1.0 INTRODUCTION

Anvil Lake, Vilas County, is an approximate 392-acre mesotrophic seepage lake with a maximum depth of approximately 35 feet estimated during 2020. 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 has high water clarity, with an average summer Secchi disk depth of 12 feet.

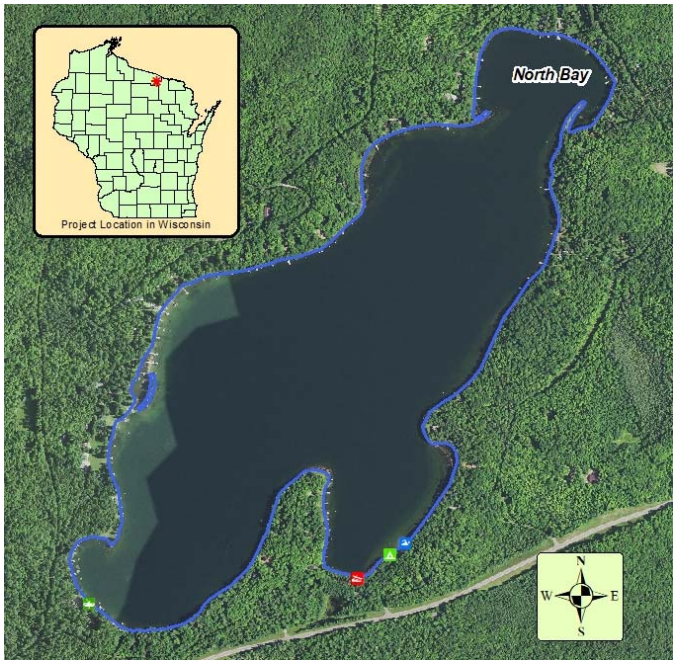


Figure 1.0-1. Anvil Lake, Vilas County, Wisconsin.

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 that the population was mainly isolated to North Bay and largely comprised of single-plant occurrences.

1.1 Historic AIS Management

The ALA received a WDNR AIS-Early Detection and Response grant in spring 2013 (AIRR-144-13) and a second in summer 2015 (AIRR-177-15) to fund hand-harvesting and monitoring programs. The *Anvil Lake Comprehensive Management Plan* (Jan 2018) included the development of a more aggressive EWM hand-harvesting program utilizing the recently constructed ALA DASH boat. The strategy involved a three-year trial program from 2017-2019 to evaluate the effectiveness of using a combination of paid and volunteer DASH and traditional hand-removal implemented at a much higher level of effort (350 annual hours). The ALA received a series of WDNR grants to fund the hand-harvesting (ACEI-194-17) and monitoring (AEPP-497-17) aspects of the three-year trial program. The objective of this project was to determine if the increased level of hand-harvesting effort could reduce and maintain an EWM population to a level which exerts little to no detectable impact on the lake's ecology, recreation, and aesthetics. The *Comprehensive Management Plan* as well as annual *AIS Monitoring and Control Strategy Assessment Reports* (2013-2019) include additional details of management history.

1.2 2020 EWM Control & Monitoring Plan

As outlined in the *2017-2019 EWM Monitoring & Control Strategy Assessment Report* (Jan 2020), EWM population expansion and increase in density continued despite management efforts, particularly in the North Bay. Hand-harvesting in North Bay shifted to a nuisance relief strategy where lanes were created through dense EWM that was impeding navigation. As outlined in the report, the project included a written riparian stakeholder survey in the final year (2019) to judge the level of support for continued EWM management and support for alternative management strategies.

The ALA explored multiple herbicide options for 2020 and ultimately decided to pursue a whole-basin 2,4-D amine treatment of the North Bay and conduct aggressive hand-harvesting in other areas. The target area would be considered a "whole-bay treatment;" therefore, it was expected the herbicide concentrations would remain high enough for a longer period of time (a couple of days) to cause mortality to the EWM. This is opposed to a traditional spot treatment where high concentrations of herbicides for shorter periods of time (hours) bring on mortality. A typical target whole-lake treatment targets a lake-wide 2,4-D concentration of 0.300-0.350 ppm acid equivalent (ae). In order to account for herbicide loss outside of the semi-enclosed bay, Onterra recommended a 2-times rate (0.600 ppm ae) for the North Bay. Operationally, this consisted of targeting 17 acres at a dose of approximately 1.0 ppm ae to achieve a bay-wide concentration of 0.6 ppm ae within the Area of Potential Impact (AOPI) as shown on Map 1.

The 2020 herbicide treatment was monitored through the quantitative and qualitative evaluations. The quantitative assessment was completed through the replication of the sub-set point-intercept survey that occurred in the North Bay during 2019 (*year before treatment*, n=73) in 2020 (*year of treatment*) and is planned for 2021 (*year after treatment*). Understanding the EWM population in the *year of treatment* (2020) is important, however the results of a replication of the survey in 2021 (*year after treatment*) will allow for a better understanding of the efficacy of the treatment and help to understand whether EWM mortality was achieved rather than the treatment simply injuring the plants and suppressing their growth during the year of treatment. The quantitative success criteria for the 2020 treatment would be a 70% reduction in the littoral frequency of occurrence from 2019 (*year before treatment*) to 2021 (*year after treatment*). The 2021 survey will aid in the understanding of the changes of aquatic plant populations in the treated area and assess the recovery stage of any native species that were initially impacted.

A qualitative assessment of the 2020 herbicide treatment includes comparing the 2019 Late-Season EWM Mapping Survey (*year before treatment*) to the 2020 Late-Season EWM Mapping Survey (*year of treatment*) mapping results. The treatment would be considered successful in meeting the EWM control goals if the *year of treatment* survey indicates little to no EWM present in the targeted areas during the year of treatment. Further, reductions in EWM in the targeted areas would be expected to last into 2021.

The ALA coupled the herbicide treatment with a coordinated hand harvesting strategy in 2020. The hand harvesting strategy focused on harvesting EWM in the southwest end of the lake as well as a few other sites which were found to harbor *dominant* density EWM colonies in the 2019 Late-Season EWM Mapping Survey (Map 2). The ALA aimed to maintain or suppress the EWM population in these areas to avoid having nuisance conditions that interfere with recreational opportunities.

The ALA was awarded a WDNR AIS-Established Population Control grant in February 2020 that includes funding to carry out the active management and associate 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 first year of this project.

2.0 2020 HERBICIDE TREATMENT

2.1 Pre-Treatment Confirmation and Refinement Survey

Onterra ecologists completed the pre-treatment confirmation and refinement survey on May 28, 2020. The purpose of the visit was to confirm the treatment area specifics 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. Parameters such as plant growth stage, water temperature, and water depth were investigated to confirm the final treatment strategy.

Photo 1.3-1. EWM observed during a May 28, 2020 pre-treatment survey on Anvil Lake, Vilas County. Photo by Onterra, LLC

During the survey, actively growing EWM characterized by green growth was confirmed within the treatment site located in North Bay and growth of EWM elsewhere around the lake was not investigated. An underwater camera transect was completed through the targeted area which can be viewed on Onterra's YouTube webpage (Click Here). Water temperatures in the treatment area were 67°F near the surface and 53°F near the bottom. Map 1 reflects the final treatment strategy using liquid 2,4-D with an application rate of 1.05 ppm ae over 17.0 acres within North Bay. The herbicide application was completed on June 4, 2020 by Schmidt's Aquatic, LLC. The applicator noted light winds of 1-2 mph during the application.

2.2 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.

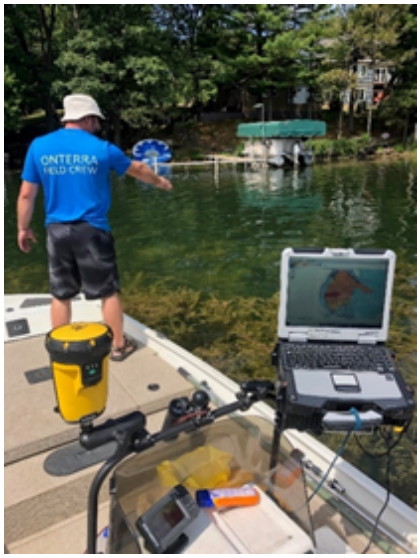
The point-intercept survey provides a standardized way to gain quantitative information about a lake's aquatic plant population through visiting predetermined locations and using a rake sampler to identify all the plants at each location. The point-intercept survey can be applied at various scales. The 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.

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 2015-2020. In association with the 2020 herbicide treatment, the summer 2019 sub-set point-intercept survey data will serve as the pre-treatment dataset and is compared to a replication of the survey completed during summer 2020 (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 2.2-1). 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 *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.



Photograph 2.2-1. EWM mapping survey on a Waushara County, WI lake. Photo credit Onterra.

2.3 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 2015-2020. Figure 2.3-1 displays the location of the sub-set sampling locations that are included in the following analysis. 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 timeframe. Only the species that had at least an occurrence of 5% were included in the analysis. 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.

The EWM occurrence increased every year during the period of monitoring from 2010 to 2018, reaching a high of 88.1% in 2018 (Figure 2.3-2). The 2019 occurrence decreased to 79.7%, however this was not statistically different than the 2018 survey. Since the EWM population's rapid increase in frequency between 2015-2019, the average number of native species per sampling site has decreased from 2.71 in 2015, to between 1.34 and 1.52 in 2017-2019.

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 number of native species per site decreased slightly from 2019-2020.

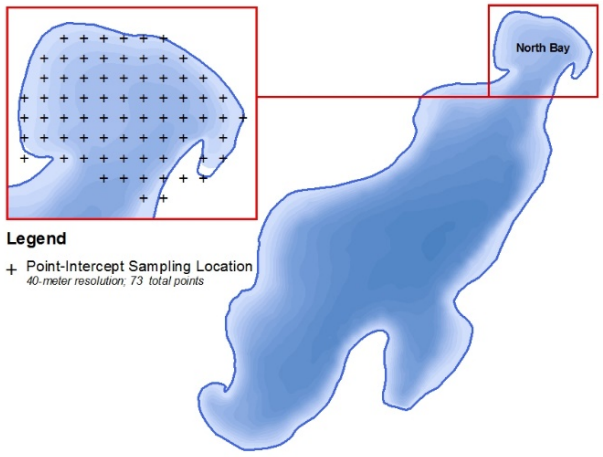


Figure 2.3-1. Sub Point-Intercept Survey Sampling Locations in North Bay of Anvil Lake. (40-meter spacing, N=73)

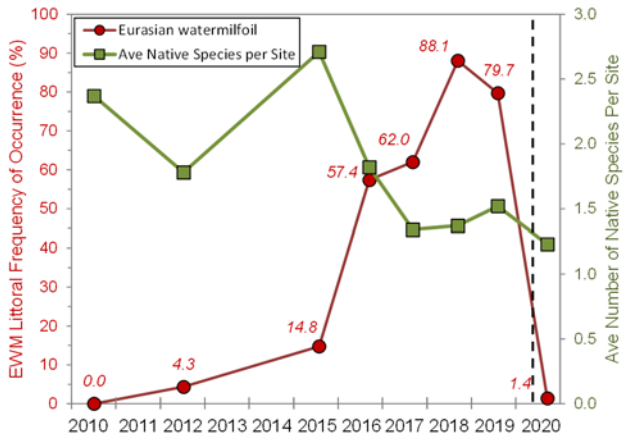


Figure 2.3-2. Frequency of occurrence of EWM and native aquatic plant species within North Bay of Anvil Lake from 2010-2019. 2010 n = 58; 2012 n = 69; 2015 n = 61; 2016 n = 61; 2017 n = 50, 2018 n = 67, 2019 n=69, 2020 n=71. Dashed line represents herbicide treatment.

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) treatment. These data are displayed in Figure 2.3-3 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.

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.

Several other native species present in the study area did not show a statistical change in occurrence. Appendix A displays the littoral frequency of occurrence for all species in the study area from 2010-2020.

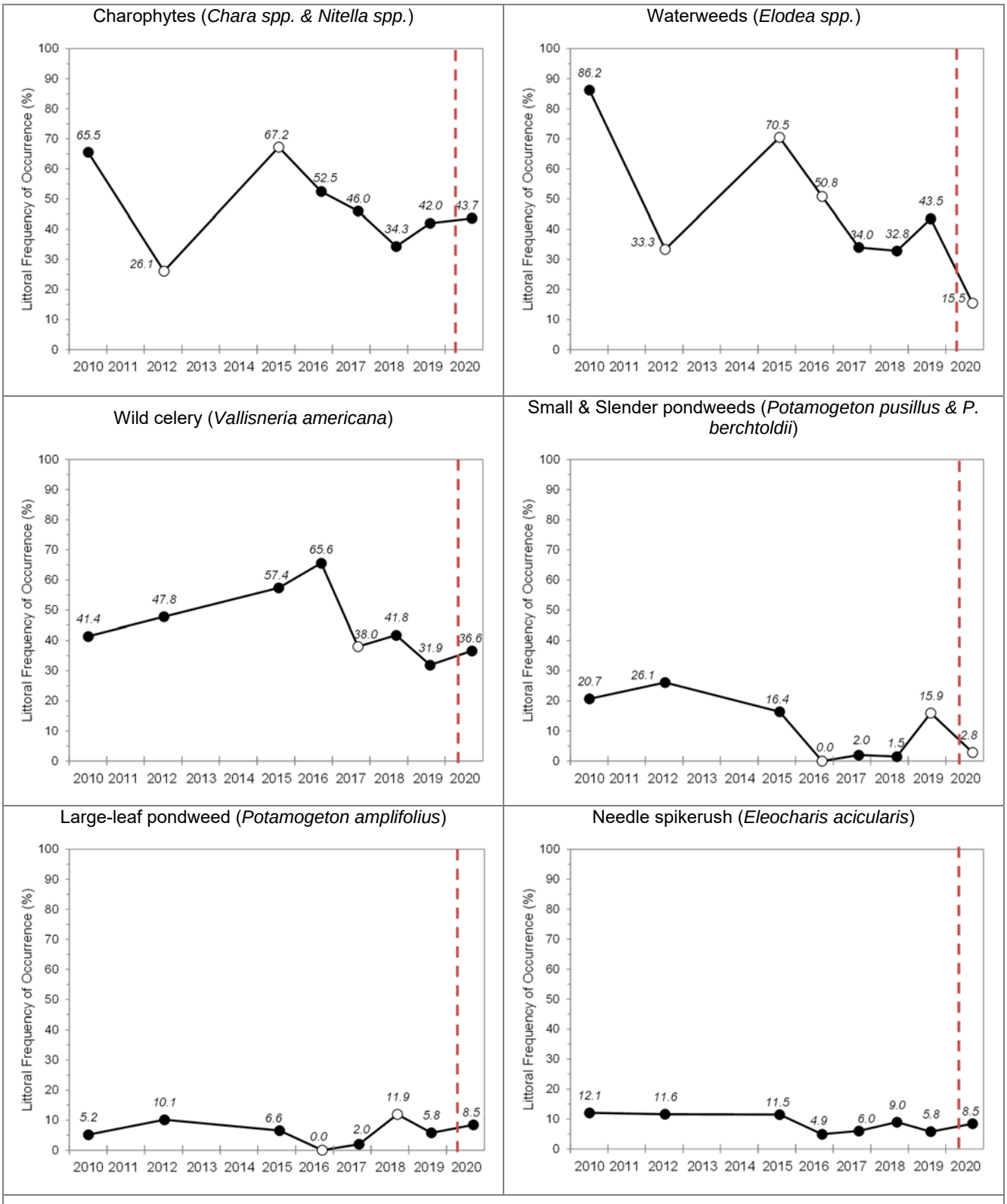


Figure 2.3-3. Littoral frequency of occurrence of native aquatic plant species common within the North Bay of Anvil Lake (n=73). Red dashed line represents 2,4-D herbicide treatment. Open circle represents statistically valid change in occurrence compared to previous survey.

Figure 2.3-4 displays the littoral frequency of occurrence of sub-set point-intercept survey sampling locations that contained either native plants only, EWM plants only, or native plants and EWM plants from point-intercept surveys completed between 2010-2020 in Anvil Lake. The figure illustrates the expanding footprint of the EWM population while the littoral frequency of occurrence for native species initially went down between 2016-2017 and was relatively consistent through 2019. Following the herbicide treatment, the littoral occurrence of native plant species in 2020 was similar to recent surveys, while the EWM occurrence was greatly reduced.

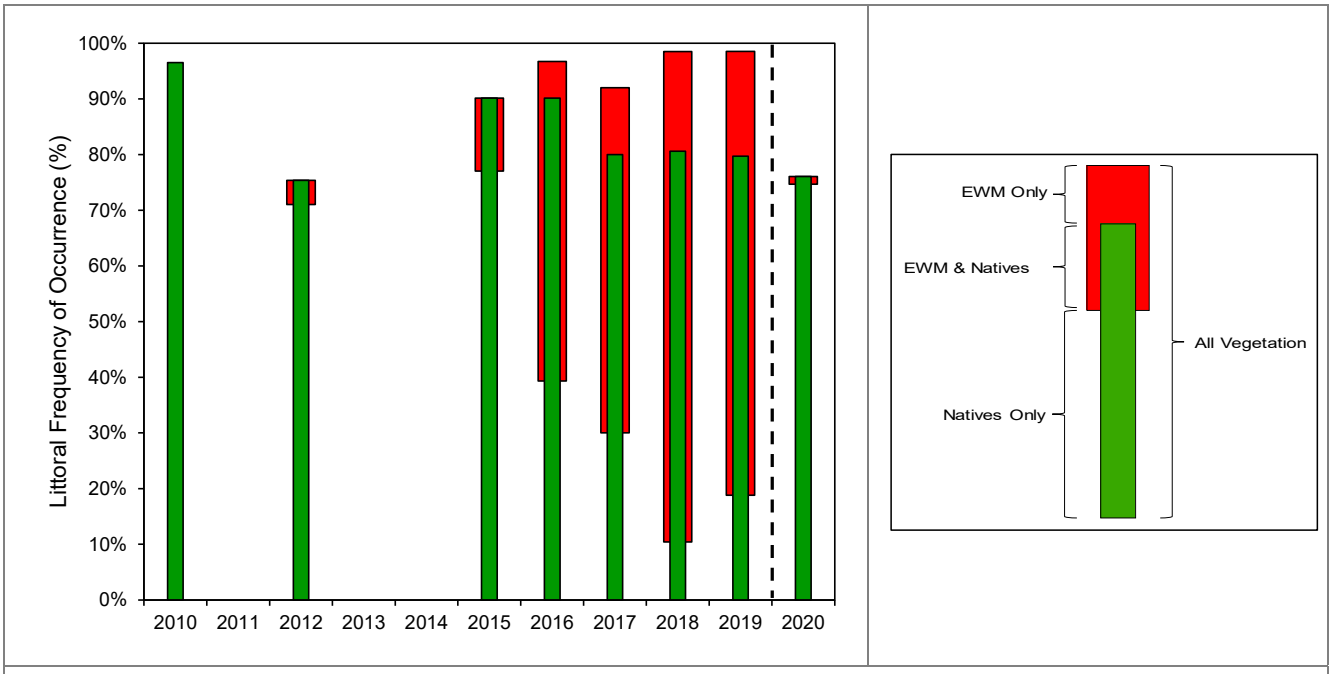


Figure 2.3-4. Littoral frequency of occurrence of native plants and EWM from sub-set point intercept surveys completed in 2010, 2012, & 2015-2020 in Anvil Lake. Dashed line represents herbicide treatment.

Figure 2.3-5 displays the relative occurrence of aquatic plant species in the North Bay of Anvil Lake in each of the point-intercept surveys spanning from 2010-2020. The figure documents the increasing relative frequency of EWM from 2012-2019. From 2017-2019, EWM has exhibited a higher relative frequency of occurrence than any native species in North Bay during the same time period. Since 2015, the collective relative frequency of occurrence of several groups of native species has declined as EWM has come to account for a greater proportion of the plant community in this sample area. Following the herbicide treatment, the relative occurrence of EWM was reduced to 1.1% while native species including wild celery and charophytes expanded to account for a larger proportion of the aquatic plant population in the site.

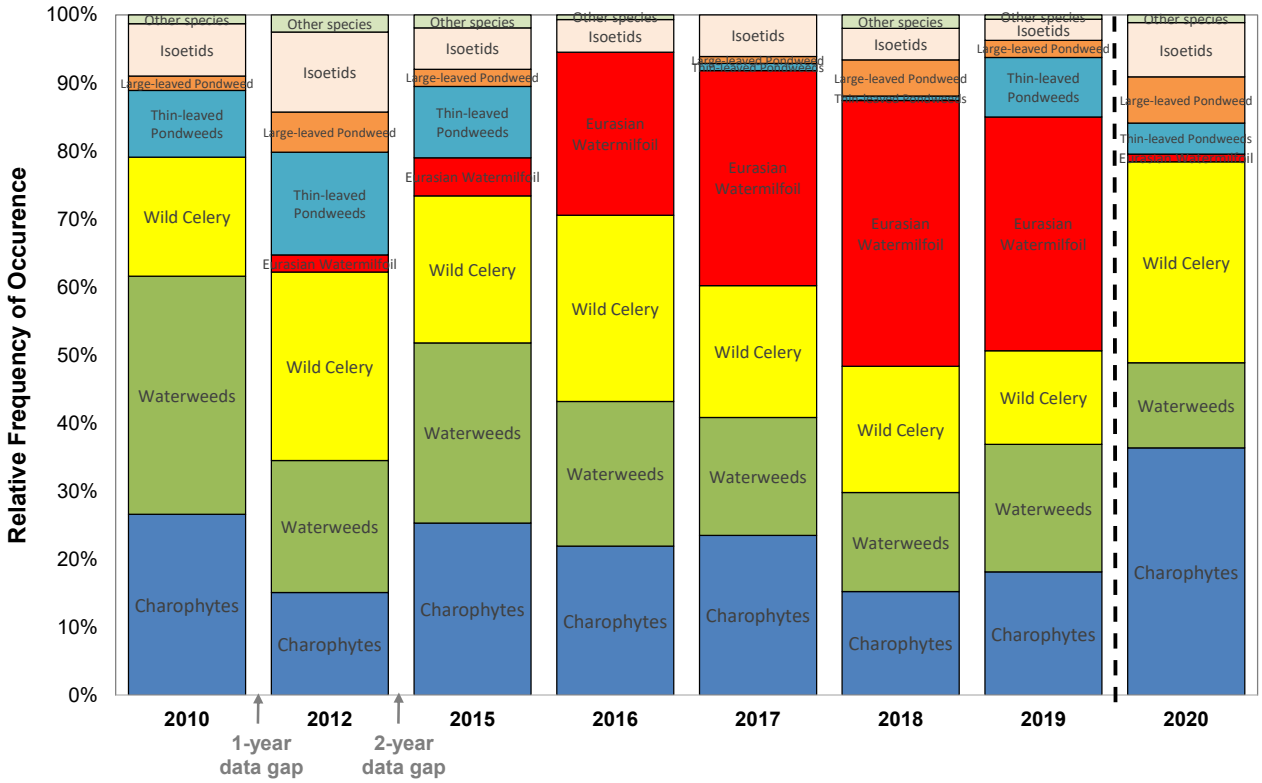


Figure 2.3-5. North Bay relative frequency of occurrence of aquatic plant species. Created using data from a subset of the 2010, 2012, 2015-2020 point-intercept surveys in Anvil Lake (n=73). Dashed line represents herbicide treatment.

2.4 Late-Season EWM Mapping Survey

Late-Season EWM Mapping Surveys have been completed annually on Anvil Lake since 2012. Initially, the population was largely contained within the North Bay of the lake; however, additional EWM occurrences in the lake have shown signs of establishment in recent years, most notably extending lakeward out from North Bay as well as in the southwest end of the lake.

Onterra staff completed a Late-Season EWM Mapping Survey on September 17 and 22, 2020. 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. A modest EWM population was detected with the submersible camera within North Bay including a relatively small (approximately 1/3 acres) colonized area comprised of either *highly scattered* or *scattered* densities (Figure 2.4-1). A number of additional *single or few plants* occurrences were detected within North Bay, all with the aid of a submersible camera. Several of the EWM plants that were located within the North Bay exhibited signs of stress in the form of fused leaflets and deformed growth (Photo 2.4-1). These injury characteristics are common with this type of herbicide (auxin hormone mimic).

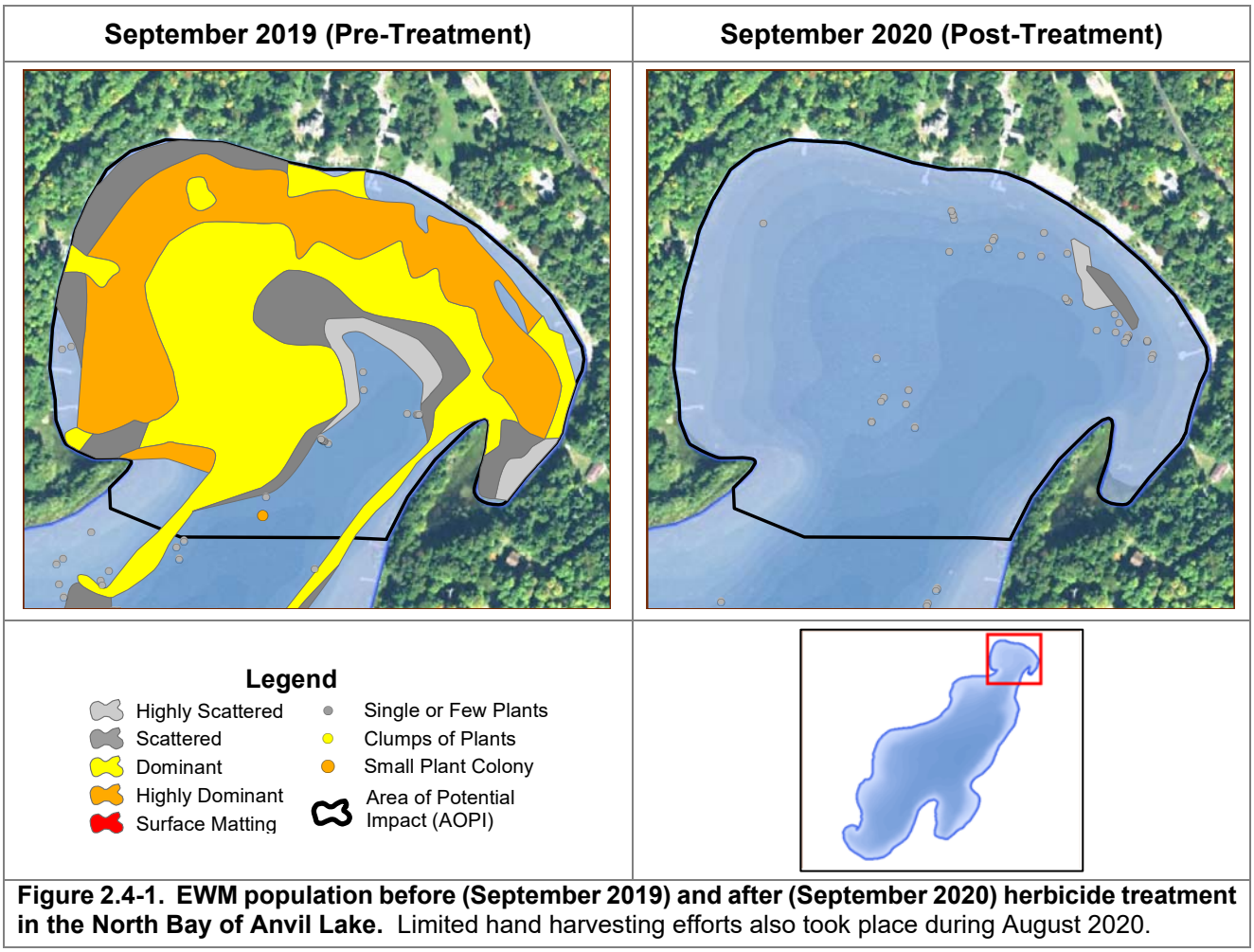


Figure 2.4-1. EWM population before (September 2019) and after (September 2020) herbicide treatment in the North Bay of Anvil Lake. Limited hand harvesting efforts also took place during August 2020.

Photos 2.4-1. EWM specimens exhibiting epinasty. Observed during a September 2020 Survey on Anvil Lake. Photos by Onterra, LLC.

The lake-wide EWM population increased every year dating back to 2012 and reached a high of 65.8 acres by the time of the 2019 mapping survey (Figure 2.4-2). Much of the colonized EWM was contained within North Bay until 2018-2019 when more areas around the lake began expanding to form colonized areas. Note that Figure 2.4-2 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. The 2020 Late-Season EWM Mapping Survey documented just 0.4 acres of colonized EWM in Anvil Lake.

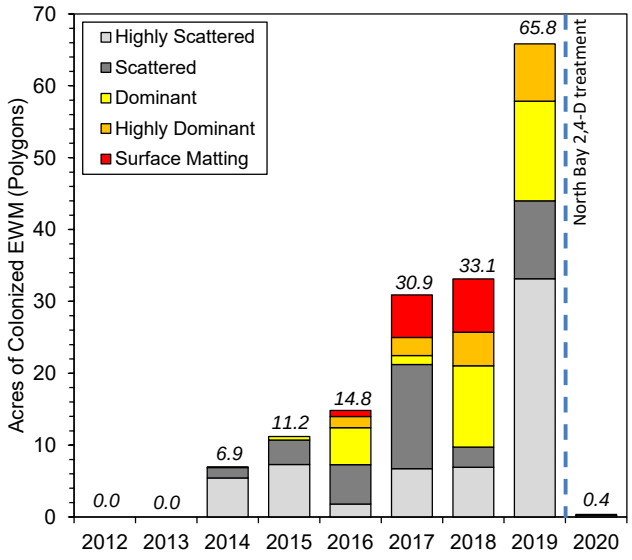


Figure 2.4-2. Anvil Lake acreage of colonized EWM (polygons) from 2012-2020. Created using data from 2012-2020 late-summer EWM mapping surveys.

Overall, the lake-wide EWM population of Anvil Lake in 2020 was lower than expected with reductions throughout the lake compared to the previous mapping survey in 2019 (Map 2). The combination of the herbicide treatment as well as environmental factors are attributed to the decrease in acreage between 2019 and 2020.

2.5 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 2,4-D that were achieved in the targeted area after treatment. Samples were collected from three sites within North Bay, A1 and A2 were within the direct herbicide application area, while A3 was outside of the application area but within the treatment's area of potential impact (AOPI). Site A4 was outside of the AOPI and served to measure herbicide dissipation out of the AOPI after treatment. Site A5 was located at the deep hole location near the center of Anvil Lake with the purpose of understanding the amount of 2,4-D that mixed within the entire lake. Samples were scheduled for collection at eleven time intervals after treatment beginning at 12 Hours After Treatment (HAT) and spanning through 35 Days After Treatment (DAT). Samples were collected by volunteer members of the ALA and upon completion of the sampling, were shipped to the Wisconsin State Lab of Hygiene for analysis. Figure 2.5-1 displays the sampling site details as well as the sampling time intervals associated with the herbicide concentration monitoring plan. A copy of the herbicide concentration monitoring plan is included as Appendix B.

Anvil Lake Herbicide Sample Sites				
Site	**Station ID**	**Latitude**	**Longitude**	**Sample Depth**
A1 w/in Application Area	10053780	45.952271	-89.055992	Integrated Sampler (0-6 ft)
A2 - w/in Application Area	10053781	45.95168	-89.053247	Integrated Sampler (0-6 ft)
A3 - North Bay AOPI	10053782	45.950495	-89.05475	Integrated Sampler (0-6 ft)
A4- Outside Treatment Area	10053783	45.948968	-89.056837	Integrated Sampler (0-6 ft)
A5-Deep Hole	643401	45.943528	-89.061563	Integrated Sampler (0-6 ft)

Interval (DAT)	A1	A2	A3	A4	A5-Deep Hole
0.5 DAT	X	X	X	X	
1 DAT	X	X	X	X	X
2 DAT	X	X	X	X	
3 DAT	X	X	X	X	X
5 DAT	X	X	X	X	
7 DAT	X	X	X	X	X
10 DAT	X	X	X	X	
14 DAT	X	X	X	X	X
21 DAT	X	X	X	X	
28 DAT	X	X	X	X	X
35 DAT	X	X	X		
Total samples: 48					

Figure 2.5-1. Anvil Lake herbicide concentration monitoring locations following 2020 2,4-D treatment.

Figure 2.5-2 displays the results of the post-treatment herbicide concentration monitoring from three monitoring sites located within the AOPI of North Bay. The top of the graph corresponds with the target 2,4-D concentration of 0.600 ppm ae within the AOPI. Concentrations collected at the earliest sampling interval (0.5 DAT) showed 2,4-D levels were variable between the sites and were all below the target of 0.600 ppm ae. Concentrations at the first sampling interval were lower at site A3 compared to A1 and A2 where herbicide was directly applied. The highest measured concentrations were between 0.2-0.3 ppm ae and were collected at site A1 during the first 24 hours after treatment. By 3 DAT concentrations were approximately the same between all three sampling locations within the North Bay indicating that the herbicide had mixed within this area of the lake. From 3 DAT to 35 DAT, 2,4-D degradation was very slow as concentrations slowly declined from approximately 0.04 ppm ae to 0.02 ppm ae.

The ALA wished to continue to monitor 2,4-D concentrations in the lake beyond the originally planned monitoring timeframe outlined in the Sampling Plan if detectable levels of herbicide were present upon reviewing the lab results from the samples collected out to 35 DAT. Low but detectable levels of 2,4-D were confirmed in samples collected at 35 DAT. Therefore, the ALA collected additional samples at 56 DAT (July 30) and 121 DAT (October 4). These results documented 9-12 ppb (0.009-0.012 ppm) 2,4-D from samples collected at 56 DAT from sites A1, A2, A3, and A4. Herbicide was not detected from samples collected from sites A1, A2, and A3 at 121 DAT.

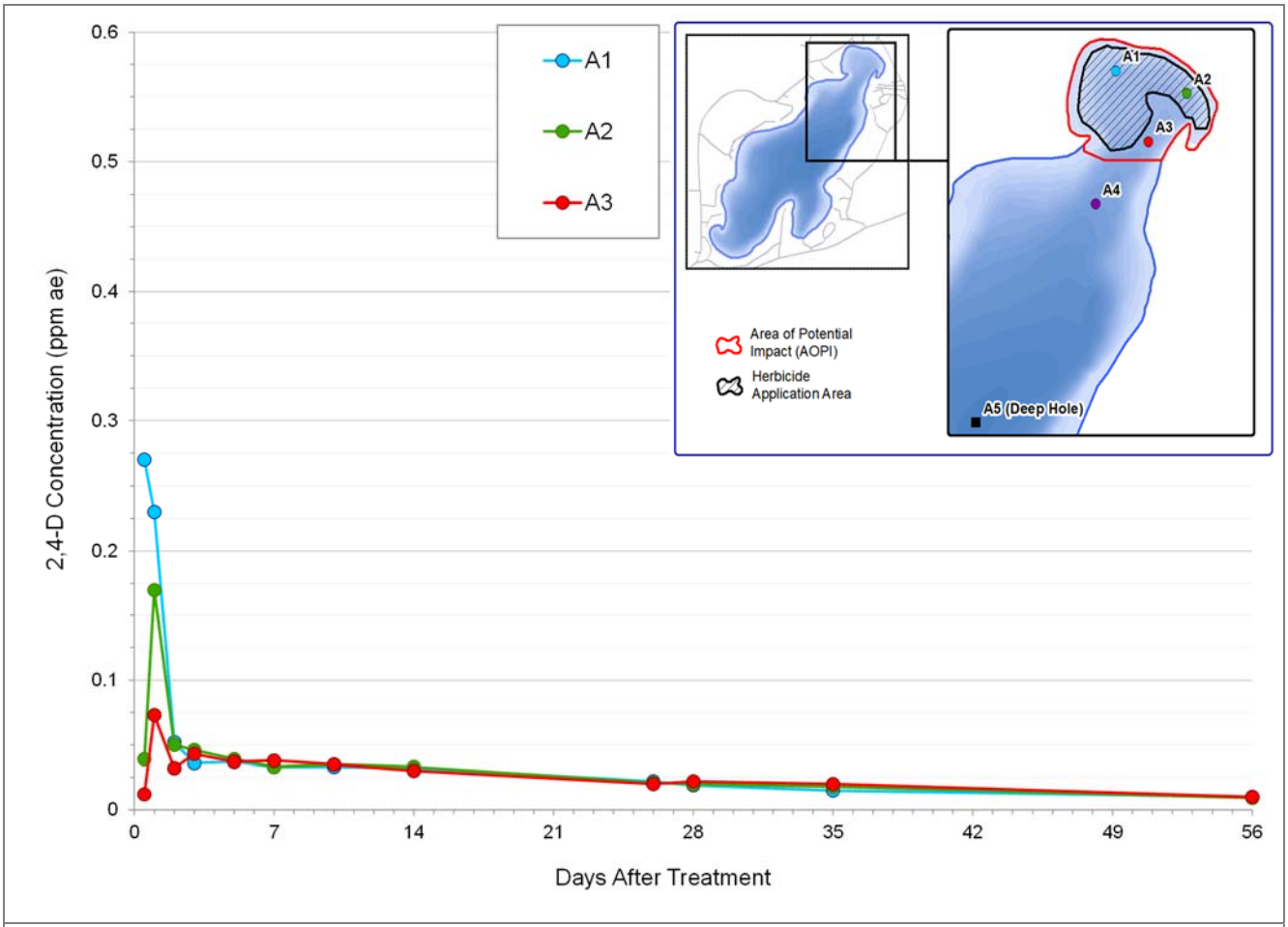


Figure 2.5-2. Herbicide concentration monitoring results from sites A1, A2, & A3 following a 2020 2,4-D treatment in Anvil Lake. 2,4-D was below detection limits in samples collected at 121 DAT.

Figure 2.5-3 displays the results of the post-treatment herbicide concentration monitoring from sites A4 and A5. The first sample collected from site 0.5 DAT showed a low 2,4-D concentration of 0.0074 ppm ae indicating very little dissipation out from the application area to this point in time. By the time of the 1 DAT sample, concentrations at site A4 increased to 0.089 ppm ae which was still lower than concentrations measured at sites A1 & A2 within North Bay. By 3 DAT, concentrations were approximately uniform between site A4, and all three sites within North Bay, indicating that an equilibrium lake-wide concentration was reached (0.038 ppm ae). Prior to the treatment, the potential whole-lake 2,4-D concentration when the lake was stratified to 20 feet was calculated to be 0.036 ppm ae.

The samples collected from site A5 are representative of the potential whole-lake concentration as the herbicide came into equilibrium within the epilimnetic water volume of the lake. Samples collected from site A5 ranged from 0.018 ppm ae to 0.032 ppm ae between the five sampling intervals collected from 1 DAT to 28 DAT. Although no samples were collected from this site after 28 DAT, it is suspected that the herbicide would have been mixed throughout the lake by this time and the concentration would likely have mirrored the concentrations measured at site A4 on 56 DAT (0.012 ppm ae).

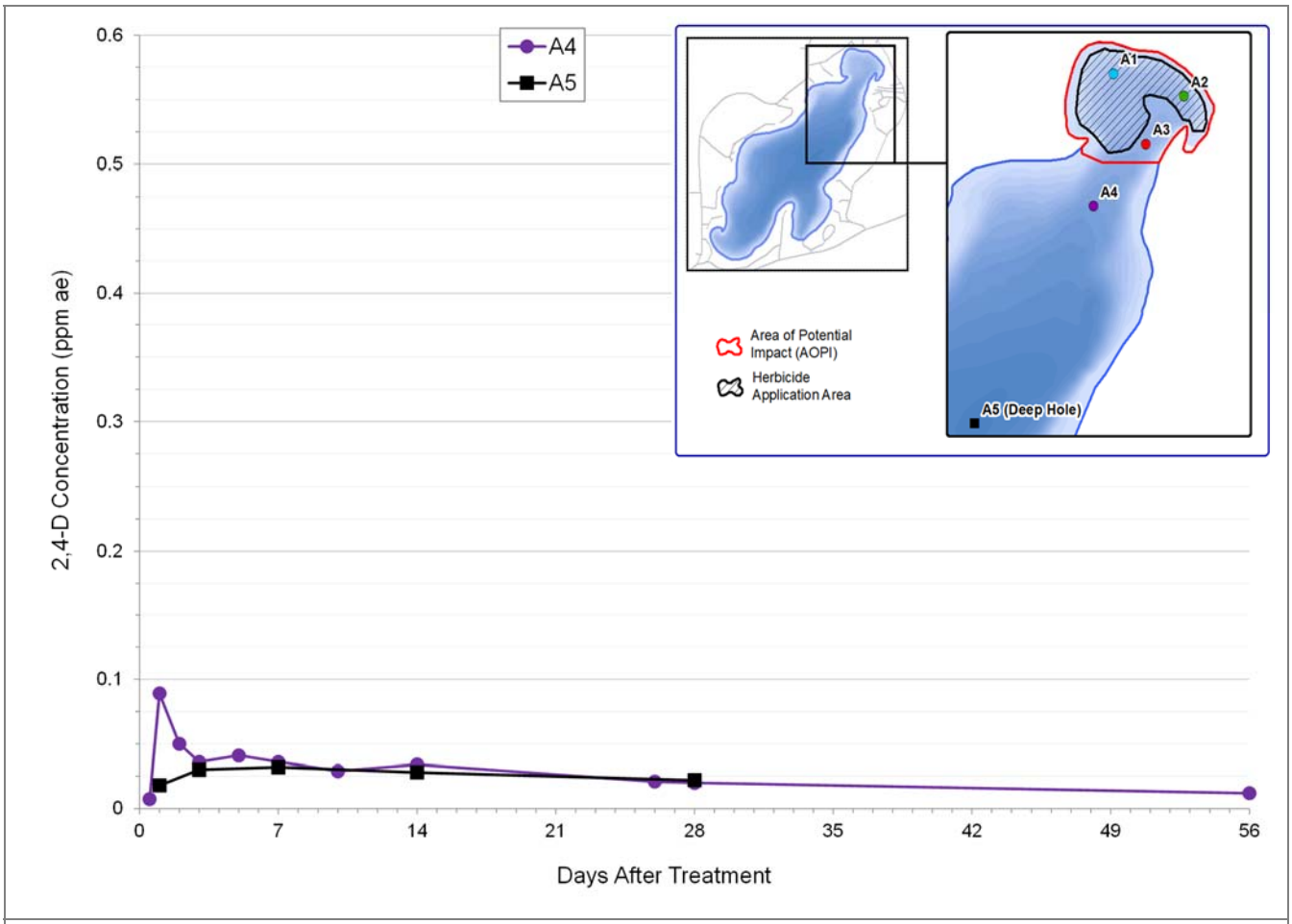


Figure 2.5-3. Herbicide concentration monitoring results from sites A4 & A5 following a 2020 2,4-D treatment in Anvil Lake.

3.0 DASH & HAND-HARVESTING ACTIVITIES SUMMARY

During some of the early season dives prior to the herbicide application in North Bay, ALA divers observed a reduced EWM population in some areas of the lake including the southern-most bay and the area near the public access location. The ALA initially focused harvesting efforts on the southwest bay of the lake during June. Divers later targeted sites in the boat landing bay near the campground, and other sites included on the DASH permit. Hired divers shared many observations of the EWM population with the ALA over the course of the growing season. During harvesting operations in mid-July, divers documented signs of obviously impacted EWM with most of the biomass appearing to be dead or otherwise unhealthy. Photos taken by one of the ALA's hired divers demonstrate the impacted EWM in the vicinity of North Bay including some plants exhibiting fused and palmate leaflets which is often associated with exposure to herbicide (Photos 3.0-1).

Another update shared by the ALA-hired diver in early-August stated that plants around the south end of the lake appeared to be dead down to the roots and native plants including wild celery appeared to be thriving. During August, divers began searching within North Bay for EWM to harvest as they struggled to locate EWM elsewhere around Anvil Lake. The final week of harvesting included the removal of EWM in North Bay that appeared brown and sickly, with small sprigs of green growth.

Photos 3.0-1. EWM specimens observed during July 2020 on Anvil Lake. Photos by J. Thompson: ALA-hired diver, cropped and marked up by Onterra, LLC. Red outline highlights palmate leaflets on EWM plant.

The Dive Logs as well as the ALA's Harvesting Summary Report associated with the 2020 hand harvesting efforts on Anvil Lake are included with this report as Appendix C. Efforts conducted during 2020 resulted in the harvest of approximately 4,784 pounds of plants of which 95%-100% was reported as EWM. The dive logs document approximately 156 hours of dive time with some additional time spent conducting scouting or searching for EWM.

4.0 CONCLUSIONS AND DISCUSSION

The coordination and implementation of the 2020 EWM management strategy was completed as planned for Anvil Lake with collaboration from several project partners including the ALA, WDNR, and Onterra. Volunteer efforts provided by the ALA were instrumental in the completion of the pre- and post-treatment planning and monitoring associated with the herbicide treatment.

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 indicate that the 2020 herbicide treatment initially resulted in a high level of control during the *year of treatment*. Understanding the EWM population during the *year-after-treatment* will be a true test of the outcome of the management action. Overall, the impacts to the native plant population appear to be limited and not of immediate concern. Continued aquatic plant monitoring will be conducted during 2021 including of a replication of the sub-set point-intercept survey in North Bay.

It is possible that some amount of EWM in Anvil Lake outside of the North Bay may have been injured by the herbicide treatment or saw suppressed growth due to environmental stressors and went undetected during the September 2020 mapping survey. Root crowns may have survived and could rebound with new growth during 2021. However, increasingly deeper water may impart additional added stress on these plants such that they are unable to rebound. It is anticipated that if water levels remain high during 2021, EWM regrowth or recovery may be less likely to occur.

Early season observations made during ALA surveillance efforts indicated that EWM growth was much lower than expected in certain areas around the lake including the southern-most bay, prior to the herbicide application. Onterra observed seemingly healthy EWM growth in North Bay during the pre-treatment survey on May 28, however; conditions in this area of the lake are unique in terms of water depth, nutrient inputs, and sediment composition, all of which may favor EWM growth and aquatic plant growth in general.

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.

The herbicide concentration monitoring data indicate that 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.

Weak-acid herbicides, like i.e. 2,4-D, are known to quickly dissipate from the application area. When these herbicides dissipate out of the treatment site, the concentrations and exposure times in these adjacent areas are typically insufficient to cause any meaningful impacts. 2,4-D degradation is largely driven by biological activity within a lake and may be slower in lakes with low productivity like Anvil Lake. Herbicide concentrations measured at the deep hole location (site A5) following treatment were consistent with predicted estimates.

Most intentional whole-lake 2,4-D treatment designs have a target concentration of around 0.3-0.4 ppm ae when dissipated lake-wide. Onterra has observed lake-wide impacts to some sensitive native plants when lake-wide concentrations were above 0.10 ppm ae in these scenarios. The lake-wide 2,4-D concentrations observed in Anvil Lake are nearly ten times lower than typical whole-lake treatment concentrations. The scientific literature does not indicate whether very low 2,4-D concentrations (< 0.04 ppm ae) can be impactful on EWM and other aquatic plant species when sustained for a period of time spanning 8 weeks or more as was observed in Anvil Lake.

4.1 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 4.1-1). Some of the lowest water levels on record occurred approximately from 2004-2015. Since 2015, water levels have risen relatively rapidly and as of 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. Water levels continued to rise in 2020, with an increase of approximately 16 inches compared to the growing season of 2019. All told, the water levels have risen approximately 5.5 feet between 2015 and 2020. The lake level in 2020 is at the highest it has been in a period of 34 years dating back to 1986

and is less than two feet below the highest ever documented levels recorded in 1943-44. The water level from January 1, 2021 to March 24, 2021 has continued to increase by almost an inch and a half.

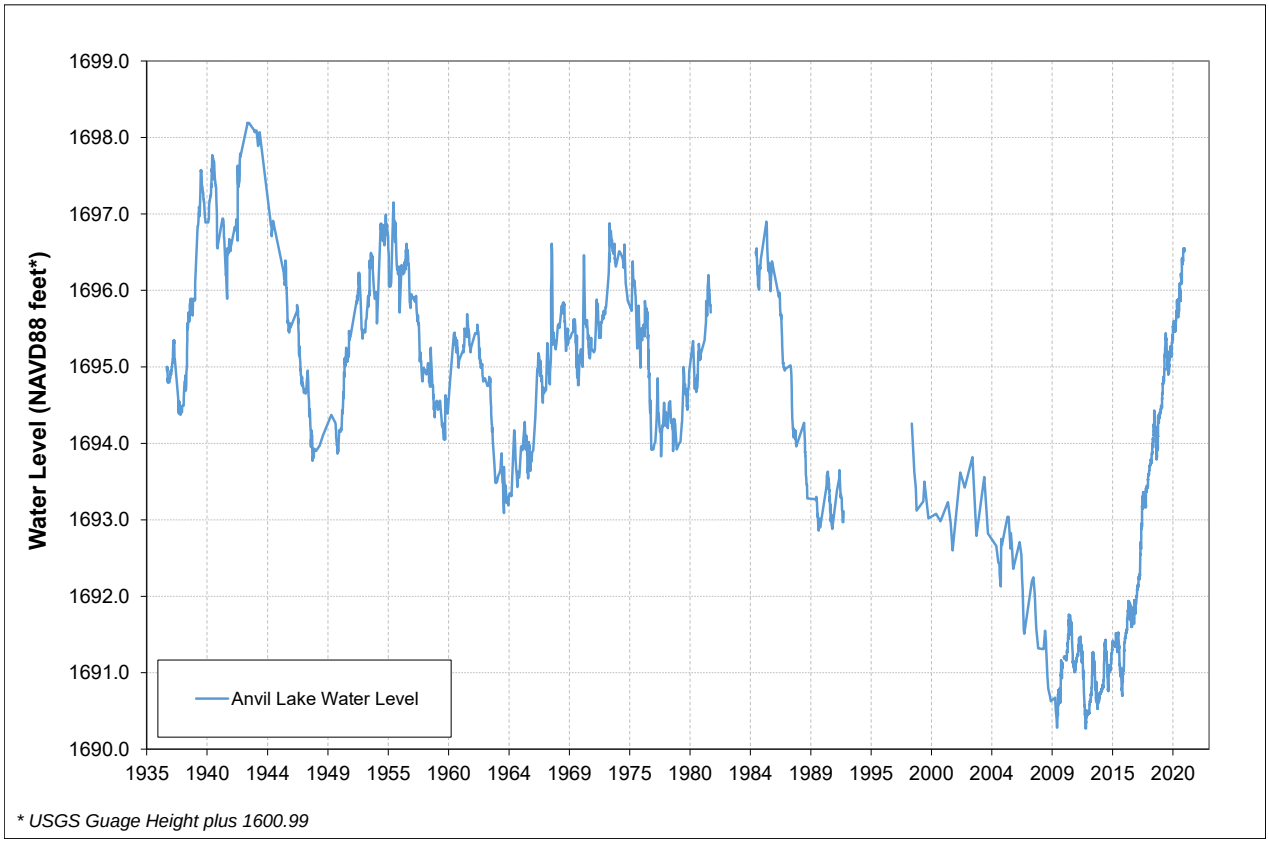


Figure 4.1-1. Anvil Lake water levels from 1936 through March 24, 2021. Created using online data from USGS Gage 05390500 with additional data and benchmarks provided by Dale Robertson, USGS).

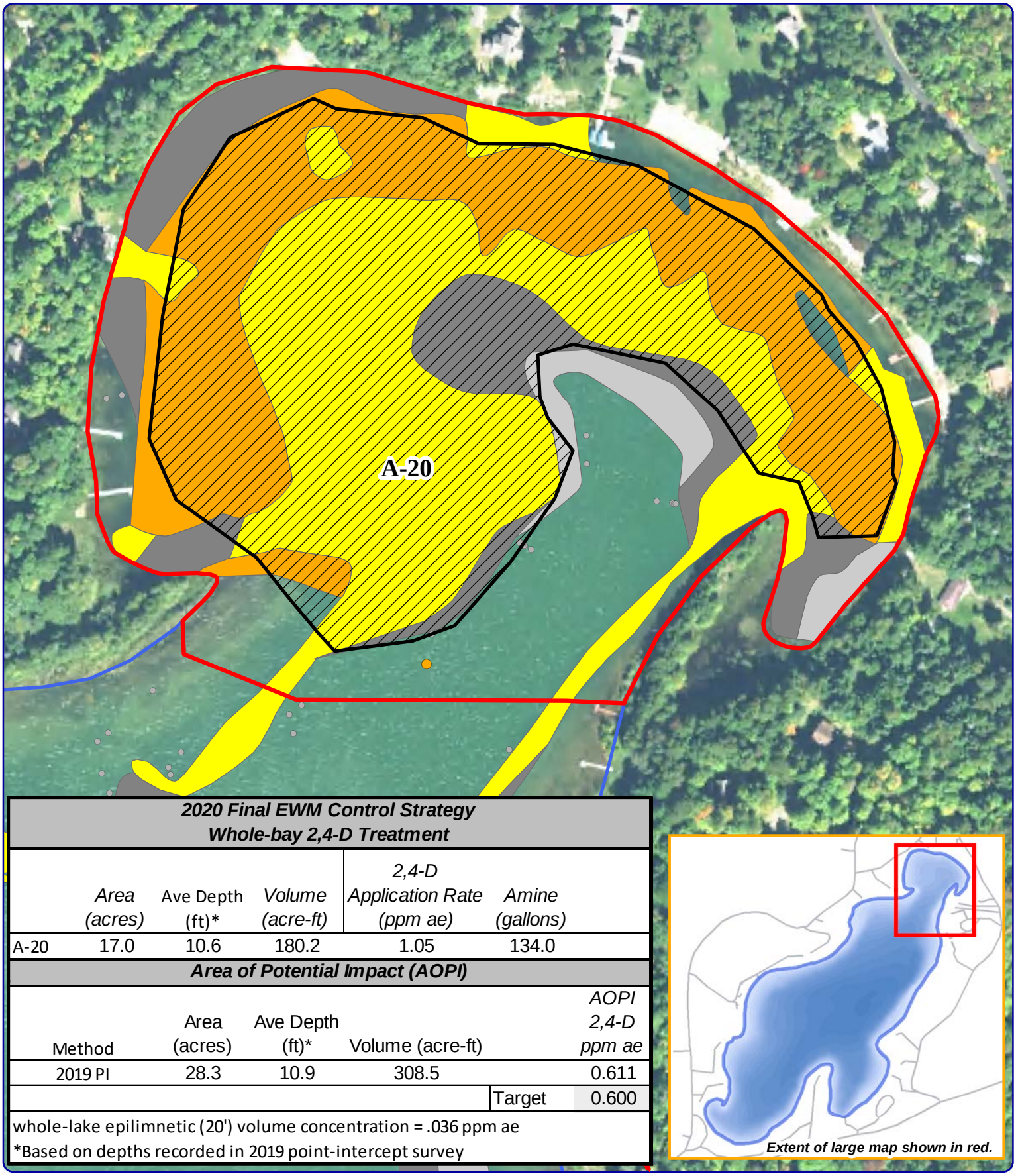
The impact that the rising water levels may impose on the aquatic plant communities in Anvil Lake are difficult to determine. Certainly, some species are well adapted to fluctuating water levels, whereas other species may struggle to adapt and survive in deeper waters. The littoral zone in Anvil Lake 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.

4.2. 2021 EWM Management Strategy

The ALA will continue with an integrated pest management strategy in 2021 through a coordinated hand harvesting program with the aid of DASH. All known EWM occurrences in the lake will be considered for hand harvesting removal efforts during 2021. Onterra believes that a hand harvesting control strategy is most likely to alter the longer-term trajectory of the rebounding EWM population when substantial

efforts are devoted during the first growing season following a large-scale population reduction. To this end, the ALA is encouraged to pursue an aggressive EWM hand harvesting effort during 2021. North Bay has the greatest likelihood of rapid EWM rebound in the lake given the favorable growing conditions in the site and the fact that a modest EWM population was detected in the area during the 2020 Late-Summer EWM Mapping Survey.

An ESAIS survey will be conducted likely during June 2021 in order to provide the most up-to-date EWM mapping data from which to update the hand harvesting strategy for the rest of the summer. The hand harvesting efforts will be evaluated through the completion of a late-season EWM mapping survey which will also serve to guide future management strategy development for 2022.



2020 Final EWM Control Strategy Whole-bay 2,4-D Treatment					
	Area (acres)	Ave Depth (ft)*	*Volume (acre-ft)*	*2,4-D Application Rate (ppm ae)*	*Amine (gallons)*
A-20	17.0	10.6	180.2	1.05	134.0

Area of Potential Impact (AOPI)					
Method	Area (acres)	Ave Depth (ft)*	Volume (acre-ft)		*AOPI 2,4-D ppm ae*
2019 PI	28.3	10.9	308.5		0.611
				Target	0.600

whole-lake epilimnetic (20') volume concentration = .036 ppm ae

*Based on depths recorded in 2019 point-intercept survey

N W E S

200

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
Aquatic Plants: Onterra, 2019
Orthophotograph: NAIP, 2017
Bathymetry: Onterra, 2014; processed by Navico
Map date: *May 29, 2020*

Legend

September 2019 EWM Survey Results

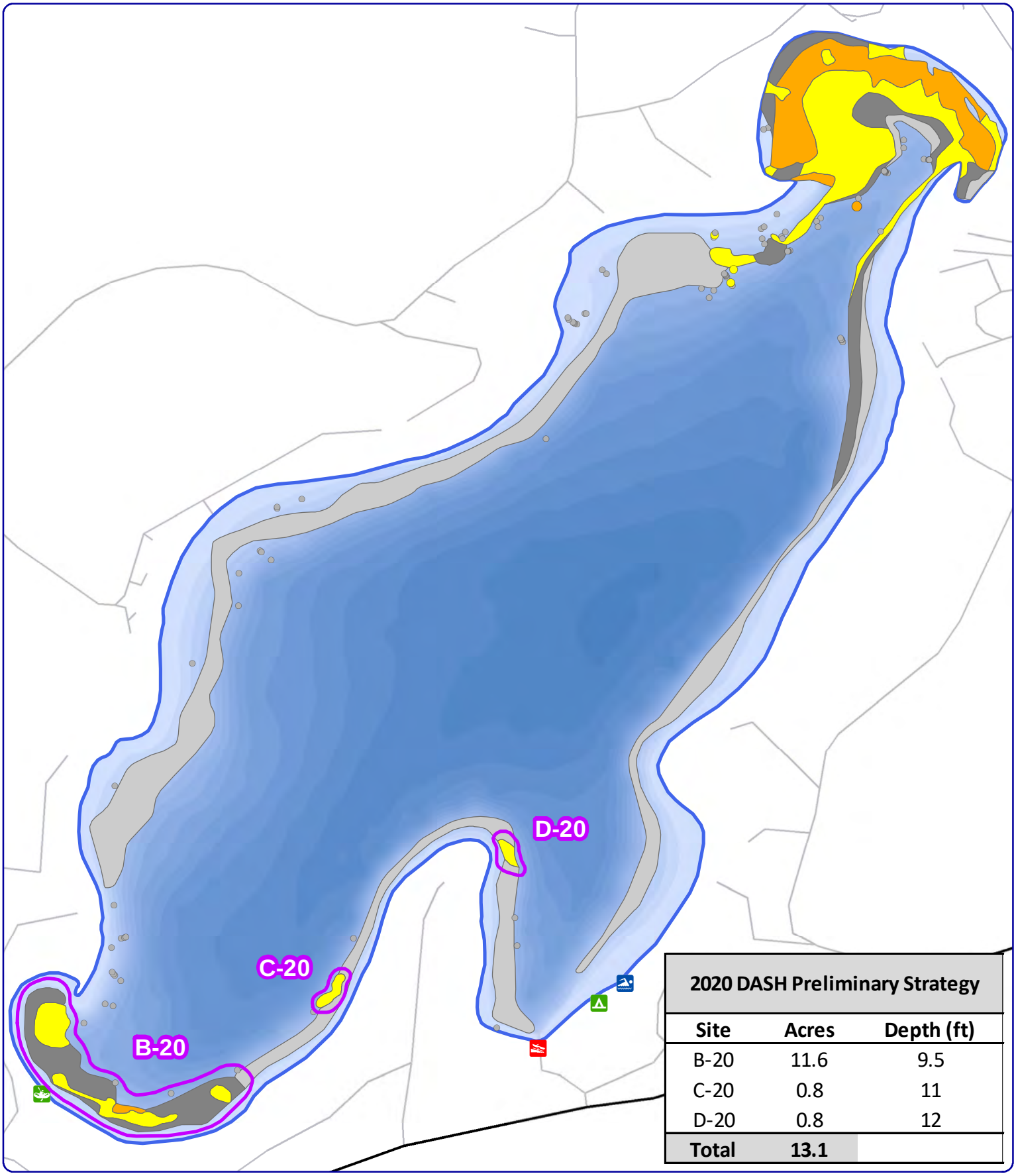
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Area of Potential Impact (AOPI)
- Final Herbicide Application Areas

Map 1

Anvil Lake

Vilas County, Wisconsin

Final 2020 EWM Herbicide Treatment Strategy



2020 DASH Preliminary Strategy		
Site	**Acres**	**Depth (ft)**
B-20	11.6	9.5
C-20	0.8	11
D-20	0.8	12
Total	**13.1**	

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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
Aquatic Plants: Onterra, 2019

Bathymetry: Onterra, 2014; processed by Navico

Map date: *December 30, 2019 AMS*

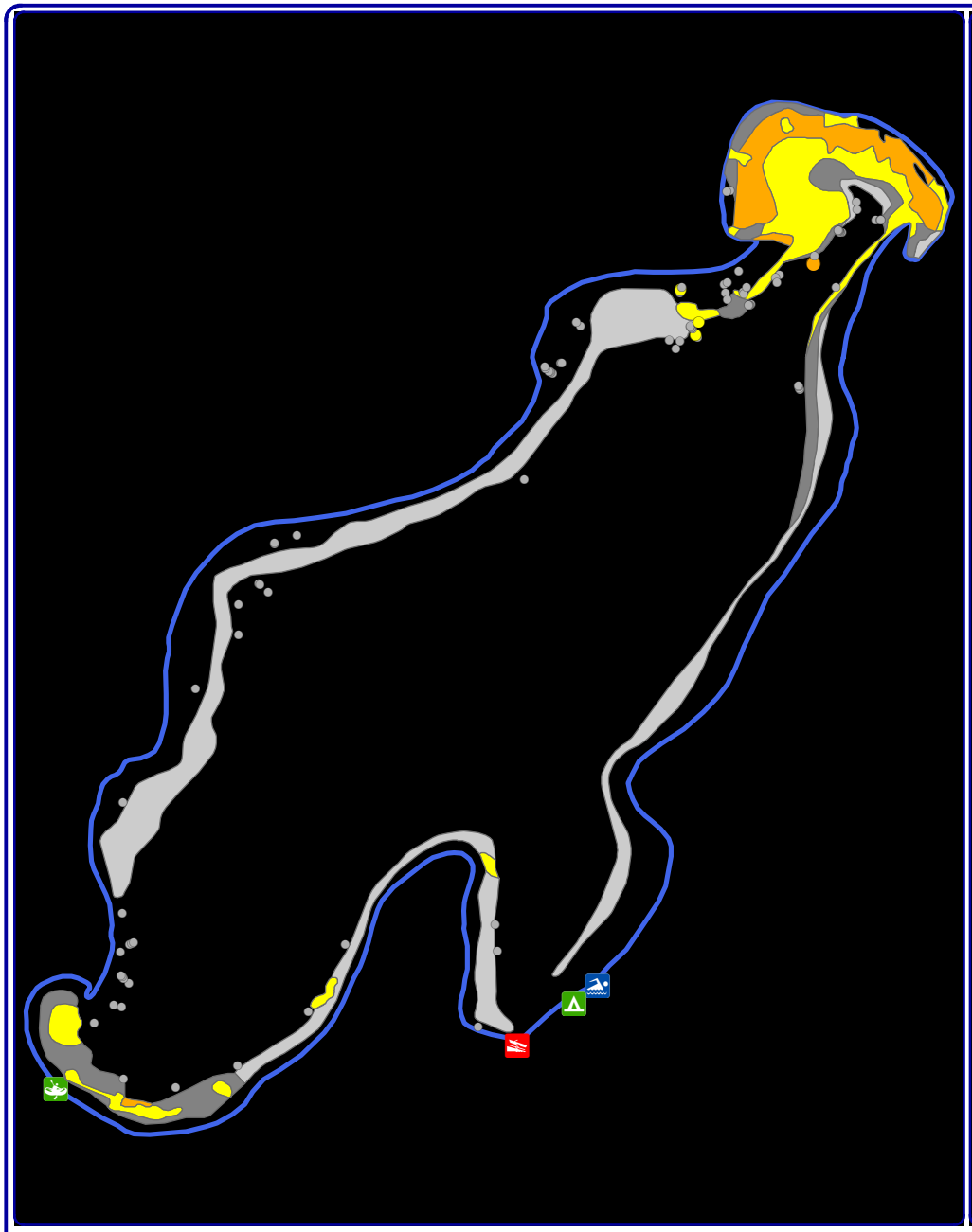
Project Location in Wisconsin

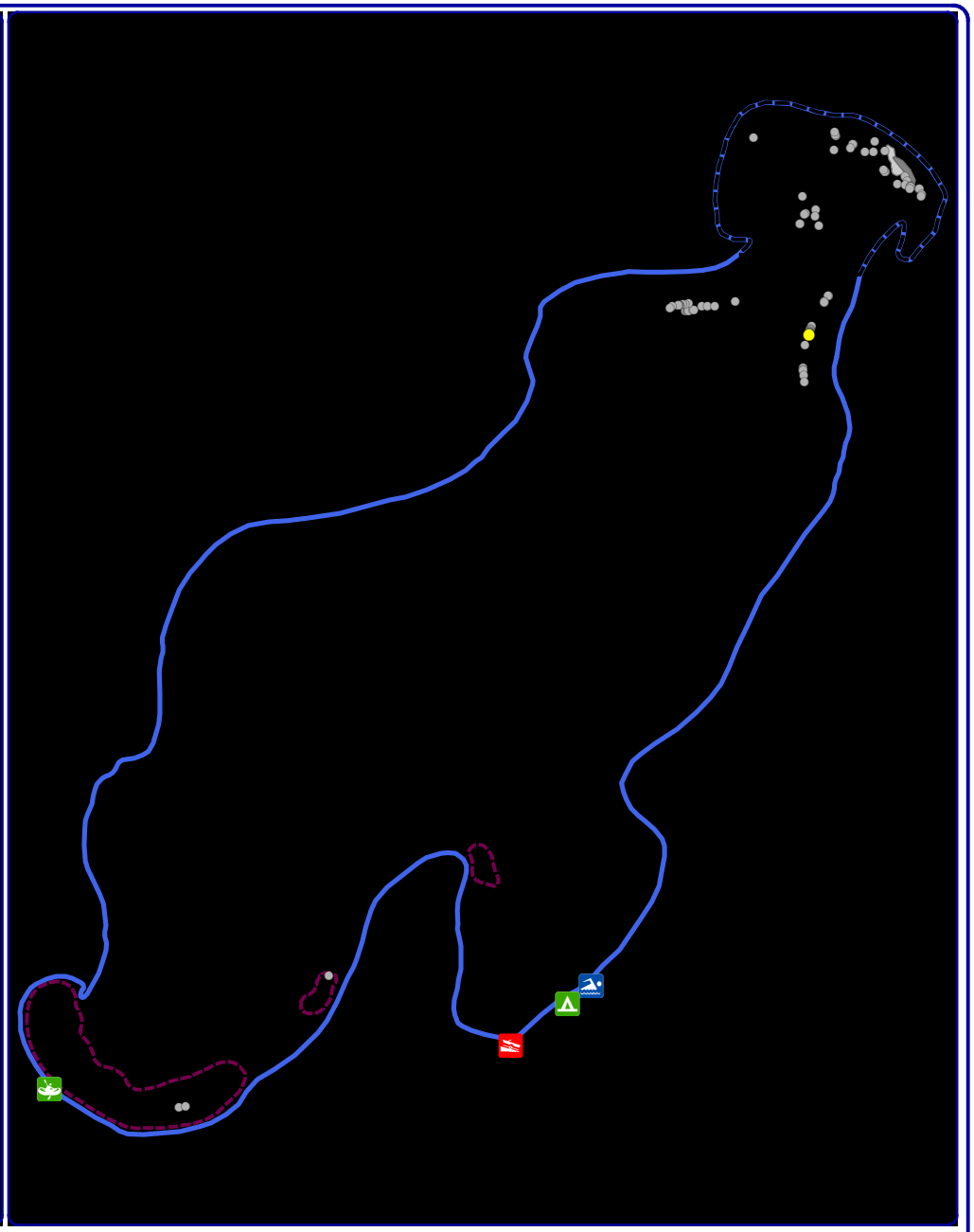
Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2020 Preliminary DASH Site

Map 2
Anvil Lake
Vilas County, Wisconsin

September 2019 EWM Survey Results & 2020 Preliminary DASH Strategy





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

Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2019 -2020
Bathymetry: Onterra, 2017
Map Date: February 2, 2021 AMS

Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2020 Herbicide Treatment Area of Potential Impact
- 2020 DASH Priority Locations

Map 3

Anvil Lake

Vilas County, Wisconsin

Late-Summer 2019-2020 EWM Mapping Results

A

APPENDIX A

Littoral Frequency of Occurrence of Aquatic Plants in North Bay of Anvil Lake from 2010-2020 Sub-set Point-Intercept Surveys

		LFOO (%)							
Scientific Name	**Common Name**	**2010**	**2012**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Chara spp. & Nitella Spp.	Muskgrasses & Stonew orts	65.5	26.1	67.2	52.5	46.0	34.3	42.0	43.7
Vallisneria americana	Wild celery	41.4	47.8	57.4	65.6	38.0	41.8	31.9	36.6
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
Nitella spp.	Stonew orts	65.5	26.1	0.0	52.5	12.0	32.8	42.0	38.0
Myriophyllum spicatum	Eurasian w atermilfoil	0.0	4.3	14.8	57.4	62.0	88.1	79.7	1.4
Elodea canadensis	Common w aterw eed	82.8	27.5	0.0	50.8	34.0	32.8	43.5	14.1
Chara spp.	Muskgrasses	0.0	0.0	67.2	0.0	34.0	1.5	0.0	7.0
Potamogeton berchtoldii & P. pusillus	Slender & Small pondw eeds	20.7	26.1	16.4	0.0	2.0	1.5	15.9	2.8
Elodea nuttallii	Slender w aterw eed	3.4	5.8	70.5	0.0	0.0	0.0	0.0	1.4
Eleocharis acicularis	Needle spikerush	12.1	11.6	11.5	4.9	6.0	9.0	5.8	8.5
Potamogeton amplifolius	Large-leaf pondw eed	5.2	10.1	6.6	0.0	2.0	11.9	5.8	8.5
Potamogeton berchtoldii	Slender pondw eed	20.7	0.0	16.4	0.0	0.0	1.5	15.9	2.8
Filamentous algae	Filamentous algae	0.0	4.3	23.0	0.0	0.0	4.5	0.0	5.6
Potamogeton pusillus	Small pondw eed	0.0	26.1	0.0	0.0	2.0	0.0	0.0	0.0
Fissidens spp. & Fontinalis spp.	Aquatic Moss	0.0	0.0	0.0	0.0	0.0	0.0	7.2	2.8
Potamogeton vaseyi	Vasey's pondw eed	3.4	0.0	8.2	0.0	0.0	0.0	1.4	0.0
Potamogeton epihydrus	Ribbon-leaf pondw eed	0.0	0.0	3.3	0.0	0.0	0.0	2.9	2.8
Myriophyllum tenellum	Dw arf w atermilfoil	1.7	0.0	1.6	4.9	2.0	0.0	1.4	0.0
Isoetes spp.	Quillw ort spp.	1.7	2.9	0.0	0.0	0.0	1.5	0.0	1.4
Sparganium angustifolium	Narrow -leaf bur-reed	3.4	0.0	3.3	1.6	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
Elatine minima	Waterw ort	1.7	2.9	1.6	1.6	0.0	0.0	0.0	0.0
Lemna minor	Lesser duckw eed	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.4
Nuphar variegata	Spatterdock	0.0	0.0	0.0	0.0	0.0	1.5	1.4	0.0
Potamogeton gramineus	Variable-leaf pondw eed	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0
Potamogeton crispus	Curly-leaf pondw eed	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0

B

APPENDIX B

Anvil Lake 2020 Herbicide Concentration Monitoring Sample Plan

Anvil Lake, Vilas County (WBIC: 968800)
2020 Herbicide Sample Plan
Onterra, LLC

Anvil Lake, Vilas County is a 377-acre mesotrophic seepage lake and has a maximum depth of 32 ft. An advanced sonar acoustic survey completed in 2014 determined the lake volume to be approximately 5,186 acre-feet. Liquid 2,4-D is proposed to be applied to 17.0 acres of the lake in spring 2020 to control Eurasian watermilfoil and is expected to mix throughout the 28.3 acres of the North Bay of the lake. Herbicide concentration sampling will be conducted in order to monitor the herbicide concentrations in the days and weeks following the application.

Water samples will need to be collected at the sites and depths listed below. Data are in decimal degrees and the datum is WGS84. A map of the herbicide sample site locations is attached.

Anvil Lake Herbicide Sample Sites				
Site	**Station ID**	**Latitude**	**Longitude**	**Sample Depth**
A1 w/in Application Area	10053780	45.952271	-89.055992	Integrated Sampler (0-6 ft)
A2 - w/in Application Area	10053781	45.95168	-89.053247	Integrated Sampler (0-6 ft)
A3 - North Bay AOPI	10053782	45.950495	-89.05475	Integrated Sampler (0-6 ft)
A4- Outside Treatment Area	10053783	45.948968	-89.056837	Integrated Sampler (0-6 ft)
A5-Deep Hole	643401	45.943528	-89.061563	Integrated Sampler (0-6 ft)

Samples will need to be collected at 11 different time intervals (Days After Treatment - DAT) throughout the project and are listed below. If a sample cannot be collected at the interval listed below, please collect the sample as soon as reasonably possible and record the change.

Interval (DAT)	A1	A2	A3	A4	A5-Deep Hole
0.5 DAT	X	X	X	X	
1 DAT	X	X	X	X	X
2 DAT	X	X	X	X	
3 DAT	X	X	X	X	X
5 DAT	X	X	X	X	
7 DAT	X	X	X	X	X
10 DAT	X	X	X	X	
14 DAT	X	X	X	X	X
21 DAT	X	X	X	X	
28 DAT	X	X	X	X	X
35 DAT	X	X	X		
Total samples: 48					

Water samples will be collected using an integrated water sampler for all near-surface samples (0-6 ft) (Photo 1). A video tutorial demonstrating the proper use of an integrated sampler is available on Onterra's YouTube web page: https://www.youtube.com/watch?v=UJl16G_7P4g It is important to rinse the sampling devices and the custom mixing bottle with the water from each sampling site upon arrival at the site.

5/29/2020

Water is collected by pushing the integrated sampler straight down to an approximate 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. The mixing bottle should be given a brief stir to mix the contents, and then emptied from the mixing bottle into the appropriately labeled final 60ml sampling bottle. Once in the final sampling bottle, the water sample must be preserved by adding 3-4 drops of sulfuric acid with an eye dropper.

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 GPS units, temperature probes, and integrated sampler devices available to loan out for the duration of the sampling upon request. All other materials including pre-labeled sampling bottles, a customized mixing bottle, vials of sulfuric acid, eye droppers, datasheets, and a shipping container will be provided.

It is important to use a separate data sheet for each day that is monitored. Please fill out one data sheet for each sample interval and fill in the highlighted boxes. Store the preserved samples in a refrigerator. After the completion of the final sampling interval, please ship all of the samples and the data sheets to the Wisconsin State Lab of Hygiene (WSLH) within the insulated shipping box. Please review the attached *Herbicide Sample Handling Instructions* for specific shipping instructions.

If you have any questions, please call or email one of the contacts listed below.

Project specifics, logistics and sampling methods	
Todd Hanke **Onterra, LLC** **thanke@onterra-eco.com** **Cell Phone (920) 360-7233**	**Eddie Heath** **Onterra, LLC** **eheath@onterra-eco.com** **Cell Phone (920) 360-1851**
WDNR Support	
Michelle Nault **WI DNR** **Michelle.Nault@wisconsin.gov** **Work Mobile (608) 513-4587**	**Ty Krajewski** **WI DNR – Northern Region** **Ty.Krajewski@wisconsin.gov**
Wisconsin State Lab of Hygiene	
Jenna Smith **WI State Lab of Hygiene** **Organic Chemistry Dept.** **Jenna.Smith@slh.wisc.edu** **Office (608) 263-6258**	

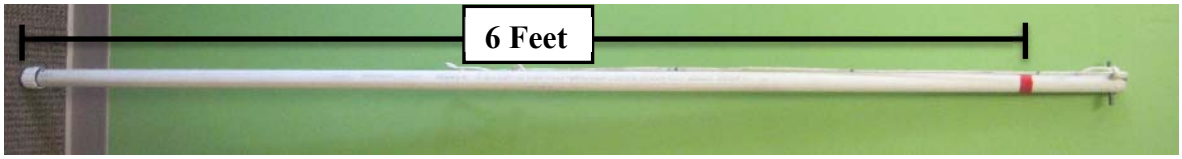
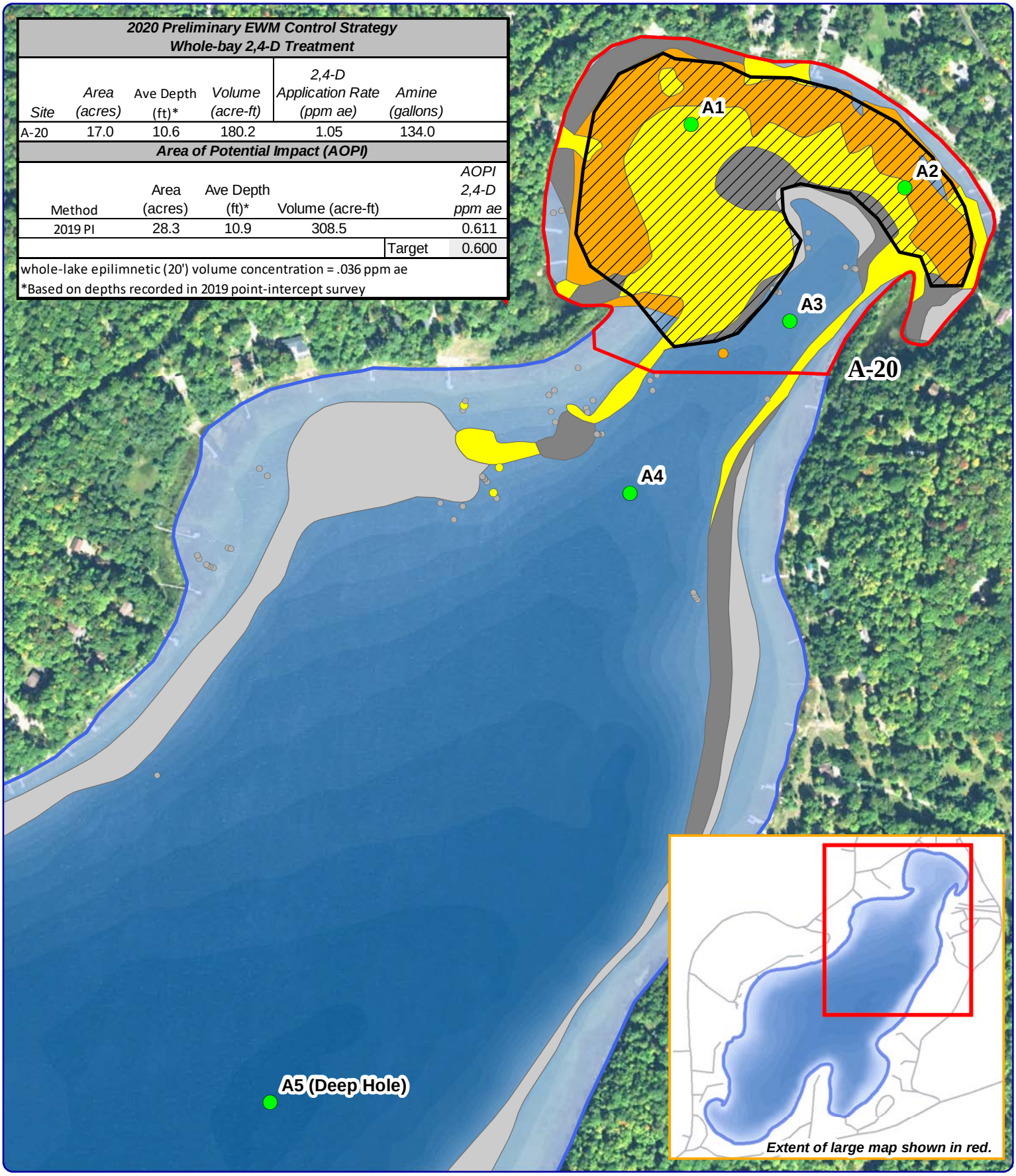


Photo 1. Six-Foot Integrated Sampler (top) & custom transfer bottle (bottom).



2020 Preliminary EWM Control Strategy
Whole-bay 2,4-D Treatment

Site	Area (acres)	Ave Depth (ft)*	Volume (acre-ft)	2,4-D Application Rate (ppm ae)	Amine (gallons)
A-20	17.0	10.6	180.2	1.05	134.0

Area of Potential Impact (AOPI)

Method	Area (acres)	Ave Depth (ft)*	Volume (acre-ft)		AOPI 2,4-D ppm ae
2019 PI	28.3	10.9	308.5		0.611
				Target	0.600

whole-lake epilimnetic (20') volume concentration = .036 ppm ae

*Based on depths recorded in 2019 point-intercept survey

N W E S

410
Feet

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

Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2019
Orthophotograph: NAIP, 2017
Bathymetry: Onterra, 2014; processed by Navico
Map date: *April 24, 2020 AMS*

Legend

September 2019 EWM Survey Results

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Herbicide Concentration Monitoring Site
- Area of Potential Impact (AOPI)
- Proposed Herbicide Application Areas

Anvil Lake
Vilas County, Wisconsin

Proposed 2020 EWM Herbicide Treatment Strategy & Herbicide Concentration Monitoring Sites

C

APPENDIX C

- **Anvil Lake Association 2020 Diver Assisted Suction Harvest Dive Logs**

- **Anvil Lake Association 2020 EWM Harvest Report**

Date	Location	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity
6/3/20		4	30	5	99%	150	Cloudy
6/8/20		4	30	6	99%	180	Cloudy Calm
6/8/20		4	40	8	99%	320	
6/9/20		4	35	7	99%	245	Cloudy light breeze
6/10/20	Fox den	3.5	30	2	99%	60	Cloudy rainy murky
6/11/20	Seidl dock	2	40	3	99%	120	Cloudy very windy
6/12/20	Seidl dock	4	40	5	99%	200	Sunny breezy
6/12/20	New Buoy	4	40	10	99	400	
6/15/20	Seidl dock	4.5	40	6	99%	240	Sunny breezy
6/16/20	SB East Side	4	40	4	99%	160	Sunny Windy
6/17/20	SB East Side	4	40	10	99%	400	Sunny Windy
6/18/20	Fox den	5.5	40	5	99%	200	High pollen Sunny Breezy
6/22/20	[illegible]	4 5	40	4	99%		Cloudy cold Breezy
6/23/20		4	40	5	99%	200	Cloudy cold very windy
6/23/20		1	35	1	99%	35	Too windy Cold Cloudy Murky

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

Date	Location	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity
6/24/20		3.5	40	4	99	160	Cloudy, Breezy with strong gusts, Cold
6/30/20	Campground	4	40	4	90-95%	160	Hot sunny Breezy
7/1/20	Campground	3.5	40	2	95%	80	Hot Partly Cloudy calm Fair vision
7/2/20	~~Point~~ D-20	4	35	2	95%	75	Sunny hazy poor visability
7/3/20	Point D-20	4	20	1 1/2	95%	40	Sunny Hot
7/5/20		4	40	2	99%	80	Sunny hot
~~7/7~~/20	~~Point~~ D-20	4	35	1	100%	35	Sunny Hot Low Visability
7/8/20	~~Brown C-20 Boathouse~~	4.5	40	4	95%	160	rainy cool lft visability
7/10/20	~~Brown beach House C-20~~	1.5	40	1	100%	40	Warm Partly cloudy La. visability
7/15/20	South of A-20	2	35	2	85%	70	Cool partly cloudy Low visability
~~7~~/16/20	B-20	2	35	1	99%	35	cloudy calm
8/3/20	~~S.W. of~~ A-20	2	20	1	50%	20	Whitecaps cloudy
8/4/20	B-20	3	20	2	75%	40	windy Cloudy cold
8/5/20	B-20	3	20	2	75%	40	Sunny High 60's good visability
8/6/20	B-20	4	30	2	75%	60	Sunny Warm good visability

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

Date	Location	Dive Time (Hrs)	EWM Weight (lbs)	Total Bags Harvested	% milfoil Harvest Sample	Total Harvest (lbs)	Local Conditions Temperature, Wind, Waves, Depth, Water Clarity
8/11/20	C-20	5	20	1	90%	20	Windy Sunny hot big waves
8/12/20	C-20	5	10	1	100%	10	Sunny Calm Low visability
8/12/20	South bay	4	10	1	100%	10	Sunny Calm
8/13/20	A-20	4.5	—	—	—	—	Sunny Windy poor visability
8/14/20	C-20	4.5	10	1	100%	10	Sunny warm poor visability
8/17/20	Forest Shore Scouting	3.5	-	-	-	-	Partly Sunny High Wind Low visability
8/18/20	A-20	4.5	25	2	95%	50	Sunny Cool Windy Low visability
8/19/20	A-20	3.5	25	2	95%	50	Partly Sunny turned to Heavy rain
8/20/20	A-20	4	30	3	95%	90	Windy Big waves Sunny
8/21/20	A-20	5.5	25	5	95%	125	Calm Sunny warm poor visability
8/24/20	A-20	4.5	30	1	95%	30	Calm Partly Cloudy poor visability
8/25/20	A-20	5	28	8	95%	224	calm sunny poor visability

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

2020 Eurasian Watermilfoil Harvest Report

Anvil Lake Association

Submitted to:

Anvil Lake Association and the Wisconsin Department of Natural Resources

Amy Kuhns: amykuhnsala@gamil.com

Ty Krajewski: ty.krejewski@wisconsin.gov

Submitted by:

Amy Kuhns

Anvil Lake Association President

February 12, 2021

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 fourth year of EWM harvesting with the DASH unit in Anvil Lake. A permit was granted to the ALA by the Wisconsin Department of Natural Resources to allow mechanical harvesting in up to 13.1 acres of EWM in Anvil Lake in designated sites of EWM colonies.

Dive Methods:

The ALA contracted in 2020 with two experienced divers that had worked in 2019 to harvest EWM with the DASH unit. The divers worked in four hour shifts, hand removing EWM plants their root ball from the lake bed and feeding the harvested EWM into the opening 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 for the suction hose to be pivoted between two adjacent bagging stands. A deckhand on the DASH unit assists the diver at all times. The deckhand is responsible for monitoring the DASH equipment and switching the collection system with additional mesh bags, as bags are filled with EWM. The deckhand also skims floating pieces of EWM around the DASH unit that surface during the harvesting process. During the harvest a sample bag is used to determine the percentage of EWM harvested. At the end of a harvest day, this sample is weighed and separated into EWM and other aquatic vegetation. At the end of a dive shift, the bags of harvested EWM are removed for the DASH pontoon and emptied. The harvested EWM was moved onto a trailer and periodically taken to the Town of Washington transfer station, the designated disposal site.

Harvest Summary:

In 2020, the DNR approved an herbicide application of 2,4-D in the north bay of Anvil Lake for control of EWM. The DASH unit dive harvesting prioritized removal of EWM in colonies in the two south bays of Anvil Lake. Later in the summer, the divers harvested EWM from the narrow colonies extending out of the north bay. At the end of the summer, divers had difficulty finding any EWM to harvest in the colonies prioritized. The final days of dive harvesting focused on scattered areas of reemerging EWM in the north bay.

Dive harvesting started on June 3rd and continued through the summer with August 25th as the final day of EWM harvesting with the DASH unit. The divers were scheduled to work one four hour dive shift five days a week, weather permitting. Dive harvesting could not take place the last two weeks of July due to mechanical issues with the DASH unit that needed to be repaired.

Both the hired divers and the volunteer EWM monitors observed a decreased amount of EWM in the colonies in the south bays of the lake this summer. These colonies are now in deeper water, as the lake level has risen five feet over the past five years. Remaining EWM plants appeared sickly. Water samples confirmed that 2,4-D levels were very low outside of north bay for the entirety of the summer after the herbicide application.

The dive logs document 152 hours of EWM hand harvesting with the DASH unit. The total amount of EWM harvested was approximately 4,800 pounds. The sample bags indicated 95-99% EWM was harvested on the majority of dive days.