INTRODUCTION

Kelly Lake, Oconto County, is a 367 acre lake with a maximum depth of 41 feet (Photo 1). Eurasian water milfoil (*Myriophyllum spicatum*; EWM) was first discovered in Kelly Lake in 2012 by the Oconto County Aquatic Invasive Species Coordinator. Its presence was also confirmed during a 2012 point-intercept survey conducted by the Wisconsin Department of Natural Resources (WDNR) in 2012. Onterra, LLC was subsequently contacted in the late summer of 2012 to conduct a EWM peak-biomass survey, which turned up much more EWM than was previously thought to exist in Kelly Lake.

Photo 1. Kelly Lake, Oconto County

In the fall of 2012, the Kelly Lake Advancement Association (KLAA) successfully applied for a WDNR AIS Early Detection and Response Grant and contracted with Onterra, LLC to conduct comprehensive studies and aid in creating a plan to control the EWM population on Kelly Lake. Due to the level of EWM found in the late summer of 2012, an herbicide treatment strategy targeting 13.2 acres of EWM with granular 2,4-D at 2.75 – 3.25 ppm ae, was implemented in the spring of 2013. Post treatment surveys conducted in 2013 showed the treatment to be highly successful.

Following surveys conducted in the late summer of 2013, the population of EWM within Kelly Lake was confined to low density EWM occurrences, with one *scattered* colony mapped but the majority of the occurrences being mapped with point-based methods. These small EWM occurrences are not effectively controlled using herbicide control methods; rather they may be appropriate for hand-removal control techniques, particularly by experienced and professional divers. A hand-harvesting program utilizing professional hand-harvesters was determined to be the most appropriate option for maintaining the low-density population of EWM within Kelly Lake in 2014. This report discusses the hand-harvesting efforts and monitoring activities conducted in 2014.

A set of EWM mapping surveys were used within this project to coordinate and qualitatively monitor the hand-harvesting efforts. The first monitoring event on Kelly Lake in 2014 was the Early Season Aquatic Invasive Species Survey (ESAIS). This late-spring/early-summer survey provides an early look at the lake to help guide the hand-harvesting management to occur on the system. Following the hand-harvesting, Onterra ecologists completed the Late-Summer EWM Peak-Biomass Survey, the results of which serve as a post-treatment assessment of the hand-harvesting. The hand-removal program would be considered successful if the density of EWM within the hand-removal areas was found to have decreased from the ESAIS Survey to the Late-Summer Peak-Biomass Survey.

EARLY SEASON AIS SURVEY RESULTS (PRE- HAND-HARVESTING)

On June 11, 2014, Onterra ecologists conducted the ESAIS Survey on Kelly Lake. During the survey, the EWM population was mapped using sub-meter GPS technology by using either 1) point-based or area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and were qualitatively attributed a density rating based upon a five-tiered scale from *Highly Scattered* to

Surface Matting. Point-based techniques were applied to EWM locations that were considered as *Small Plant Colonies* (<40 feet in diameter), *Clumps of Plants*, or *Single or Few Plants*.

Onterra provided the spatial data from this survey to the KLAA and the professional hand-harvesting firm to aid the control efforts. It was recommended that the EWM occurrences within E-13 be prioritized for treatment along with the three *small plant colonies* located during the June 2014 survey.

HAND-HARVESTING MANAGEMENT ACTIONS

The KLAA contracted with Aquatic Plant Management, LLC (APM) to conduct professional hand-harvesting of EWM in 2014. APM conducted hand-harvesting activities on August 28, 2014 and September 13, 2014, spending a total of 7.4 hours actively hand-harvesting EWM within Kelly Lake and removing approximately 360 gallons of EWM from nine locations (Table 1). For reporting purposes, the nine hand harvesting locations provided by APM are assigned a site number based on the dates that APM visited Kelly Lake. Sites 1-5 were visited on August 28, 2014 and Sites 6-9 on September 13, 2014. More information can be found in Appendix A.

Table 1. Kelly Lake, 2014 professional hand-harvesting activities

Site Number	Date	Time Underwater (Minutes)	Estimated EWM Removed (gallons)
1	8/28/2014	60	65
2	8/28/2014	45	15
3	8/28/2014	40	85
4	8/28/2014	35	5
5	8/28/2014	40	10
6	9/13/2014	30	15
7	9/13/2014	60	45
8	9/13/2014	45	25
9	9/13/2014	90	95
Totals		**445**	**360**

LATE-SUMMER PEAK-BIOMASS SURVEY RESULTS (POST HAND-HARVESTING)

The Late-Summer EWM Peak-Biomass Survey was conducted on September 16, 2014 to qualitatively assess the hand harvesting efforts as well as to understand the peak growth (peak-biomass) of the EWM population throughout the lake.

The extent of the area in which APM conducted hand harvesting activities on Kelly Lake is not abundantly clear. Given that APM would have access to GPS information relating to the June 2014 EWM findings and possibly the 2013 herbicide treatment areas, an approximate work area extending out some distance from the GPS coordinates provided by APM is assumed. The nine locations provided by APM in which EWM removal efforts were conducted are discussed in the following paragraphs.

Site 1 was just outside of a 2013 herbicide treatment area (F-13) and is near a boat landing on the northwest part of Kelly Lake (Map 1). This general area had one *single or few plants* EWM point taken during the June survey and no EWM was found in this area during the late summer 2014 survey. Aquatic Plant Management reported removing 65 gallons of EWM consisting of small clumps of plants that were 2-4 feet tall near Site 1.

Site 2, on the northern end of Kelly Lake, saw an increase in point-based EWM between the June and September surveys, expanding from a *single or few plants* point to multiple *single or few plants* points and two *clumps of plants*. Aquatic Plant Management removed 15 gallons of EWM from this area on August 28, 2014 and returned on September 13, 2014 to remove an additional 15 gallons of EWM plants around this same area (Site 6).

At Site 3, also near the north end of Kelly Lake, APM removed 85 gallons of EWM from an area mapped in June 2014 as a *small plant colony* approximately 40 feet in diameter. During the post-hand harvesting September survey, a *small plant colony* was still present although estimated at approximately 20 feet in diameter indicating some level of EWM reduction at this site.

Site 4 was near a small herbicide treatment area from 2013. EWM was not located during the June 2014 survey in this location; however Aquatic Plant Management reported the site to contain very sparse single strands of EWM and removed five gallons of EWM from the site. No EWM was located in this area during the September 2014 peak biomass survey.

Site 5 is located in a bay on the west side of the lake in an area that was treated with herbicide in 2013. Within this area, EWM decreased from a colonized *highly scattered* area in June 2014 to point-based *single or few plants* following removal efforts. Aquatic Plant Management reported removing 10 gallons of EWM from this area on their first visit and an additional 95 gallons on their second visit to this bay (Site 9).

Site 7, in the southwest corner of Kelly Lake, was not in an area where EWM was marked in June 2014 and was between two different 2013 treatment areas (Map 1). Nonetheless, APM conducted removal efforts at this location and noted a thick clump of EWM plants and removed 45 gallons of EWM from this approximate location. No EWM was located in this area during the September 2014 peak biomass survey; however two *small plant colonies* were located a short distance to the southeast of the site.

At Site 8, on the east part of Kelly Lake, no EWM was found during the Early Season AIS Survey conducted in June. Aquatic Plant Management did, however, locate EWM at Site 8 and removed 25 gallons. No EWM was located in this area during the September 2014 peak biomass survey.

During the meander survey, many of the EWM locations that had been previously mapped in 2013 or in June of 2014 were still present but in decreased size/density. Overall, the amount of colonized EWM has decreased from 3.3 acres in 2012 to no (zero) colonized acres in 2014 (Figure 1). Currently, the EWM population in Kelly Lake has been reduced to levels that are only able to be mapped using point-based designations that do not contribute to colonized acreage estimates (Map 2).

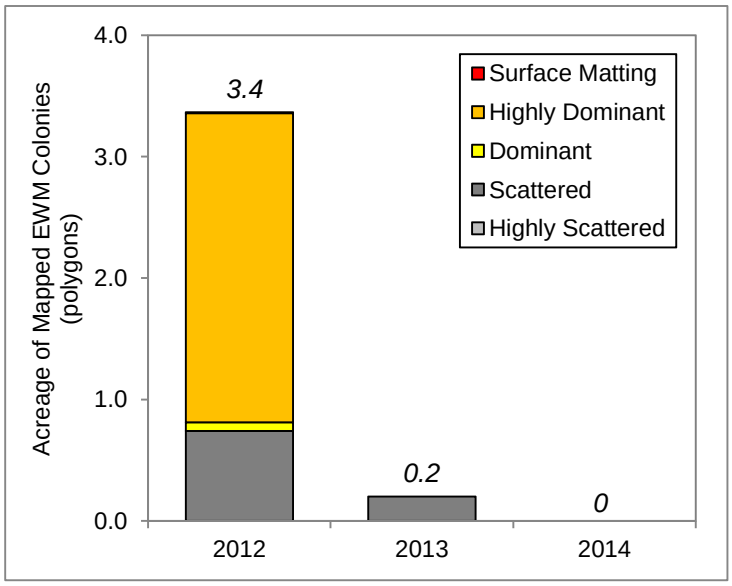


Figure 1. Acreage of mapped EWM colonies on Kelly Lake from 2012-2014.

Many Wisconsin lakes observed a suppressed EWM population in 2014 likely as a result of a later than usual ice-off and cooler temperatures affecting general plant growth. The overall 2014 EWM population reductions in Kelly Lake were likely a result of a combination of the 2013 herbicide treatment, 2014 hand-harvesting efforts, and environmental factors. .

CONCLUSIONS AND DISCUSSION

Overall, the 2014 professional hand-harvesting EWM control program on Kelly Lake was met with mixed results. Some of the hand-harvest sites saw an increase in EWM while others maintained densities or decreased (Map 1). In some of the sites where Aquatic Plant Management conducted EWM removal efforts, Onterra did not document EWM during the Early-Season AIS Survey which then does not allow for a qualitative assessment. It is probable that some EWM was not visible due to the shorter stature of the plants and/or deeper water depths during the June survey and had since grown to the point that APM or KLAA members observed them and thus targeted these occurrences for removal.

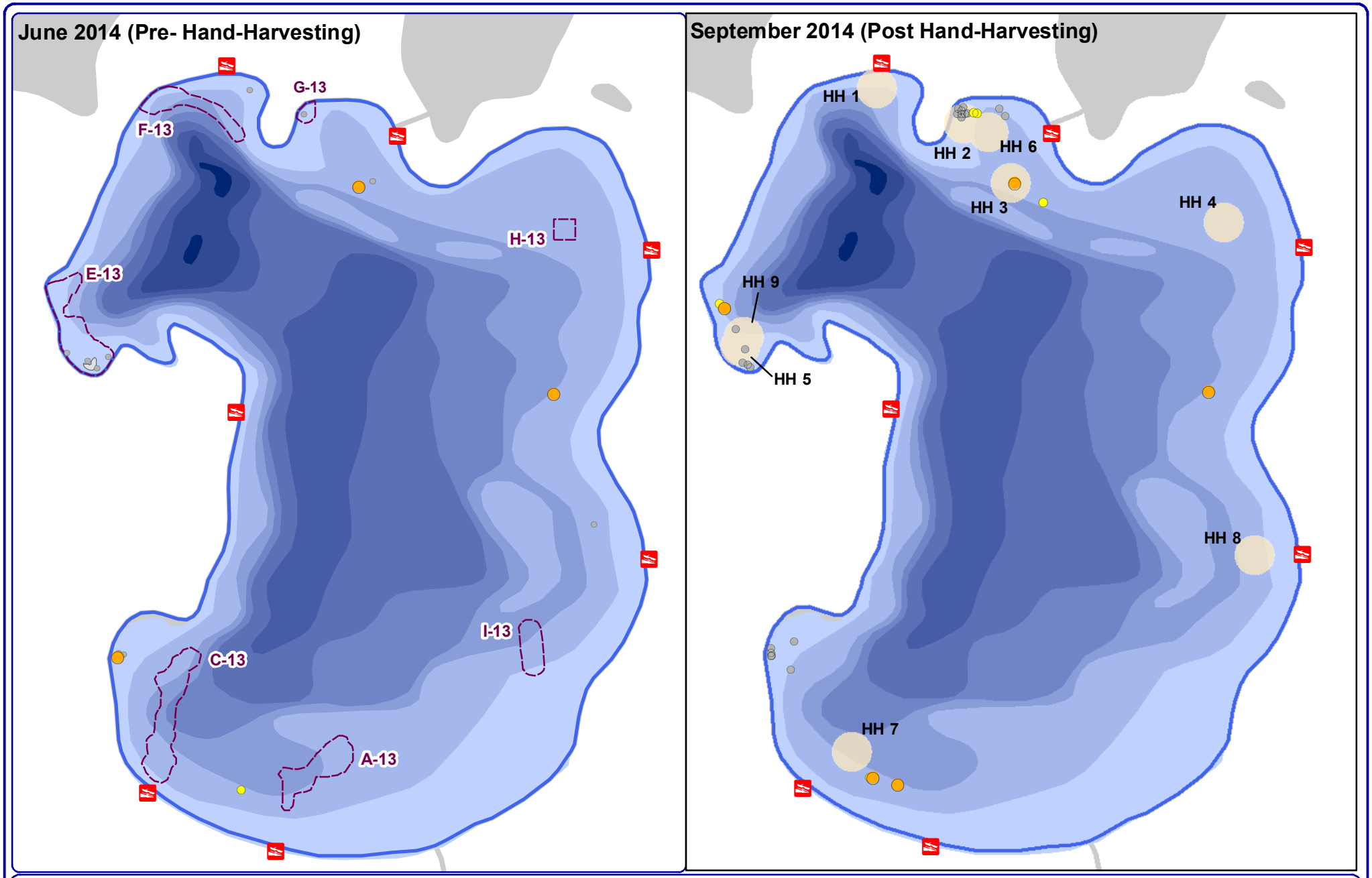
The EWM population in Kelly Lake has not rebounded since the 2013 herbicide treatment. Professional hand-harvesting conducted in 2014 aided in keeping the EWM levels in Kelly Lake low. With the low level of EWM currently existing in Kelly Lake, the proposed 2015 control strategy does not include an herbicide treatment. Building on the hand removal efforts in 2014, it is recommended that a two-tiered hand harvesting approach be implemented in 2015. This would include a combination of professional and volunteer-based hand harvesting of EWM.

As EWM rebounds following management actions, strategic hand-removal efforts will be beneficial to slow the expansion of the EWM population and possible keep the population below levels that will require additional herbicide treatments. The KLAA is also investigating implementing the use of the Diver-Assisted Suction Harvest (DASH) system. The DASH system involves scuba divers removing AIS by hand and feeding them into a suction hose attached to a pontoon boat for removal. It is believed that the DASH system will be able to remove/reduce areas of EWM more efficiently than standard manual removal by scuba divers, particularly dense colonies or those located in deep water.

In addition, the DASH system likely reduces the amount of HWM fragments created during hand-removal.

Currently, there is not much outside information from other projects that can be gleaned to determine how much professional hand-harvesting will be required to target the 1.2 acres outlined on Map 2. Last year, Aquatic Plant Management, LLC spent approximately 7.4 hours over two days working to decrease levels of EWM around Kelly Lake. More effort may be required in 2015 to carry out the preliminary hand-harvesting plan. Work zones around the EWM small plant colonies (approximately 40 ft by 40 ft each) and clumps (roughly the size of a kitchen table) will be targeted by professional hand-harvesters. All the hand-harvesting work zones are believed to be in semi-organic sediments on the edge of sand/marl shoals. There should not be any obstacles (fallen trees, fish cribs, etc) in any of these work areas.

Volunteer-based hand-harvesting efforts would also be beneficial to slow the progression of the EWM population within Kelly Lake. Any known areas of EWM outside of where professional removal is occurring should be considered for volunteer-based removal efforts. In order to maximize the volunteer efforts for the greatest benefit, higher priority areas should be targeted first and additional areas should be targeted if time allows. Some of the higher priority locations of EWM to be considered for volunteer removal include areas in the shallow waters where only low density EWM plants were located. Additionally, areas near public access locations or other areas that are prioritized by KLAA members should be considered for a volunteer based removal effort. Onterra would conduct an EWM mapping survey during June 2015 and provide the KLAA and professional hand-harvesters with a basemap containing the survey findings which will help guide the volunteer-based activities. Volunteer-based hand-harvesting should be approximately tracked in the same fashion as the professional activities; where volunteers record where, when, and how much effort (time) that are spent conducting these activities. These data would be provided to Onterra prior to the lake-summer survey that would be used to evaluate the 2015 professional and volunteer-based hand-harvesting efforts, as well as to propose a control strategy (hand-removal and/or herbicide treatment) for 2016.



N
W E
S

900
Feet

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

Sources:
Hyrdro: WDNR
Bathymetry: WDNR - digitized by Onterra
Orthophotography: NAIP, 2013
Plant Survey: Onterra
Map Date: March 4, 2014

Extent of large map shown in red.

Legend

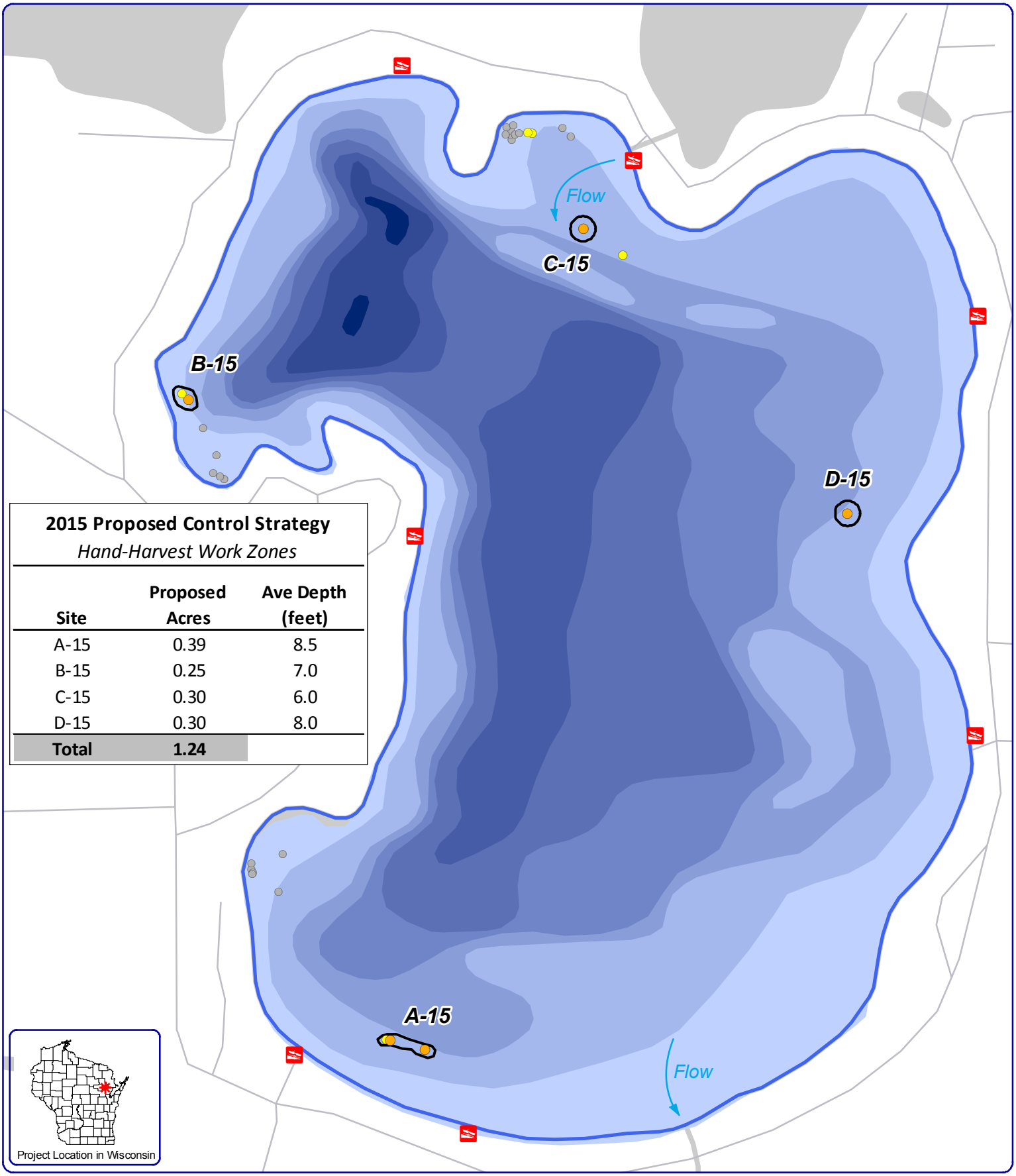
- Highly Scattered
- Scattered *(none)*
- Dominant *(none)*
- Highly Dominant *(none)*
- Surface Matting *(none)*
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2014 Hand-Harvest Locations
- 2013 Treatment Areas

Map 1

Kelly Lake

Oconto County, Wisconsin

2014 EWM Survey Results



2015 Proposed Control Strategy

Hand-Harvest Work Zones

Site	Proposed Acres	Ave Depth (feet)
A-15	0.39	8.5
B-15	0.25	7.0
C-15	0.30	6.0
D-15	0.30	8.0
Total	**1.24**	

N W E S

750

Feet

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

Sources:
Roads and Hyrdo: WDNR
Bathymetry: WDNR - digitized by Onterra
Orthophotography: NAIP, 2010
Plant Survey: Onterra, 2014
Map Date: October 15, 2014
Filename: *KellyOconto_EWM_T2015_Prelim1.mxd*

Legend

EWM PB Survey Results *(September 2014)*

- Highly Scattered *(none)*
- Scattered *(none)*
- Dominant *(none)*
- Highly Dominant *(none)*
- Surface Matting *(none)*
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2015 Preliminary Hand Harvest Area

Map 2

Kelly Lake

Oconto County, Wisconsin

Preliminary 2015 EWM Control Strategy

Appendix A: EWM Hand Harvesting Results - Kelly Lake

Date	Latitude	Longitude	# divers	Time Underwater (Minutes)	Diver time (minutes)	Diver Time (Hours)	Estimated EWM Removed (Gallons)	Comments
29-Aug	45.02877	-88.23065	4.0	60	240	4.0	65	Plants were 2-4 feet high and in small clumps. Water depth 4-9 feet
29-Aug	45.02805	-88.22831	4.0	45	180	3.0	15	Plants very scarce, but some were healthy and up to 4 feet long. Water depth 6-10 feet
29-Aug	45.02690	-88.22708	4.0	40	160	2.7	85	Plants were 6-8 feet in length and in one large swath about 15 feet in diameter. Water depth up 8 to 12 feet
29-Aug	45.02605	-88.22135	4.0	35	140	2.3	5	Very sparse single strands. Water depth 8-12 feet
29-Aug	45.02389	-88.23447	4.0	40	160	2.7	10	Very sparse single strands. Water depth 3-8 feet
14-Sep	45.02788	-88.22765		30			15	Plants were 2-4 feet high and in small clumps. Water depth 4-9 feet
14-Sep	45.01606	-88.23170		60			45	Thick clump with healthy 8 feet tall plants. Water depth 10 feet
14-Sep	45.01968	-88.22071		45			25	Scattered single plants approximately 5 feet long. Water depth 7-10 feet
14-Sep	45.02406	-88.23438		90			95	3 large clumps of healthy plants in a small vicinity. Plant length 6-9 feet and water depth 7-10 feet