1.0 INTRODUCTION

Anvil Lake, Vilas County, is an approximate 392-acre mesotrophic seepage lake with a maximum depth of 35 feet estimated during 2020 (Map 1 and Photograph 1.0-1). The lake harbors a high-quality native aquatic plant community with 37 native species, 22 of which have a coefficient of conservatism of 7 or higher. Anvil lake also contains a population of Vasey's pondweed (*Potamogeton vaseyi*), a native aquatic plant listed as special concern in Wisconsin due to its relative rarity. The lake maintains high water clarity, with an average summer Secchi disk depth of 12 feet.

Photograph 1.0-1. Anvil Lake, Vilas County, Wisconsin.

The non-native, invasive aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*; EWM) was discovered in Anvil Lake in the summer of 2012 by Great Lakes Indian Fish and Wildlife Commission (GLIFWC) staff. After being made aware of GLIFWC's discovery, the Wisconsin Department of Natural Resources (WDNR) completed a whole-lake aquatic plant point-intercept survey that same summer which confirmed additional occurrences of EWM within the lake's approximate 25-acre northern bay (North Bay). The Anvil Lake Association (ALA) contracted with Onterra, to map the EWM population in the lake in August of 2012 which determined the population was mainly isolated to the North Bay and largely comprised of single-plant occurrences. Curly-leaf pondweed (CLP) was discovered in 2013, however, its population has never impacted recreational activities and has appeared to integrate itself within the rest of the aquatic plant community.

The ALA was awarded a WDNR AIS-Established Population Control grant in February 2020 that includes funding to carry out the active management and associated monitoring from 2020-2022 (ACEI-241-20). The project includes funds for the ALA to implement an Integrated Pest Management (IPM) strategy that includes a robust hand harvesting effort to follow up the herbicide treatment in 2020. This report discusses the management and monitoring activities that took place during the third year of this project (2022).

1.1 Water Levels

Like many other seepage lakes in Wisconsin, Anvil Lake experiences more dramatic fluctuations in water levels through time when compared to lakes that receive surface water inflow and outflow (drainage lakes). There is a long, mostly continuous, record of lake levels for Anvil Lake spanning from 1936 to present (Figure 1.1-1). Some of the lowest water levels on record occurred approximately from 2004-2015. From 2015-2020, water levels rose relatively rapidly and by 2019 were closer to the historical average depths observed during the first 50 years of available data. Record rainfall in many parts of Wisconsin in recent years contributed to the relatively rapid increase in water depth in Anvil Lake. All told, the water levels rose approximately 5.5 feet between 2015 and 2020. The lake level in 2020 was at the highest it had been in a period of 34 years dating back to 1986 and was less than two feet below the highest ever documented levels recorded in 1943-44. Water levels remained high in the

first half of 2022 before gradually beginning to decrease by approximately one foot between June and November 2022. Water levels have been gradually declining since May 2021.

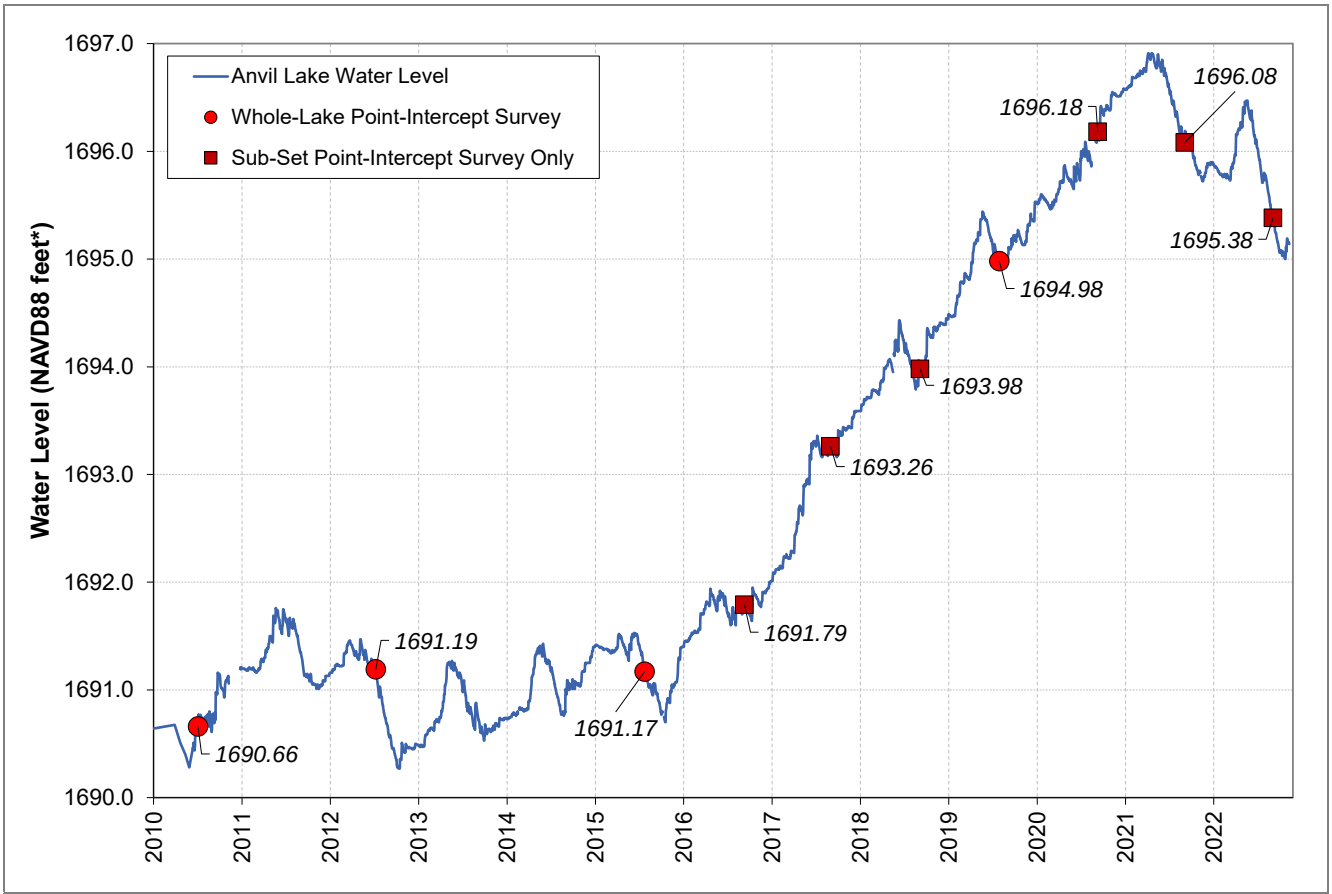


Figure 1.1-1. Anvil Lake water levels from 1936 through November 20, 2022. Created using online data from USGS Gage 05390500 with additional data and benchmarks provided by Dale Robertson, USGS).

The impact that the rising water levels may impose on the aquatic plant communities in Anvil Lake are difficult to determine. Certainly, some species are well adapted to fluctuating water levels, whereas other species may struggle to adapt and survive in deeper waters. The littoral zone in Anvil Lake has changed in recent years as areas that were previously near the deepest limits of plant growth prior to 2015 may now be too deep for aquatic plants to obtain sufficient light to persist. Additionally, exposed lakebed that were present around much of Anvil Lake during periods of low lake levels, are now underwater again and results in "new" littoral areas for plants to establish. Pioneer species, which can include invasive plants such as EWM, are often at an advantage in establishing newly available habitat (i.e. empty niches) in lakes. Much of the EWM population outside of North Bay in Anvil Lake has historically been located in the deeper extents of the littoral area of the lake. As water levels increase, these plants may struggle to receive sufficient sunlight to survive.

1.2 2020 Herbicide Treatment Summary

Figure 1.2-1 reflects the final 2020 herbicide treatment strategy using liquid 2,4-D with an application rate of 1.05 ppm ae over 17.0 acres within North Bay. Herbicide was expected to mix within the North Bay to reach a bay-wide concentration of 0.600 ppm which was expected to have impacts on EWM throughout that area of potential impact (AOPI). The herbicide application was completed on June 4, 2020 by Schmidt's Aquatic, LLC. Monitoring conducted during 2020 indicate a large reduction in the EWM population within the targeted area of North Bay. Comparative pre- and post-treatment EWM mapping surveys and sub-set point-intercept surveys indicated that the 2020 herbicide treatment initially resulted in a high level of control during the *year of treatment*.

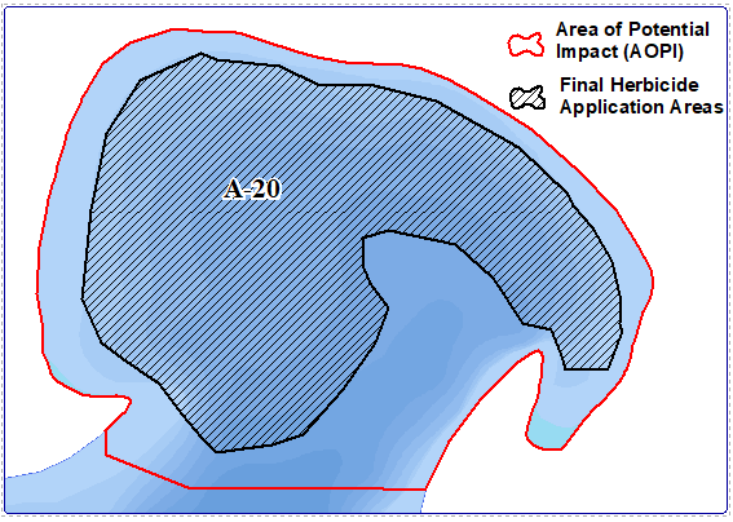


Figure 1.2-1. Anvil Lake 2020 herbicide treatment site in North Bay.

The herbicide concentration monitoring data indicates the 2,4-D concentrations were below target levels in all samples collected within North Bay after treatment. It is suspected that herbicide dissipation was the largest contributing factor resulting in below-target concentrations. Known ground water inputs in this area of the lake may have also increased directional dissipation. Herbicide concentrations measured at the deep hole location following treatment were consistent with predicted estimates. The lake-wide 2,4-D concentrations observed in Anvil Lake were nearly ten times lower than typical whole-lake treatment concentrations.

Environmental factors naturally influence aquatic plant populations as well and it is not known to what extent this played a role in the aquatic plant population dynamics in Anvil Lake. It is suspected that the active management was a significant driver in the reductions of EWM and some native aquatic plants in the studied areas; however, environmental factors, such as water levels, likely also contributed. It is suspected that environmental conditions in Anvil Lake in 2020 were not favorable for EWM growth, in particular, areas where EWM was growing towards the deeper extents of the littoral zone.

1.3 2022 EWM Management & Monitoring Plan

As outlined in the *2020 EWM Monitoring & Control Strategy Assessment Report* (Feb 2021), monitoring of the EWM population indicated a large reduction had occurred within the target area of North Bay following the 2,4-D treatment. The ALA chose to continue with an integrated pest management strategy in 2022 through an aggressive hand-harvesting program with the aid of DASH (Diver Assisted Suction Harvesting). The majority of known EWM occurrences in the lake were considered for hand harvesting removal efforts during 2022. The ALA aimed to suppress the EWM population in the North Bay and other areas within the lake to increase the longevity of control following the 2,4-D treatment.

An ESAIS survey was conducted on June 22, 2022 in order to provide the most up-to-date EWM mapping data to guide the hand harvesting strategy for the rest of summer 2022. The summer hand harvesting efforts were evaluated through the completion of a late-season EWM mapping survey which occurred on September 13, 2022. This survey also served as a guide for future management strategy development in 2023.

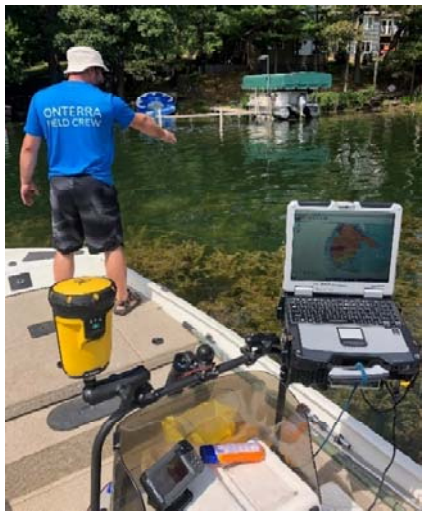
2.0 AQUATIC PLANT MONITORING RESULTS

It is important to note that two main types of aquatic plant surveys are discussed in the subsequent materials: 1) point-intercept surveys and 2) AIS 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 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 on Anvil Lake in 2010, 2012, 2015, and 2019. In depth discussion of these surveys can be found with the *2019 AIS Monitoring & Control Report.*

Using a portion of the whole-lake point-intercept grid, a sub-set point intercept survey allows an understanding of aquatic plant populations in a particular area of a lake. A benefit of a sub-sample point-intercept survey is that data from previous whole-lake point-intercept surveys can be used as comparisons. However, the area being monitored typically has to be relatively large for sufficient sampling locations to be contained within its boundaries for meaningful comparison. Because of the available historic point-intercept data, a sub-set point-intercept survey is used within this project during the mid-summer to understand the aquatic plant population where the herbicide management activities are taking place within the North Bay of Anvil Lake. A sub-set of the whole-lake point-intercept survey comprising 73 sampling points within the North Bay of Anvil Lake has been monitored annually from 2015-2022. In association with the 2020 herbicide treatment, the summer 2019 sub-set point-intercept survey data served as the pre-treatment dataset and is compared to a replication of the survey completed during summer 2020 (post-treatment), 2021 (one-year-post-treatment), and 2022 (two-years-post-treatment).

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 an AIS Mapping Survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photograph 2.0-1). Field crews supplemented the visual survey by deploying a submersible camera along with periodically doing rake tows. The AIS 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



Photograph 2.0-1. EWM mapping survey on a Wisconsin lake. Photo credit Onterra.

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

2.1 Early Season AIS Survey

Onterra's field survey crews conducted an Early Season AIS Survey on Anvil Lake on June 22, 2022. The main objective of the survey was to search the lake for EWM and provide the results to aid the ALA's hand harvesting efforts for the summer. The crews noted sunny skies and light winds during the survey. A Secchi disk reading of 15 ft indicated high water clarity at the time of the survey.

The results of the mapping survey are displayed on Map 2. Crews initially completed the visual meander survey around the littoral areas of the lake and located EWM visually from the surface. Following the visual survey, the crews deployed submersible cameras within deeper areas (9-12ft) where EWM had been located previously in surveys. Numerous camera transects through the south bay of the lake yielded a few more *single or few plant* occurrences EWM. Within the north bay of Anvil Lake, EWM was visibly mapped from the surface. Numerous point data was collected including a *highly scattered* colony. Onterra provided the spatial data from the June 2022 survey to the ALA to guide the hand harvesting efforts for the season.

2.2 North Bay Sub-Set Point-intercept Data Analysis

A subset of the whole lake point intercept survey located in the North Bay of Anvil Lake has been sampled annually from 2015-2022. Previous reports have documented the progression of EWM and native aquatic plant species in this data set. Figure 2.2-1 displays the monitoring results from this site during the timeframe surrounding the 2020 herbicide treatment with 2019 representing pre-treatment, 2020 representing the year of treatment, and 2021/2022 representing the years-after-treatment. A total of 73 sampling locations are included in the analysis, however in any given year, some sampling locations were not sampled when the sampling location was found to be terrestrial or non-navigable. This dataset was intended to specifically monitor the EWM and native plant population dynamics during this period of active management. Because of their morphological similarity and often difficulty in differentiating between them, the occurrences of muskgrasses (*Chara* spp.) and stoneworts (*Nitella* spp.), small pondweed (*Potamogeton pusillus*) and slender pondweed (*P. berchtoldii*), as well as common (*Elodea canadensis*) and slender waterweeds (*E. nuttallii*) were combined for this analysis.

Prior to the herbicide treatment, the 2019 survey found EWM was present on 55 sampling locations for a littoral frequency of occurrence of 79.7%. After the herbicide treatment, EWM was detected at one sampling location during a replication of the survey in September 2020 resulting in an occurrence of 1.4%. The year-after-treatment replication of the survey completed in 2021 also recorded EWM at one sampling location for an occurrence of 1.4%. Two years after treatment EWM was recorded on four sampling locations for an occurrence of 5.6%. The reduction in the occurrence of EWM between the pre-treatment and year-after-treatment surveys exceeded quantitative success criterion for the treatment. Monitoring in 2022 indicated a slight increase in the EWM occurrence in the study area, but at 5.6%, it remains well below pre-treatment levels.

Potential impacts to the native aquatic plant species within North Bay can be evaluated by comparing the littoral frequency of occurrence before (2010-2019) and after (2020 - 2022) the treatment. These data from the past four years are displayed in Figure 2.2-1 below. The collective occurrence of common

and slender waterweed exhibited a statistically valid 64.4% decrease in occurrence between 2019 and 2020. Common waterweed is not believed to be particularly sensitive to 2,4-D treatments. Onterra has reviewed data from a number of regional lakes that have not conducted herbicide management strategies, noting declining common waterweed populations in many of them. It is possible that some combination of herbicide treatment and environmental factors contributed to the decline of this species from 2019-2020. In 2021 the population rebounded somewhat to 30% littoral frequency of occurrence which was maintained during 2022.

The collective occurrence of small and slender pondweed exhibited a statistically valid 82.3% decrease from 2019-2020. These species are known to be highly sensitive to 2,4-D, even at low concentrations. In some cases, these species have recovered relatively quickly in the years following treatment; however, in other cases rebound is slower. These sensitive pondweed species appear to be recovering well with a littoral frequency of occurrence of 11% in 2021 and nearing 13% in 2022. Despite EWM beginning to recover in 2022, no native species present in the study area showed a statistical change in occurrence between 2021 and 2022. Appendix A displays the littoral frequency of occurrence for all species in the study area from 2010-2022.

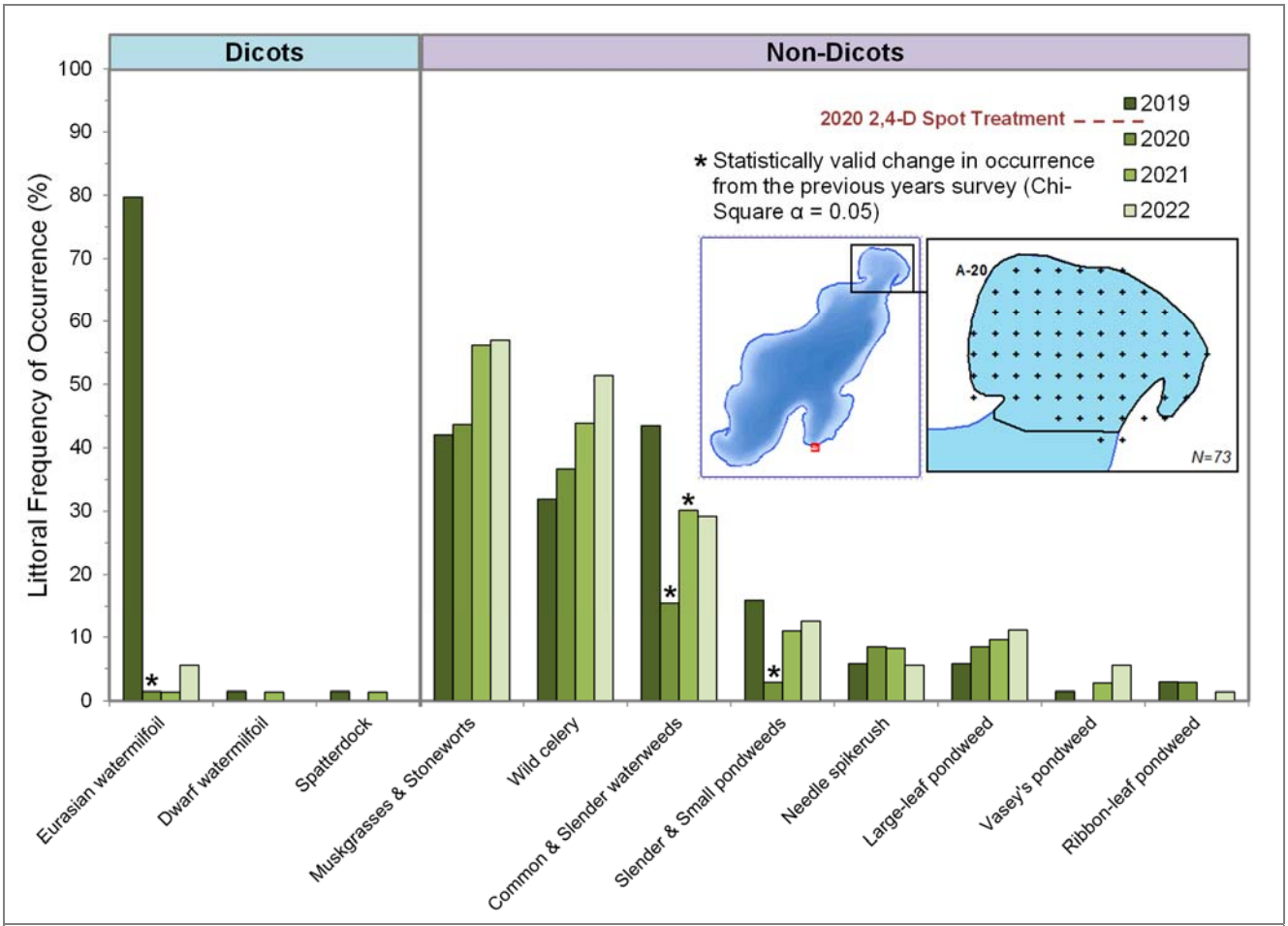


Figure 2.2-1. Frequency of occurrence of EWM and native aquatic plant species within North Bay of Anvil Lake from 2019-2022. (40-meter spacing, N=73) 2019 n=69, 2020 n=71, 2021 n=73, 2022 n=72.

2.3 Late-Season EWM Mapping Survey

Onterra staff completed a Late-Season EWM Mapping Survey on September 13, 2022. Crews surveyed the entire littoral area of Anvil Lake from the bow of the survey boat. A submersible camera was used to supplement the visual survey in select locations including within North Bay and other areas known to have previously harbored significant populations of EWM. The results of the survey are displayed on Map 3.

Within North Bay, field crews delineated four separate *highly scattered* areas and two *scattered* density areas of EWM throughout the bay. Just outside of the North Bay, a small *scattered* and *dominant* colony was also mapped. These colonies in total covered 5.2 acres within Anvil Lake. Numerous *single or few plants* occurrences and six *clumps of plants* occurrences were also marked in the North Bay. The EWM population in North Bay in 2022 has remained lower than the population mapped in 2019 prior to herbicide management, however, it is evident the EWM population is beginning to rebound (Figure 2.3-1). The EWM that has re-established since 2019 is located in the shallower and mid-depth areas of North Bay while it has not expanded into deeper areas in the center of the Bay as of 2022.

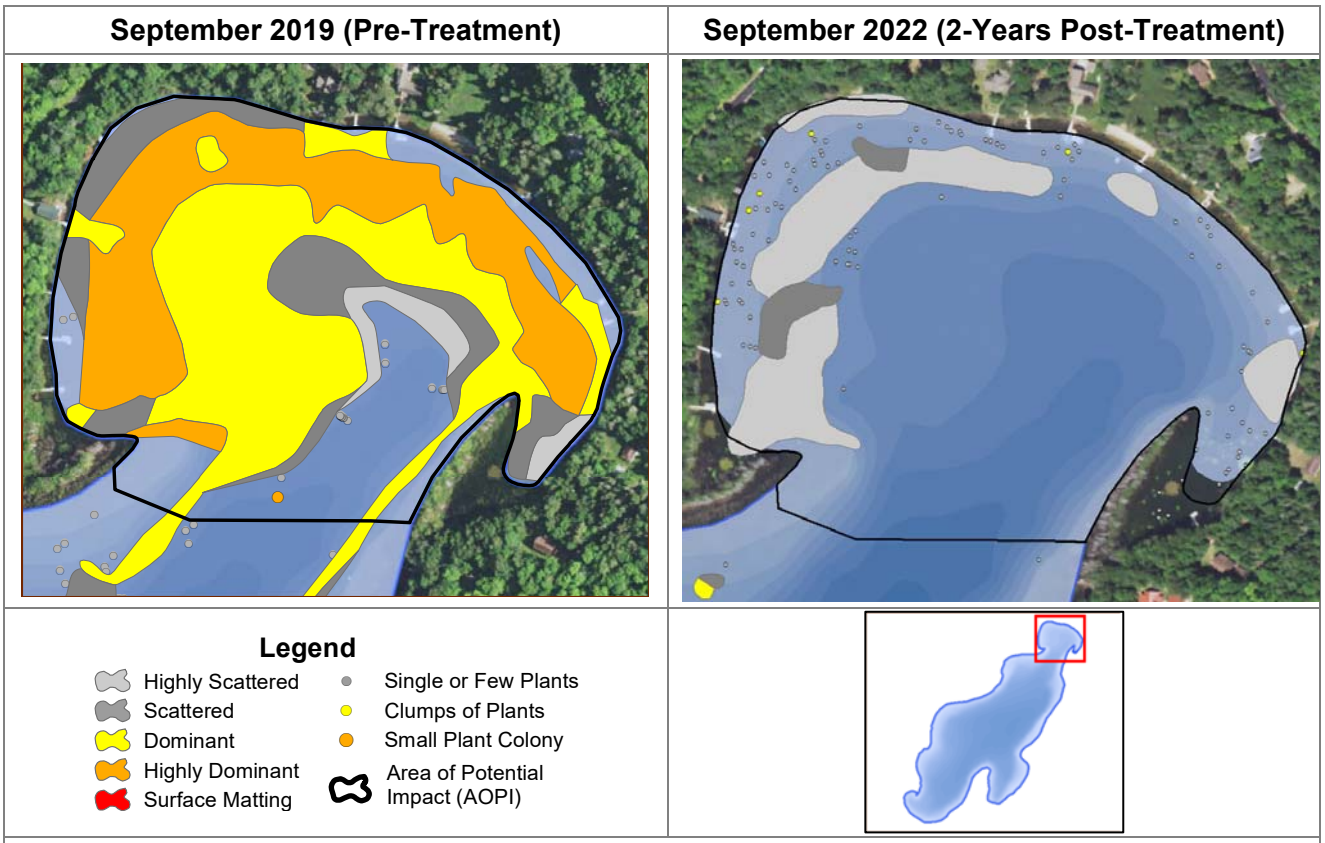


Figure 2.3-1. EWM population in September 2019 & 2022 in the North Bay of Anvil Lake. Herbicide treatment occurred in 2020 and coordinated hand harvesting efforts also took place from 2020 -2022.

The lake-wide EWM population increased each year during monitoring spanning from 2012 - 2019. The total amount of colonized EWM reached a high of 65.8 acres in the 2019 mapping survey (Figure 2.3-2). Note that Figure 2.3-2 only accounts for EWM mapped with area-based methodologies (polygons) and does not account for occurrences mapped with point-based methods including *single or few plants*, *clumps of plants*, and *small plant colonies*. After a spring 2020 2,4-D treatment in North Bay, the 2020 Late-Season EWM Mapping Survey documented just 0.4 acres of colonized EWM in Anvil Lake. The colonized EWM population remained low in the 2021 survey with a total of 0.7 acres delineated in the lake. The colonized acreage of EWM mapped in 2021 and 2022 consisted of low-densities mapped as either *highly scattered* or *scattered*. The acreage of EWM increased from 0.7 acres in 2021 to 5.2 acres in 2022 with all of the colonized areas of EWM being located within the vicinity of North Bay.

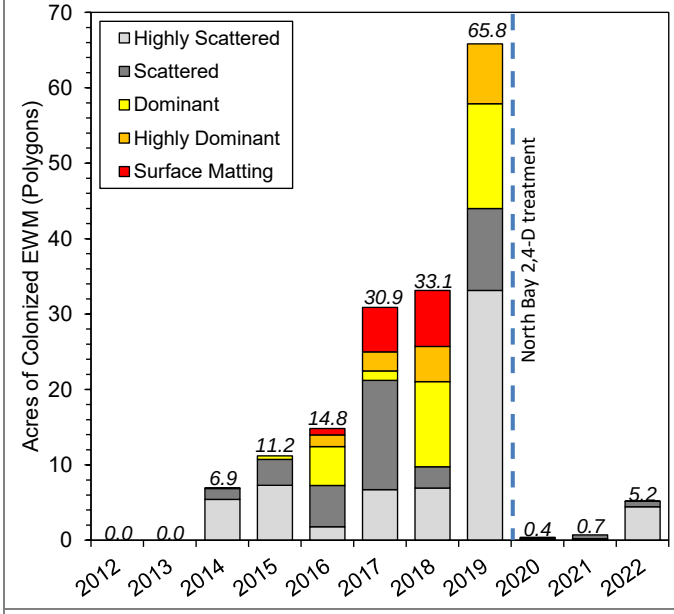


Figure 2.3-2. Anvil Lake acreage of colonized EWM (polygons) from 2012-2022. Created using data from 2012-2022 late-summer EWM mapping surveys.

3.0 DASH & HAND-HARVESTING ACTIVITIES SUMMARY

The ALA conducted a coordinated DASH EWM management strategy during 2022 that utilized four divers and three deckhands. A summary of these efforts is available in the ALA's 2022 EWM Harvest Report included as Appendix B with this report. Harvesting efforts took place between June 16 and August 31, 2022. In total, 35 dive shifts were completed for a total of 111.5 hours of diving effort. Harvest totals included 538 pounds and majority of the harvest was from the North Bay. The ALA has used a grid monitoring system to aid in tracking the DASH efforts in recent years, with the numbered grid locations uploaded onto the ALA's dedicated hand-held GPS unit. The grid system is displayed in Appendix B.

4.0 CONCLUSIONS AND DISCUSSION

Aquatic plant monitoring surveys conducted in 2022 indicate that EWM population has begun to show some signs of rebound or recovery two years after the North Bay treatment. The rate of EWM recovery and expansion observed in Anvil Lake over the past few years is consistent with expectations following an herbicide treatment strategy. Comparative pre- and post-treatment EWM mapping surveys and subset point-intercept surveys indicate that the 2020 herbicide treatment resulted in a high level of control during the *year after treatment*. Overall, the impacts to the native plant population continue to appear to be limited. Lake-wide EWM reductions that were observed in 2020 and 2021 continue to recover slowly outside of North Bay.

Coordinated hand harvesting efforts during 2022 appear to have aided in maintaining a low EWM population in most of North Bay that did not include any areas mapped as dominant or greater in density.

This means that limitations in recreational activities including boating and swimming in the area was likely avoided during 2022. Based on the known EWM population, a continued hand harvesting strategy is a scale appropriate management strategy to consider in 2023. With sufficient effort, all known EWM occurrences in Anvil Lake could be targeted for hand harvesting efforts in 2023. North Bay has been proven to be a favorable location for EWM growth in Anvil Lake in the past and, based on 2022 EWM peak-biomass results, it is expected that EWM population expansion in this area of the lake is likely. Similar to the 2022 expectations, a realistic goal of a hand harvesting strategy in North Bay during 2023 might be an to attempt to maintain the population near its current level while also suppressing the population from expanding to form higher densities (mapped as *dominant*, *highly dominant*, or *surface matting*) that could impact recreational activities such as boating or swimming.

Even with hand-harvesting activities during 2023 on Anvil Lake, the EWM population is anticipated to increase. Typically, during the third summer following an herbicide treatment, the EWM population becomes a little more noticeable to lake users, with some areas approaching levels that may be impactful to navigation and recreation. After a year or two of conducting hand-harvesting, some lake groups transition to a "Let Nature Take its Course" goal by not actively managing the EWM population. The lake group may target specific areas with management to alleviate the nuisance conditions, but not attempt to manage the population as a whole. Once the EWM population approaches pretreatment levels, the lake group often considers another herbicide treatment to reset the population to a lower level that may once again be scale appropriate for management with manual removal techniques.

The ALA has gained valuable experience relating to managing EWM in Anvil Lake with a coordinated hand harvesting approach following an herbicide treatment. The ALA has gained further understanding of the expectations and potential limitations associated with this management technique.

4.1. 2023 AIS Monitoring & Management Strategy

The ALA's original grant project scope included several items that were planned to occur during the final year of the project (2022). However, the ALA has not used all of the available funding for paid hand harvesting within the original grant budget, and therefore requested and received a grant extension in July 2022 that extended the project through 2024 in order to utilize all available funding. A subsequent grant scope amendment was acquired in March 2023 that specifies that remaining funds in the grant could also be applied to continued EWM hand harvesting/DASH efforts for 2023 and 2024. Given the project extension, the following tasks are now planned for 2023: a June CLP mapping survey, a riparian stakeholder survey, a whole-lake point-intercept survey, and a late-summer EWM mapping survey. Additionally, the ALA will work towards updating their aquatic plant management implementation plan in late-2023 to ensure that this aspect remains updated with current Best Management Practices for EWM management.

Eurasian watermilfoil

The late-season 2022 EWM mapping survey contains sufficient information to guide harvesting efforts in 2023. The ALA is encouraged to continue with volunteer-led EWM surveillance efforts in 2023, particularly in areas where EWM has been located in the past. Any newly located occurrences should be marked with the ALA's handheld GPS unit and may be considered for removal by paid or volunteer divers. Any new EWM occurrences that ALA volunteers recorded during the summer months should be provided to Onterra prior to the Late-Season Survey for integration into the on-board GIS software.

A proposed 2023 DASH/hand harvesting strategy is included on Map 4 which targets all known EWM locations from the September 2022 EWM Mapping Survey. A total of ten sites are included in the preliminary DASH strategy and total 45.5 acres. The ALA is encouraged to prioritize DASH efforts during 2023 based on factors important to the ALA. This may include targeting low-density occurrences around the lake to inhibit population expansion, or removing high amounts of biomass in North Bay to alleviate possible nuisance growth conditions later in summer that could impact recreational use of the area. The ALA plans to continue with plans to hire paid divers to operate the ALA's DASH boat to a similar magnitude in 2023 as has been done in recent years. Additionally, the ALA has contracted with a professional firm that offers DASH services, with four days of DASH efforts currently planned for 2023.

Towards the end of the growing season, likely during August or September, a Late-Season EWM Mapping Survey will occur. This survey will serve to evaluate the 2023 hand harvesting efforts, and will be used to understand the whole-lake EWM population allowing for a preliminary management strategy for the following year.

Curly-leaf pondweed

Curly-leaf pondweed (Photograph 4.1-1) was discovered in Anvil Lake in 2013, and its population has since remained modest. An Early Season AIS Survey is planned to occur in approximately late-June 2023 to assess the CLP population and subsequently provide an update to the population. Continued monitoring of the CLP population will yield information on its dynamics in Anvil Lake. This invasive species can cause great ecological and recreational impacts on some lakes, but in other lakes including many in northern Wisconsin, the CLP population remains low and does not cause these impacts. At these low levels, there are likely no observable ecological impacts to the lake and are no reductions in ecosystem services to lake users.

Photograph 4.1-1. Eurasian watermilfoil on Anvil Lake (left) and curly-leaf pondweed (right).

The ALA has enacted a volunteer-based surveillance monitoring program as part of previous projects. Any CLP occurrences that have been documented in recent years by ALA volunteers will be provided to Onterra for integration into the on-board GIS software in advance of the professional CLP mapping survey planned for June 2023.

Whole-Lake Point-Intercept Survey

A whole lake point-intercept survey was originally scheduled to occur in 2022 and is now planned to occur in 2023 due to the grant extension. The 2023 reporting would include discussion of the results of the whole-lake point-intercept survey. Aquatic plant data would be summarized and compared utilizing various metrics to past whole-lake point-intercept surveys that have been completed on Anvil Lake.

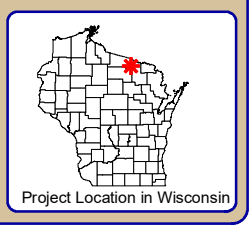
From the whole-lake point-intercept survey, a sub-set of sampling points within North Bay will be extracted to analyze and compare to previous years. This will be a replicate of the same monitoring data that has been collected in this site annually since 2015 as described within section 2.2 of this report.

Riparian Stakeholder Survey

In 2023, a WDNR-approved stakeholder survey will be sent to all ALA members and Anvil Lake riparian property owners. Questions would replicate the 2019 survey when applicable. Specific questions will be included to solicit perceptions of the management activities that took place during this multi-year project as well as to gauge direction for management strategies moving forward.

It will also be important for the ALA to strive to receive over a 60% response rate to consider the results statically representative of all ALA members and riparian owners. It will be beneficial when making comparisons to the 2019 survey results since that survey received over a 64% response rate. The information gathered would be critical to the development of a realistic plan by supplying an indication of the needs of the stakeholders and their perspective on the current and future management of the lake. Survey invites would be distributed to ALA members and riparian property owners via postcard with instructions on how to participate in the survey online or how to request a paper copy. Distribution and other logistical aspects will be facilitated by a third-party to ensure anonymity.

This display is for visual reference only and is not legally binding.



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www.onterra-eco.com

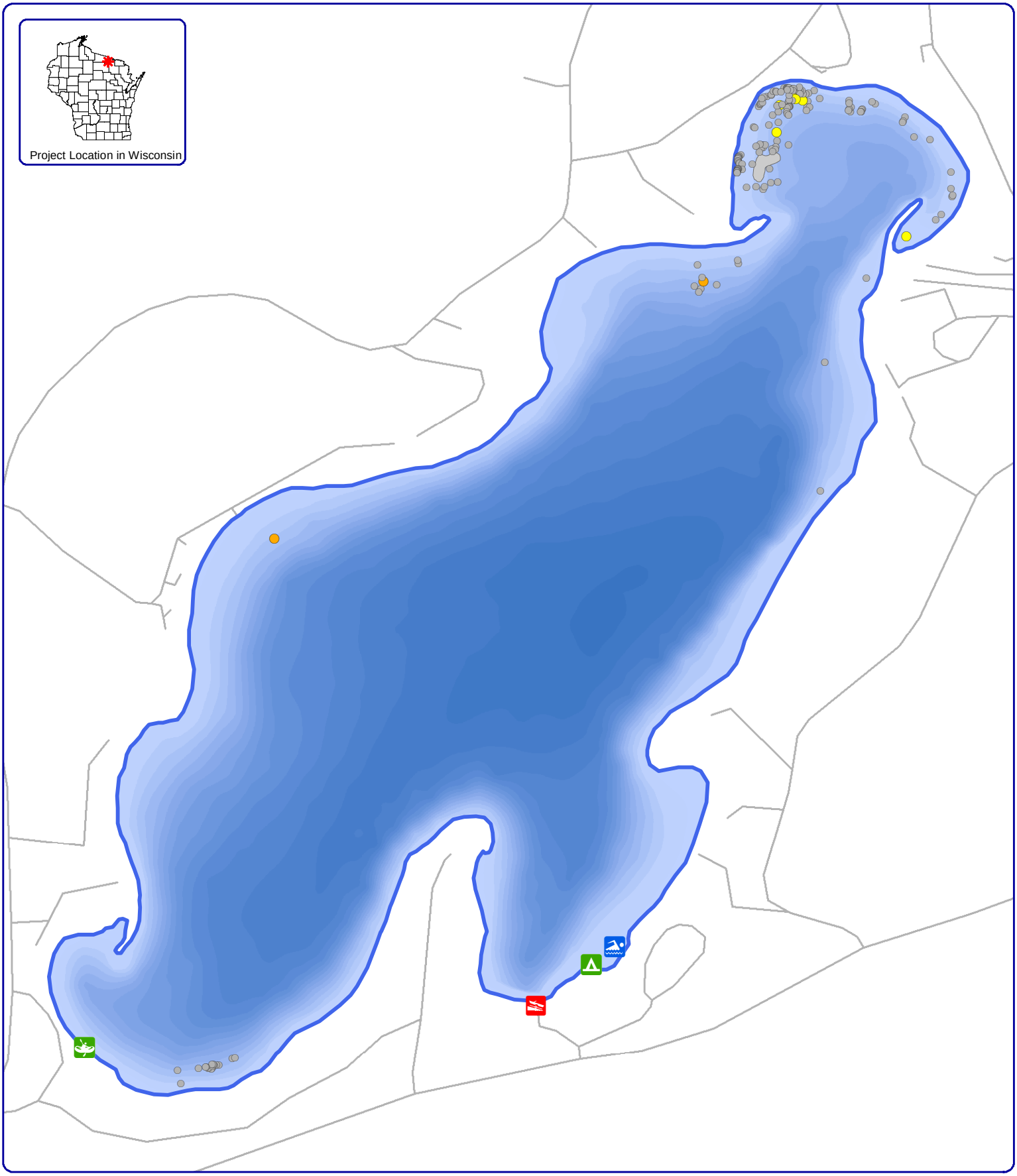
Sources:
Roads and Hydro: WDNR
Bathymetry: NAIP, 2017
Public Lands: WDNR

Map Date: January 4th, 2023 KLW
Map1_Anvil_Vilas_Location.mxd

Legend

- Anvil Lake ~ 357 acres
  Onterra Definition
- Forest Service Land: Chequamegon-Nicolet National Forest
- Point-intercept Sample Location
  40-meter spacing points
- Public Access
- Carry - In
- Campsite
- Swimming Beach

Map 1
Anvil Lake
Vilas County, Wisconsin
Project Location & Lake Boundaries



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Sources
Roads and Hydro: WDNR
Bathymetry: NAIP, 2017
Aquatic Plants: Onterra, 2022
Orthophotography: NAIP, 2022
Map Date: December 30th, 2022 KLW
Filename: *Map2_Anvil_ESAIS_Summer2022.mxd*

Legend

Eurasian watermilfoil (June 22nd, 2022)

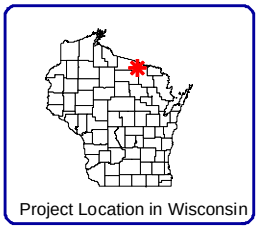
- Highly Scattered
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Beach
- Campsite
- Public Boat Landing
- Carry - In

Map 2

Anvil Lake

Vilas County, Wisconsin

June 2022 ESAIS Survey Results



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Sources
Roads and Hydro: WDNR
Bathymetry: NAIP, 2017
Aquatic Plants: Onterra, 2022
Orthophotography: NAIP, 2022
Map Date: December 30th, 2022 KLW
Filename: *Anvil_EWMPB_Summer2022.mxd*

Legend

Eurasian watermilfoil (September 13th, 2022)

- Highly Scattered
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Beach
- Campsite
- Public Boat Landing
- Carry - In

Map 3

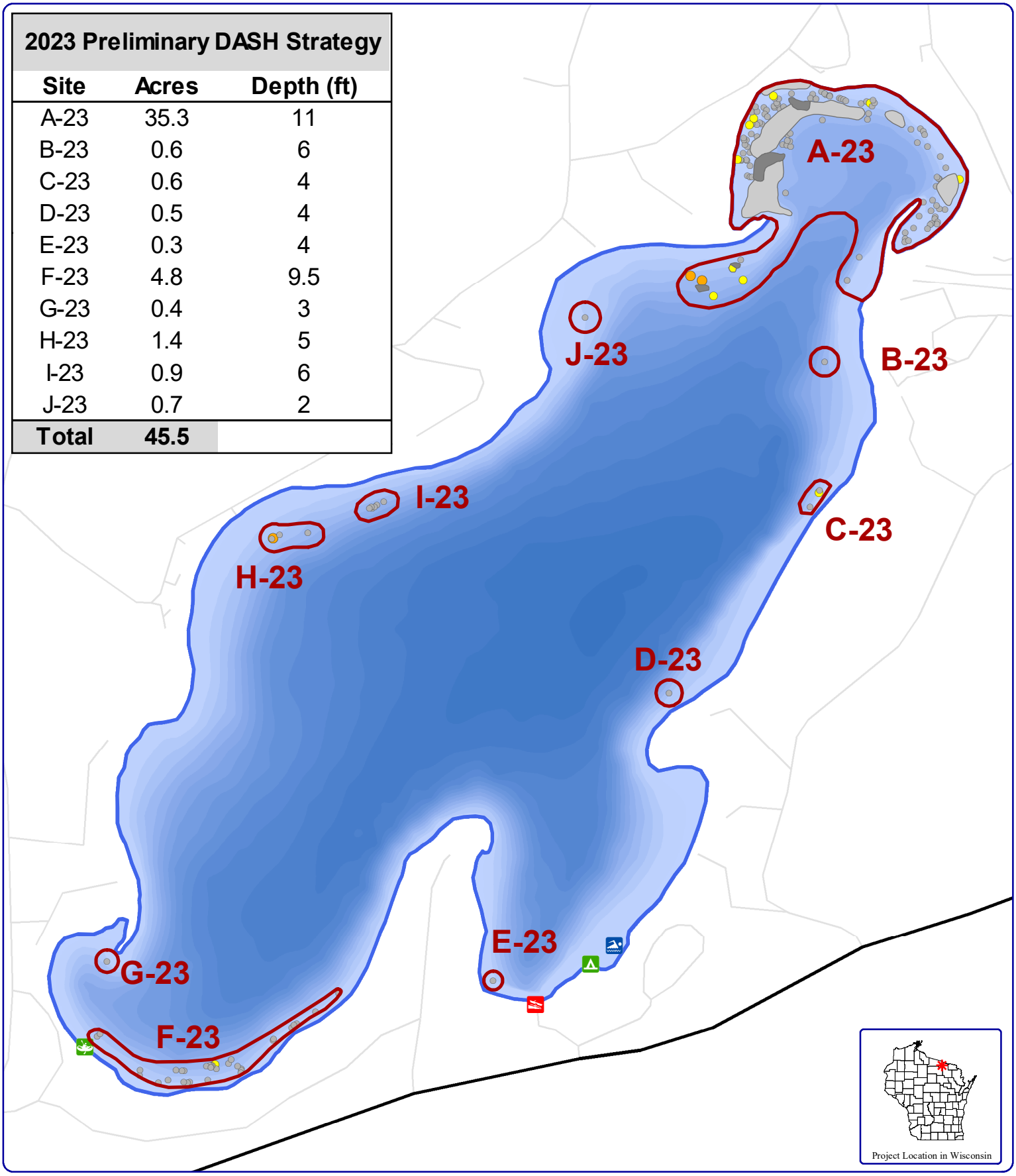
Anvil Lake

Vilas County, Wisconsin

September 2022 EWMPB Survey Results

2023 Preliminary DASH Strategy

Site	Acres	Depth (ft)
A-23	35.3	11
B-23	0.6	6
C-23	0.6	4
D-23	0.5	4
E-23	0.3	4
F-23	4.8	9.5
G-23	0.4	3
H-23	1.4	5
I-23	0.9	6
J-23	0.7	2
Total	**45.5**	



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Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2022
Bathymetry: Onterra, 2014; processed by Navico
Map date: *February 16, 2023 JMB*

Legend

EWM Survey Results (9/13/2022)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2023 DASH Priority Location

Map 4
Anvil Lake
Vilas County, Wisconsin

Preliminary 2023 DASH Strategy

A

APPENDIX A

Littoral Frequency of Occurrence of Aquatic Plants in the North Bay of Anvil Lake from 2010-2022 Sub-set Point-Intercept Surveys

		LFOO (%)									
Scientific Name	**Common Name**	**2010**	**2012**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Chara spp. & Nitella Spp.	Muskgrasses & Stonew orts	65.5	26.1	67.2	52.5	46.0	34.3	42.0	43.7	56.2	56.9
Vallisneria americana	Wild celery	41.4	47.8	57.4	65.6	38.0	41.8	31.9	36.6	43.8	51.4
Elodea canadensis & E. nuttallii	Common & Slender w aterw eeds	86.2	33.3	70.5	50.8	34.0	32.8	43.5	15.5	30.1	29.2
Elodea canadensis	Common w aterw eed	82.8	27.5	0.0	50.8	34.0	32.8	43.5	14.1	30.1	29.2
Nitella spp.	Stonew orts	65.5	26.1	0.0	52.5	12.0	32.8	42.0	38.0	4.1	40.3
Myriophyllum spicatum	Eurasian w atermilfoil	0.0	4.3	14.8	57.4	62.0	88.1	79.7	1.4	1.4	5.6
Chara spp.	Muskgrasses	0.0	0.0	67.2	0.0	34.0	1.5	0.0	7.0	52.1	16.7
Potamogeton berchtoldii & P. pusillus	Slender & Small pondw eeds	20.7	26.1	16.4	0.0	2.0	1.5	15.9	2.8	11.0	12.5
Eleocharis acicularis	Needle spikerush	12.1	11.6	11.5	4.9	6.0	9.0	5.8	8.5	8.2	5.6
Potamogeton amplifolius	Large-leaf pondw eed	5.2	10.1	6.6	0.0	2.0	11.9	5.8	8.5	9.6	11.1
Potamogeton berchtoldii	Slender pondw eed	20.7	0.0	16.4	0.0	0.0	1.5	15.9	2.8	2.7	11.1
Elodea nuttallii	Slender w aterw eed	3.4	5.8	70.5	0.0	0.0	0.0	0.0	1.4	0.0	0.0
Potamogeton pusillus	Small pondw eed	0.0	26.1	0.0	0.0	2.0	0.0	0.0	0.0	8.2	1.4
Potamogeton vaseyi	Vasey's pondw eed	3.4	0.0	8.2	0.0	0.0	0.0	1.4	0.0	2.7	5.6
Potamogeton epihydrus	Ribbon-leaf pondw eed	0.0	0.0	3.3	0.0	0.0	0.0	2.9	2.8	0.0	1.4
Myriophyllum tenellum	Dw arf w atermilfoil	1.7	0.0	1.6	4.9	2.0	0.0	1.4	0.0	1.4	0.0
Fissidens spp. & Fontinalis spp.	Aquatic Moss	0.0	0.0	0.0	0.0	0.0	0.0	7.2	2.8	0.0	0.0
Elatine minima	Waterw ort	1.7	2.9	1.6	1.6	0.0	0.0	0.0	0.0	0.0	1.4
Potamogeton robbinsii	Fern-leaf pondw eed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.8
Isoetes spp.	Quillw ort spp.	1.7	2.9	0.0	0.0	0.0	1.5	0.0	1.4	1.4	0.0
Sparganium angustifolium	Narrow -leaf bur-reed	3.4	0.0	3.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0
Juncus pelocarpus	Brow n-fruited rush	0.0	2.9	1.6	0.0	4.0	0.0	0.0	0.0	0.0	0.0
Nuphar variegata	Spatterdock	0.0	0.0	0.0	0.0	0.0	1.5	1.4	0.0	1.4	0.0
Lemna minor	Lesser duckw eed	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.4	0.0	0.0

B

APPENDIX B

Anvil Lake EWM Harvest Report (2022)

2022 Eurasian Watermilfoil Harvest Report

Anvil Lake Association

Submitted to:

Anvil Lake Association and the Wisconsin Department of Natural Resources

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Submitted by:

Amy Kuhns

Anvil Lake Association President

February 1, 2023

Introduction:

The Anvil Lake Association has been hand harvesting EWM in Anvil Lake since it was discovered in the summer of 2012. The ALA funded the construction of their own Diver Assisted Suction Harvesting-DASH unit in 2017 for more effective and cost efficient removal of EWM in the lake. This past summer was the sixth year of EWM harvesting with the DASH unit in Anvil Lake. Divers also hand harvest EWM without the DASH unit in more shallow areas of the littoral zone and in areas of more scattered EWM growth. A permit was granted to the ALA in 2022 by the Wisconsin Department of Natural Resources to allow mechanical harvesting in up to 52 acres of EWM in designated areas of Anvil Lake.

Dive Methods:

The ALA contracted in 2022 with four divers and three deckhands to harvest EWM with the DASH unit. The divers worked in shifts up to four hours a day. They removed EWM plants and their root balls from the lake bed by hand and fed the harvested EWM into the open end of the suction hose. The suction hose carries the harvested EWM to the deck of the DASH unit, where it is deposited into large mesh bags. The mesh bags allow water to filter back into the lake, while retaining the harvested EWM. The DASH unit is designed to allow the other end of the suction hose to pivot between two adjacent bagging stands on the deck. A deckhand on the DASH unit assists the diver at all times. The deckhand is responsible for monitoring the DASH unit equipment and replacing mesh bags once they are filled with EWM. The deckhand also skims floating pieces of EWM around the DASH unit that surface during the harvesting process. After the dive shift, a sample bag is used to estimate the percentage of EWM harvested. At the end of a dive shift, the bags of harvested EWM are removed from the DASH unit, weighed and emptied. The harvested EWM is periodically moved onto a trailer and taken to the Town of Washington transfer station, the designated disposal site.

A volunteer diver utilized a portable hookah system to hand harvest additional scattered EWM into mesh bags. The diver would surface when the mesh bag was full of harvested EWM and transfer the EWM into a boat to be transported back to the shore.

Harvest summary:

An herbicide application in the north bay of Anvil Lake in 2020, along with continued EWM hand harvesting in other areas of the lake, has greatly decreased the amount of EWM in the lake for the past three years. Several years of higher water levels have also decreased EWM growth in the deeper areas of the littoral zone of the lake. Since the herbicide treatment in 2020, EWM has been gradually re-emerging, primarily in the north bay of Anvil Lake. Harvesting EWM from the north bay has been the priority for the DASH unit for the past two summers.

EWM dive harvesting efforts for 2022 began on June 16th and ended on August 31st. The divers were scheduled to work a four hour dive shift, five days a week, weather permitting. The divers initially prioritized dive harvesting in the colony of scattered EWM in the western part of the north bay.

A combination of personnel problems and mechanical issues with the DASH unit complicated the dive harvesting effort for 2022. One diver quit after several weeks, another diver had a foot injury that limited his diving in August and a third diver was anxious when diving with the DASH unit and switched to hand harvesting in shallow areas of the littoral zone. Our more veteran diver had hoped to schedule a weekly dive shift, but was only able to complete four dive shifts last summer. The DASH unit was not able to be used for two weeks of the season, as parts were being repaired.

Despite these challenges, divers were able to complete 19 dive harvesting shifts with the DASH unit and an additional 16 shifts of EWM hand harvesting without the DASH unit. Dive hours with the DASH unit totaled 53.5 hours. The 16 shifts of hand harvesting without the DASH unit by paid divers totaled 58 hours.

The divers continued to report that the EWM that was harvested was scattered in the littoral zone. The paid divers harvested a total of 538 pounds of EWM in 2022. The majority of the EWM harvesting occurred in the north bay, in sites 1, 2 and 3 of our grid map of the lake. Several dive shifts with the DASH unit and without the DASH unit focused on the scattered EWM identified outside of the north bay.

The volunteer diver that uses a portable hookah system for an air supply, was able to conduct five dive shifts to harvest EWM growing in the southwest bay of

the lake. He continues to report very scattered growth of EWM in this area of Anvil Lake. He harvested an estimated 150 pounds of EWM in his five dives.

The Onterra late season EWM survey, conducted on September 13th, revealed a slowly expanding EWM growth in the north bay, with a colony of scattered to highly scattered EWM in the western part of the bay. A few small colonies of scattered EWM, along with clumps of EWM and single EWM plants were identified in the eastern part of the bay. The current amount of EWM is what has been expected three summers after an herbicide treatment in the bay.

The late season EWM survey found very isolated and scattered EWM in the littoral zone of the lake outside of the north bay. EWM growth is significantly more limited in all areas of the lake other than the north bay.

ALA DASH Sign In Log 2022

Date	Deck Hand	Diver	Paid Hours	Donated Hours	Other
6/16/22	Meike M	Colin B	4	0	
6/20/22	Meike M	Colin B	6	0	
6/20/22	Colin B	Meike M	1	0	
6/22	Hannah M	Alex T	4	0	
6/16/22	Hannah Mark	Alex T	4	0	
6/23/22	Hannah M	Alex T	4	0	
6/27/22	Kaitlyn Davis	Colin B	4	0	
6/27/22	Meike	Colin B	4	0	
6/27/22	Colin	Meike	2.5	0	
6/29	Kaitlyn D	Alex T	4	0	
6/30	Hannah M	~~Hannah~~ Alex T	3	0	Ran outta Gas
6/24	Sadie J	Marty J	4.5	0	
7/1	Sadie J	Marty J	4.5	0	
7/5	Hannah M	Alex T	4	0	
7/6	Hannah	Meike	2	0	RESP. Not Working

ALA DASH Sign In Log 2022

Date	Deck Hand	Diver	Paid Hours	Donated Hours	Other
7/7	Hannah M	Alex T	2	0	Picked by hand
7/8	Sadie J	Marty J	4	0	Scuba
7/11	Hannah M	Meike M	2.5	0	Picked Bath by hand
7/12	Kaitlyn D	Meike M	4	0	Picked by hand
7/13	Kaitlyn D	Alex T	4	0	Picked by hand
7/14	Kaitlyn D	Alex T	4	0	Picked by hand
7/16	Sadie J	Marty Jones	6	0	
7/18	Alex T.	Meike	4	0	Picked by hand
7-19	Kaitlyn D.	Colin	3		Boat Problems
7-25	Hannah M.	Alex T.	4	0	Picked by hand
7-27	~~Alex T. Hannah M.~~	Alex T.	4	0	Picked by hand
7 28	Hannah M	~~Alex~~ Meikem	4		Picked by hand
8/3	Hannah M	Alex T	4		
8/4	Hannah M	Meike	4		Boat Issues ~~Dived~~ dived Shoreline
8/7	Sadie J	Marty J	4	0	

ALA DASH Sign In Log 2022

Date	Deck Hand	Diver	Paid Hours	Donated Hours	Other
8/8	Hannah M	Alex T	3.5	~~0~~	
~~8~~/9	Hannah M	Alex T	2	~~0~~	Left Early due to injury
8/9	—	Hannah M	1.5	~~0~~	Picked Shoreline
8/10	—	HannahM	4	~~0~~	Picked Shoreline
8-11	Hannah M	Meike	4	~~0~~	Free dove shoreline
~~8~~-15	—	Hannah M	4	~~0~~	Picked Shoreline
~~8~~/~~17~~	Hannah M	Meike	4	0	free dove Shoreline
8/18	Hannah M	Meike	4	0	free dove Shoreline

Date 2022	Location End number	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity GPS Coordinates
7-14	2,3	2½ s	13	3/4	85%	13	70°, Sunny, Slight wind, Pollen water
7-18	1,3	4	6	1/4	95%	6	82°, Sunny, Slight wind, Pollen water
7-19	—	—	0	—	—	0	Boat problems
7-25	3,33	4	3	1/8	95%	3	66° Mostly Cloudy,
7-27	2,6,21,23,33,24,33,45	4	3	1/8	90%	3	70°, Sunny, Slight wind
7-28	40,41 3,18,6	4	10	1/4	95%	10	70 Party Sunny, Slightly Windy
8-3	3	4	20	1	90%	20	66° Mostly Cloudy Windy
8-4	2	4	10	½	95%	10	45°57.171 N. 89°03.365W 45°57.165N, 89°03.370W Sunny, No wind 78° Clear
8/7	36,37	4	60	1	100%	60	65 Mostly cloudy
8/8	1,2	3.5	9	1/2	85%	9	60°, Rain, No wind, Cloudy
8/9	1,2	2	16	1¼	90%	16	70, Sunny, No wind
8/9	3	1.5	3	1/8	95%	3	70 Sunny, No wind
8/10	1,3	4	11	½	90%	11	70, Sunny Slight Wind
8/10	1,2	4	20	1½	90%	20	71° Sunny, Slight wind Clearish 4feet
8/15	1,23	4	7	¼	90%	7	68, Partly Sunny No wind Foggy, Clear

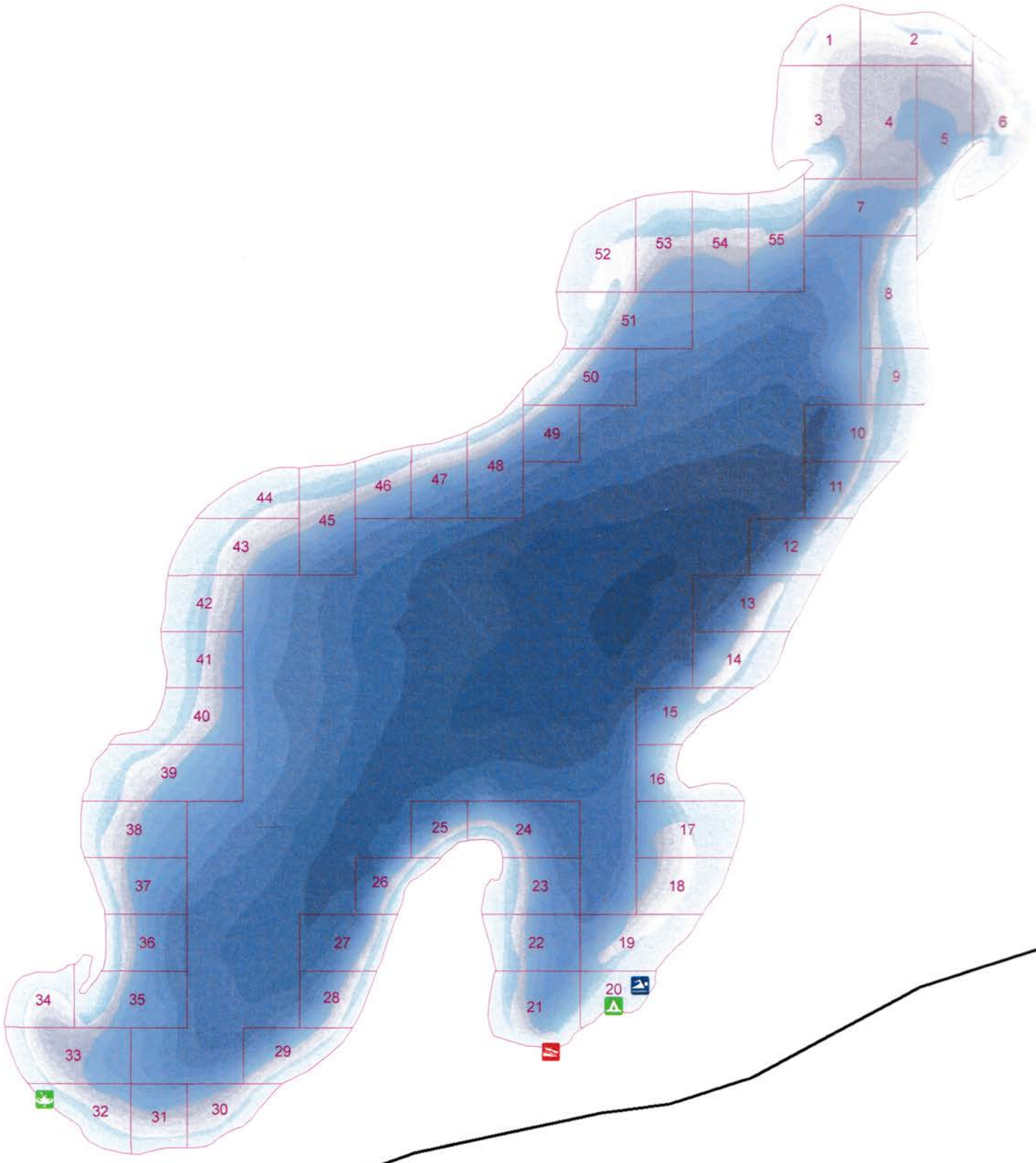
NOTE: The Outboard and Water Pump Both use Regular Gasoline. No Oil Mix

Date	Location Grid number	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity GPS Coordinates
6-16	3	1	1	1	95%	1	70°. windy - 6' - clear
6-20	3, 1	6	3.5	1	95%.	3.7	85°. Clear (day), 10', Pollen, water
6-22	5	4	4	1	90%	4	71° - Slight wind - 6' Pollen Water
6-23-	3	4	25/25	1 3/4	95%	50	78 - Clear, super 12', Pollen water
6-27	3	6.5	30	2	95	32 dry	
6-29	3 #	3	85	2½	90%	85	69°, Partly Sunny, 15', Clear
6-30	3	3	15	½	85%	15	78, Sun & wind, 15' ~~clear~~, few white caps, MUCKY water
7-1	1, 3, 7, 51, 55	4.5	60	2	100%	60	80°, Sunny, Clear
7-5	3, 1	4	44	1¼	95	44	70° No wind & waves, Cloudy
7-6	1	2	Ø	Ø	Ø	Ø	cold, Cloudy, resp. NOT working
7-7	3	2	3	.05	90%	3	Cloudy. light wind, 75°
7-8	55, 19	4	20	1	100%	20	Sunny, windy, 70°
7-11	1, 2, 3	2	6	1	90%.	5.5	cloudy, raing, left early for CDCW
7-12	1, 2, 3	Ø	6	½	90%.	5.5	Cloudy, dark, breezy
7-13	3, 5, 2	Ø	2	.05%	95%.	2	Sunny, windy.

NOTE: The Outboard and Water Pump Both use Regular Gasoline. No Oil Mix

Date	Location Grid number	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity GPS coordinates
8-17	1,2,3	4	33	1 1/2	90%	33	72° Windy Sunny
8-18	1,2,3	4	30	1	95%	30	73° Slight wind, Partly Sunny

NOTE: The Outboard and Water Pump Both use Regular Gasoline. No Oil Mix



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Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2020
Bathymetry: Onterra, 2014;
Map date: *June 29, 2021 - EJH*

Project Location in Wisconsin

Legend

Grid Monitoring System

2019 EWM Footprint

Anvil Lake
Vilas County, Wisconsin

Grid Monitoring System