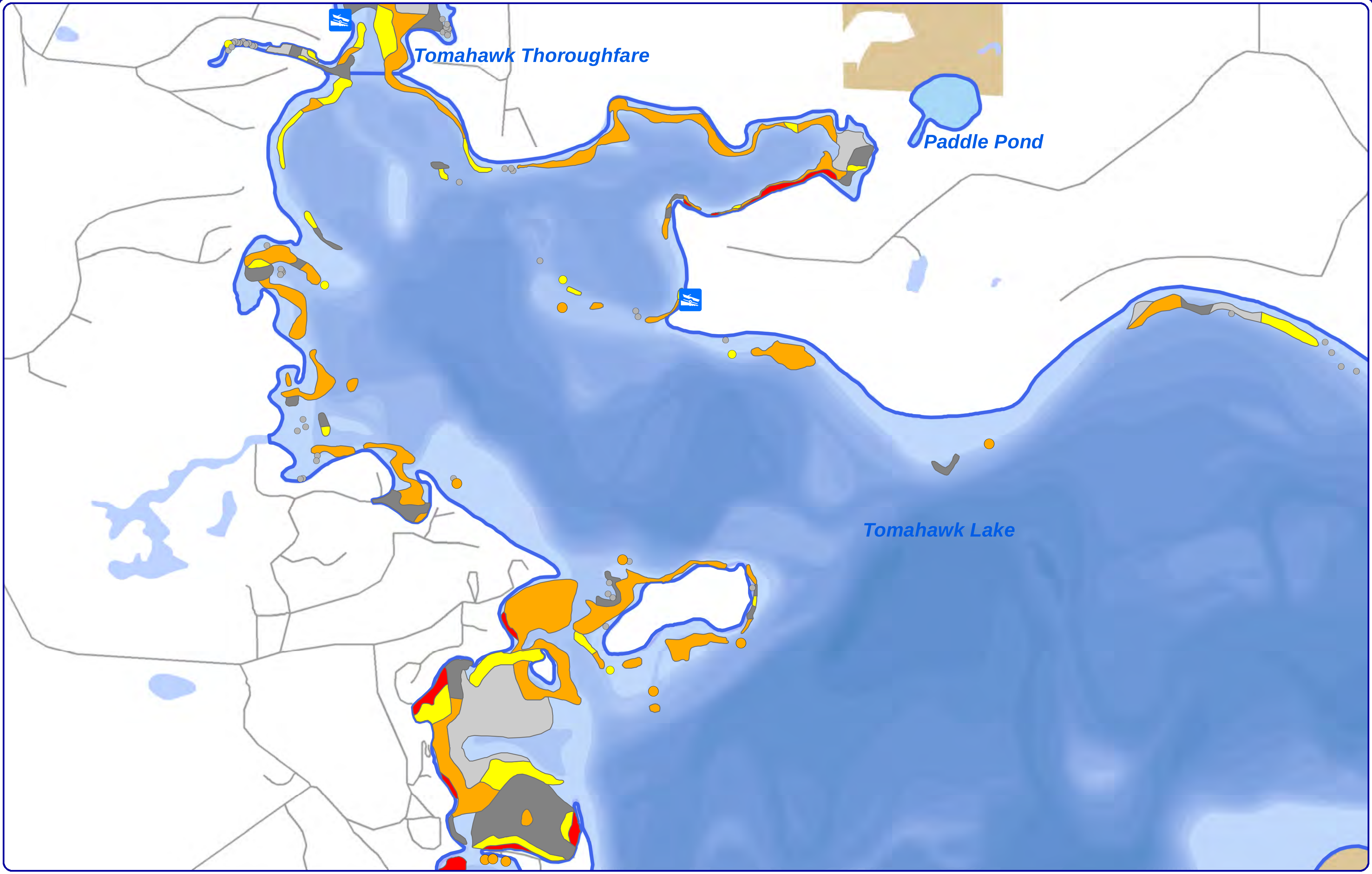
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB

Map 4 (inset 1 of 7)

Tomahawk Lake

Oneida Co, Wisconsin

September 2023 EWM Survey Results



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Feet

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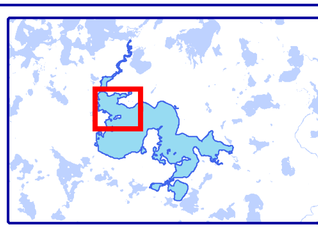
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophotography: NAIP, 2020
Map Date: October 12, 2023 JMB



Legend

Eurasian watermilfoil (September 18-20, 2023)

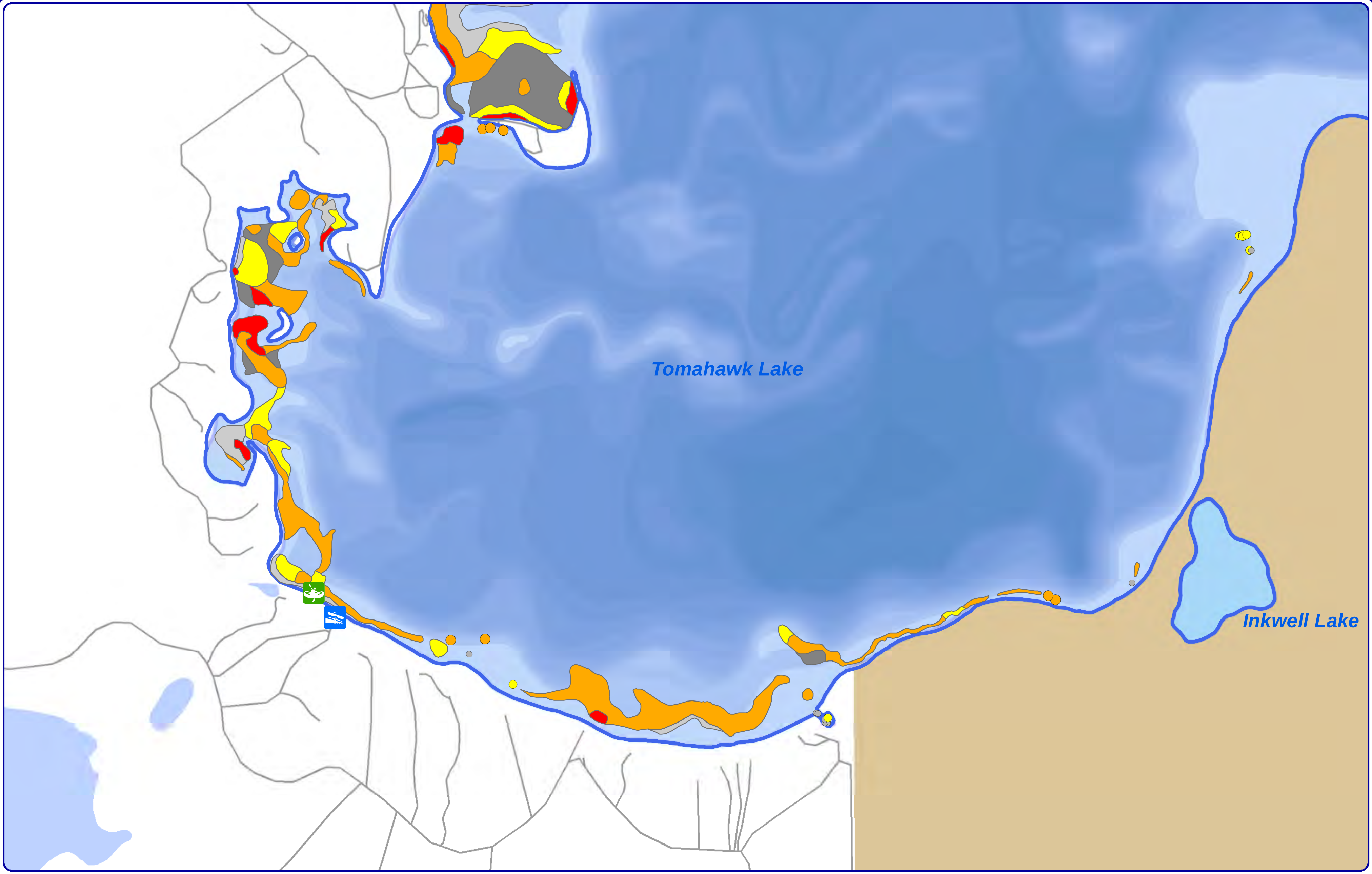
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Public Boat Landing
- Private Boat Landing
- Carry-In
- American Legion State Forest

Map 5 (inset 2 of 7)

Tomahawk Lake

Oneida Co, Wisconsin

September 2023 EWM Survey Results



Legend

Eurasian watermilfoil (September 18-20, 2023)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Public Boat Landing
- Private Boat Landing
- Carry-In
- American Legion State Forest

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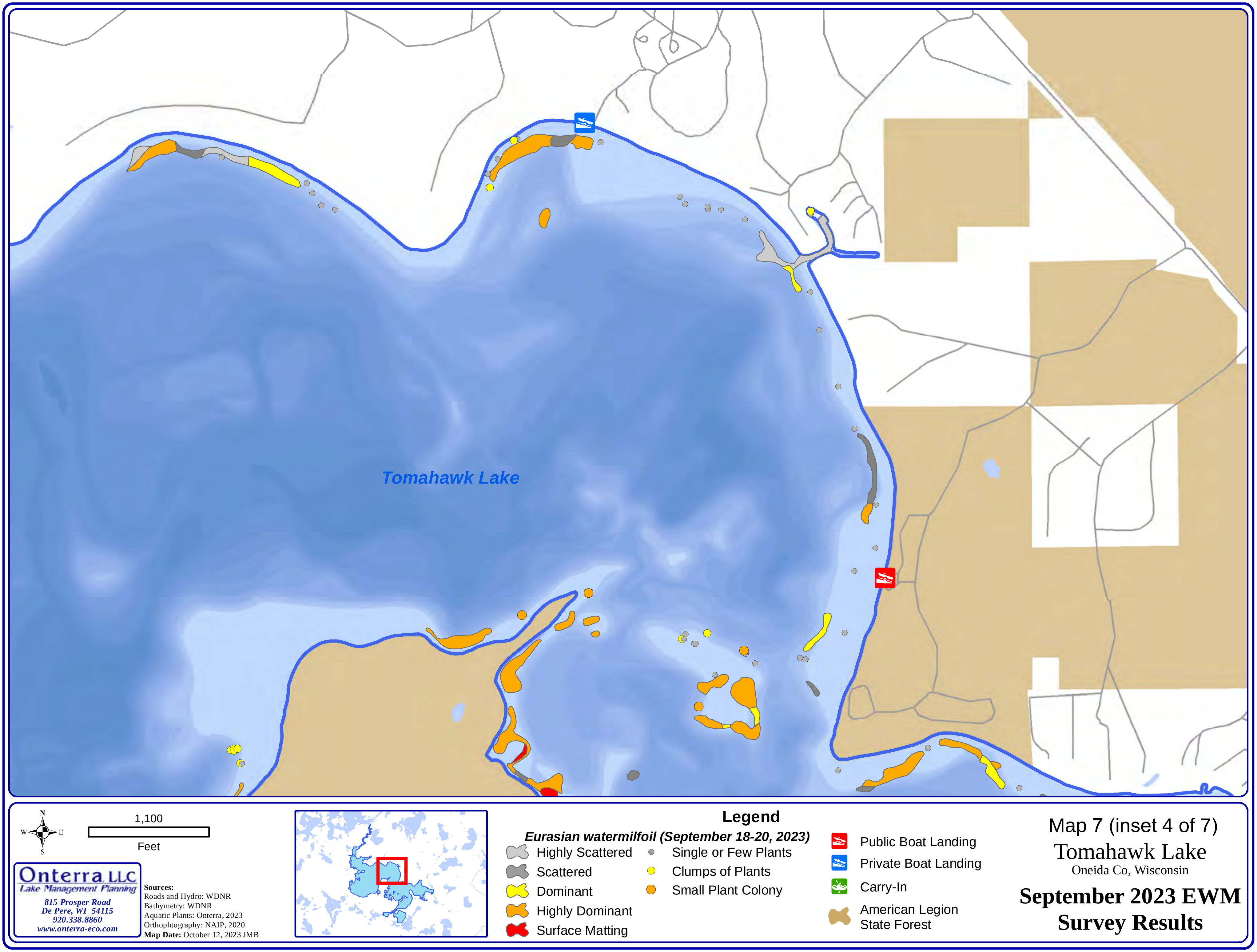
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB

Map 6 (inset 3 of 7)

Tomahawk Lake

Oneida Co, Wisconsin

September 2023 EWM Survey Results


Tomahawk Lake
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Onterra LLC
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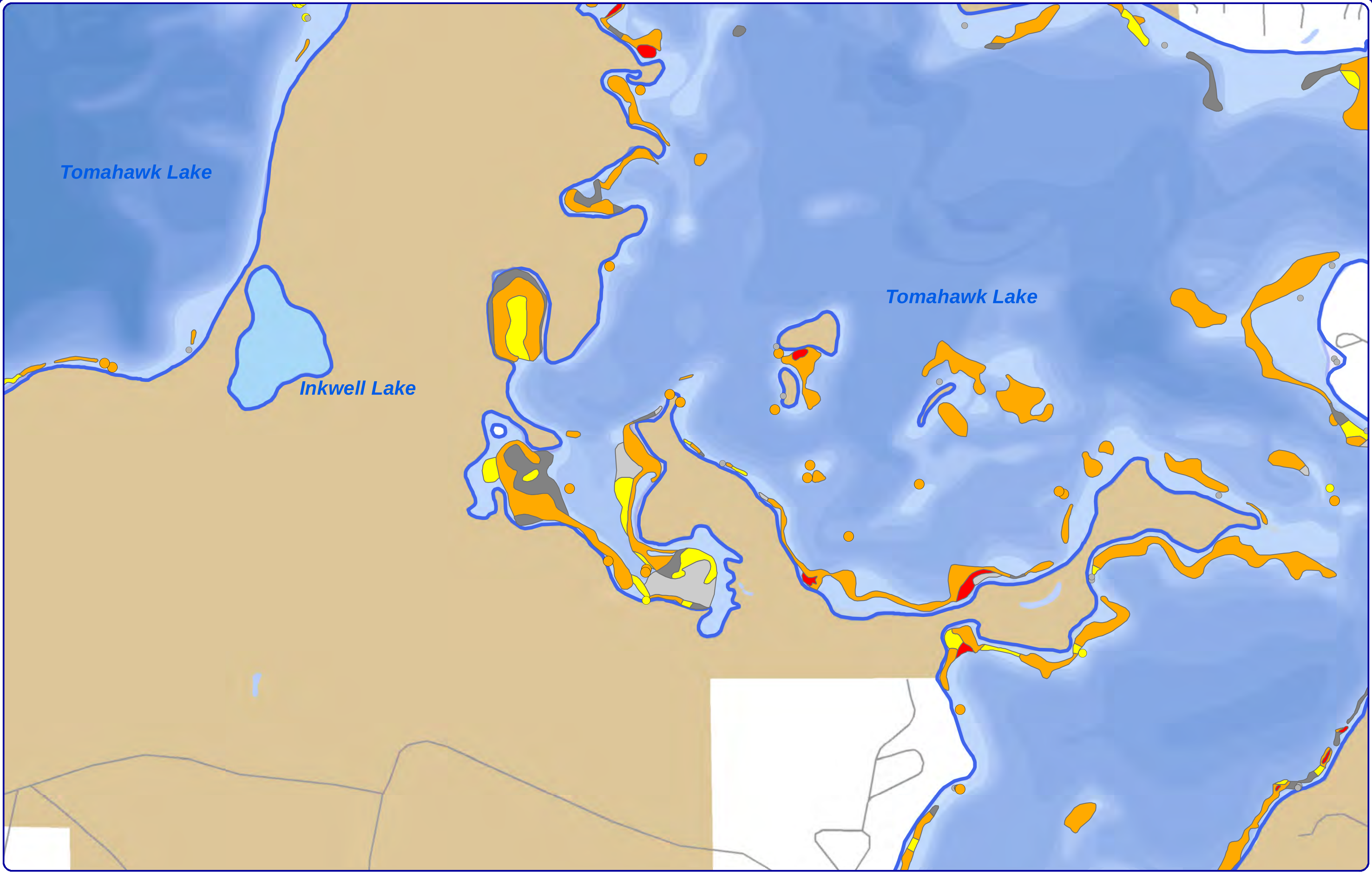
De Pere, WI 54115
920.338.8860
www.onterra-eco.com
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB
Legend
Eurasian watermilfoil (September 18-20, 2023)
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony
Public Boat Landing
Private Boat Landing
Carry-In
American Legion State Forest
Map 7 (inset 4 of 7)
Tomahawk Lake
Oneida Co, Wisconsin
September 2023 EWM Survey Results



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Onterra LLC
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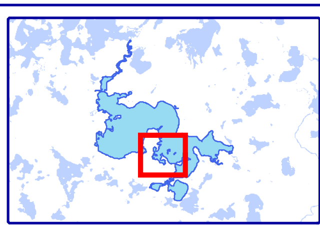
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB



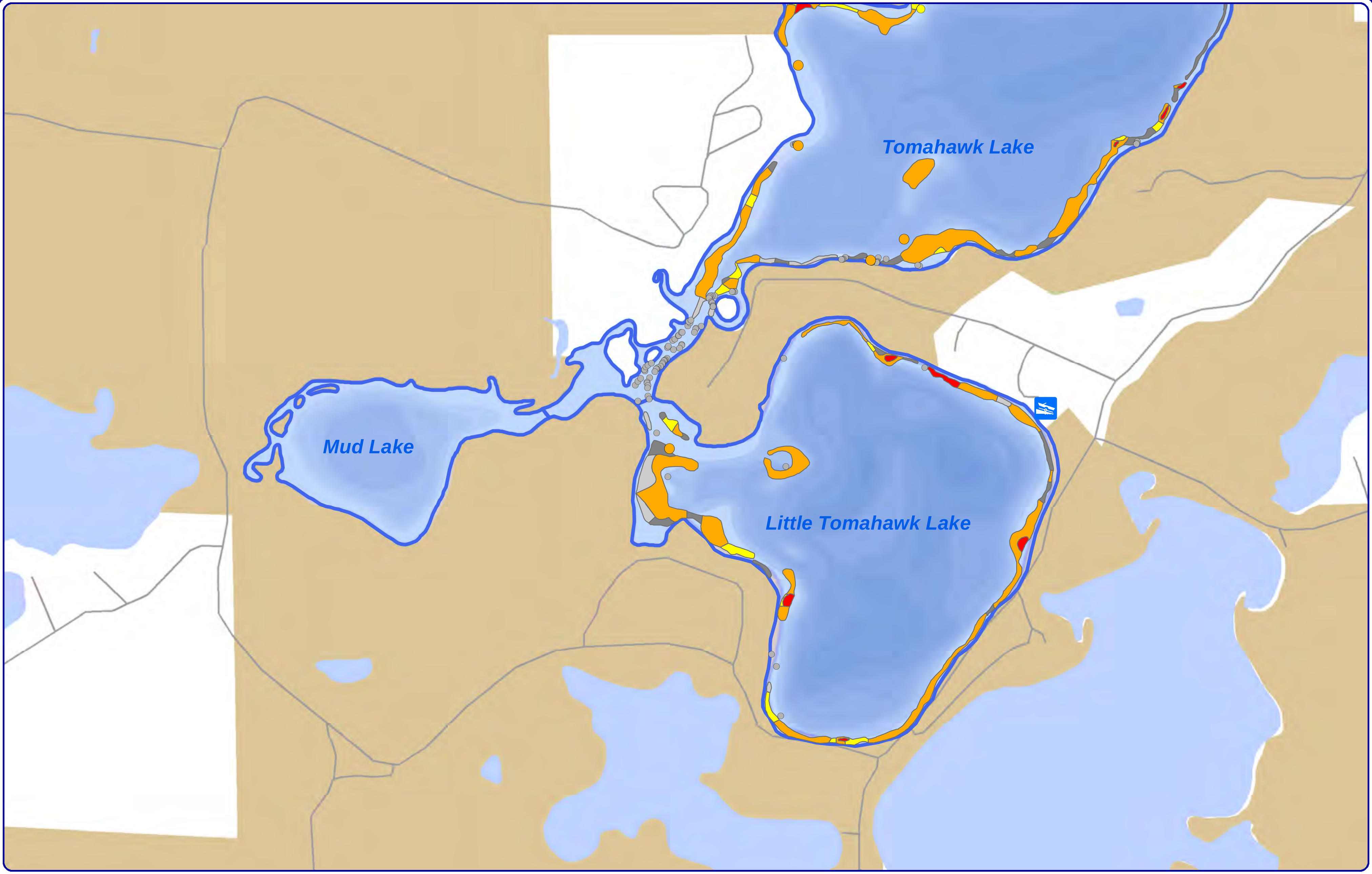
Legend

Eurasian watermilfoil (September 18-20, 2023)

Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony

Public Boat Landing
Private Boat Landing
Carry-In
American Legion State Forest

Map 8 (inset 5 of 7)
Tomahawk Lake
Oneida Co, Wisconsin
September 2023 EWM Survey Results



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Feet

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Lake Management Planning
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920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophotography: NAIP, 2020
Map Date: October 12, 2023 JMB

Legend

Eurasian watermilfoil (September 18-20, 2023)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony

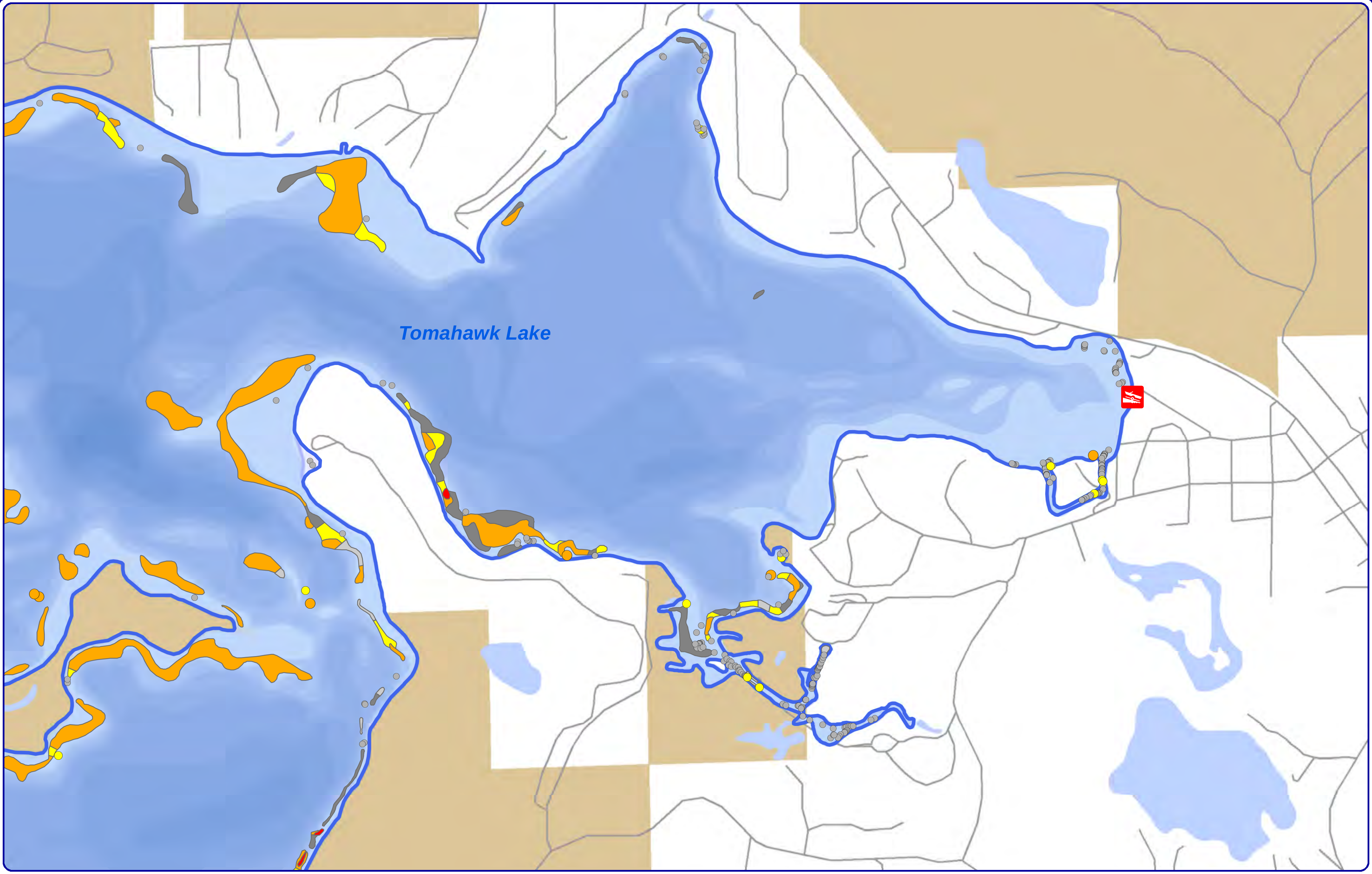
- Public Boat Landing
- Private Boat Landing
- Carry-In
- American Legion State Forest

Map 9 (inset 6 of 7)

Tomahawk Lake

Oneida Co, Wisconsin

September 2023 EWM Survey Results



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920.338.8860
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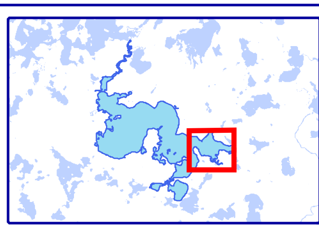
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB



Legend

Eurasian watermilfoil (September 18-20, 2023)

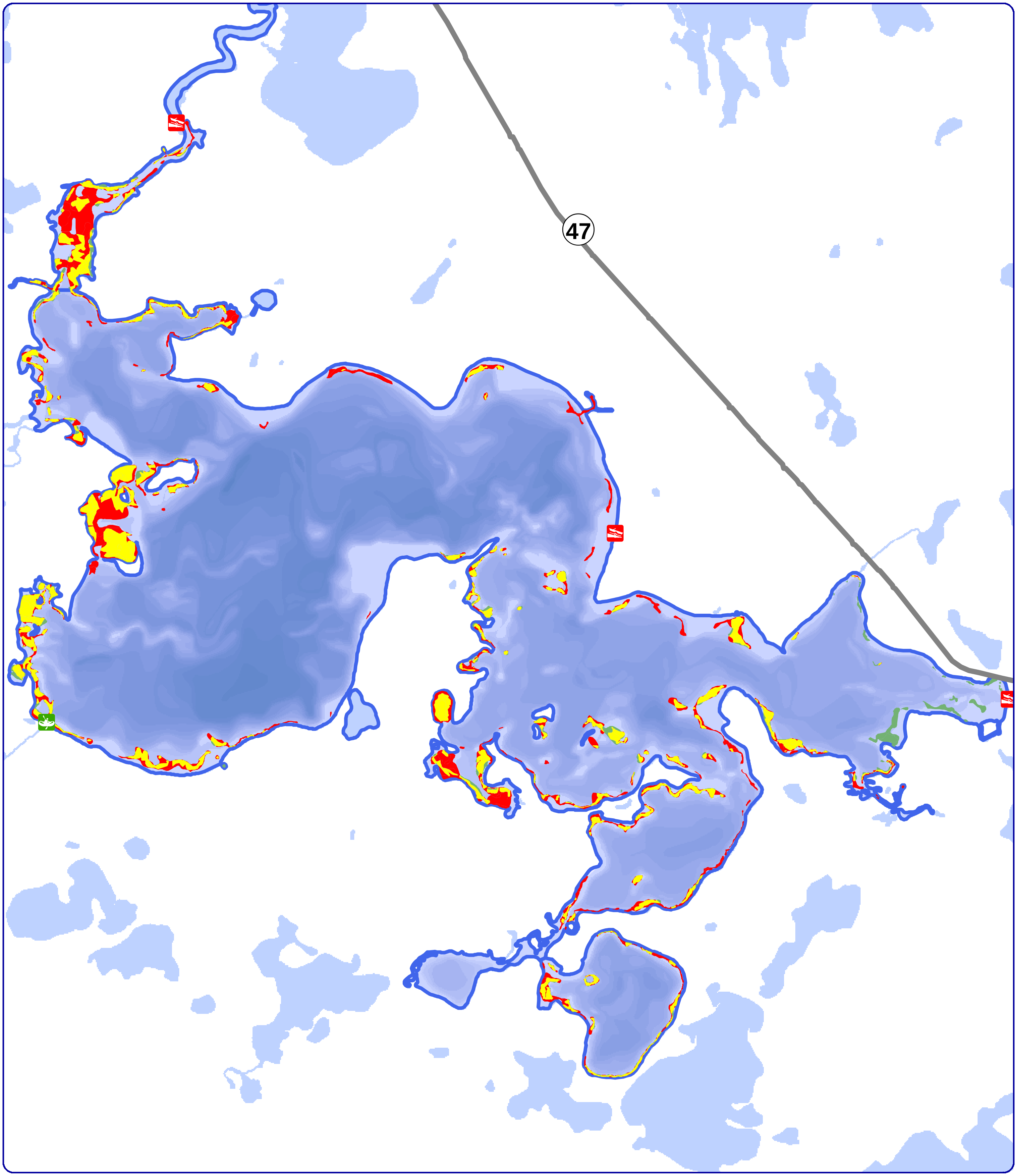
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Public Boat Landing
- Private Boat Landing
- Carry-In
- American Legion State Forest

Map 10 (inset 7 of 7)

Tomahawk Lake

Oneida Co, Wisconsin

September 2023 EWM Survey Results



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920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plants: Onterra, 2023
Map Date: October 23, 2023 - EJH

Project Location in Wisconsin

Legend

Colonized Eurasian Watermilfoil

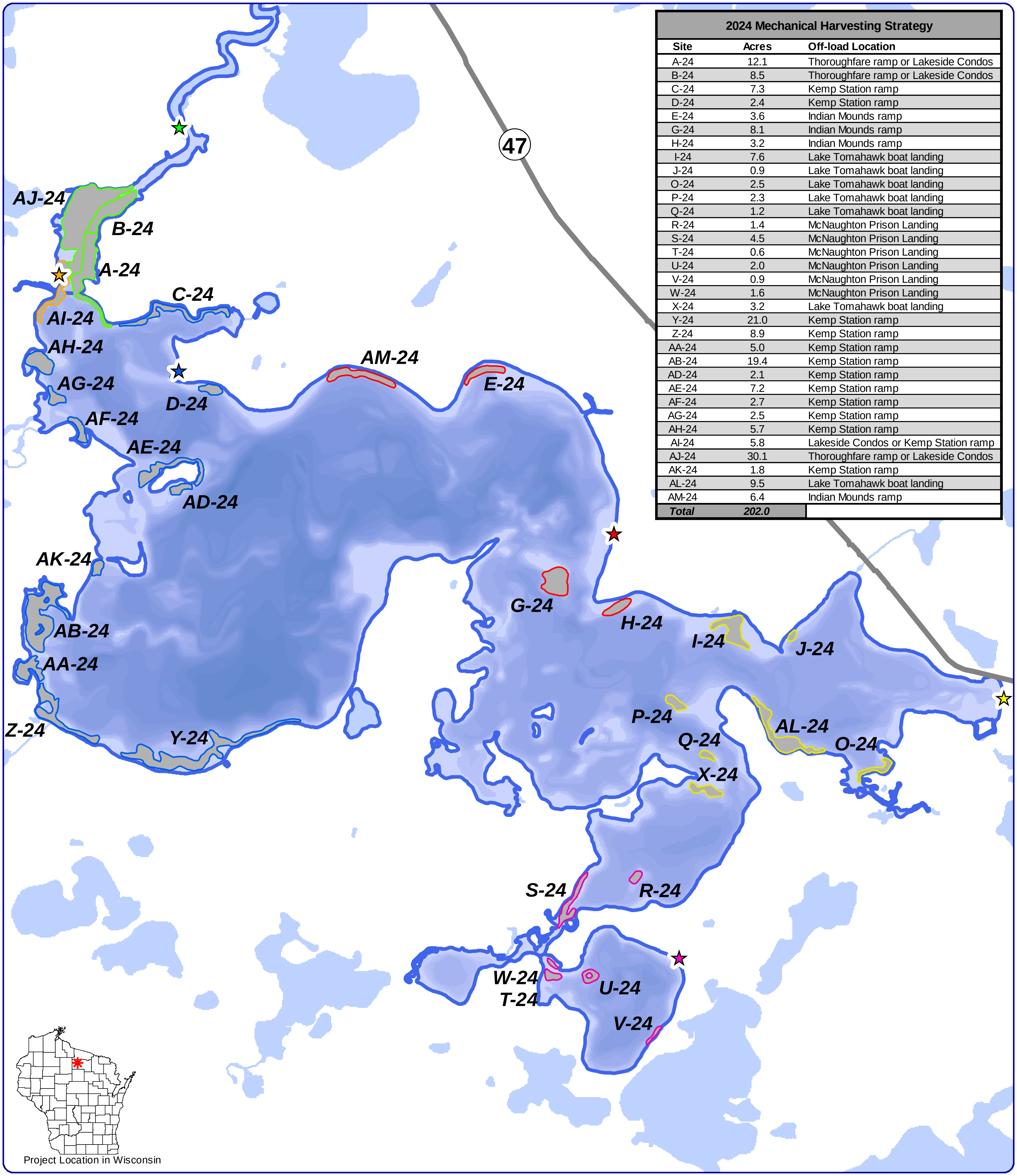
- Present in 2021, absent in 2023
- Present in both 2021 & 2023
- Absent in 2021, Present in 2023

Map 11

Tomahawk System

Oneida County, Wisconsin

Late-Season 2021 vs 2023
EWM Colony Footprints



2024 Mechanical Harvesting Strategy

Site	Acres	Off-load Location
A-24	12.1	Thoroughfare ramp or Lakeside Condos
B-24	8.5	Thoroughfare ramp or Lakeside Condos
C-24	7.3	Kemp Station ramp
D-24	2.4	Kemp Station ramp
E-24	3.6	Indian Mounds ramp
G-24	8.1	Indian Mounds ramp
H-24	3.2	Indian Mounds ramp
I-24	7.6	Lake Tomahawk boat landing
J-24	0.9	Lake Tomahawk boat landing
O-24	2.5	Lake Tomahawk boat landing
P-24	2.3	Lake Tomahawk boat landing
Q-24	1.2	Lake Tomahawk boat landing
R-24	1.4	McNaughton Prison Landing
S-24	4.5	McNaughton Prison Landing
T-24	0.6	McNaughton Prison Landing
U-24	2.0	McNaughton Prison Landing
V-24	0.9	McNaughton Prison Landing
W-24	1.6	McNaughton Prison Landing
X-24	3.2	Lake Tomahawk boat landing
Y-24	21.0	Kemp Station ramp
Z-24	8.9	Kemp Station ramp
AA-24	5.0	Kemp Station ramp
AB-24	19.4	Kemp Station ramp
AD-24	2.1	Kemp Station ramp
AE-24	7.2	Kemp Station ramp
AF-24	2.7	Kemp Station ramp
AG-24	2.5	Kemp Station ramp
AH-24	5.7	Kemp Station ramp
AI-24	5.8	Lakeside Condos or Kemp Station ramp
AJ-24	30.1	Thoroughfare ramp or Lakeside Condos
AK-24	1.8	Kemp Station ramp
AL-24	9.5	Lake Tomahawk boat landing
AM-24	6.4	Indian Mounds ramp
Total	*202.0*	

N W E S

1,500 Feet

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

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plants: Onterra, 2023
Map Date: October 23, 2023 - EJH

Legend

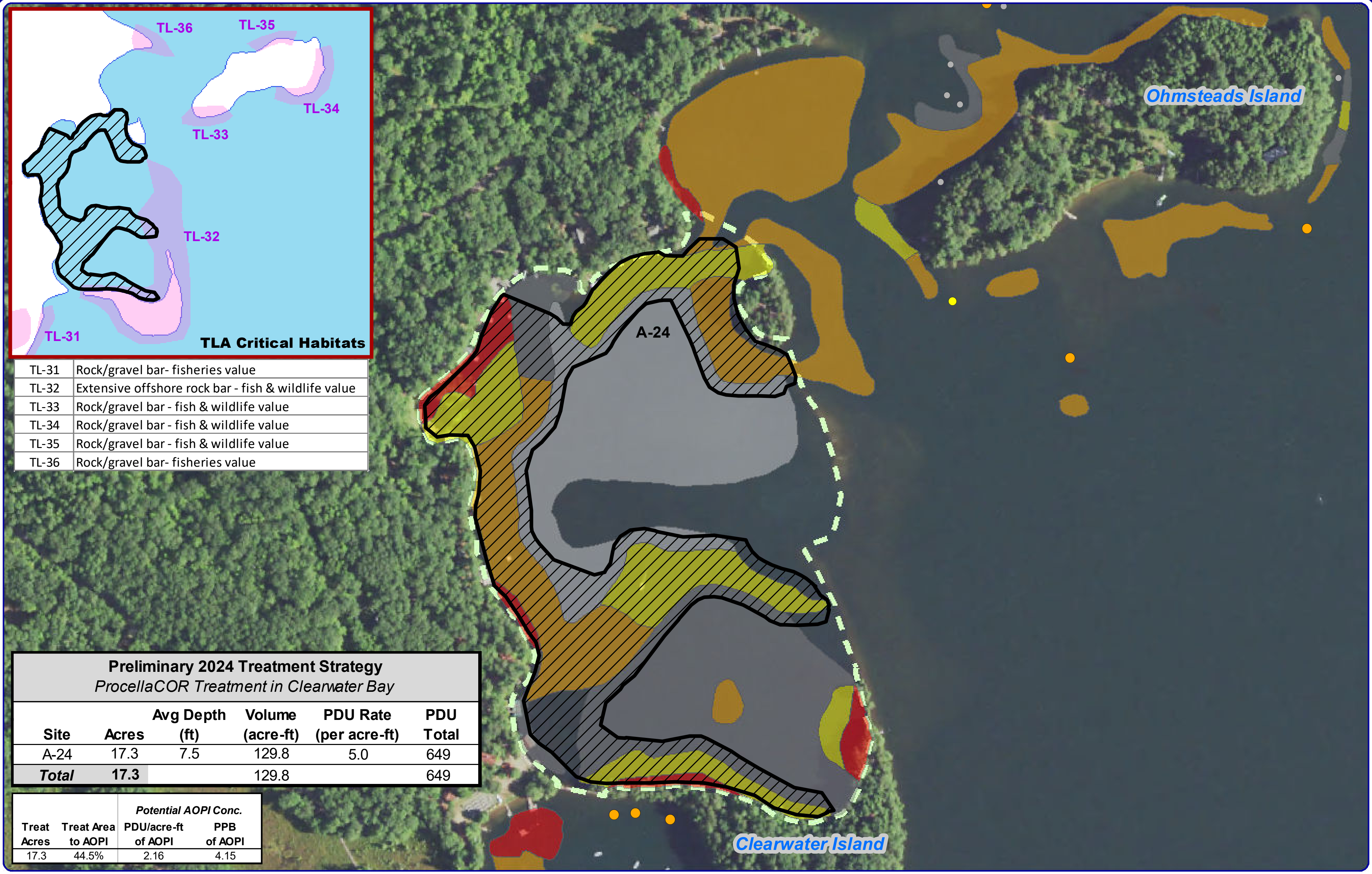
Mechanical Harvest Sites - Off-load Locations

- Indian Mounds Ramp
- Kemps Station Ramp
- Lake Tomahawk Ramp
- Lakeside Condos or Kemps Station Ramp
- McNaughton Prison Ramp
- Thoroughfare Ramp or Lakeside Condos

Map 12

Tomahawk System
Oneida County, Wisconsin

2024 Mechanical Harvest Plan v1



TL-31	Rock/gravel bar- fisheries value
TL-32	Extensive offshore rock bar - fish & wildlife value
TL-33	Rock/gravel bar - fish & wildlife value
TL-34	Rock/gravel bar - fish & wildlife value
TL-35	Rock/gravel bar - fish & wildlife value
TL-36	Rock/gravel bar- fisheries value

Preliminary 2024 Treatment Strategy
ProcellaCOR Treatment in Clearwater Bay

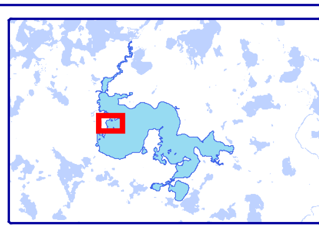
Site	Acres	Avg Depth (ft)	Volume (acre-ft)	PDU Rate (per acre-ft)	PDU Total
A-24	17.3	7.5	129.8	5.0	649
Total	**17.3**		129.8		649

Treat Acres	Treat Area to AOPI	*Potential AOPI Conc.* PDU/acre-ft of AOPI	PPB of AOPI
17.3	44.5%	2.16	4.15

410
Feet

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

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2023
Orthophtography: NAIP, 2020
Map Date: October 12, 2023 JMB



Legend

Eurasian watermilfoil (September 18-20, 2023)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2024 Preliminary Applicaiton Area
- Clearwater Bay - Area of Potential Impact (AOPI)

Map 13

Tomahawk Lake
Oneida Co, Wisconsin

Preliminary 2024 EWM Treatment Strategy v2

A

APPENDIX A

Tomahawk Lake EWM Management Report 2023 – *Aquatic Plant Management LLC.*

- **2023 Mechanical Harvesting Results**
- **2023 Riparian DASH Results**
- **2023 ProcellaCOR Treatment Results**

Tomahawk Lake
EWM Management Report 2023

PO Box 1134 Minocqua, WI 54548

Executive Summary

- Tomahawk Lake in Oneida County, WI has an extensive population of Eurasian Watermilfoil (EWM) covering **200+ acres**

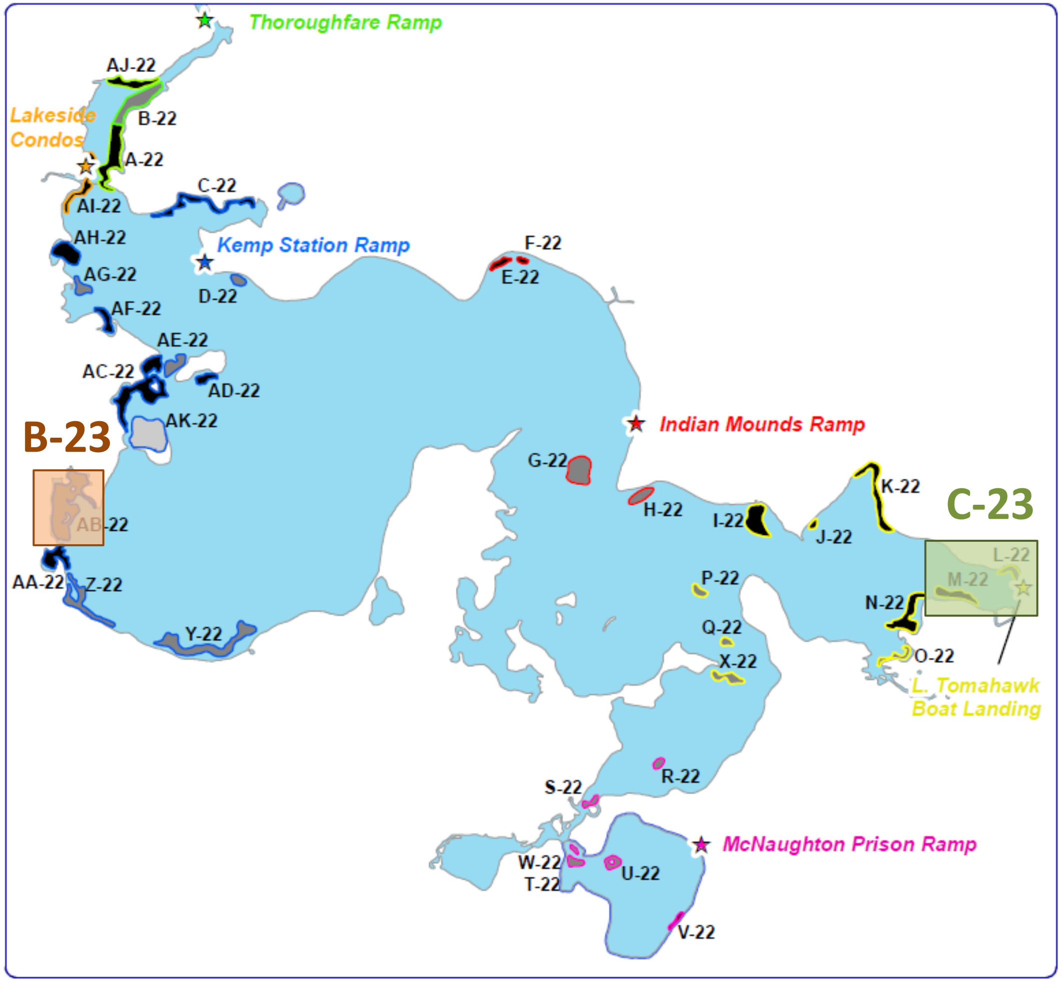
- To address the EWM population, the Tomahawk Lake Association (TLA) and Aquatic Plant Management (APM) partnered on a **multi-year program of mechanical harvesting, diver assisted suction harvesting (DASH), and herbicide control**

- In the first year of the program, APM completed
  - ~90 days of mechanical harvesting, removing ~123K cubic feet of EWM from 36 prioritized sites throughout the lake
  - DASH at 10 different locations, removing 810 cubic feet for TLA members who received a discounted DASH rate through the program

- In the second year of the program, APM completed:
  - ~94.5 days of mechanical harvesting, removing ~130K cubic feet of EWM from 39 prioritized sites throughout the lake
  - DASH at 10 different locations, removing 897 cubic feet for TLA members who received a discounted DASH rate through the program
  - Herbicide (ProcellaCOR) treatment of 14.5 acres of EWM near the Lake Tomahawk boat landing

- In total, APM has **removed 254K cubic feet** of EWM from Tomahawk Lake in 2022 and 2023

2023 EWM Management Approach



Source: 4.21.2022 EWM Survey Completed by Onterra LLC; Site Selection & Prioritization by TLA

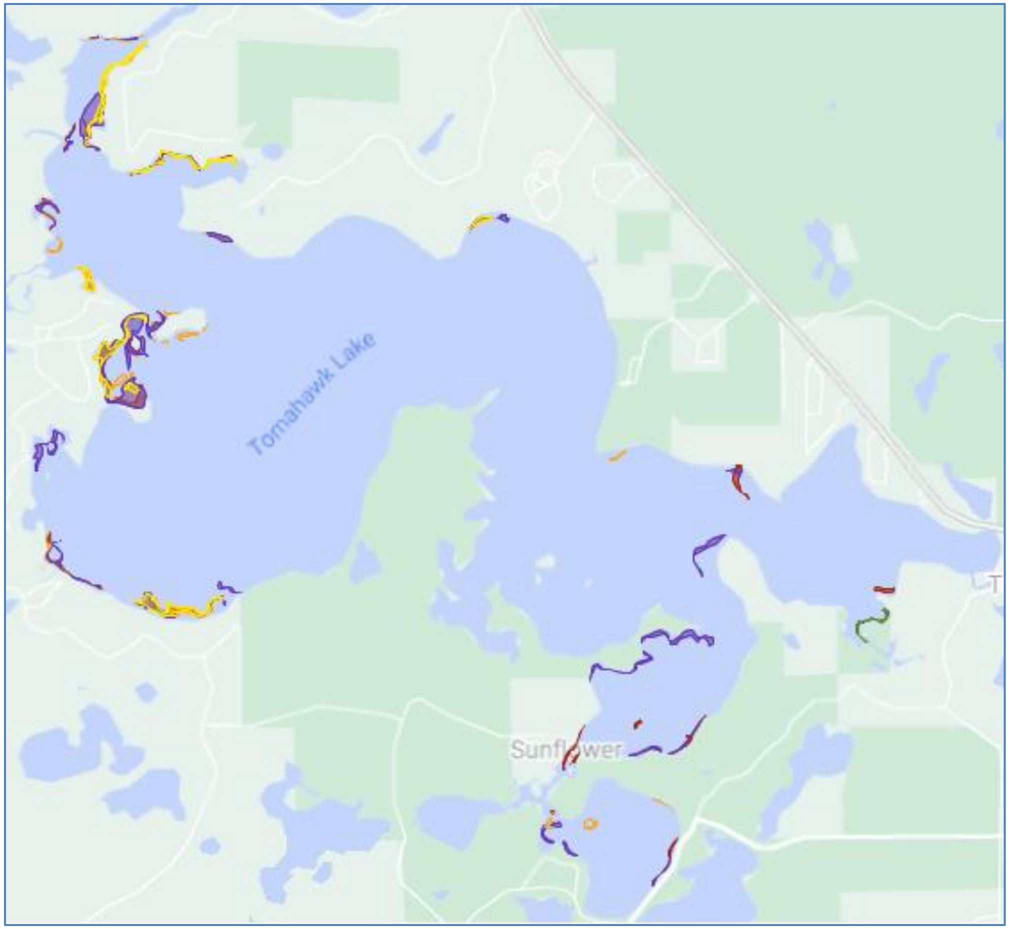
Mechanical Harvesting Approach

- Continue similar approach as 2022 with primary focus on Total Colony Harvests
- EWM low enough in water column where cutting access lanes not required
- Continued focus on late season harvest for overall EWM reduction, giving native plants a chance in Spring 2024

ProcellaCOR Spot Treatment

- Two sites were proposed, WDNR approved a single site (C-23) near Lake Tomahawk boat landing
- Non-approved site (B-23) was rejected due to walleye spawning concerns
- On Wednesday, June 14th, APM **treated 14.5 acres at site C-23 with 443 PDUs** (Prescribed Dosage Unit) of ProcellaCOR

2023 Mechanical Harvesting Results



		Cubic Feet Removed		
Area	**Acres**	**2022**	**2023**	**More (Less)**
Indian Mounds	6.9	2,740	3,650	910
Lake Tomahawk	50.7	35,027	21,630	(13,397)
Southeast	38	2,866	14,050	11,184
East Total	**95.6**	**40,633**	**39,330**	**(1,303)**
Kemp	19.6	19,787	15,867	(3,920)
Lakeside	29.7	10,938	12,700	1,762
Olmstead	35.5	25,212	39,703	14,491
Southwest	44.4	26,064	22,200	(3,864)
West Total	**129.2**	**82,001**	**90,470**	**8,469**
Grand Total	**224.8**	**122,634**	**129,800**	**7,166**

Legend Jun Jul Aug Sep Oct

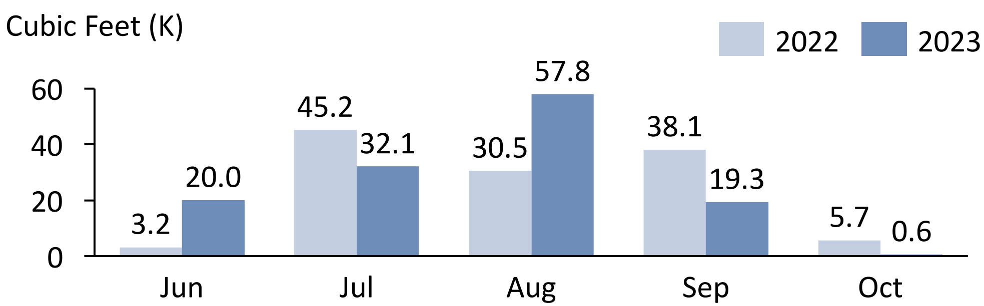
Source: APM Harvest Records June – October 2023

Summarized Harvesting Results

Mechanical Harvesting Commentary

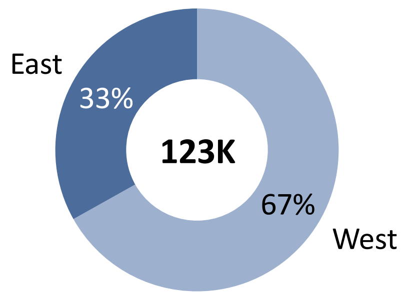
- The bulk of the EWM harvest occurred in the months of July and August when ~70% of the total biomass was removed
- Two thirds of the EWM was harvested from 17 sites in the western portion of the lake
- EWM fragmentation was noted by riparians as a result of boat traffic and harvesting; APM made best efforts to remove floating fragments but prioritized the total colony harvest strategy per discussions with the TLA
- The main hinderance to productivity was the distance between some of the large, dense beds in the southwest portion of the lake, and the nearest off-load location at Kemp station

Harvest by Month



	Jun	Jul	Aug	Sep	Oct
Days[1]	16.1	21.1	43.5	14.1	1.0
# of Sites	17	23	24	10	1

Harvest by Lake Section



- **East**: Main offload location at Lake Tomahawk Landing
- **West**: Main offload location at Kemp Station

Source: APM Harvest Records June – October 2023

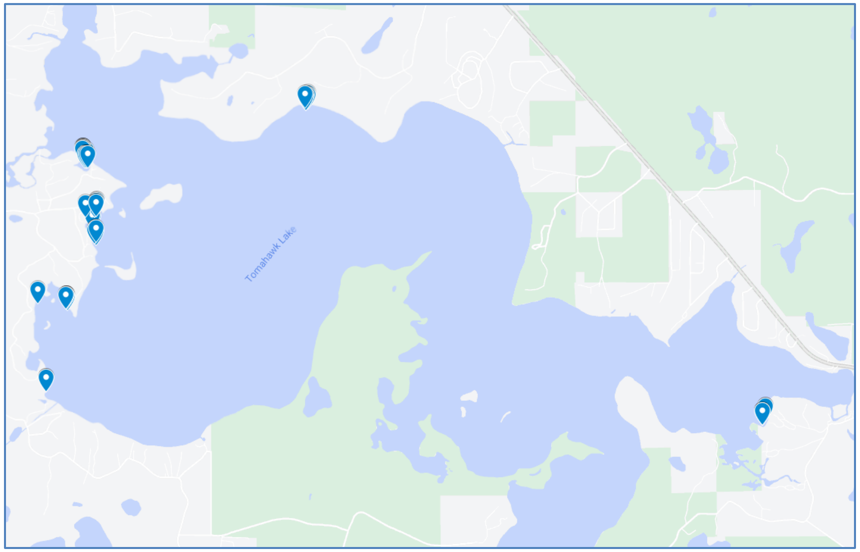
1) Day corresponds to 8 hours of harvesting; some dates included up to 14 hours of harvesting

Riparian DASH Harvest Results

Diver Assisted Suction Harvesting Commentary

- 9 TLA members took advantage of the discounted DASH program to remove EWM from in and around their piers, boat lifts, and swim areas
- APM targeted shallower areas of AF-22 with DASH to clear areas the harvester could not reach
- In total, APM was able to remove 897 cubic feet with ~116 hours of underwater dive time

Location	Avg. Water Depth	# of Dives	Underwater Dive Time	AIS Removed (cubic feet)
Riparian 1	7.5	5	7.2	55.0
Riparian 2	5.3	7	13.5	153.0
Riparian 3	7.8	6	11.5	33.0
Riparian 4	6.0	2	7.5	44.5
Riparian 5	5.0	1	7.5	30.0
Riparian 6	8.0	7	14.1	124.5
Riparian 7	5.5	2	7.5	40.0
Riparian 8	6.5	2	6.8	45.0
Riparian 9	7.4	4	7.3	60.5
AF-22 Bay	5.0	14	33.3	311.5
Grand Total	**6.4**	**50**	**116.2**	**897.0**

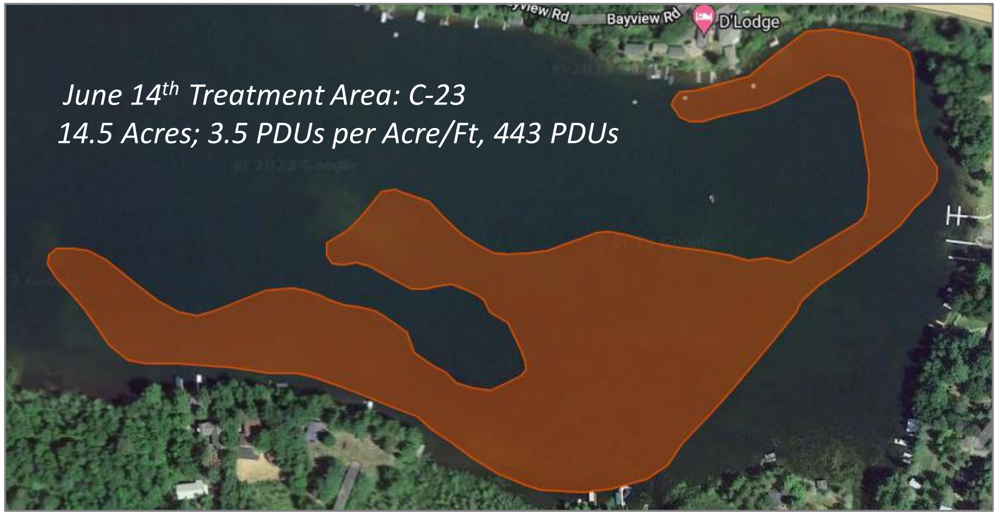


Source: APM DASH Records June – September 2023

June 14th ProcellaCOR Treatment Recap

Herbicide Treatment Commentary

- Onterra LLC completed pre-treatment survey on June 12th, confirming a modified treatment plan of 443 PDUs based on higher water levels than originally planned
- On June 14th, 2023, APM completed a treatment under the supervision of both Wisconsin Department of Natural Resources (WDNR) and Department of Agriculture, Trade and Consumer Protection (DATCP) personnel
- Conditions were ideal for the herbicide spot treatment, with a recorded wind speed of 2.6 MPH, starting at 5:58 AM and ending at 8:23 AM



Next Steps

- TLA and APM plan to create a 2024+ prioritization strategy prior to the start of the management season. Factors to consider include spring survey results, grant funding and budget, management goals, and TLA member feedback

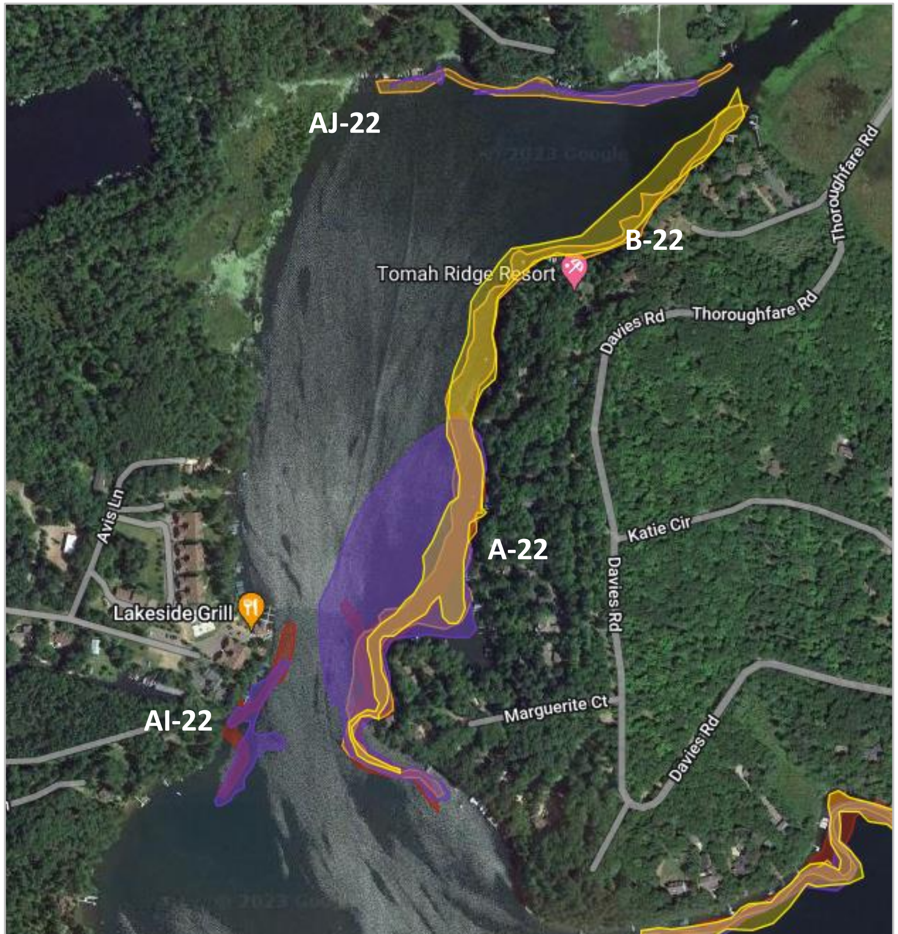
- There will be more focus on saving planned harvest days for the late season (Sep-Oct)

- TLA and APM should discuss a strategy for fragment collection as fragmentation was common complaint from riparians

- TLA should continue to consider other management options (e.g., herbicides) for the densest beds that have high traffic (e.g., AC-22) so the harvesting can maximize time in other areas

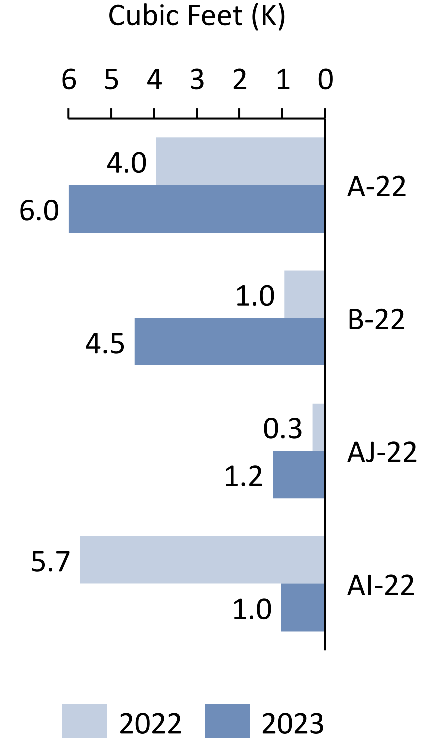
Mechanical Harvesting Maps

Mechanical Harvesting Results | Lakeside



Legend Jun Jul Aug Sep Oct

Harvest Details by Site



Site	Hours	Cuts
A-22	25.6	15
B-22	8.8	11
AJ-22	2.6	3
AI-22	3.9	3

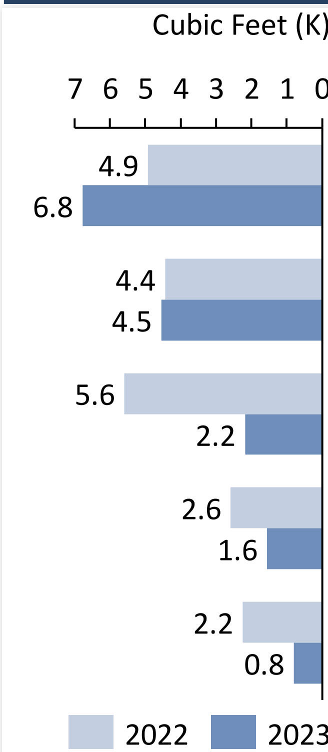
	Cubic Feet (K)	Hours	Cuts
Total	12.7	40.8	32
% of Lake	9.8%	11.2%	9.5%

Source: APM Harvest Records June 2022 – October 2023

Mechanical Harvesting Results | Kemp

Legend: Jun, Jul, Aug, Sep, Oct

Harvest Details by Site

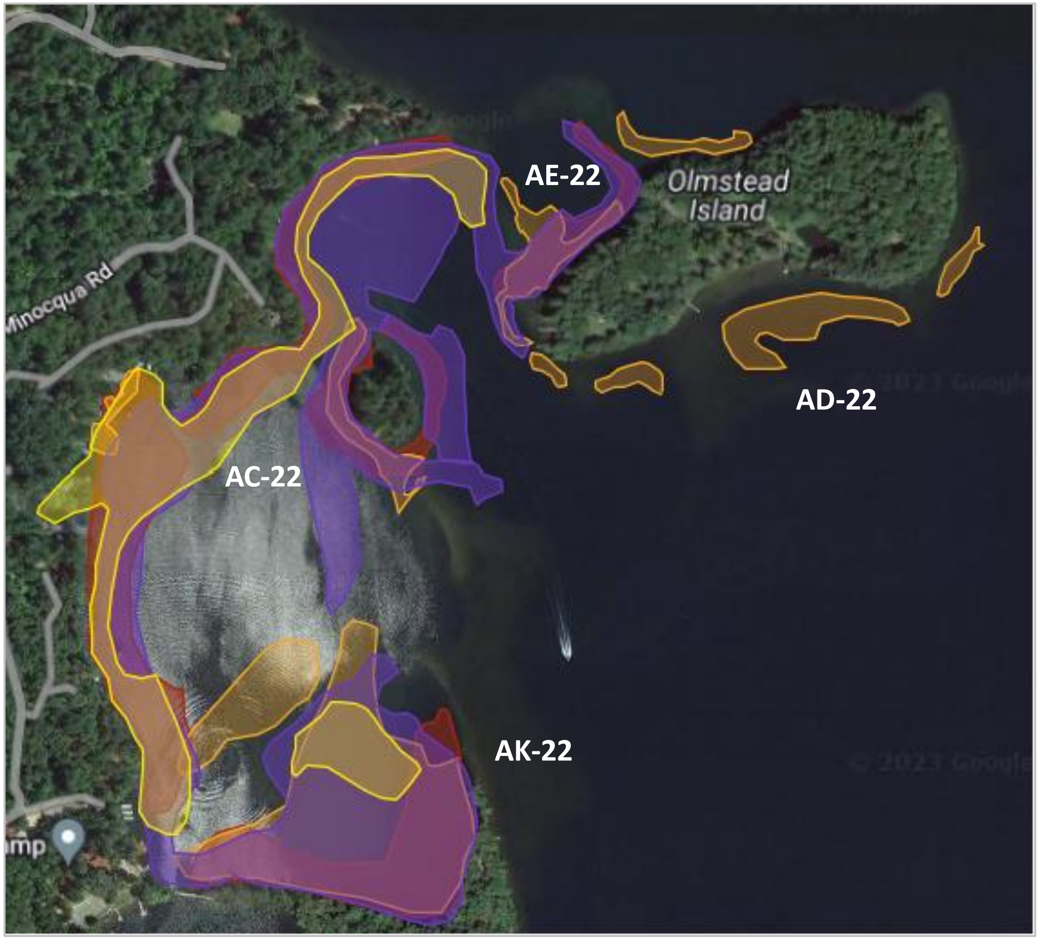


	Hours	Cuts
C-22	23.6	18
AF-22	11.6	13
AH-22	8.3	7
D-22	3.4	5
AG-22	2.0	2

	Cubic Feet (K)	Hours	Cuts
Total	15.9	48.8	45
% of Lake	12.2%	13.3%	13.4%

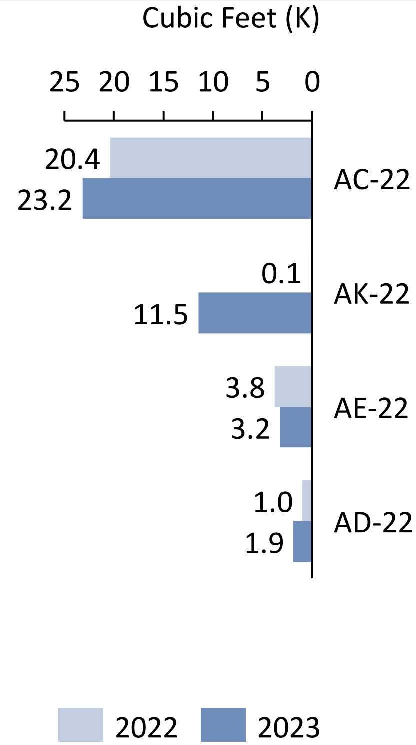
Source: APM Harvest Records June 2022 – October 2023

Mechanical Harvesting Results | Olmstead



Legend Jun Jul Aug Sep Oct

Harvest Details by Site

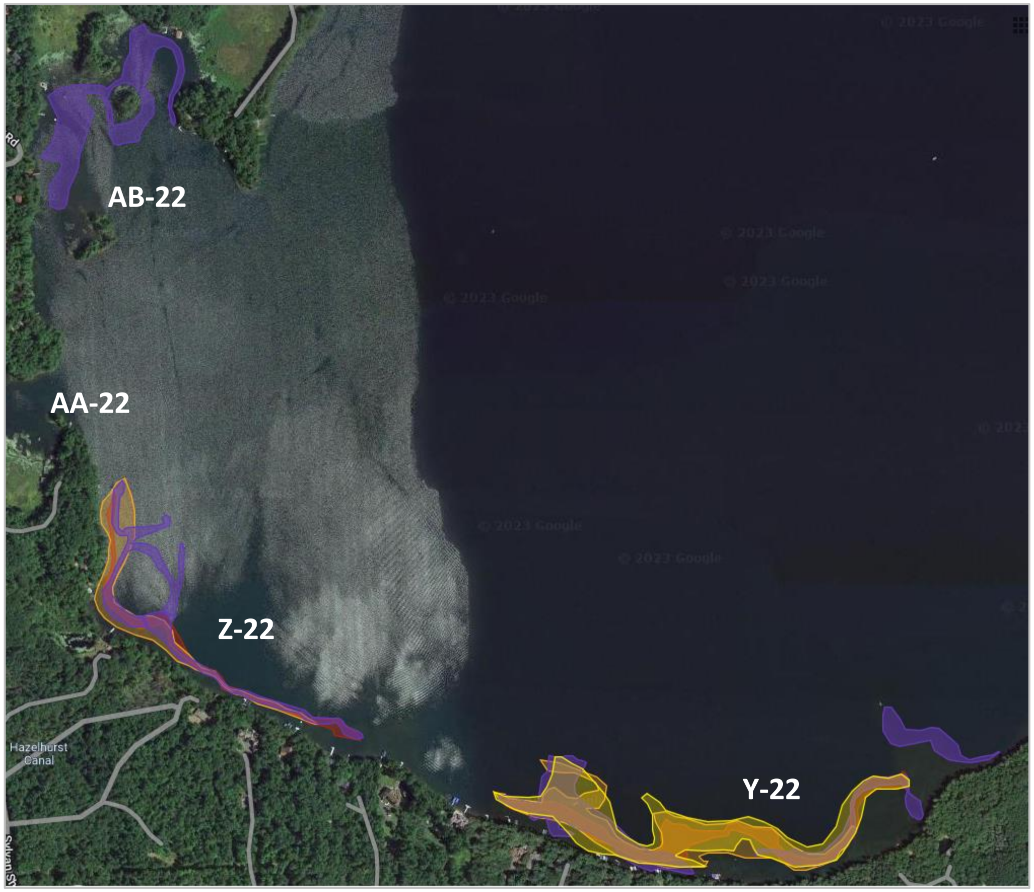


Site	Hours	Cuts
AC-22	78.5	58
AK-22	29.9	28
AE-22	8.9	8
AD-22	4.6	5

	Cubic Feet (K)	Hours	Cuts
Total	39.7	121.9	99
% of Lake	30.6%	33.3%	29.5%

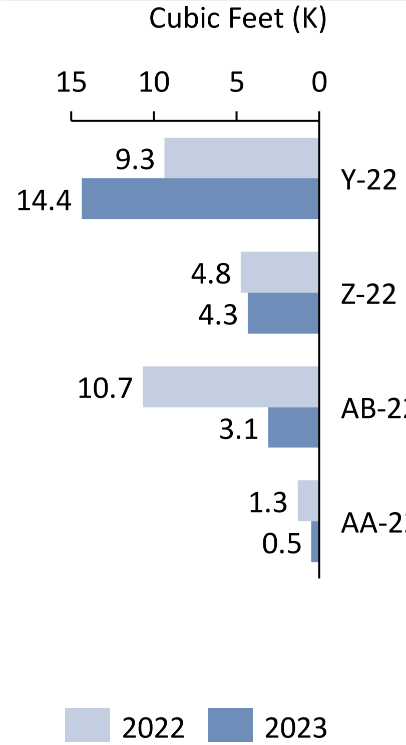
Source: APM Harvest Records June 2022 – October 2023

Mechanical Harvesting Results | Southwest



Legend: Jun, Jul, Aug, Sep, Oct

Harvest Details by Site



Site	Hours	Cuts
Y-22	37.2	34
Z-22	14.3	12
AB-22	12.4	8
AA-22	0.8	1

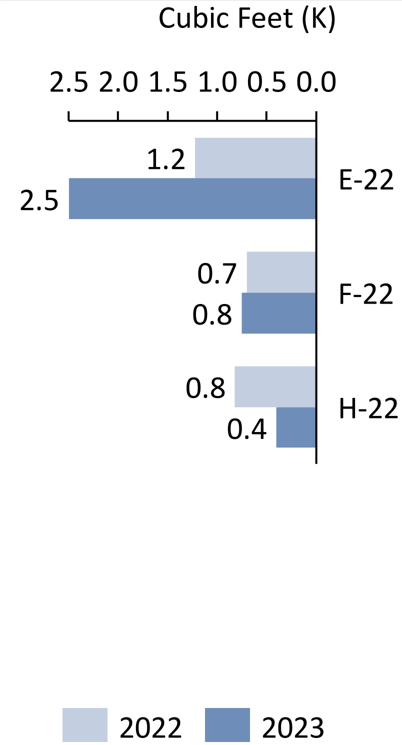
	Cubic Feet (K)	Hours	Cuts
Total	22.2	64.7	55
% of Lake	17.1%	17.7%	16.4%

Source: APM Harvest Records June 2022 – October 2023

Mechanical Harvesting Results | Indian Mounds

Legend Jun Jul Aug Sep Oct

Harvest Details by Site

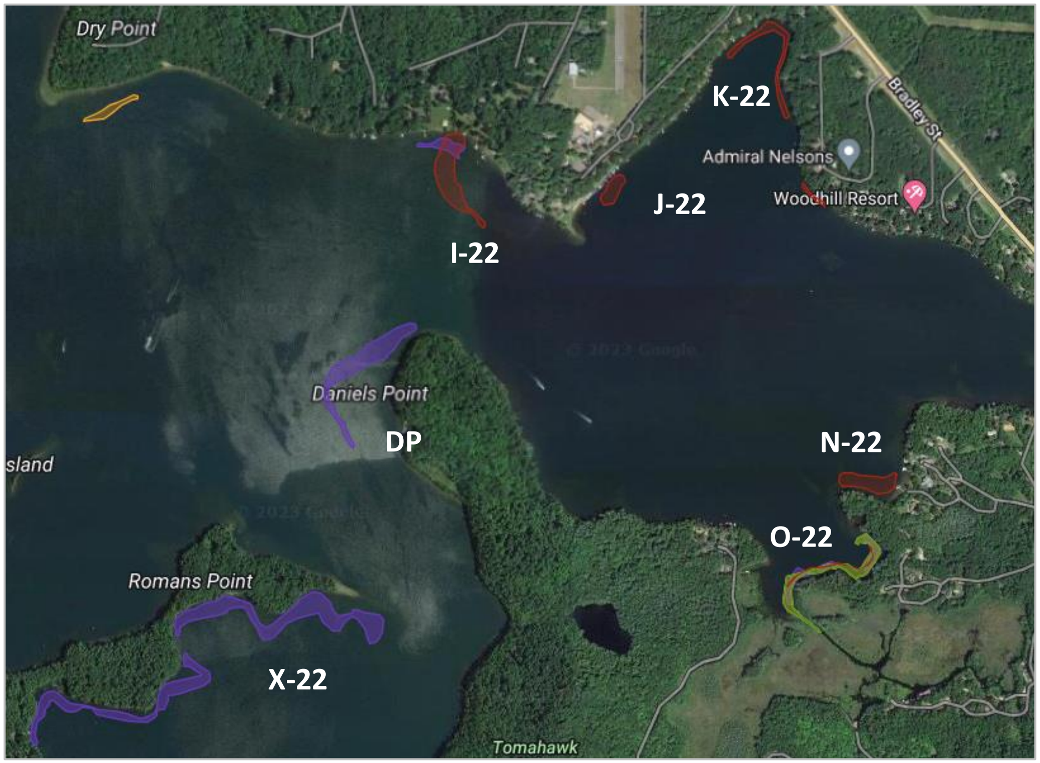


Site	Hours	Cuts
E-22	7.8	7
F-22	1.9	2
H-22	1.0	1

	Cubic Feet (K)	Hours	Cuts
Total	3.7	10.7	10
% of Lake	2.8%	2.9%	3.0%

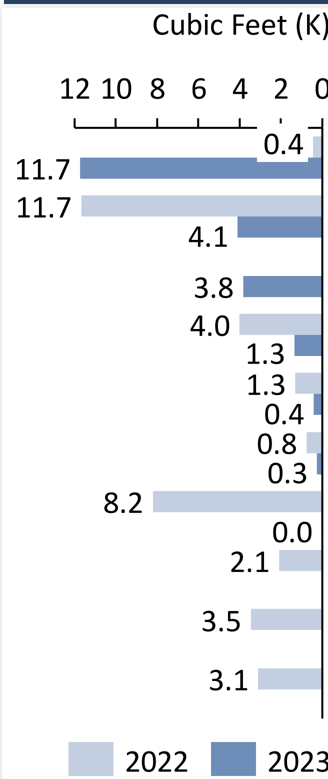
Source: APM Harvest Records June 2022 – October 2023

Mechanical Harvesting Results | Lake Tomahawk



Legend Jun Jul Aug Sep Oct

Harvest Details by Site

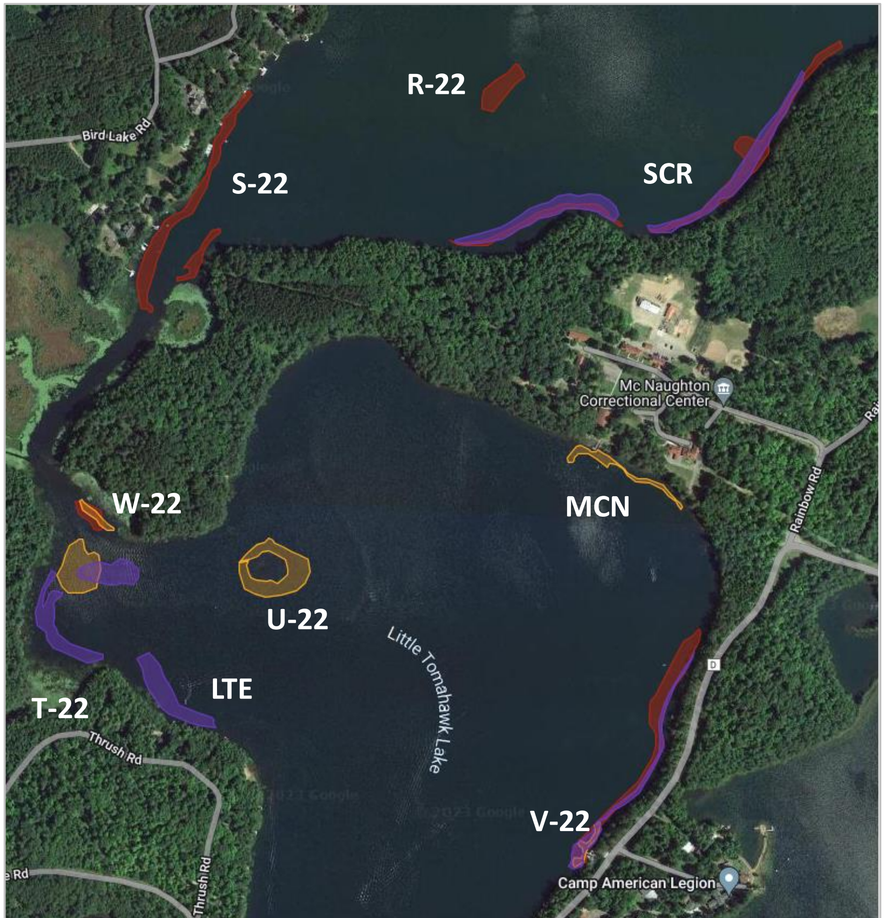


Site	Hours	Cuts
X-22	22.5	27
I-22	8.0	11
DP	7.2	9
O-22	7.5	5
K-22	1.6	1
J-22	0.7	1
N-22	0.4	1
P-22	-	-
M-22	-	-
L-22	-	-

	Cubic Feet (K)	Hours	Cuts
Total	21.6	47.9	55
% of Lake	16.7%	13.1%	16.4%

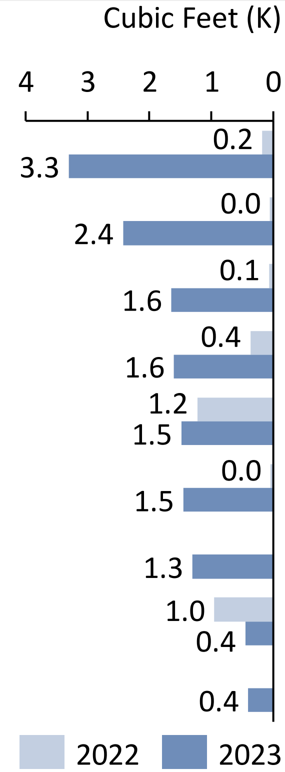
Source: APM Harvest Records June – October 2022

Mechanical Harvesting Results | Southeast



Legend Jun Jul Aug Sep Oct

Harvest Details by Site



Site	Hours	Cuts
SCR	6.5	8
V-22	5.3	8
W-22	3.1	6
U-22	2.9	4
S-22	4.0	4
T-22	3.4	4
MCN	2.3	3
R-22	2.4	2
LTE	1.4	1

	Cubic Feet (K)	Hours	Cuts
Total	14.1	31.2	40
% of Lake	10.8%	8.5%	11.9%

Source: APM Harvest Records June – October 2023

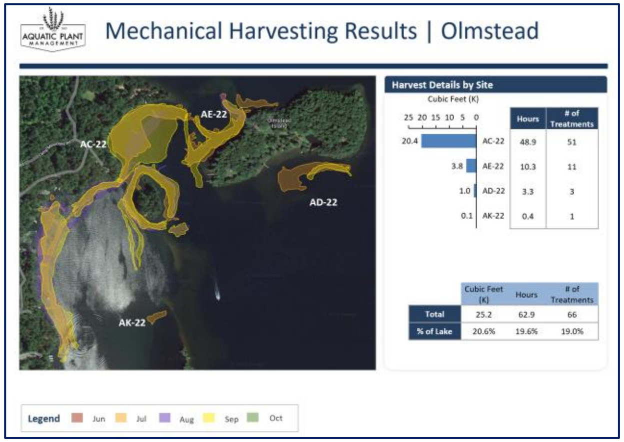
Appendix

2022 Mechanical Harvesting Highlights

2022 Mechanical Harvest Approach

- **Riparian Access Lanes:** APM started the season by harvesting 'access lanes' from riparian piers/ lifts to the main section of the lake
- **Total Colony Harvest:** After lanes are harvested, the approach shifted to target full colonies *prioritized by boat traffic and density*
- APM worked down the site priority list as **wind conditions permitted** making best efforts to **minimize transit time** between sites/offloads
- **Late season (Sep/Oct) harvests** to limit ability for Spring 2023 rebound

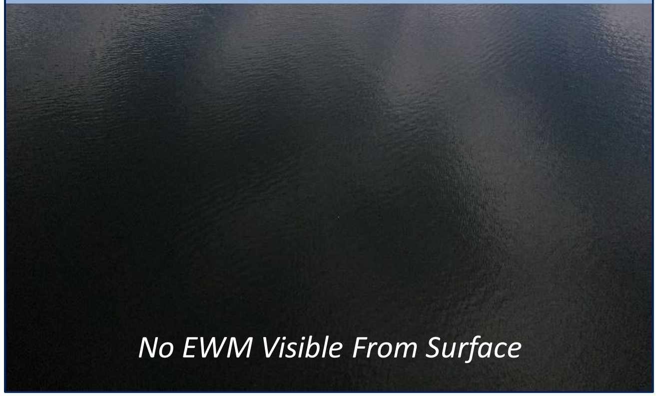
Example Harvest Results



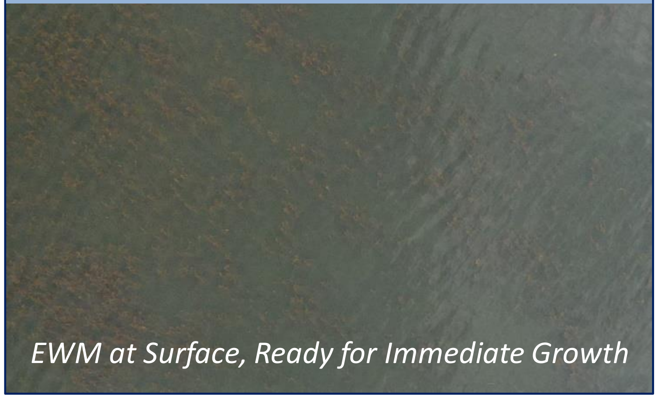
Site	Hours	# of Treatments
AC-22	48.9	51
AE-22	10.3	11
AD-22	3.3	3
AK-22	0.4	1

	Cubic Feet (K)	Hours	# of Treatments
Total	25.2	62.9	66
% of Lake	20.6%	19.6%	19.0%

*May 14th 2023: Clearwater Bay **with** Late September/ Early Oct Harvest*



*May 14th 2023: Clearwater Bay **without** Late September/ Early Oct Harvest*



B

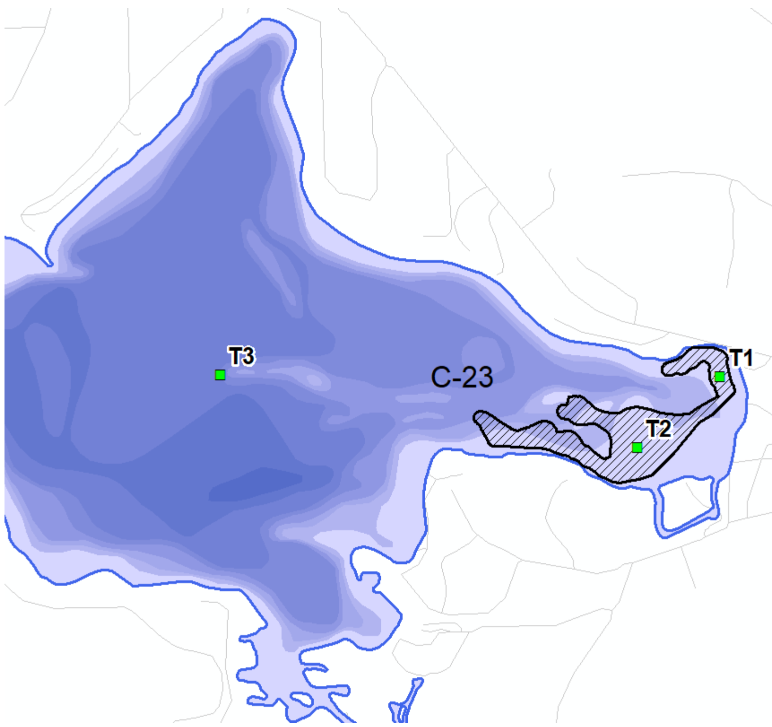
APPENDIX B

2023 Herbicide Concentration Monitoring Plan

Tomahawk Lake, Oneida County (WBIC: 1542700)
2023 Herbicide Sample Plan
Onterra, LLC

Tomahawk Lake located in Oneida County, is an approximately 3,462-acre drainage lake that has a maximum depth of 84 feet. Florpyrauxifen-benzyl (commercially as ProcellaCOR™) is proposed to be applied to the application area, C-23, on the East side of Tomahawk Lake: an area totaling 14.9 acres, in early-summer 2023, to control Eurasian watermilfoil. Herbicide concentration sampling will be conducted in order to monitor the herbicide concentrations in the hours and days following the application.

Water samples will need to be collected at the sites and depths listed below. Coordinates are in decimal degrees. Locations of each sampling site are displayed with green squares on the image below.



Tomahawk Lake Herbicide Sample Sites					
Site Label	**Site Description**	**Station ID**	**Latitude**	**Longitude**	**Sample Depth**
T1	Application area C-23	10057561	45.817343	-89.601193	Integrated (0-6 feet)
T2	Application area C-23	10057562	45.815845	-89.603718	Integrated (0-6 feet)
T3	East Basin	10057563	45.817432	-89.616378	Integrated (0-6 feet)

Please note that a single sample is to be collected before the treatment as a 'control' for the lab analysis. Please collect the pre-treatment sample from site T1 at a time that is most convenient for the volunteer but as close to the treatment date as possible. After the herbicide application is completed, 19 additional samples will need to be collected at nine different time intervals throughout the project and are listed in the table below. Sample collection intervals are listed either as Hours After Treatment (HAT) or Days After Treatment (DAT). Direct communication between the water sample collector and the herbicide applicator is necessary to ensure the collector is prepared to begin three hours after treatment is completed. If a sample cannot be collected at the interval listed below, please collect the sample as soon as reasonably possible and record the change.

Sampling Interval Matrix (X indicates sample to be collected)			
Interval	Application Area T1	T2	Untreated T3
Pre-Treatment	X		
3 HAT	X	X	
6 HAT	X	X	
9 HAT	X	X	
24 HAT	X	X	X
2 DAT	X	X	
4 DAT	X	X	X
7 DAT	X	X	
14 DAT			X
21 DAT			X
HAT = Hours After Treatment, DAT = Days After Treatment			

All water samples will be collected using a six-foot integrated sampler (Photo 1). A video tutorial demonstrating the proper sample collection methodology is available on Onterra's YouTube web page: click here

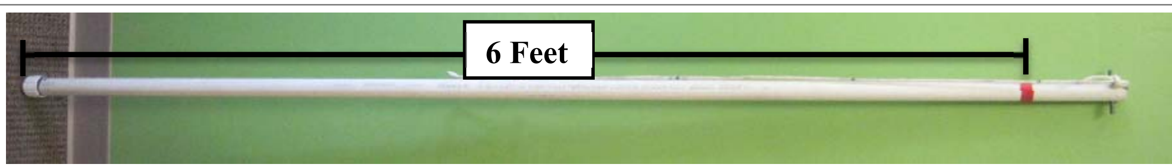


Photo 1. 6-foot Integrated sampling device constructed of PVC tubing.

Due to the extremely low concentrations being measured at the laboratory (<1 part per billion), **it is very important to thoroughly rinse the integrated sampler device and the custom mixing bottle with the water from each sampling site upon arrival at the site**. Water is collected by pushing the integrated sampler straight down to a depth of six feet; or in water shallower than six feet, down to approximately one foot above the bottom sediment. The sampler is brought to the surface and emptied into a customized mixing bottle by pushing open the stop valve at the end of the integrated sampler (Photo 2). Water should be poured from the custom mixing bottle to triple rinse the clear glass bottle. After the clear glass bottle is triple rinsed, it is to be filled for a fourth time with the water from the custom mixing bottle and then carefully poured into the brown glass bottle which has a preservative solution already inside (Photo 3).

Please use a fine-tipped permanent marker to record the date and time the sample is collected on the sticker label of the brown glass bottle. The final sample (in the brown bottle) as well as the emptied clear glass bottle should be carefully placed back within the bubble wrapped pouch to protect from accidental breakage.

While the samples are being collected, they should be kept cold and out of direct sunlight by keeping them in a small cooler on the boat. After collection, all samples should be stored in a refrigerator until shipping.

	
Photo 2. Emptying the water sample from the integrated sampler device into the custom mixing bottle.	**Photo 3. Clear glass mixing bottle and final brown glass bottle.**

Onterra will provide all of the necessary supplies to complete the sampling and provide training to the volunteer(s) collecting the samples. Onterra has a supply of handheld GPS units and integrated sampler devices available to loan out for the duration of the sampling upon request. All other materials, including sampling bottles with labels, a customized mixing bottle and necessary paperwork will be provided.

Please fill out the yellow highlighted fields on the Chain of Custody forms including:

- Sampler: (Volunteer Name)
- Client Sample ID: (example: T1, T2, or T3)
- Date sample is collected

Shipping Instructions

1) When all sampling is complete, make sure all sample vials are placed in bubble wrap within the provided soft cooler.
2) Put an ice pack into the soft cooler. This can also be a frozen water bottle (contained in an unlabeled zip lock bag). Do not place loose ice in the cooler.
3) Find a cardboard box that will fit the soft cooler for transport. If needed, pack empty space with packing material so the soft cooler is secure within the cardboard box.
4) Place the completed Chain of Custody forms in the cardboard box.
5) Only ship Monday - Thursday. The lab will not be open to receive the samples on a Saturday.
6) We recommend utilizing *FedEx Standard Overnight* so the samples can be received the next day by the lab before 4:30PM (when the lab closes).
7) Shipping costs are expected to be $150-$200 for next day delivery.
8) Ship the cardboard box containing the soft-sided cooler bag, water samples, and Chain of Custody forms to the address below:

EPL Bio Analytical Services
9095 W. Harristown Blvd.
Niantic, IL 62551