INTRODUCTION

Lone Stone Lake is a 171 acre, drained, headwater lake in Oneida County, with a maximum depth of about 30 feet. The invasive Eurasian water milfoil (EWM) was first reported in the lake in 2011. Following consultation with the Wisconsin Department of Natural Resources (WDNR) and Oneida County AIS Coordinator Michele Saduaskas, the Friends of Lone Stone Lake (FLSL) contracted Onterra, LLC to complete a EWM survey in late summer of 2013. This 2013 survey provided data on the extent of EWM within the lake, which was used to develop a project strategy during the winter of 2013/2014. It should be noted that although the EWM was believed to be pure strain, samples of EWM were collected during this survey and sent to a lab in Michigan for genetic testing. The testing confirmed the plants were pure-strain *Myriophyllum spicatum* (EWM) as opposed to a hybrid species between northern water milfoil (*Myriophyllum sibericum*) and the aforementioned EWM. This hybrid species (termed HWM) has been confirmed in several Wisconsin lakes and may complicate management due to its aggressive nature and suspected decreased susceptibility to herbicides. The FLSL were awarded a three-year Aquatic Invasive Species (AIS) Early Detection & Response in February of 2014 to initiate monitoring and hand-removal actions in 2014-2016. This report discusses the second year of monitoring and control under this grant-funded project and concludes with recommendations and strategies for the last year of the three year project, 2016.

Photo 1. Lone Stone Lake, Oneida County, Wisconsin.

Early Season AIS Survey

Onterra ecologists visited Lone Stone Lake on July 1, 2015 to complete an Early Season AIS (ESAIS) survey. This survey is completed during the late spring/early summer and consists of a crew meandering over the entire littoral (shallow, plant growing) zone. At this point in the year, curly-leaf pondweed (CLP) is nearing its peak growth period and should be growing near the surface of the water, thus making it more visible. EWM, while not at its peak growth yet, is typically taller in the water column than native plant species and thus is also quite visible. Additionally, during the early summer algae growth is limited in comparison to late summer which creates better viewing conditions. Finally, the timing of this survey allows for data collection for mid-summer control efforts; in this case, hand-harvesting.

When EWM was encountered, data was collected using a Trimble Global Positioning System (GPS) unit with sub-meter accuracy. Mapping was completed using a point-based and polygon-based methodology. Point-based information was collected on EWM occurrences less than 30-40 feet in diameter. Density ratings were assigned to the observed EWM plant groupings in terms of whether a *Single or Few Plants*, *Clump* (5-10 plants), or *Small Plant Colony* (colony ranging from 10-30 ft in size) was observed. For larger, colony-forming observations, EWM

was mapped through use of a polygon or aerial designation. Density was also applied to these observations in categories of *Highly Scattered, Scattered, Dominant, Highly Dominant and Surface Matting.*

During the survey, conditions were good with much sunlight and mild winds. EWM was located in several areas of the lake, many of which were similar areas to 2013 and 2014 observations (Map 1). Over the course of this project, a *Dominant* colony along the lakes southeast shoreline had been monitored repeatedly (late summer 2013, early and late summer 2014). This colony was targeted for hand-removal in 2014 and its density in late summer 2014 was observed to decrease due to the control efforts. This survey confirmed its reemergence in the same area, with scattered *Single Plants, Clumps* and *Small Plant Colonies* dotting the perimeter.

Following the 2015 ESAIS survey, a control strategy involving primarily professional but also limited volunteer hand-removal was developed. Aquatic Plant Management LLC, a plant hand-harvesting firm, was contracted to target control areas A-15, B-15, C-15, D-15 and E-15. FLSL volunteers were instructed to hand-remove the *Clump* on the northeastern side of the lake, along with the *Single or Few Plants* and *Clump* along the lake's southern shoreline. The FLSL was instructed not to hand-pull within the designated APM control areas, as these would be visited by APM and dual efforts would complicate examination of EWM control effectiveness. Through this grant funded project, the FLSL purchased a Garmin GPS Map 78 unit that is updated by Onterra staff with the most recent EWM survey information. They may use this device to navigate to the plant locations and view the control areas, which are outlined on the units basemap annually.

Mid-Summer Control Efforts

APM crews visited Lone Stone Lake on July 7, 20, and 25, 2015 to complete hand-removal of EWM within the treatment areas outlined on Map 1. A total of 71.32 hours were spent by APM divers hand-removing EWM on Lone Stone Lake. Table 1 displays the diving time and hand-removal results by control site, while a full EWM harvesting report provided by APM has been attached to this report as Appendix A. Note that the total time underwater per site is multiplied by the total number of divers to indicate a metric of "total effort" of hand-removal per site.

Table 1. 2015 Lone Stone Lake professional hand-harvesting summary. Data summarized from APM, LLC 2015 EWM Harvesting Report (Appendix A). Site locations depicted on Map 1.

Lone Stone Lake Professional Hand-Harvesting Summary, 2015

Date	Site	Time Underwater (minutes unless specified)	Number of Divers	Total Effort (minutes unless specified)	Est. EWM Removed (Gallons)
7/20/2015	A-15	25	4	100	10
7/20/2015	A-15	25	4	100	10
7/27/2015	A-15	30	4	120	15
7/27/2015	A-15	40	4	160	35
7/27/2015	A-15	60	4	240	20
	Totals	***3 hrs***	***4***	***12 hrs***	***90***
7/7/2015	B-15	40	4	160	25
	Totals	***40 min***	***4***	***2 hrs 40 mins***	***25***
7/7/2015	C-15	45	4	180	15
7/7/2015	C-15	35	4	140	15
7/7/2015	C-15	60	4	240	30
7/7/2015	C-15	60	4	240	20
7/20/2015	C-15	60	4	240	30
7/20/2015	C-15	60	4	240	15
7/20/2015	C-15	60	4	240	35
7/27/2015	C-15	60	4	240	25
7/27/2015	C-15	60	4	240	12
	Totals	***8 hrs, 20 min***	***4***	***33 hrs 20 mins***	***197***
7/7/2015	D-15	45	4	180	20
	Totals	***45 min***	***4***	***3 hrs***	***20***
7/20/2015	E-15	40	4	160	25
	Totals	***40 min***	***4***	***2 hrs 40 mins***	***25***
7/20/2015	Single	15	4	60	5
7/20/2015	Single	15	4	60	2
7/20/2015	Single	15	4	60	2
	Totals	***45 min***	***4***	***3 hrs***	***9***
Grand Total		**14 hrs 10 min**	**4**	**56 hrs 40 mins**	**366**

EWM Peak Biomass Survey

On August 19, 2015, Onterra ecologists visited Lone Stone Lake to complete the EWM Peak Biomass survey. This meander-based survey, which mimics the methodology used in the ESAIS survey, is completed in the late growing season (August/September) when EWM has reached its peak growth. Because EWM should be at its maximum density, the results of this survey provide an assessment of where EWM is in the lake and what its full impact on the ecology is. As a result, these data are useful in determining the efficacy of control actions used during the summer months as well assisting in next year's planning. The weather on August 19th was optimal at the beginning of the survey, with winds and overcast skies approaching towards the survey's completion. Onterra staff meandered the littoral region of the lake, marking occasional *Single or Few Plants* and only several *Clumps of Plants*. No colonized EWM (*Small Plant Colonies* or polygon colonies) were observed during this survey (Map 2).

EWM Hand-Removal Control Results

Following the ESAIS survey, the majority of EWM marked was assigned to a professional hand-harvesting firm while it was recommended that small isolated occurrences be targeted by volunteers with the FLSL. Volunteers were able to hand-pull plants on a few occasions along the lakes south side. No attempts were made along the lake's northern side, as there are fewer property owners along this shoreline and the soft, mucky substrate had made pulling in this area difficult for volunteers in 2014.

Five locations were identified for APM to hand-pull in 2015 (Maps 1 & 2). All five locations were visited by APM staff as well as a small group of singles plants located ~100 feet west of site B-1, indicated as "Single" site on Table 1. Each control site is evaluated below:

A-15

In June, several dozen *Single or Few Plants* were observed along with four *Clumps* and two *Small Plant Colonies*. Four APM divers spent 3 hours (total of 12 hours) hand-pulling plants between two site visits, removing a total of 90 gallons of EWM. Following these efforts, only three *Single or Few Plants* were observed within the control area in the late summer.

B-15

This location held a *Small Plant Colony* as well as several *Single or Few Plants* in June. Following 2 hrs and 40 minutes worth of diver effort, the site was reduced only to a *Clump* and several *Single or Few Plants*.

C-15

Since the discovery of EWM, this site has held the largest continuous as well as densest EWM colony within the lake. In June of 2015, a *Dominant* colony was delineated along with scattered occurrences of EWM nearby. Four APM divers spent a total of 8 hrs and 20 minutes at the site (total effort of 33 hrs, 20 mins) and removed 197 gallons of EWM. Following these efforts, the site was observed to contain over a dozen *Single or Few Plants* as well as three *Clumps*. Overall, this is an encouraging reduction from the biomass of EWM observed during mid-summer.

D-15

This site, containing a *Small Plant Colony*, *Clump*, and *Single or Few Plants* within its boundaries in mid-summer, was reduced to two *Clumps* and a *Single or Few* plant by late summer. APM divers spent a total of 3 hours in this location removing 20 gallons of EWM.

E-15

During the ESAIS survey, this location was observed to hold a sizable (~45 feet in diameter) EWM *Small Plant Colony*. In addition to the EWM, this area holds abundant watershield, a native floating-leaf plant, is roughly three feet in depth and contains soft, organic sediments. Overall, these factors would present difficult conditions for work with much native plant biomass and limited visibility due to easy sediment disruption. APM divers spent a total of 2 hrs and 40 mins within the site and removed 25 gallons of EWM. By late summer, a *Clump* and *Single Plant* were all that remained.

2016 Monitoring and Control Strategy

Once again, utilization of professional hand-removal as a control technique met expectations for EWM control in Lone Stone Lake, with a demonstrated reduction in EWM occurring in each designated control area. A total of 56 hours and 40 minutes of effort was placed upon hand-removal of EWM in Lone Stone Lake, with roughly 366 gallons of EWM removed. This is a dramatic increase from the total of 18 hours spent in 2014, with 95 gallons removed.

While the results appear to be positive, it is becoming apparent that these results may only be successful on a seasonal basis and that these efforts may need to be continued annually in order for a similar level of annual success to be obtained. A time series of the lake's southeast corner is projected in Figure 1. In 2014 and 2015, survey data indicated a *Dominant* EWM colony present in this area, roughly 0.15 acres in size. This colony has been targeted each of the two years through professional hand-removal and a large reduction has been observed in each of these years. The re-emergence of the colony in 2015, following this large reduction in 2014, suggests that there are remaining elements that are allowing for the re-growth of EWM. This situation has been observed within other control areas, though to a lesser extent.

Several potential factors could be the remnants of root crowns or stolons (shoots developing from the root crown) from the existing EWM plants, fragments from pre-existing parent plants lying on the sediment, or a seed bank existing within the sediment. APM divers indicated on their annual reports that best efforts were taken to remove root systems when hand-pulling all plants. So, this is not likely to be the case. The development and removal of stolons from the sediment is unknown; it is expected that the stolons would be removed along with the entire root system or could break off and remain. The potential exists that remnant fragments remain in the sediment and are allowing the re-emergence of EWM on an annual basis. There is likely a seed bank within the sediments of the lake. Currently, it is largely believed that stolon production and fragmentation are the dominant means of EWM vegetative spread, though seeds are believed to serve as a long-term mechanism of reproduction (Madsen and Smith, 1997).

The FLSL are currently working under a three-year (2014-2016) AIS-EDR grant, awarded to them by the WDNR. Continued monitoring and professional hand-removal is funded through this grant award and it is recommended that these activities continue as scheduled, with a similar effort of hand-removal to continue in 2016 as was completed in 2015. Volunteer hand-removal is encouraged to occur as well within the lake. Another year of these efforts will allow the FLSL to determine if the dynamics discussed in the paragraph above are continuing, and give an indication as to whether this approach will continue to be effective in terms of seasonal control. Following 2016, the FLSL will need to re-examine their options for continued EWM management within the lake. A lake management planning effort would assist the group in this exercise. In addition to collecting data regarding many aspects of the lake ecosystem, a lake management planning project would lead the FLSL down a road of fully understanding EWM management, including an outline of realistic tools and goals to have in managing an EWM population in their lake. This project would be applicable for funding from the State of Wisconsin in a number of grant categories. It is recommended that the FLML, WDNR and Onterra discuss this initiative during 2016 to develop an approach that is supported by all involved.

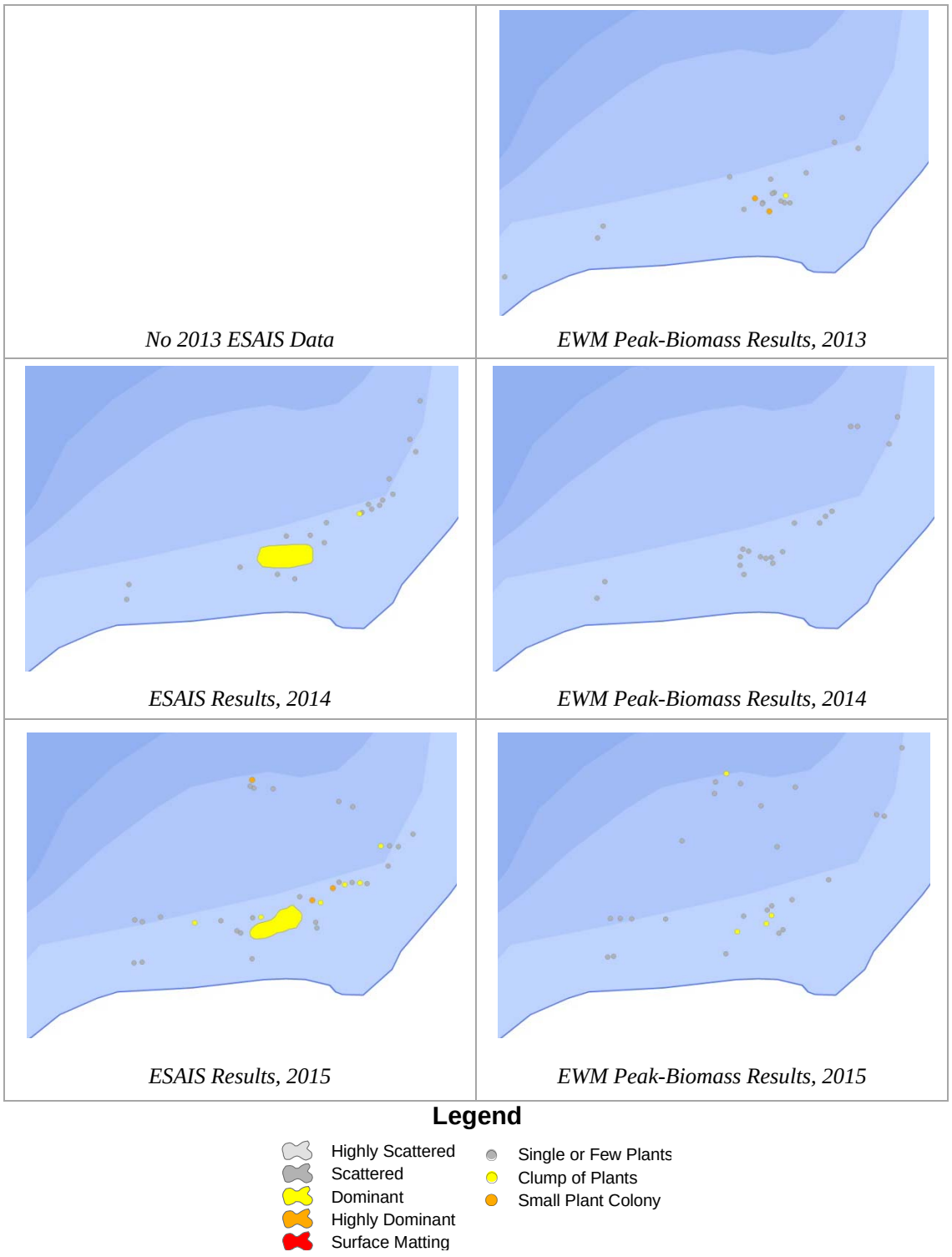


Figure 1. Lone Stone Lake EWM time-series, 2013-2015. Data is depicted for the lake's southeast corner for mid-summer (ESAIS) and late summer (EWM Peak-Biomass) time periods.

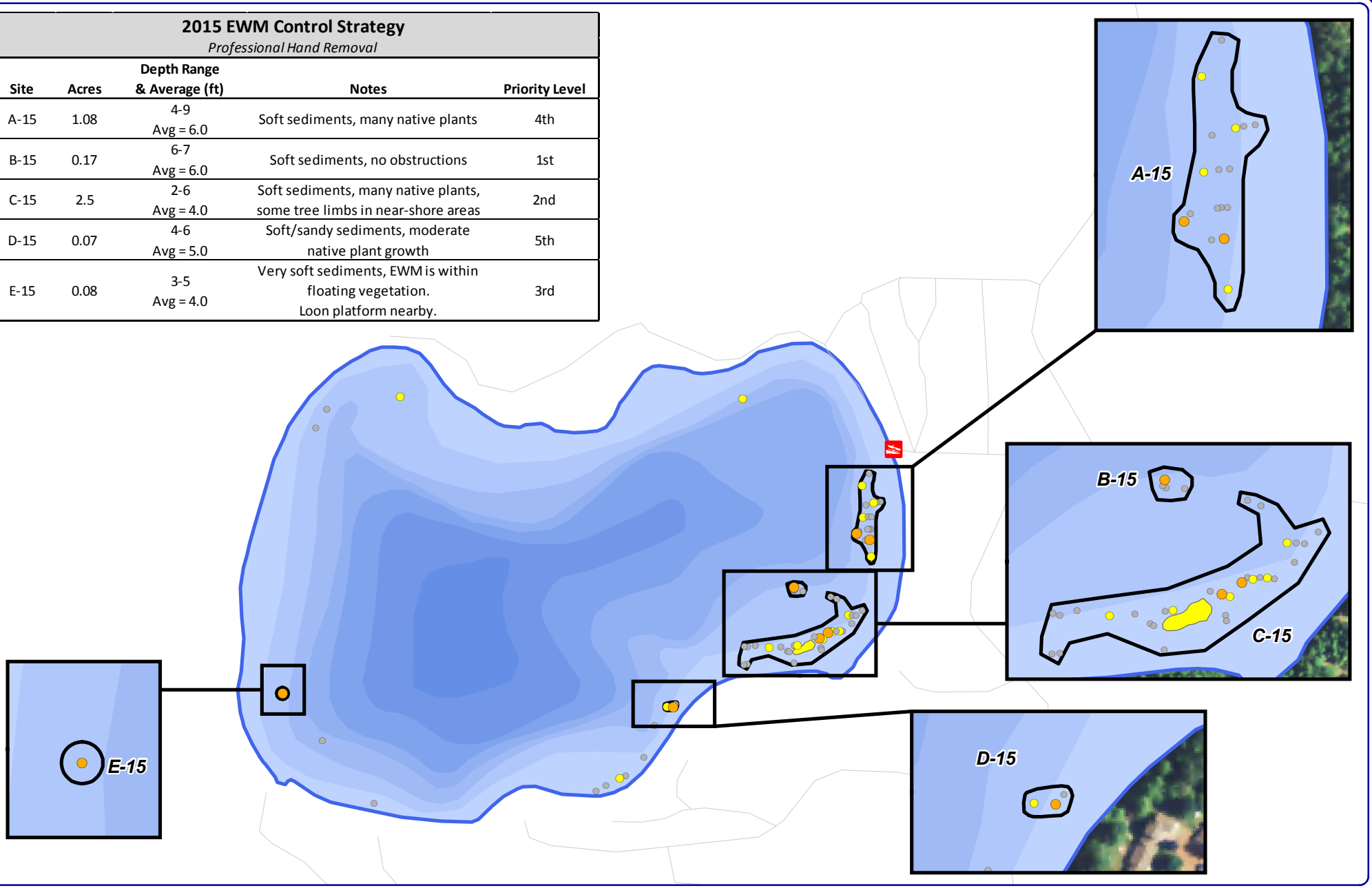
Literature Cited

Madsen, J.D. and D.H. Smith. 1997. Vegetative Spread of Eurasian Watermilfoil Colonies. J. Aquat. Plant Manage. Vol. 35, pp. 63-68.

2015 EWM Control Strategy

Professional Hand Removal

Site	Acres	Depth Range & Average (ft)	Notes	Priority Level
A-15	1.08	4-9 Avg = 6.0	Soft sediments, many native plants	4th
B-15	0.17	6-7 Avg = 6.0	Soft sediments, no obstructions	1st
C-15	2.5	2-6 Avg = 4.0	Soft sediments, many native plants, some tree limbs in near-shore areas	2nd
D-15	0.07	4-6 Avg = 5.0	Soft/sandy sediments, moderate native plant growth	5th
E-15	0.08	3-5 Avg = 4.0	Very soft sediments, EWM is within floating vegetation. Loon platform nearby.	3rd



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Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plant Survey: Onterra, 2015
Map Date: July 2, 2015
Filename: LoneStone_EWM_July2015.mxd


Project Location in Wisconsin

Legend

EWM Survey Results *(July 1, 2015)*

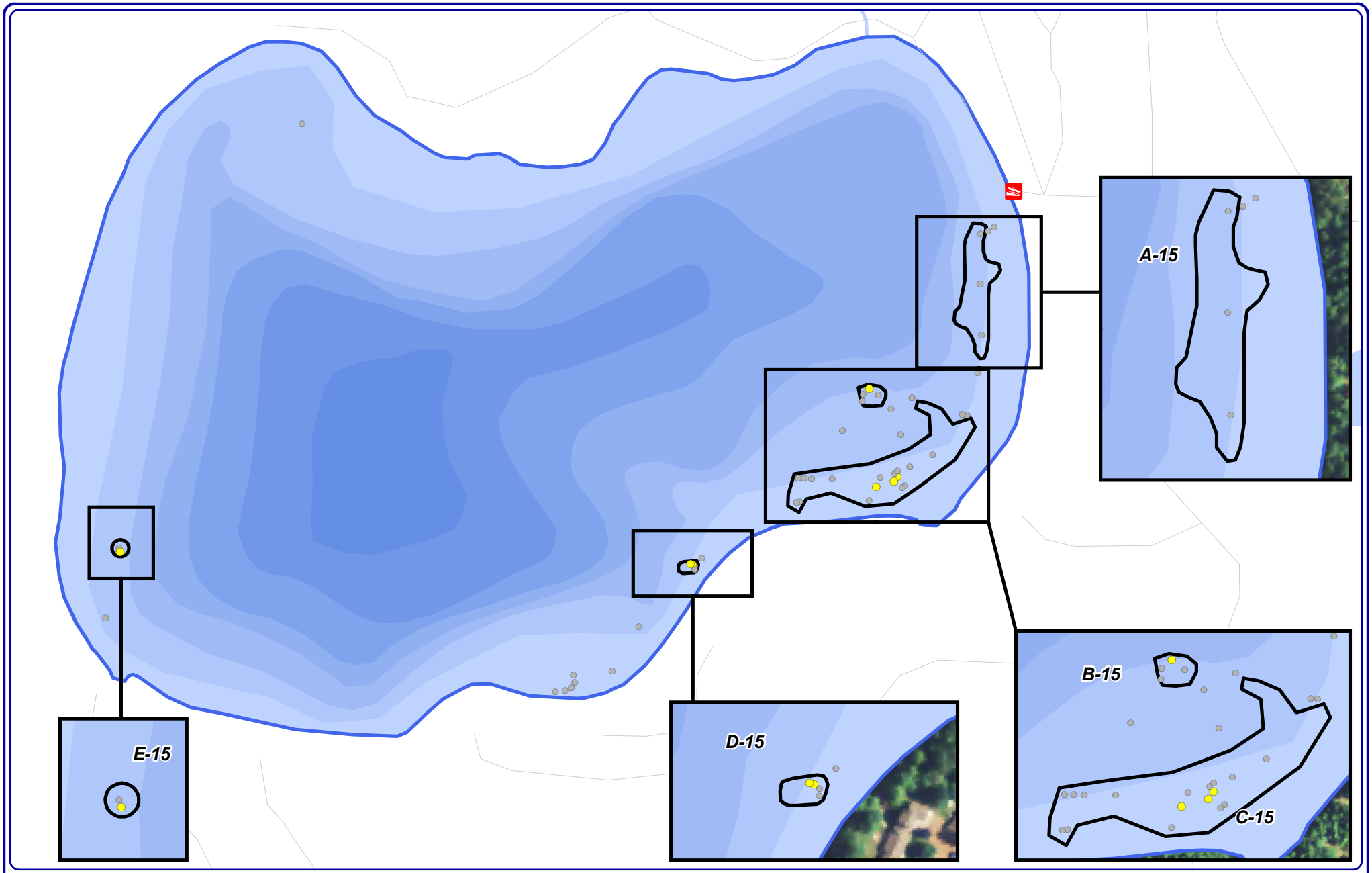
- Highly Scattered *(none found)*
- Scattered *(none found)*
- Dominant
- Highly Dominant *(none found)*
- Surface Matting *(none found)*

- Single or Few Plants
- Clump of Plants
- Small Plant Colony

Hand Removal
Professional Hand-Removal Focus Area

Map 1
Lone Stone Lake
Oneida County, Wisconsin

Survey Results & Hand-Removal Strategy



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Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, digitized by Onterra
Aquatic Plant Survey: Onterra, Aug. 2015
Map Date: Sept. 4, 2015
Filename: LoneStone_EWM_Aug2015.mxd

Project Location in Wisconsin

Legend

EWM Survey Results *(August 19, 2015)*

- Highly Scattered *(none found)*
- Scattered *(none found)*
- Dominant *(none found)*
- Highly Dominant *(none found)*
- Surface Matting *(none found)*
- Single or Few Plants
- Clump of Plants
- Small Plant Colony *(none found)*

Hand Removal
Professional Hand-Removal Focus Area

Map 2
Lone Stone Lake
Oneida County, Wisconsin

EWM Peak-Biomass Survey Results

A

APPENDIX A

APM 2015 EWM Control Report

Aquatic Plant Management LLC

Lone Stone Lake EWM Harvesting Report Summer 2015

1696 Silver Beach Drive Lac du Flambeau, WI 54538

Lone Stone Lake EWM Removal Summary 2015

Summary: On July 7th, 20th and 25th, 2015 Aquatic Plant Management LLC (APM) conducted hand removal services of Eurasian Watermilfoil (EWM) on Lone Stone Lake. Our experienced divers spent a combined total of 71.32 hours on the water and were able to successfully remove approximately **366 gallons** of EWM from the lake.

Dive Conditions: Conditions on 7/7/2015 were ideal, little to no wind with abundant sunshine. Conditions on 7/20/2015 were less than ideal with 20+ MPH winds and sparse cloud cover. Conditions on 7/27/2015 were ideal, with light winds and clear sunny skies. Underwater visibility was roughly 7-8 feet on all three days with healthy EWM plants standing tall in the water column. The relatively soft substrate of Lone Stone Lake allowed for near complete removal of the EWM root systems, greatly decreasing the chance of regrowth.

Recommendations: At most sites, the EWM growth was relatively localized, allowing APM to scour the area and remove all visible plants. However, at site C-15, the EWM consisted mainly of short individual plants spread out through the entirety of the control area. Due to this, continued monitoring of this site is recommended, as some new growth may have been obscured by the abundant native plant communities located within the site. The EWM infestation on Lone Stone Lake is very manageable by our standards, and with continued monitoring and an annual hand-harvesting effort, can be kept in check.

Detailed Summary of Diving Activities

Date	Dive Location	Latitude	Longitude	Time Underwater (Min)	Estimated EWM Removed (Gallons)	EWM Density Rating	Comments
7/7/2015	B-15	45.86505	89.07818	40	25	5	Soft organic substrate, one small colony, relatively easy to remove entire root ball. EWM was located in 6 feet of water.
7/7/2015	C-15	45.8642	89.07674	45	15	3	Soft organic substrate, several small clumps of plants spaced roughly 10 feet apart. EWM was located in 3-7 feet of water.
7/7/2015	C-15	45.86434	89.07708	35	15	3	Soft organic substrate, single plants spaced 5-10 feet apart. EWM was located in 3-7 feet of water.
7/7/2015	C-15	45.86415	89.07674	60	30	3	Soft organic substrate, short plants in 4-5 feet of water
7/7/2015	C-15	45.86429	89.07657	60	20	3	Soft organic substrate, short plants in 4-5 feet of water
7/7/2015	D-15	45.86384	89.07979	45	20	5	Soft organic substrate, one small colony and one clump of plants surrounded by small single plants
7/20/2015	Single	45.86852	89.08598	15	2	1	Soft organic substrate. Located and removed a single EWM plant. EWM was located in 5-6 feet of water.
7/20/2015	Single	45.86852	89.08598	15	5	1	Soft organic substrate. Located and removed a single EWM plant. EWM was located in 5-6 feet of water.
7/20/2015	Single	45.86852	89.08598	15	2	1	Soft organic substrate. Located and removed a single EWM plant. EWM was located in 5-6 feet of water.
7/20/2015	E-15	45.8636	89.08864	40	25	4	Dense medium-sized colony located within water shield, easy to remove entire root ball. EWM was located in 5 feet of water.

EWM Density Rating	0	1	2	3	4	5	6	7	8	9	10
Plants per 5 Square Yards	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20

Detailed Summary of Diving Activities

Date	Dive Location	Latitude	Longitude	Time Underwater (Min)	Estimated EWM Removed (Gallons)	EWM Density Rating	Comments
7/20/2015	C-15	45.86434	89.07708	60	30	3	Soft organic substrate, short plants in 4-5 feet of water.
7/20/2015	C-15	45.8642	89.07674	60	15	2	Soft organic substrate, short plants in 4-5 feet of water.
7/20/2015	C-15	45.86415	89.07674	60	35	3	Soft organic substrate, short plants in 4-5 feet of water.
7/20/2015	A-15	45.86561	89.07532	25	10	1	Soft organic substrate, sparse plants located in 5-6 feet of water.
7/20/2015	A-15	45.8662	89.07536	25	10	1	Soft organic substrate, sparse plants located in 5-6 feet of water.
7/27/2015	C-15	45.86429	89.07738	60	25	2	Soft organic substrate. EWM was sparse, with most plants between 12-18 inches, but a few 3-4 foot plants. EWM was located in 4-7 feet of water.
7/27/2015	C-15	45.86429	89.07657	60	12	1	Soft organic substrate. EWM was sparse, with most plants between 12-18 inches, but a few 3-4 foot plants. EWM was located in 4-7 feet of water.
7/27/2015	A-15	45.86545	89.07564	30	15	2	Soft organic substrate. Located and removed a few clumps of 4-5 foot tall plants. EWM was located in 6-10 feet of water.
7/27/2015	A-15	45.86689	89.07545	40	35	3	Soft organic substrate. Located and removed several clumps of 4-6 foot tall plants. EWM was located in 6-12 feet of water.
7/27/2015	A-15	45.86729	89.07503	60	20	2	Soft organic substrate. Located and removed several clumps of 4-6 foot tall plants, as well as a few clumps near the boat landing in shallower water. EWM was located in 5-12 feet of water.

EWM Density Rating	0	1	2	3	4	5	6	7	8	9	10
Plants per 5 Square Yards	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20

EWM Picture

Map Created by Onterra LLC