

## INTRODUCTION

Lost Lake, Vilas County is a 544 acre lake with a maximum depth of 20 feet. During the 2013 growing season, a member of the district found a suspicious milfoil plant which was later confirmed by the Vilas County Land and Water Conservation Department to be Eurasian water milfoil (*Myriophyllum spicatum*, EWM). Onterra, LLC was contracted by the Lost Lake Protection and Rehabilitation District (LLPRD) to complete a focused EWM survey in October 2013 within the area of the lake where EWM had been located. Onterra ecologists located two colonized areas of *dominant* and *scattered* EWM as well as numerous occurrences of *clumps of plants* or *single or few plants* during this survey.



Photo 1. Lost Lake, Vilas County.

Based upon the 2013 EWM findings, a professional hand-harvesting strategy was proposed for EWM control in Lost Lake during 2014. With Onterra's assistance, the LLPRD successfully secured a Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Early Detection and Response (EDR) Grant to fund the monitoring and implementation of the control strategy. The control activities conducted in 2014 were found to have had little impact on the EWM in the areas targeted by hand harvesting as the EWM population expanded somewhat. Another exotic invasive species, Curly-leaf pondweed (*Potamogeton crispus*, CLP) was located in Lost Lake during surveys conducted in 2014. A professional hand harvesting program at greater levels of effort was recommended for EWM control in 2015 with additional volunteer based removal suggested for known areas of CLP. This report discusses the AIS monitoring and control efforts conducted in 2015 on Lost Lake.

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 Lost Lake in 2015 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 (PRE-HAND-HARVESTING)

On May 28-29, 2015, Onterra ecologists completed the Early-Season AIS Survey on Lost Lake. While EWM is usually not at its peak growth at this time of year, the water is typically clearer during the early summer allowing for more effective viewing of submersed plants, and EWM is often growing higher in the water column than many of the native aquatic plants at that time of year. The EWM mapped during the Early-Season AIS Survey is refined during the Late-Summer Peak-Biomass survey. Curly-leaf pondweed was mapped during this survey as it typically reaches its full growth potential in

the first half of summer before dying back around mid July. In addition, the locations of EWM and CLP occurrences located during early summer are provided to professionals or volunteers to aid in their hand-removal efforts.

During the survey, the entire littoral zone of the lake was surveyed and the EWM and CLP populations were 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 were qualitatively attributed a density rating based upon a five-tiered scale from *Highly Scattered* to *Surface Matting*. Point-based techniques were applied to locations that were considered as *Small Plant Colonies* (<40 feet in diameter), *Clumps of Plants*, or *Single or Few Plants*.

From this survey, the highest concentrations of EWM were identified and prioritized for hand removal. The largest concentration of EWM was found in the same location within the eastern bay as it was found in 2013 and 2014 with two colonies composed of *scattered* or *highly scattered* plants. These two sites totaling 2.1 acres were permitted for professional-based hand-harvesting in 2015 (Map 1). Onterra provided the spatial data from this survey to the LLPRD and the professional hand harvesting firms to aid the control efforts. A few other low density occurrences of EWM were found within the eastern portion of the lake and along the northern shoreline during the late-May ESAIS survey (Map 1). As will be discussed further in this report, CLP levels were found to have increased significantly within the western bay compared to levels observed in 2014 and was considered too expansive for control using hand removal methods.

## HAND-HARVESTING MANAGEMENT ACTIONS

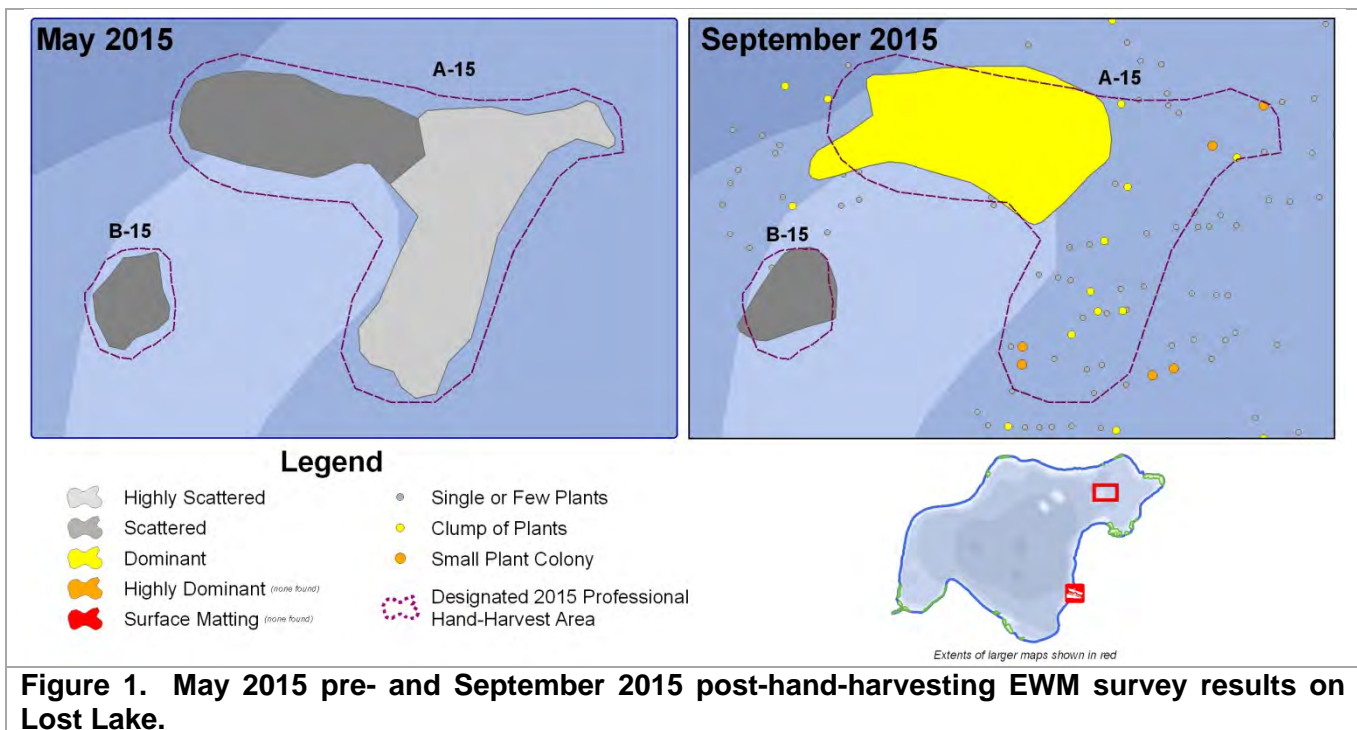
Working with Many Waters during 2014, the LLPRD again contracted this firm to conduct professional hand-harvesting of EWM in 2015. However, this firm’s schedule only allowed limiting time on Lost Lake. The LLPRD solicited bids from additional firms, ultimately hiring EcoWaterway Services to also conduct hand-harvesting on Lost Lake during 2015. Both of these firms utilize a Diver Assisted Suction Harvester (DASH) which requires a WDNR permit. This system involves a scuba diver feeding EWM plants through a suction hose that delivers and filters the plants to a boat on the surface and is thought to be able to harvest plants more efficiently than traditional diving alone. Many Waters conducted hand-harvesting activities on July 1, 2015, spending a total of 5.75 hours actively harvesting EWM from the lake and removing approximately 163 pounds of EWM from Site A-15 (Table 1). Eco Waterway Services conducted hand harvesting efforts on August 11-13, 2015 removing approximately 2417.6 pounds of EWM from sites A-15 and B-15 over the course of 30 hours (Table 1). Details of the hand-harvesting operations are included as an appendix to this report. No volunteer based hand removal is known to have occurred in 2015 on Lost Lake.

**Table 1. Lost Lake, 2015 professional hand-harvesting activities**

Many Waters, LLC			EcoWaterway Services		
	<b>Dive Time</b>	<b>EWM Removed</b>			
<b>Site</b>	<b>(hours)</b>	<b>(pounds)</b>	<b>Site</b>	<b>Dive Time (hours)</b>	<b>EWM Removed (pounds)</b>
A-15	5.75	163	A-15	27.25	2273.6
			B-15	2.75	144
			<b>Total</b>	<b>30.00</b>	<b>2417.6</b>

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

On September 22, 2015 Onterra ecologists meandered the entire littoral zone of Lost Lake to understand the peak growth (peak-biomass) of the EWM population during 2015 as well as to assess the hand harvesting control efforts. Within the hand harvesting site A-15, where 33 combined hours of professional hand-harvesting efforts yielded approximately 2,936 pounds of EWM removed, the late-summer survey confirmed that the EWM population within this area increased (Figure 1). This indicates that while a great deal of EWM biomass was removed during the 2015 hand-harvesting efforts, the efforts were not sufficient to overcome the overall population increase within the targeted areas within Lost Lake. Similarly, no detectable change was observed in site B-15. Overall, the combined hand removal efforts within the hand harvesting sites A-15 and B-15 did not meet control expectations.



During the meander survey, EWM was found to have expanded within the lake, most notably within the eastern bay of the lake. An additional *highly scattered* colonized area of EWM was located in the western bay near the Lost Creek outlet. Several *single or few plant* occurrences were marked in additional parts of the lake during the survey as well. Map 2 displays the progression of the EWM population in Lost Lake since its initial discovery in October 2013.

## CURLY-LEAF PONDWEED

Onterra ecologists located a few occurrences of curly leaf pondweed (CLP) consisting of a *small plant colony, clumps of plants and single or few plants* in the western portion of Lost Lake during June and September 2014 surveys (Map 3, top frame)(Photo 2a). This was the first recorded occurrence of CLP within Lost Lake, and given the smaller number of plants located, it was theorized that it may have been introduced to the lake relatively recently.

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. The plants begin growing almost immediately after, if not immediately before, ice-out and by early-summer they reach their peak growth. As they are growing, each plant produces numerous turions (asexual reproductive structures) which break away from the plant and settle to the bottom following the plant's senescence in early summer (Photo 2b). The deposited turions lie dormant until autumn when they sprout to produce small winter foliage, and they remain in this state until spring foliage is produced. The advanced growth in spring gives the plant a significant jump on native vegetation. In certain lakes, CLP can become so abundant that it hampers recreational activities within the lake. In instances where large CLP populations are present, its mid-summer die-back can cause significant algal blooms spurred from the release of nutrients during the plants' decomposition. However, in some lakes, mostly in northern Wisconsin, CLP appears to integrate itself within the community without becoming a nuisance.

During the late-May 2015 ESAIS survey, Onterra ecologists mapped CLP when it was expected to be near its peak-biomass level in Lost Lake. The survey found a marked increase in the CLP population within the western bay of the lake in and around the previously known locations from 2014 (Map 3, middle frame). A few occurrences outside of the bay were also located during the survey near the north shore and in the eastern bay of the lake. Given the typical life-cycle of CLP, it was unexpected to find CLP growing during the September 2015 survey. Due to the amount of CLP observed during the late September EWM mapping survey, both CLP and EWM were mapped within the lake. Curly-leaf pondweed was found to have expanded beyond the west bay of the lake and numerous occurrences were mapped in various other parts of the lake (Map 3, bottom frame). The CLP observed during the late-summer survey were found with fully-formed turions in the leaf axils.



**Photo 2a. Curly-leaf Pondweed.**



**Photo 2b. Curly-leaf Pondweed reproductive turions. Photos taken on Lost Lake 2014-2015.**

## CONCLUSIONS & DISCUSSION

Following EWM detection, professional hand-harvesting was determined to be the appropriate initial control strategy. In many lakes, this method is able to slow the spread and population of EWM throughout the lake. But in other lakes, the population progression is too great for the control method to provide effective control.

At the level of EWM within Lost Lake, there is no clear-cut control strategy to be recommended. Continuing the hand-harvesting efforts may have localized impacts where the control strategy is applied, reducing that specific colony from contributing to the overall population increase to the lake. These efforts may also reduce recreational impediments that are caused by dense EWM colonies. But it is not believed that hand-harvesting will be able to impact the overall EWM population within Lost Lake. Conducting an herbicide treatment is likely the only management action that *may* be able to reduce the EWM population within Lost Lake.

At this time, it is not understood whether the EWM population on Lost Lake will increase to a level where herbicide treatments would be warranted. Herbicide treatments have financial costs, as well as can have potential secondary impacts to the lake. Therefore, herbicide treatments are generally postponed until the EWM population exceeds a certain threshold in order to balance these factors. On some area lakes, EWM may cause a small amount of localized recreational impact, but overall causes minimal ecological impacts to the lake. In these instances, the respective lake group may choose to tolerate the EWM within the lake and focuses their attention away from EWM management and towards other meaningful lake management activities such as shoreline condition enhancement.

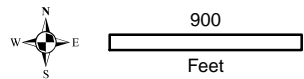
Onterra proposes that the LLPRD continue to monitor the EWM population within Lost Lake for a few years in absence of management (i.e. hand-harvesting) to determine if further population increases may suggest herbicide treatment strategies are warranted, or if the population plateaus and active management is not needed. Some types of herbicide treatments are all encompassing (i.e. whole-lake treatments), so the level of the pretreatment EWM population has minimal impact on the outcome of the treatment. This means that if the EWM population in Lost Lake increases exponentially in the next few years, a whole-lake treatment would still be effective and would not have any additional costs associated.

The LLPRD plans to update their Comprehensive Lake Management Plan during 2017-2018, following a WDNr grant application during the next applicable grant cycle (December 10, 2016). The planning project would allow the district to better understand aquatic herbicide strategies and if they are supported by district members. While the updated Plan would include a strong aquatic plant-related component, it would also include investigations of the system's water quality, watershed, shoreland habitat, stakeholder perceptions, and fisheries that will lead to a holistic management strategy for the LLPRD.

Recently, the LLPRD submitted a WDNr grant (AIS-EDR) to aid in the monitoring of both CLP and EWM within the lake through 2018. After 2018, the LLPRD will have completed the updated Plan and thus be eligible for additional WDNr grants (AIS-EPC) to aid in the monitoring and potential control of aquatic invasive species in Lost Lake.

**2015 Final Control Strategy**  
Professional Hand-Harvest

Site	Final Acres	Ave Depth (feet)	Sediment	Obstructions
A-15	1.9	8.5	Heavy Organic	No Physical, Heavy Native Plants
B-15	0.2	5.5	Heavy Organic	No Physical, Heavy Native Plants
<b>Total</b>	2.1			



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Sources:  
Aquatic Plants: Onterra, 2014  
Bathymetry: WDNR, 1964; digitized by Onterra  
Orthophotography: NAIP, 2013  
Map date: May 31, 2015  
Filename: LostVias\_EWM\_JH\_2015\_Perm1.mxd

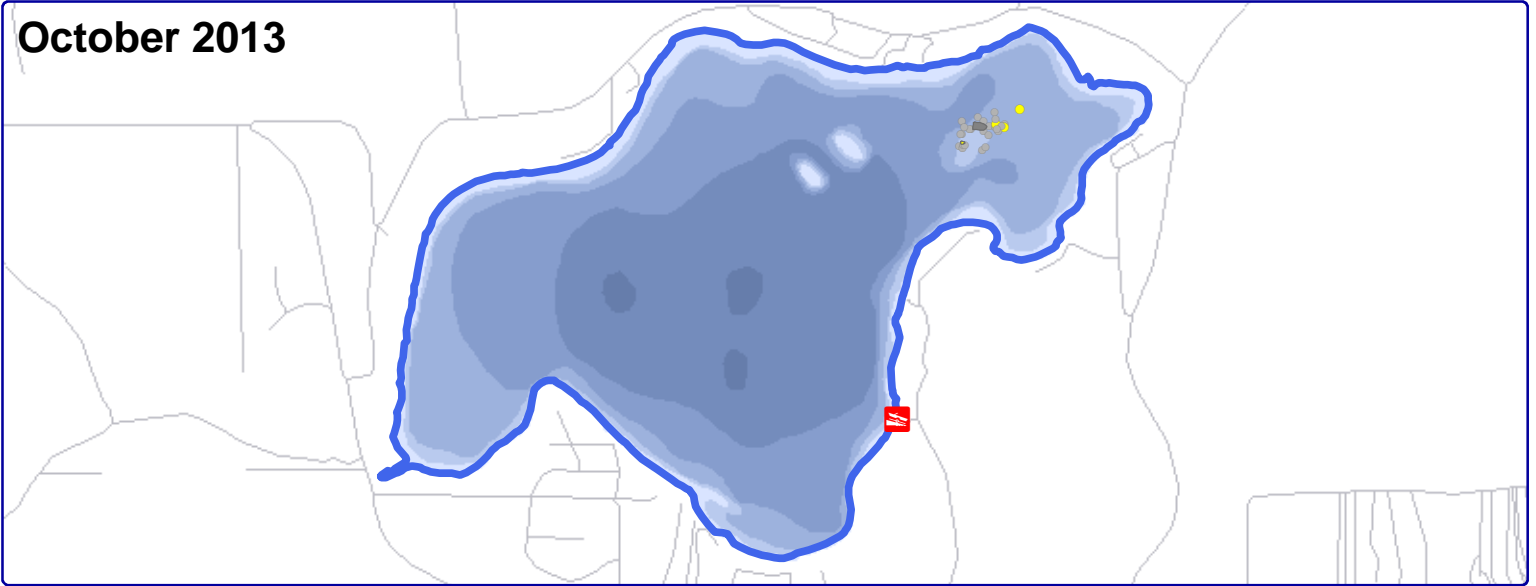
**Legend**

- Highly Scattered
- Scattered
- Dominant (none found)
- Highly Dominant (none found)
- Surface Matting (none found)
- Single or Few Plants
- Clump of Plants
- Small Plant Colony
- Final 2015 Hand Harvest Area

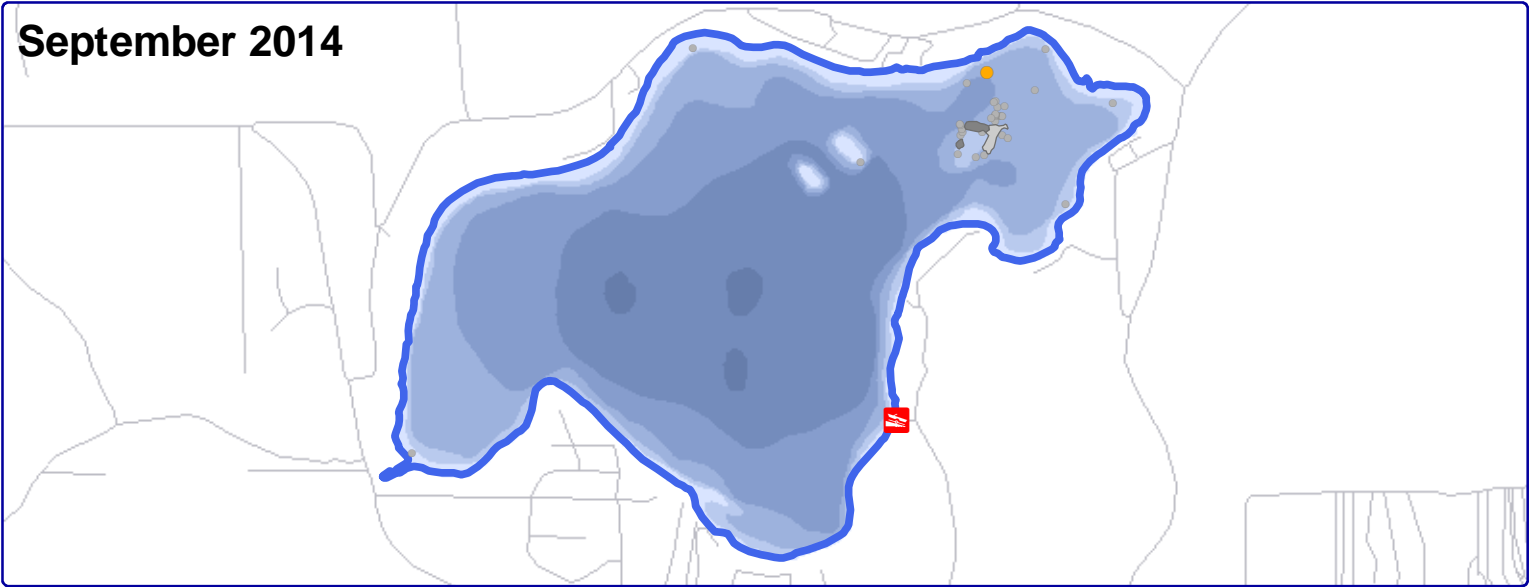
Map 1  
Lost Lake  
Vilas County, Wisconsin

**May 2015 EWM Locations  
& 2015 Final DASH Areas**

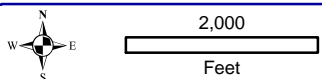
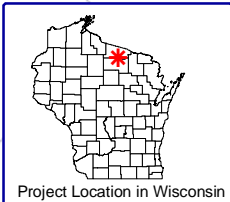
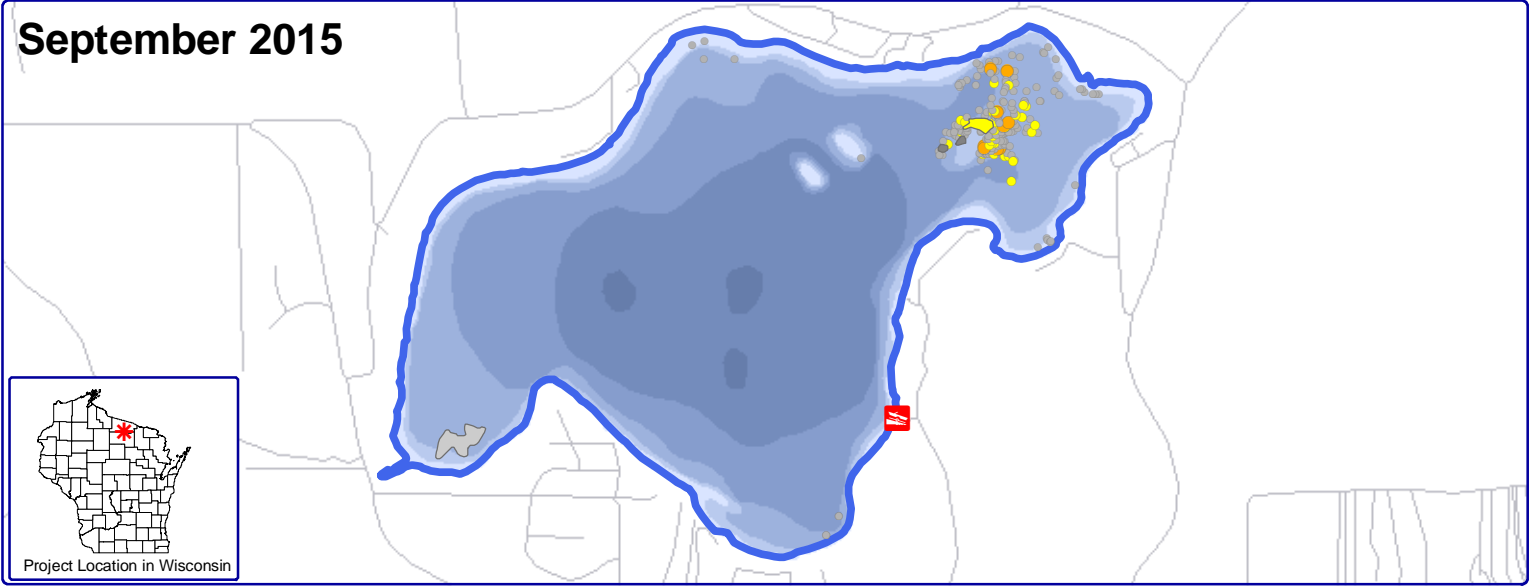
October 2013



September 2014



September 2015



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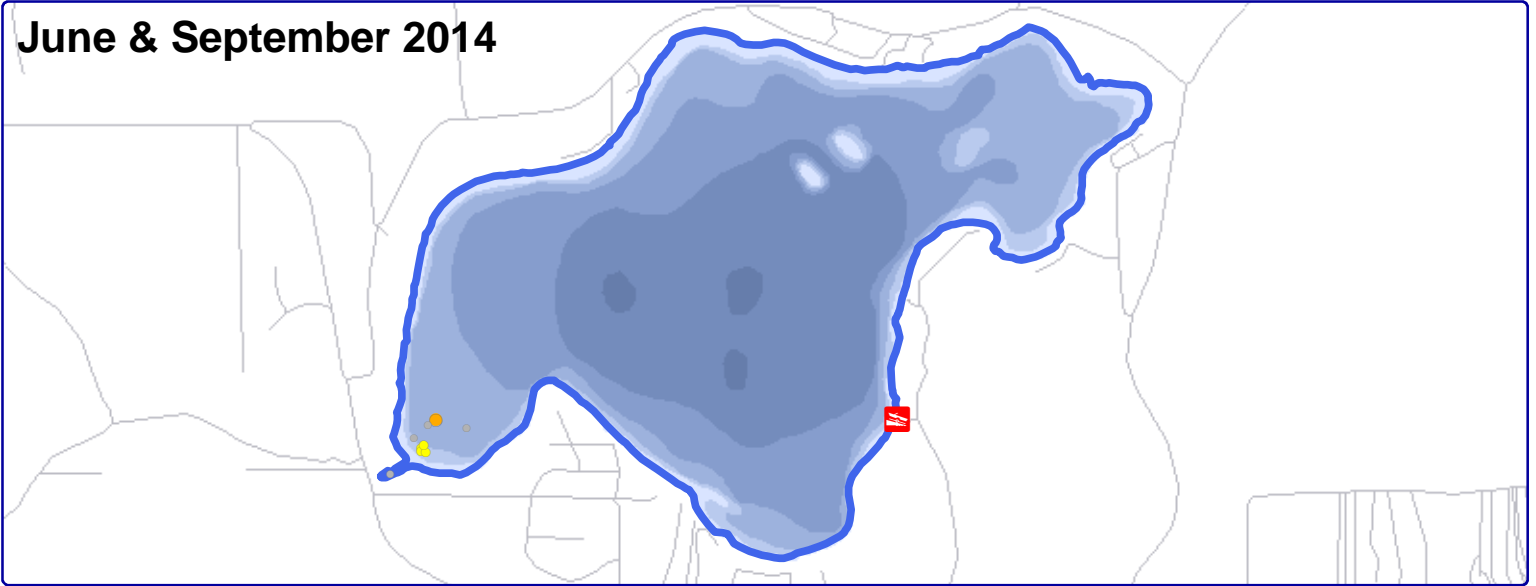
Sources:  
 Roads, Hydro, and Bathymetry: WDNR  
 Plant Surveys: Onterra, 2013-2015  
 Map Date: December 9, 2015  
 Filename: LostVilas\_EWMSeries\_2013-2015.mxd

**Legend**  
 Eurasian Watermilfoil

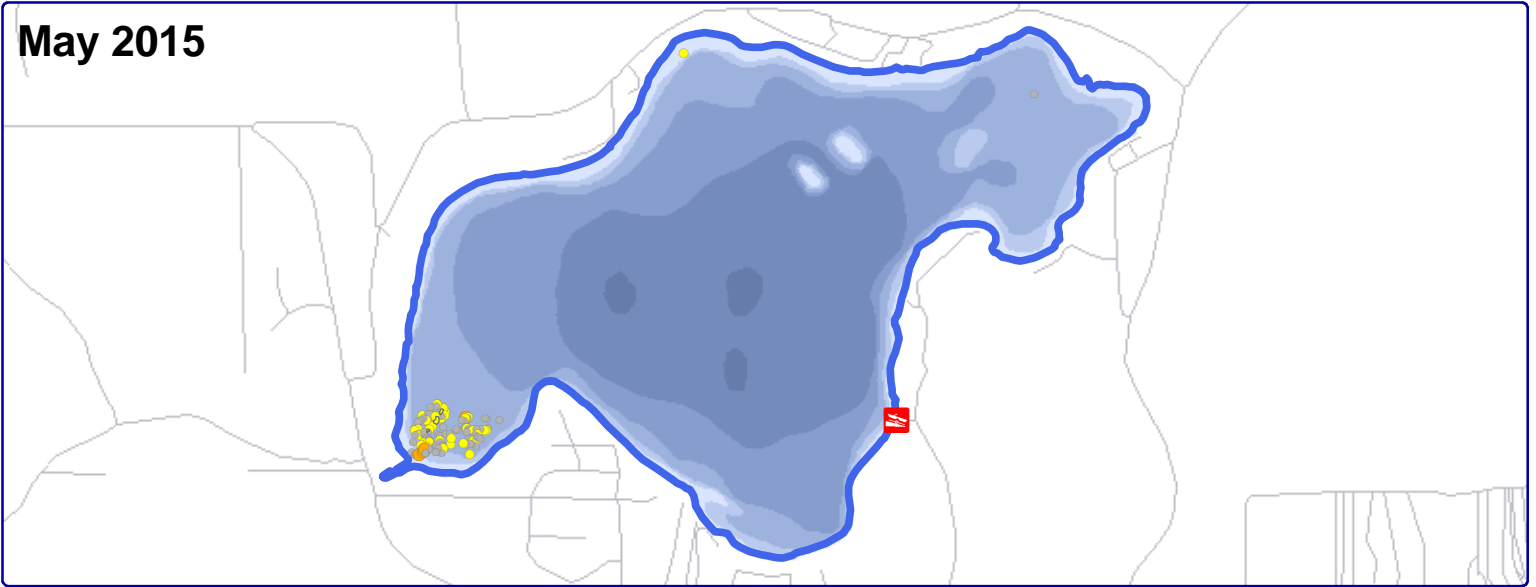
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony

Map 2  
 Lost Lake  
 Vilas County  
 2013-2015 EWM  
 Survey Results

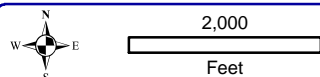
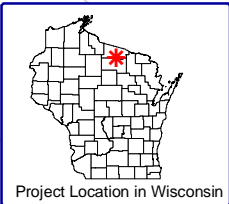
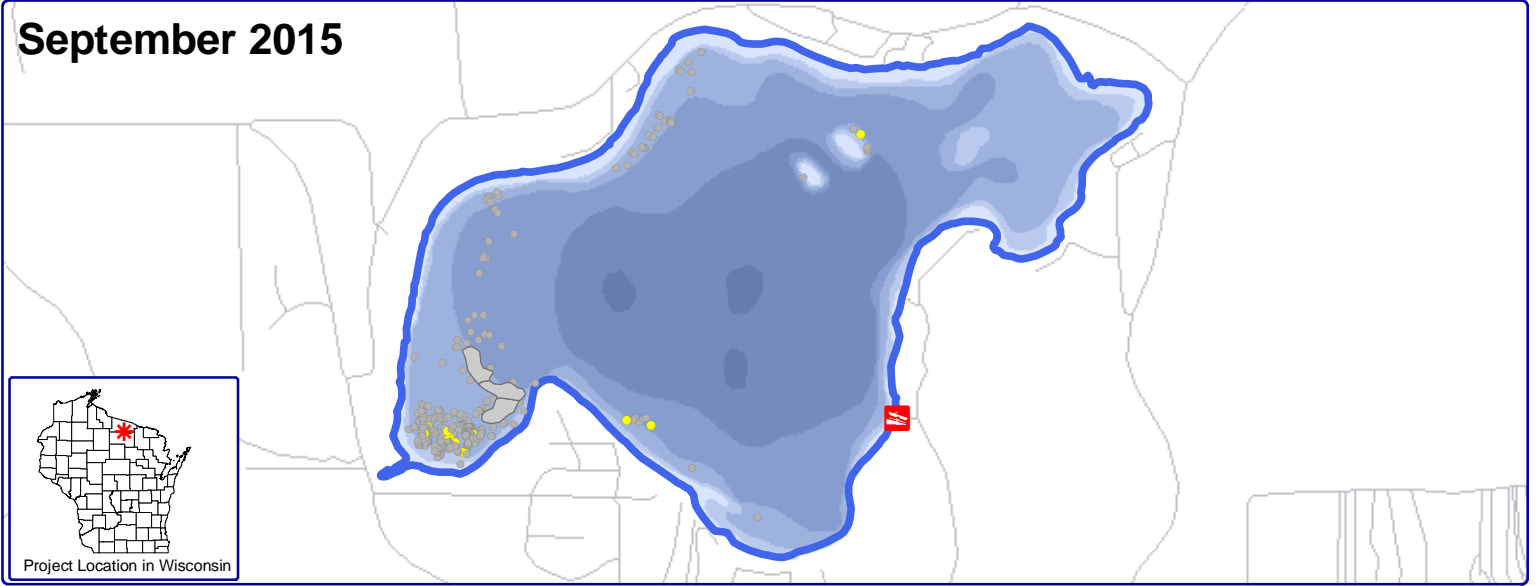
## June & September 2014



## May 2015



## September 2015



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Sources:  
 Roads, Hydro, and Bathymetry: WDNR  
 Plant Surveys: Onterra, 2014-2015  
 Map Date: December 9, 2015  
 Filename: LostVilas\_CLP Series\_2014-2015.mxd

- Legend**  
 Curly-leaf Pondweed
- Highly Scattered
  - Scattered
  - Dominant
  - Highly Dominant
  - Surface Matting
  - Single or Few Plants
  - Clumps of Plants
  - Small Plant Colony

Map 3  
 Lost Lake  
 Vilas County  
**2014-2015 CLP  
 Survey Results**





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# Summary of Diver Assisted Suction Harvesting Efforts

Lost Lake – Vilas County, WI

2015 WDNR Mechanical Harvesting Permit Annual Report

Permit ID: NO-2015-64-88M

Date: 11.28.2015

**Submitted To:**

Lost Lake Preservation and Rehabilitation District  
and  
Wisconsin Department of Natural Resources

**Submitted By:**

Many Waters, LLC  
2527 Lake Ottawa Road  
Iron River, MI 49935

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Barb Gajewski: [skih2o@hotmail.com](mailto:skih2o@hotmail.com), 715.617.4688

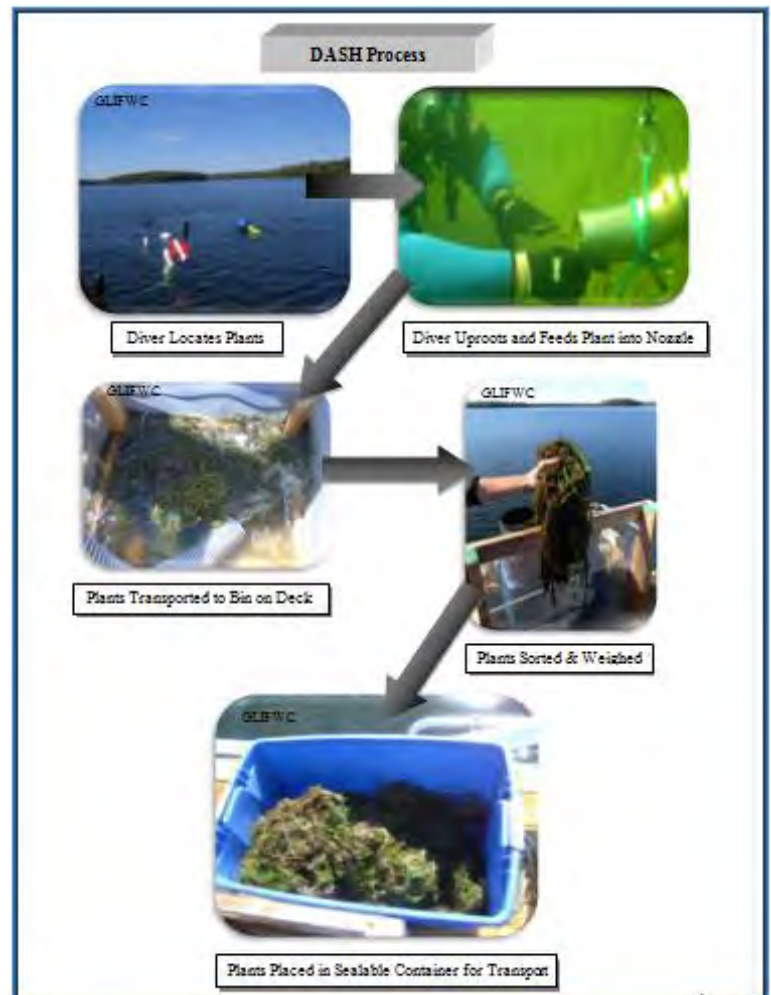
## Introduction

The Lost Lake Preservation and Rehabilitation District solicited the services of Many Waters, LLC to use Diver Assisted Suction Harvesting (DASH) to manage for Eurasian watermilfoil (EWM) on Lost Lake, located in Vilas County, WI. DASH is a mechanical process and requires a mechanical harvesting permit (Form 3200-113 (R 3/04)) from the Wisconsin Department of Natural Resources (WDNR). The 2015 WDNR Permit ID is NO-2015-64-88M.

## Dive Methods

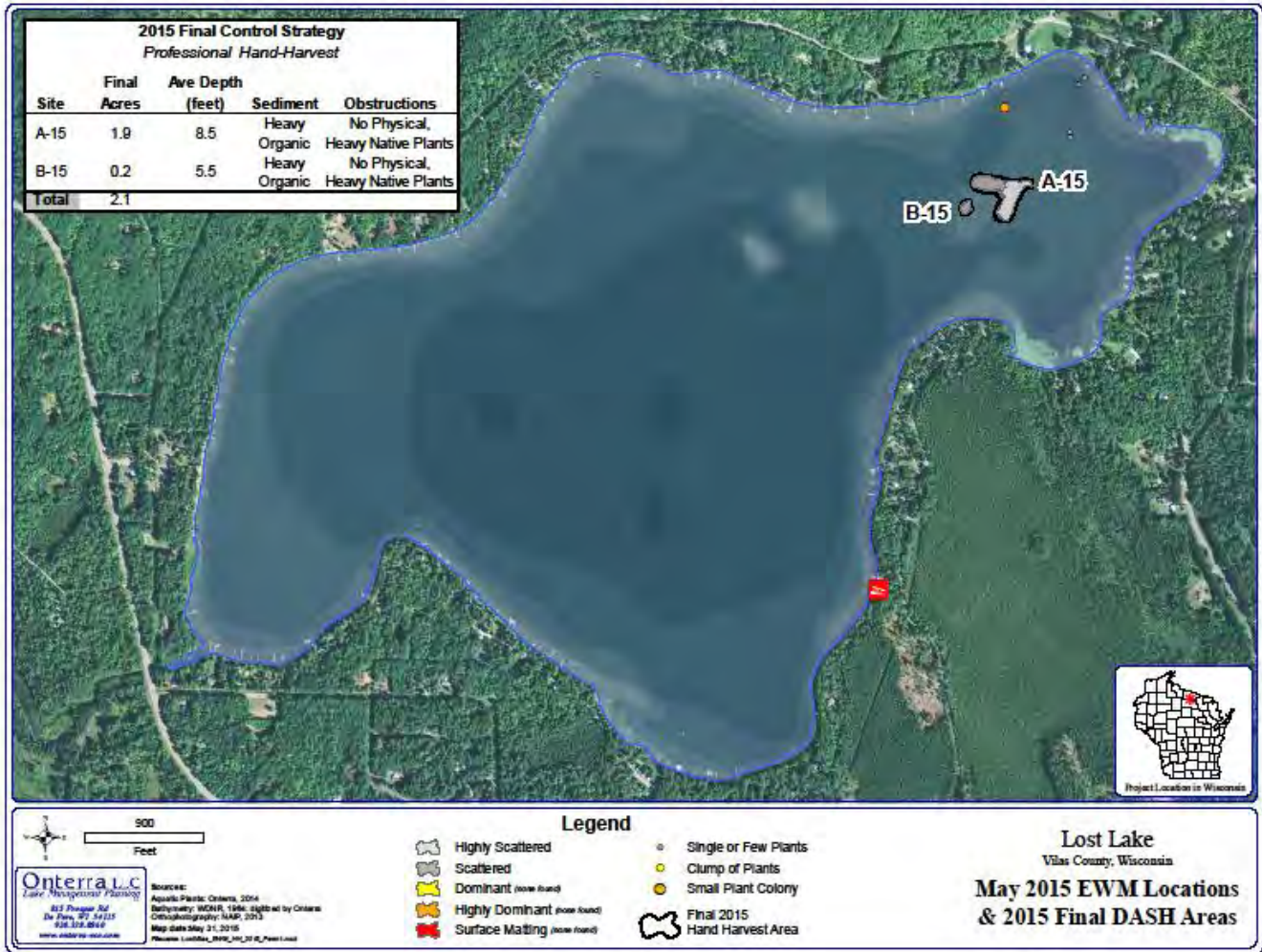
While using DASH, a diver typically will begin by locating the invasive plant such as Eurasian watermilfoil from the surface, and then descend next to the plant while simultaneously lowering the nozzle. Divers work along the bottom by using fin pivots, kneeling on the bottom or hovering above the bottom at a distance where the root mass of the plant is within hands reach. The diver will either feed the top of the plant into the hose first and then uproot the plant or uproot the plant and feed its rootwad first into the hose. It is very important that the diver shake as much sediment from the rootwad before getting the rootwad near the nozzle. Shaking the rootwad away from the nozzle helps maintain visibility for the diver and minimizes debris and sediment in the holding bins. The diver carefully observes plants fed into the nozzle for possible fragments. Fragments are caught by hand and fed into the nozzle.

Work sites that have dense monotypic beds of EWM, the initial DASH efforts are quite simple. The diver will descend adjacent to the bed and begin hand pulling or harvesting systematically across the bed to dismantle the bed. Once the majority of the bed is removed, a more systematic approach follows to target remaining clustered, scattered or outlier plants in the work site. As part of our method for covering a work area while using DASH (or divers alone), a grid pattern is used. A diver will start at either the port or starboard side of the boat and work to and from the boat perpendicular to the direction the boat is facing. For example, with the boat facing north and the diver starting on the port side, the diver begins by heading west. The diver will continue to work perpendicular to the boat until reaching the end of the suction hose. The diver then works back to the boat on a new transect line. Distance between each transect is dictated by visibility, density of EWM, and obstructions. This process is repeated on the opposite side and in front of the boat. Depending on the site, once the diver has adequately covered the area, which the suction hose can reach, they will signal the deckhand to let out more anchor line or determine that the boat needs re-positioning.



Once plants reach the surface, a hose dispenses the plant material into a series of screened bins located on the deck of the boat. These bins capture plants and allow water to drain out back into the lake. Plants on deck are sorted into two categories: the targeted invasive plant and native vegetation. A wet weight of both the invasive plant and all native species combined is taken. Plants are placed in sealable containers or bags for transport to the dumping site. The dumping site is a pre-determined site upland, away from any water body.

Figure 1: 2015 DASH Work Areas (Onterra, 2015)



## Summary

**Table 1:** Daily Summary of DASH Efforts

Date	Location	Size (acres)	Ave. Depth (ft)	DASH Boat Location		Working Direction	Dive Time (hrs)	EWM (lbs*)	Native (lbs*)	Incidental Native Plant Harvest (%)	Total (lbs*)
				Lat (NAD 83)	Long (NAD 83)						
7/1/2015	A-15	1.9	8.5	45.58.164	89.28.395	NNW	4.00	110.0	3.0	3%	113.0
				45.58.175	89.28.396	WNW	0.50	9.0	0.0	0%	9.0
				45.58.176	89.28.406	N & W	1.25	44.0	2.0	5%	46.0
							<b>5.75</b>	<b>163.0</b>	<b>5.0</b>	<b>2% (average)</b>	<b>168.0</b>

## Daily Conditions

**July 1<sup>st</sup> 2015**

Weather – clear, 70°F, light wind

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DASH efforts focused on A-15, which appeared to have denser EWM of the two designated work areas. Native vegetation did hinder diving efforts, all though not to a point where we felt incidental harvest of native plants was high nor vegetation reduced diving efforts to a degree that was unacceptable. Actual incidental harvest of native vegetation was minimal considering the degree of native vegetation present. Curly leaf pondweed was observed at most of our work sites in small colonies to individual plants. Five and three quarter dive hours removed 153 pounds of EWM. Incidental harvest of native vegetation included: white stem pondweed (*P. praelongus*), fern pondweed (*P. robbinsii*), water celery (*V.americana*), clasping leaf pondweed (*P rickarsonii*), waterweed (*E. canadensis*), flat stem pondweed (*P. zosteriformis*) and curly leaf pondweed (*P. crispus*).

<b>Lost Lake /Onterra Project</b>		<b>Weed</b>	<b>Divers hrs</b>	<b>Bag</b>						
		<b>Non Diver hrs</b>	<b>Disposal</b>	<b>Billable</b>	<b>Count</b>	<b>LBS</b>	<b>CY</b>	<b>% non milfoil</b>	<b>lbs EWM*</b>	
Job Report										
8/10/2015	Travel Day/Set up	7.0	0.00	-	0	0	0	0%		
8/11/2015	Site B-15 Harvesting		0.00	2.75	4	160	4	10%	144	
8/11/2015	Site A-15 Harvesting			7.00	20	800	20	2%	784	
8/12/2015	Site A-15 Harvesting			8.00	16	640	16	2%	627.2	
8/13/2015	Site A-15 Harvesting		0.00	12.25	22	880	22	2%	862.4	
8/14/2015	Travel/Take down	5.5								
	Boat Cleaning	1.5								
	<b>Project Total</b>	14.00	0.00	<b>30.00</b>	62	2480	62		<b>2417.6</b>	
									*calculated by Onterra, LLC	