



P.O. Box 494, Osceola, WI 54020

Church Pine, Round and Big Lakes Protection and Rehabilitation District

Aquatic Invasive Species Control Grant Project # ACEI-145-14

*October 1, 2013 to December 31, 2017
(Includes 1yr Extension)*

Final Report

Board of Commissioners

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I Project Scope

(From Grant Application)

The project includes three lakes in southwestern Polk County: Church Pine (107 acres), Round (38 acres), and Big (259 acres) Lakes.

This grant project will continue implementation of the approved Aquatic Plant Management Plan for Church Pine, Round and Big Lakes (December 2010). This grant project is taken directly from the APM plan. The plan and this project continue extensive efforts the Church Pine, Round, and Big Lakes Protection and Rehabilitation District (the Lakes District) has undertaken to address concerns related to invasive species. The project will continue plan implementation through the end of 2015 when an updated aquatic plant management plan will be in place. This grant project supports an updated plant survey and aquatic plant management plan.

II Project Goals, Objectives, Actions and Accomplishments

(From Grant Application)

These project goals and objectives are taken directly from the September 2010 APM plan.

Note ... Goal 3 addresses maintaining navigation, which is not included in this project. Only Actions and Accomplishments funded by this project are addressed.

Goal 1, Prevent introduction of aquatic invasive species and pursue any new introductions aggressively.

Objectives

- A. Boaters inspect, clean, and drain boats, trailers and equipment.
- B. Identify new aquatic invasive species as soon as possible after introduction to the lakes.
- C. Rapidly and aggressively respond to new introductions of invasive species such as Eurasian water milfoil.

Actions

1. Monitor regularly for invasive species introduction at areas of high public use such as the boat landings using volunteers, divers, and/or other comprehensive, reliable method. (Objective B)

Accomplishments

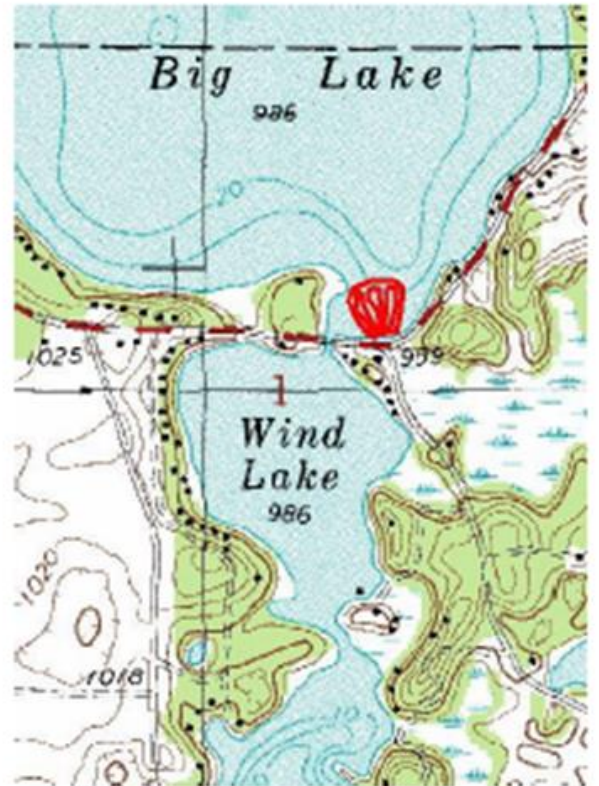
- 2014 - 2017, Ecological Integrity Services, LLC (EIS) continued to monitor the littoral zone area adjacent to the boat landings on Big and Church Pine Lake for AIS (special emphasis for Eurasian water milfoil (EWM). The map below shows the landing coverage through the use of SCUBA and underwater

cameras. There was no evidence of any EWM or other AIS plant species.

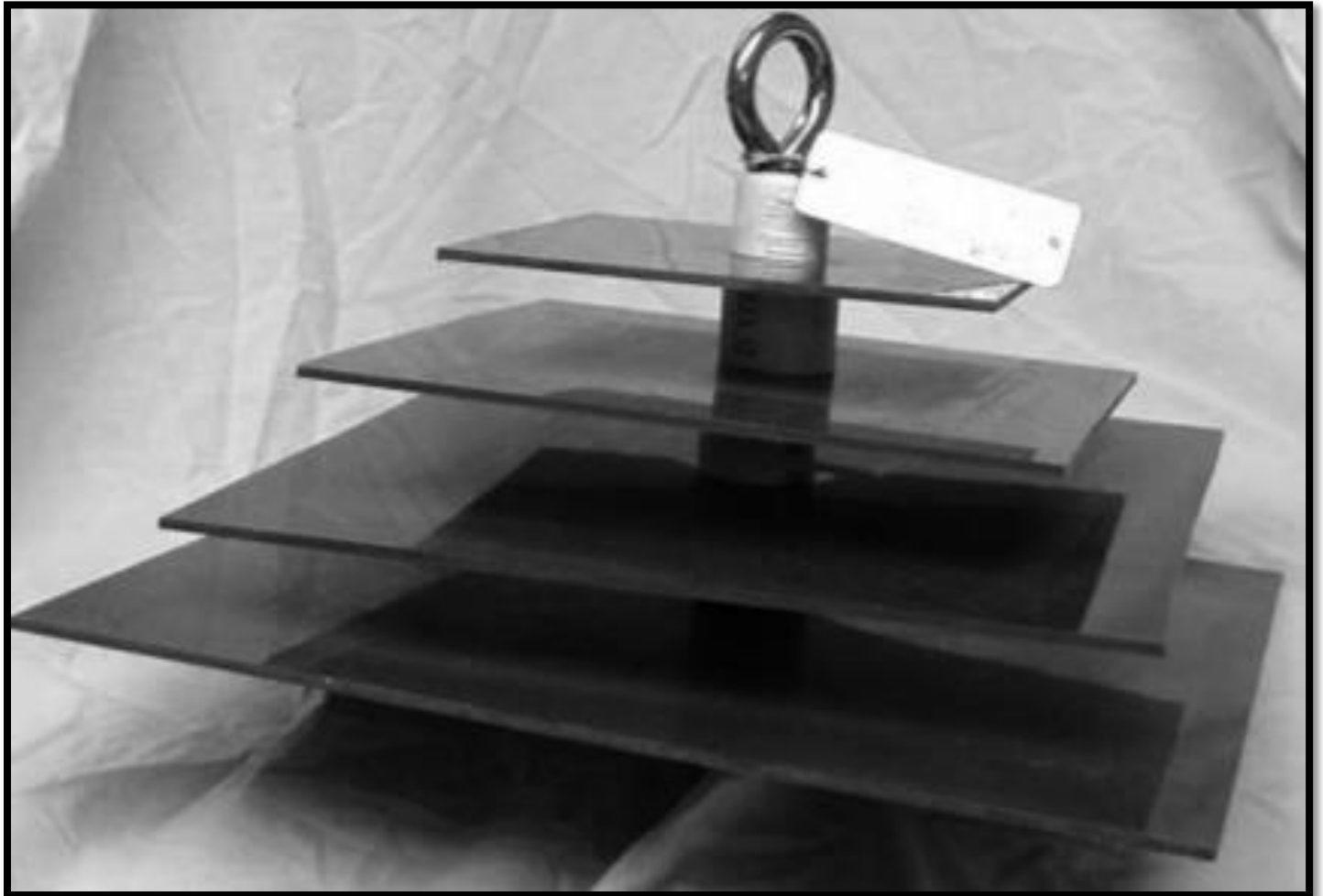


Prevention

Annual Scuba / Camera Survey



- Constructed and deployed 6 Zebra Mussel Substrate Samplers near high usage areas on all three lakes.



Goal 2, Reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.

Objectives: Curly leaf pondweed

Church Pine Lake

A. Eradicate curly leaf pondweed if found in Church Pine Lake.

Round Lake

B. Eliminate dense growth at the north end of Round Lake

Big Lake ... (20 acres of CLP beds currently)

- C. Priority 1: Reduce dense growth of curly leaf pondweed in beds near the boat landing to a mean rake density less than 1.
- D. Priority 2: Reduce dense growth of curly leaf pondweed in remaining beds to a mean rake density of 1.

Actions

1. Hand pull any curly leaf pondweed found growing in Church Pine Lake. Use herbicide treatment only if hand pulling is not effective or practical. (Objective A)

Accomplishments

- No action required since the latest 2014 Church Pine PI Survey, Annual Pre/Post CLP Treatment Surveys and AIS Monitoring have not shown evidence of CLP on Church Pine Lake.
2. Control CLP growing in dense beds using low dose, early season Endothall treatment or other accepted method. (Objectives B, C, D)
 - a. Select tentative beds for treatment in July of previous year (APM Lead or APM Advisory Committee)
 - b. Select APM contractors (Herbicide Contractor, APM Monitor) in December (Board). (Northern Aquatic Services is the selected contractor)
 - c. Apply for APM permits in January or February (underway)

Accomplishments

- Target beds and concentrations have been selected annually by Ecological Integrity Services, LLC. Selection has been based upon their prior years post treatment and current years pre-treatment surveys.
- Harmony Environmental Inc. has managed procuring qualified herbicide contractors each year of this project.
- APM permits have successfully been applied for and granted each year by the DNR

- "The Church Pine, Round and Big Lake Protection and Rehabilitation District used an early season herbicide control program to successfully control curly leaf pondweed each year from 2011-2017. Herbicide treatment was almost entirely in Big Lake with one small bed treated in Round Lake. These treatments resulted in nearly complete removal of CLP during each treatment period, with treatment acres declining to nearly half the original acreage over the years. (See Appendix A for current 2017 status) *Steve Schieffer, Ecological Integrity Service.*

Table 1. CLP Treatment Summary (2011 – 2017)²

Year	Acres	Target ppm	Temp. in F reported at treatment	Reported wind speed	Decline in CLP Frequency	Significant Declines in Native Plants	Notes
2011	25.6	1.25 to 2	54	3-6 mph	76% to 4% 95% decline	NA	Data not available
2012	20.7	1.25 to 2	50 to 51	2-5 mph	75 to 11% 85% decline	Some pondweeds	Coontail increased (grows early season)
2013	20.9	1.5 to 2.5	59.9	2-6 mph	81 to 9% 89% decline	Wild celery	Coontail not affected
2014	14.1	1.5 to 2.5	55	3 mph	70% to 2% 97% decline	None	
2015	14.0	1.5 to 2.5	53	to 3 mph	80% to 5% 94% decline	Coontail	
2016	13.8	1.5 to 2.5	51	3-5 mph	56% to 3% 94% decline	None	
2017	13.0	1.5 to 2.5	53	Calm	62% to 1% 98% decline	Waterweed Forked duckweed	Coontail increased

Table 2. Mean Turion Density by Bed (turions/m²)

Turions/m ²							
Bed	2011	2012	2013	2014	2015	2016	2017
B1		30.7	27	12.4	18.4	6.2	6.1
B2		32.28	4	10.9	0.0	28.7	0.0
B3		7.1	15	21.7	0.0	0.0	0.0
B8		0	6.7	n/a	n/a	n/a	n/a
B12		28.7	39.7	0	129	34.4	4.4
B14		0	20	0	0.0	21.5*	11.0
B15		30.7	16.7	0	8.6	17.2*	17.7
R1		0	20	n/a	n/a	n/a	n/a
All Treated	44	12.8	13.6	6.4	24.3	18.7	7.5

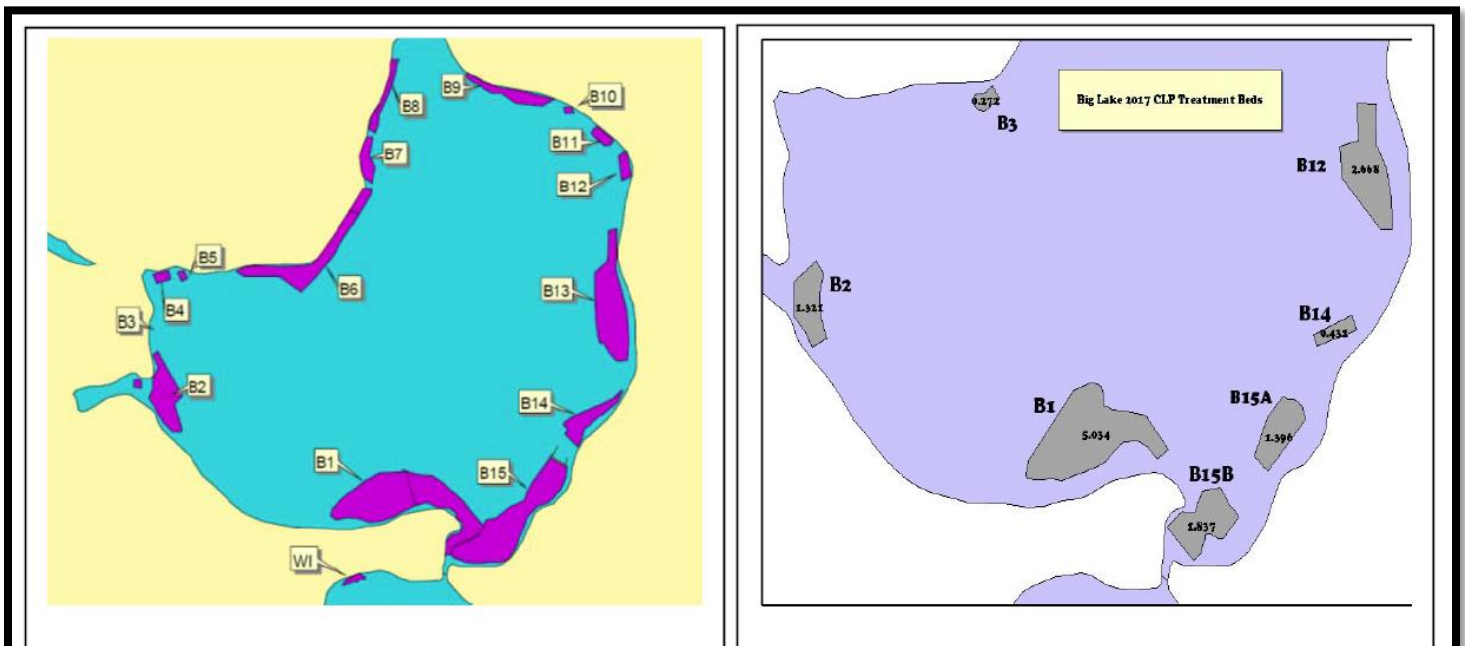


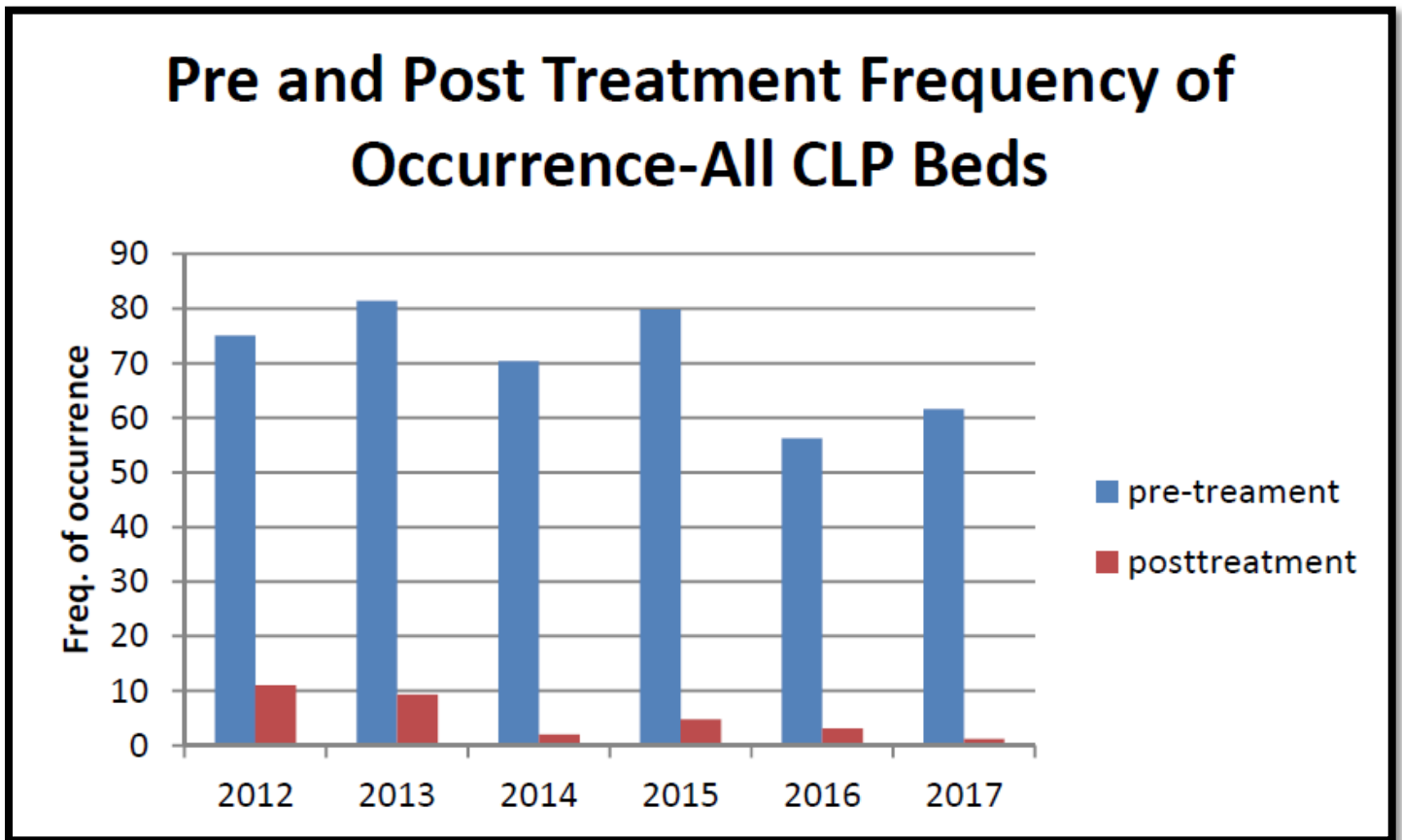
Figure 1. CLP Treatment Beds 2011 and 2017 (planned 2018)

¹ Schieffer, Steve. Ecological Integrity Service. *Herbicide Treatment Analysis for Potamogeton crispus (CLP) Big Lake Polk County, WI. 2011-2017*

3. Conduct DNR specified and required third-party pre and post herbicide monitoring for CLP herbicide treatment. (Objectives B, C, D)

Accomplishments

- Pre and post herbicide treatment surveys and analysis have been conducted since 2012 by Ecological Integrity Service, LLC, Amery, WI



- The Lake District participated in an herbicide concentration study led by John Skogerboe of the Army Corps of Engineers. Volunteers collected water samples as directed by the study design in order to fine-tune herbicide application rates for Big Lake. These studies were continued during the grant period. Results also provided guidance for lakes across the state.

Figure 1. Big Lake 2014 Endothall Sample Locations:

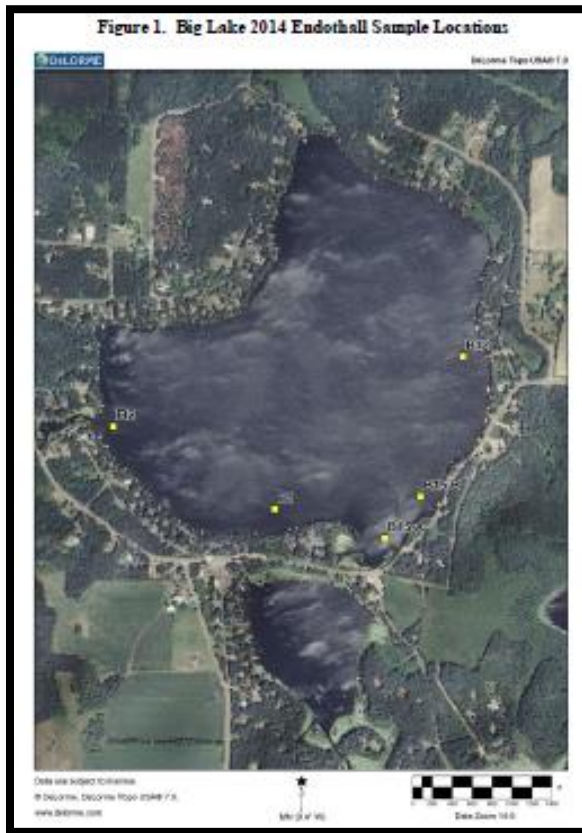


Figure 2

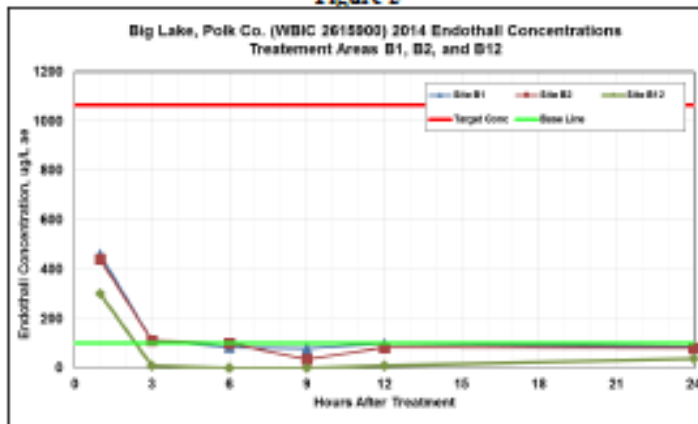
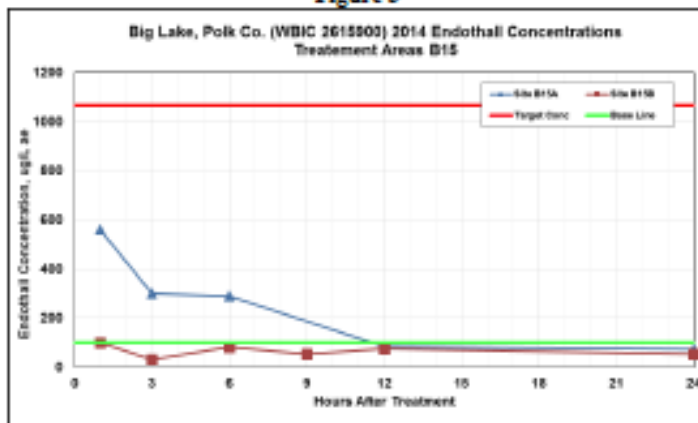


Figure 3



4. Map beds of curly leaf pondweed annually. Look for curly leaf pondweed growth in Church Pine where reported in 1997 in transects 11 and 13. (Objective A- D)

Accomplishments

- Bed mapping has been conducted annually by Ecological Integrity Services, LLC. No CLP has been observed in Church Pine Lake during the pre / post surveying, 2014 Church Pine PI Survey or AIS monitoring.

Objectives: Purple loosestrife and Giant and Japanese Knotweed

A. Eradicate individual plants

B. Reduce populations in larger, established areas

Actions

1. Hire contractor to cut/apply herbicides to individual plants/patches. (Objective A and B)

Accomplishments

- Northern Aquatic Service has been hired each project year to cut and apply herbicide to individual plants. The contractor stated at the end of the 2014 treatment year “Really the lakes looked good except for the trouble spots like the point and Starbucks.”

2. Release beetles in inaccessible patches. (Objective B)

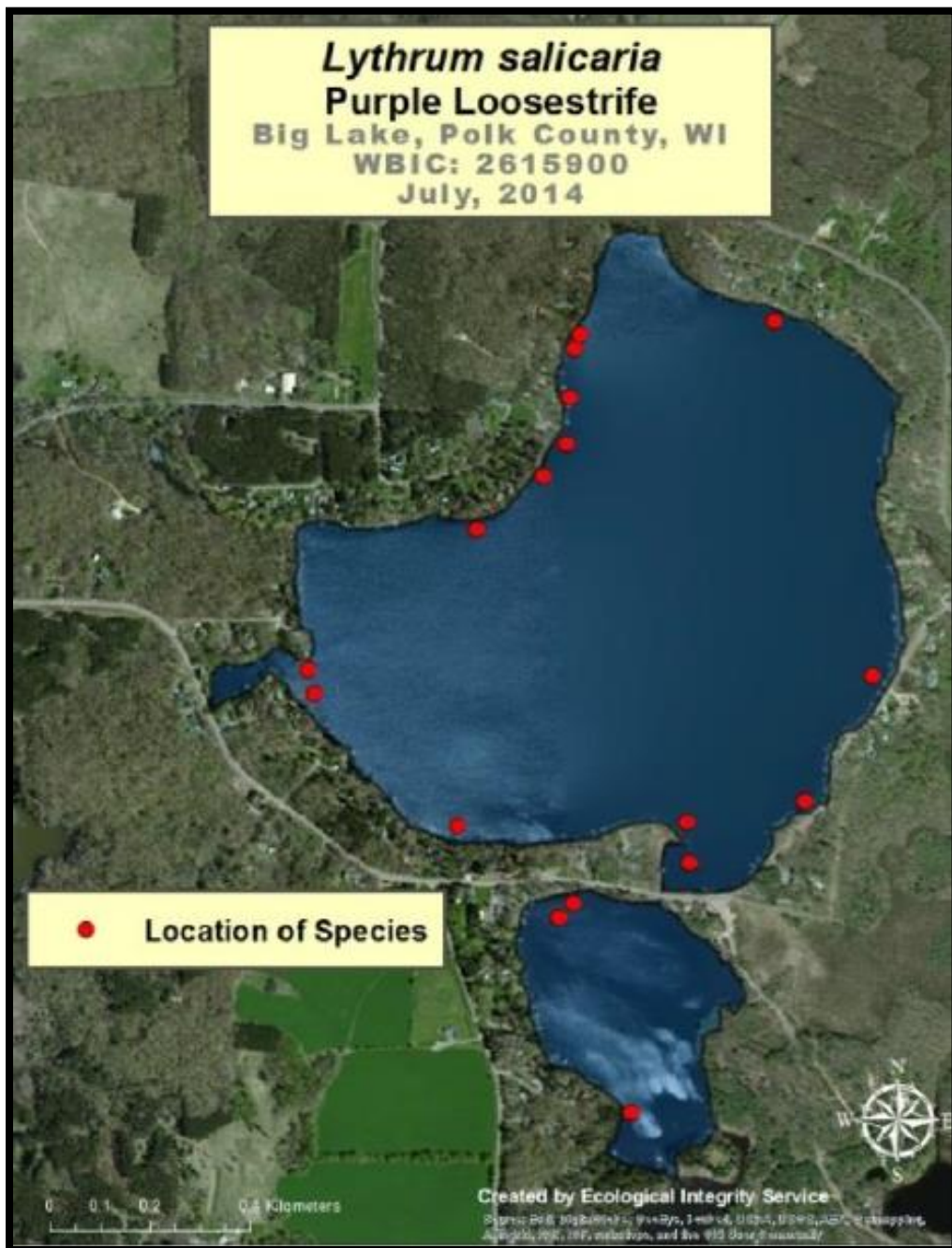
Accomplishments

- No additional beetles have been introduced since 2003. “Most of the areas with multiple PL plants had evidence of bugs chewing on them; a lot of the singular plants did not.” Northern Aquatic Service.

3. Map purple loosestrife growth (how often) to monitor progress toward objectives.(Objective A and B)

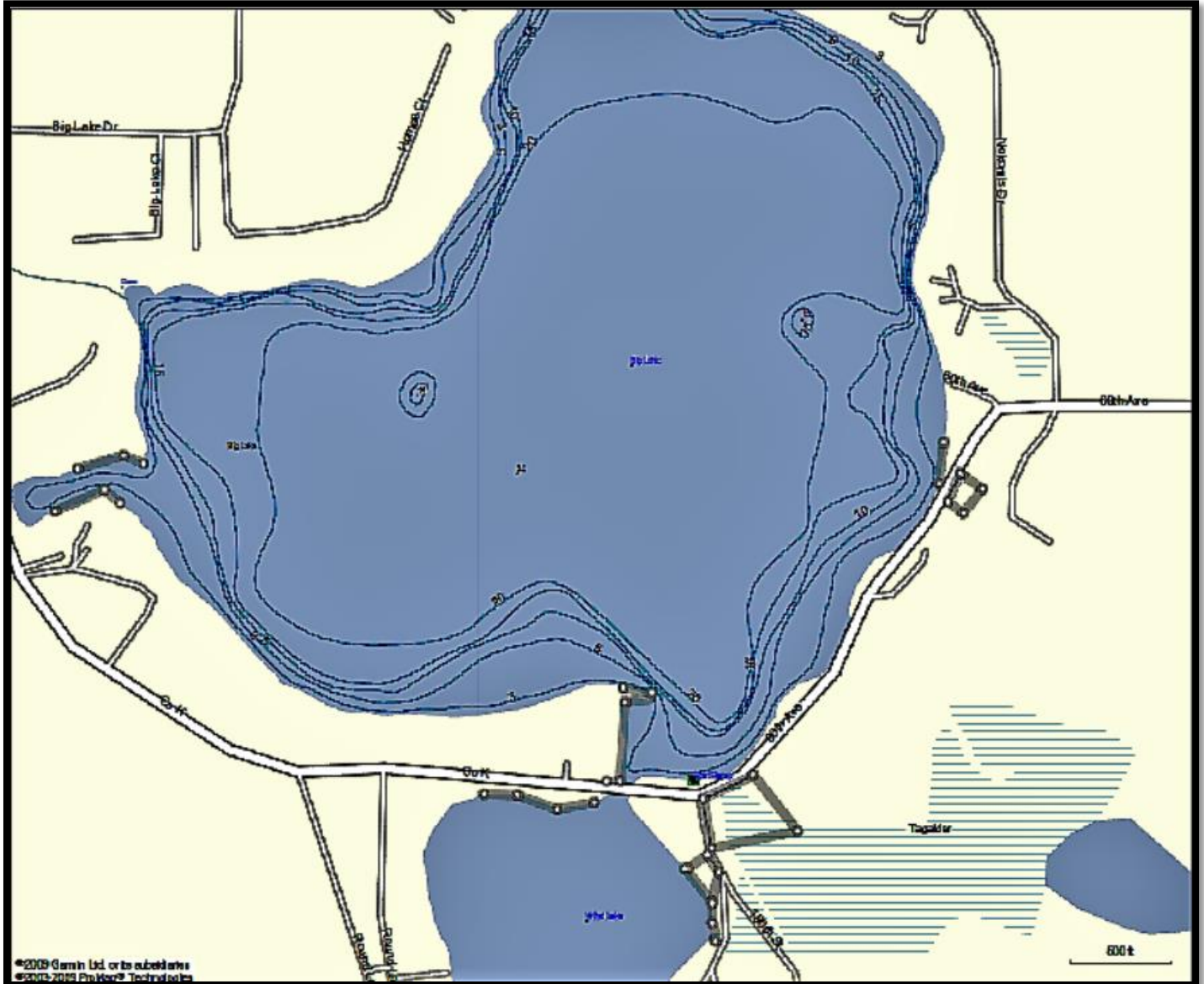
Accomplishments

- Northern Aquatic Services uses the survey below provided by Ecological Integrity Services, LLC as the basis for annual treatment. Northern Aquatic Services, Ecological Integrity Services LLC, District officials and APM committee members annually monitored and directed treatments to attack remaining infestations.



- Northern Aquatic Service has been hired each project year to map and treat Purple Loosestrife.

Map of 2016 Purple Loosestrife



Goal 4, Preserve our diverse native aquatic plant community.

Objectives

- A. Maintain native plants to prevent AIS introduction.
- B. Protect native plant sensitive/critical habitat areas – especially areas with emergent vegetation like rushes and cattails.
- C. Increase residents’ understanding of the role and importance of aquatic plants and their impacts on them.

Actions

- 2. Implement strict adherence with treatment standards (early CLP treatment prior to native plant growth) and monitoring methods prior to and following herbicide treatment. (Objective A, B)

Accomplishments

- “Reductions in CLP likely occurred without significant impacts to native plants. While pre and post monitoring surveys showed some declines in native plants, these changes may have been due to natural variability in growth. One indication is that Coontail did not decline in some years when other species did. Coontail is a plant likely to be affected by an early season Endothall treatment because it also grows early in the year. Endothall is a broad spectrum herbicide.” *Steve Schieffer, Ecological Integrity Service*. See Appendix A, Table 4 for data on 2016 to 2017 treatment impact on native plants.
 - See Table 1 for a record of compliance with treatment standards.
- 4. Use methods outlined in Goal 6 to deliver messages regarding native plant values.(Objective C)

Accomplishments

- See Goal 6

5. Complete a point intercept survey of project lakes.

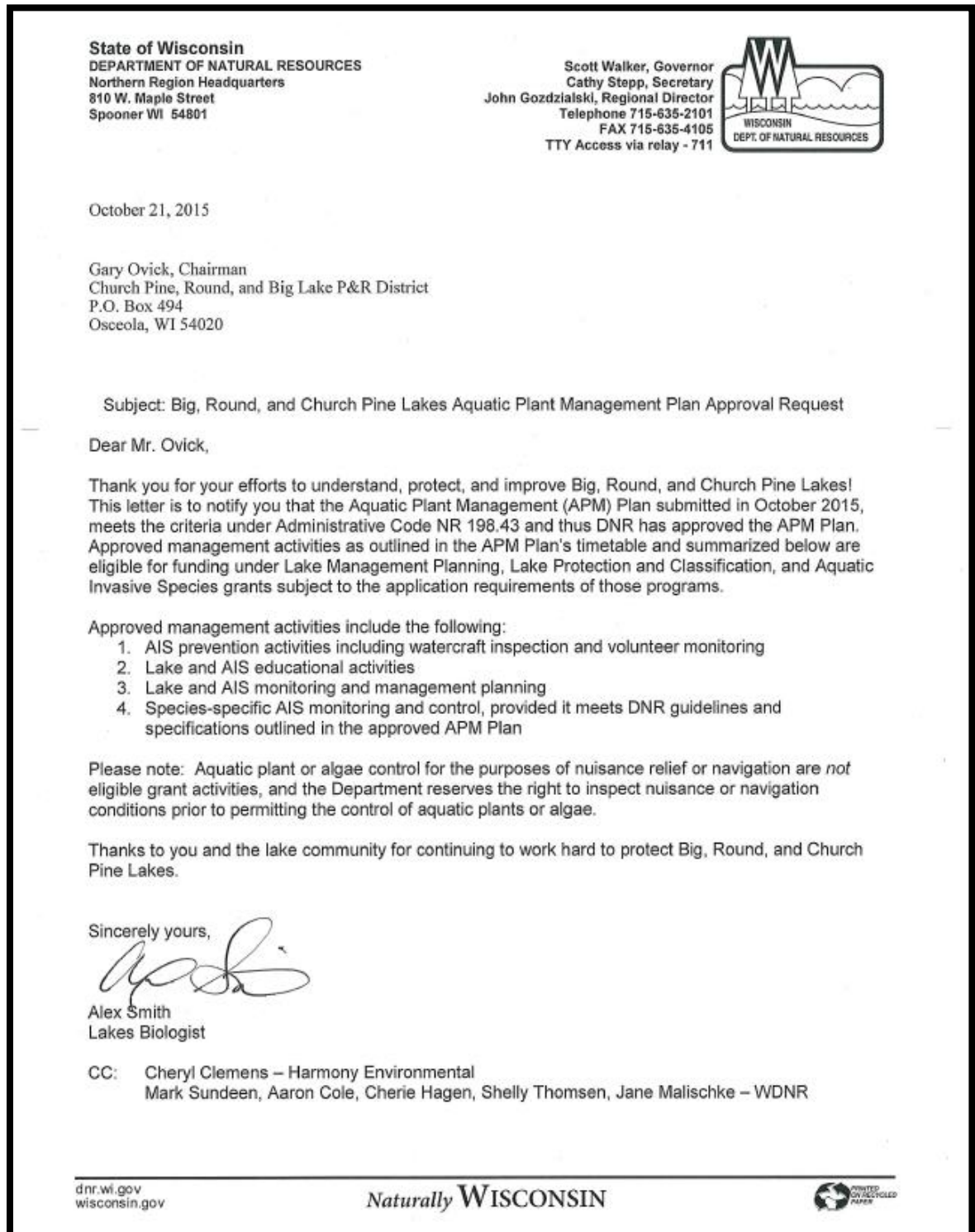
Accomplishments

- A full lake, aquatic macrophyte point intercept survey was conducted on Big Lake, Church Pine Lake, and Round Lake Polk County Wisconsin in June and July, 2014. Big Lake had a species richness of 28 and a Simpson's diversity index of 0.87. The littoral zone had plants present in 64.58% of the sample points. Church Pine Lake has a species richness of 33 and a Simpson's diversity index of 0.92. The littoral zone had plants sampled in 84.14% of the sample points. Round Lake had a species richness of 37 with a Simpson's diversity index of 0.94. The littoral zone had plants present in 92.23% of the sample points. There were two invasive species sampled and/or observed on Big Lake and Round Lake. These species were *Potamogeton crispus*-curly leaf pondweed (one location only on each lake), *Lythrum salicaria* -Purple loosestrife (several locations in Big Lake and three locations on Round Lake). There was one invasive species observe, *Lythrum salicaria* - Purple loosestrife in one location only on Church Pine Lake. *Typha augustifolia*-narrow leaf cattail, which is a potential invasive species was observed in a few locations on each lake (could be extensive in two cattail beds in Church Pine Lake). In a comparison between the 2014 survey and a previous 2007 point intercept survey very small differences were found. Species richness, maximum depth of plants, Simpson's diversity index and FQI changed little or none. A chi-square analysis resulted in significant reduction in *Potamogeton crispus* (AIS) in Big Lake. Significant increases occurred in two native species in Big Lake, and six native species in both Church Pine Lake and Round Lake. Significant decreases occurred in one native species in Big Lake, four native species in Church Pine Lake and two native species in Round Lake. Causes were speculated to potentially be due to seasonal and/or sampling variation and field identification. *Steve Schieffer, Ecological Integrity Service*, Complete survey has been provided to the DNR and is on file at the Lake District.

6. Update the Aquatic Plant Management Plan

Accomplishments

- The Aquatic Plant Management Plan has been updated and approved by the DNR as stated below:



Goal 6, Educate the public regarding aquatic plant management.

Actions

6. Post signs and distribute brochures to encourage lake users to clean plants from boats and equipment and to drain live wells and to inform them about aquatic transport laws.

Accomplishments

- “AIS Educational Kiosks” are maintained at both boat landings with the latest documentation. These kiosks create an obvious professional presence for the display of AIS related material, including signs related to the “do not transport” ordinances. Additionally, the kiosks serve as a presentation platform for CBCW Inspectors. Second only to having inspectors present, installing the kiosks continues to have the most impact on our AIS prevention program.



- Custom literature was produced and distributed at boat landings by CBCW inspectors.

Church Pine, Round and Big Lake

Church Pine Lake
Aces 107
Total Shoreline: 2.4 miles
Maximum Depth: 45 feet

Round Lake
Aces 38
Total Shoreline: XX miles
Maximum Depth: 22 feet

Big Lake
Aces 259
Total Shoreline: 3 miles
Maximum Depth: 24 feet

Town of Alden, Town of Garfield, Polk County, Wisconsin

STOP aquatic hitchhikers...
Clean your boat and equipment to prevent the spread of invasive species!

In Wisconsin it's the law...
Failure to follow these steps can lead to fines up to \$2000.

Before you leave a body of water:

- **Inspect** boats, trailers, and equipment.
- **Remove** all attached aquatic plants, animals, and mud before launching and before leaving the water access.
- **Drain** all water from boat, motor, bilge, live wells, bait containers and equipment before leaving the water access.
- **Never move** plants, live fish, bait, or fish eggs away from a water body.
- **Buy** minnows from a Wisconsin licensed bait dealer.
- **Dispose** of unwanted bait in the trash, not in the water or on land.

Additional steps

- Spray, rinse, or dry your boat and equipment to remove or kill species not visible. Spray/rinse with hot or high pressure water OR dry your boat for 5 days before entering another lake or river.
- Disinfect boats and equipment to kill species and fish diseases using a mixture of two tablespoons of household bleach to one gallon of water.

Polk County Sheriff
715-485-8300
(non emergency)
EMERGENCY DIAL 911

- AIS literature was distributed to residents attending Annual Lake District meetings / workshops. Presentations were given by District Commissioners and County Land and Water Resource Department representatives. Topics included:
 - Pictures of AIS to aid in identification
 - What to do if found.
 - How to prevent AIS.
 - Our CBCW prevention program.
 - AIS detrimental impact on the lake and property values.
 - Funding of AIS programs.
 - Protection and value of native plants
- (A sample of presentation excerpts are shown below)

Control

Curly-Leaf Pondweed

Serrated leaf margin & angled veins

Control

Purple Loosestrife

Education

Blunt tip

Leaf

12 to 20 Leaflets

Eurasian Watermilfoil

Control

Japanese Knotweed

Education

Zebra Mussels

Education

What if you think you found Eurasian Water Milfoil (EWM)?

1. Mark the location
2. Bag the sample
 - Do not fragment the plant ... it spreads by fragmentation!
3. Contact Lake District EWM ID Volunteers
 - Mike Reiter (715) 294-3950
 - Steve Oswald (715) 294-3135 (651) 248-8827 Cell
 - Gary Ovick (715) 294-3988 (715) 417-1770 Cell
4. If positive ... The Lake District Board will execute the Rapid Response Protocol per the Aquatic Plant Management Plan

Control

Yellow Flag Iris

Control

APMP Implementation Summary

- CLP treatment reducing nutrients from adult decay & turion production
- Purple Loosestrife treatment / beetles eliminated most populations

Prevention

- Scuba or underwater camera inspection of vulnerable areas (launches)
- Clean Boats Clean Waters boat inspections at both landings
- Volunteer Spotters (*Volunteers needed for 2015!*)
- AIS Rapid Response Plan

Education

- AIS Educational Kiosks at both landings
- Signs, Audio Warning & Video Camera deterrent at Church Pine 24/7
- Clean Boats Clean Waters education at both landings
- General Meeting education on AIS

Education

Aquatic Invasive Species (AIS)
Existing & Potential

- **Existing Aquatic Invasive Species**
 - Curly Leaf Pondweed
 - Purple Loosestrife
 - Japanese Knotweed
 - Chinese Mystery Snails
- **Potential Aquatic Invasive Species**
 - Eurasian Water milfoil
 - Zebra Mussels
 - Asian Carp

Eurasian Water-milfoil Distribution

4 Polk County Waterbodies:
Horseshoe Lake,
Long Trade Lake,
Pike Lake, St.
Croix River

Control

Lake Management Committee Accomplishments 2017

3. Treated Curly Leaf Pondweed (CLP) With Our 2014 Grant Which Now Extends Thru 2017

Big Lake 2016 Turion Density

Big Lake Mean Turion Density 2012-2016

Education

Lake Management Committee Accomplishments 2017

4. Treated Purple Loosestrife

Purple Loosestrife

08/01/16 Treatment

08/17/16 Treatment

Education

Lake Management Committee Accomplishments 2017

5. Annual AIS Survey at Boat Landings (*Pending*)

Zebra Mussels

Eurasian Water-milfoil Distribution

Eurasian Watermilfoil

Check Docks & Lifts!

Healthy Lakes Best Practices

FISH STICKS NATIVE PLANTINGS DIVERSION ROCK INFILTRATION RAIN GARDEN

<http://healthylakeswi.com>



- Presentations, AIS information, Aquatic Plant & Lake Management Plans are available on our newly designed state of the art website. The website became our new showcase for AIS and CBCW activities, <http://www.bigroundpine.com>

Home Events News **District Business** Safety Community Links About Contact
Q

Water Quality and Aquatic Plant Management

[Current Lake Management Plan](#)
 [Current Aquatic Plant Management Plan](#)
 [AIS Information](#)

SLOW THE SPREAD OF AQUATIC INVASIVE SPECIES TO LAKES, RIVERS AND WETLANDS

The primary way aquatic invasive species spread to new waters is often through the very people who most enjoy those waters. Zebra mussels and Eurasian watermilfoil actually hitch a ride on boats and trailers and in livewells, traveling from one lake to another. It is illegal for anybody to launch a boat with zebra mussels or aquatic plants attached. To prevent accidentally transporting invasive species:

- INSPECT your boat, trailer and equipment and REMOVE visible aquatic plants, animals and mud before leaving the water access area.
- DRAIN water from livewells, bilge, motor, bait buckets and transom wells before leaving the access area.
- Empty bait buckets into the trash.
- DRY the boat and equipment for at least five days before transferring to a new lake. If drying isn't possible, RINSE boat, tackle, downriggers and trailers with hot (above 104 degrees F) and/or SPRAY with high-pressure water.

Learn what invasive organisms look like. REPORT questionable species to your local DNR service center for identification assistance; preserved specimens are needed to confirm sightings.

Eurasian water-milfoil (*Myriophyllum spicatum*)

An emergent, herbaceous aquatic plant, Eurasian watermilfoil, usually extends 3 to 10 feet, but can reach as much as 33 feet in length. The stems are reddish-brown to whitish-pink. It forms dense mats on the surface of water bodies, and new plants that may emerge from each node on a stem root on contact with mud. Regenerates mostly from rhizomes, fragmented stems, and axillary buds that develop throughout the year. Eurasian watermilfoil can be found in nearly 400 WI lakes.



III Aquatic Plant Management Summary



Aquatic Plant Management Plan “Implementation Update”

Accomplishments	2011	2012	2013	2014	2015	2016	2017
APM Plan Update					Oct		
Aquatic Plant PI Survey				July			
CLP Treatment	5/14	4/20	5/20	5/22	4/30	4/22	4/25
PL Treatment	Aug	Aug	Aug	Aug	July	Aug	None
AIS Diver Inspection	July	Aug	Aug	Aug	Aug	Aug	Aug
AIS Education	5/21 8/27	5/19 8/25	5/18 8/24	5/17 8/25	5/16 8/28	5/16 8/27	- 8/26

IV Project Financials

State of Wisconsin
 Department of Natural Resources
 Box 7921
 Madison, WI 53707-7921

Grant Payment Request
 Form 8700-001 (R 8/12) Page 1 of 2

Notice: Project Sponsors are required to provide information requested on this form when applying for payment of a grant funded by the Department. See Reporting Requirements on reverse. The Department will not process your payment request unless you provide all information requested. This information will be used to determine the amount of your payment and issue your check. Personally identifiable information collected will be used for program administration and may be made available to requesters as required under Wisconsin's Open Records law [ss. 19.31-19.39, Wis. Stats.].

Submit one copy of this request form, your completed Grant Payment Worksheet (Form 8700-002), and required documentation, listed on reverse, to your DNR Grant Specialist. See the DNR web site for additional information: <http://dnr.wi.gov/Aid>

Project Sponsor Information	
Project Sponsor / Management Unit Name Church Pine, Round & Big Lake P&R District	Grant Number ACEI-145-14.1
Project Name APM Plan Implementation	County Polk

The DNR will mail the check to the name identified on the application as "Check Recipient." Questions? Contact DNR Grant Specialist.

Type of Request: Partial Final

Payment Information (see reverse for instructions)

A. Payment Record to Date	Amount	This Column for DNR Use Only
1. Amount of Grant (from original or amended Grant Agreement)	47,844.30	
2.a. Advance Payment Received, if any	0.00	
2.b. Total Payments Received after Advance Payment, if any	43,056.18	
2.c. Total Payments Received to Date (Lines 2.a. + 2.b.)	43,056.18	
3. Funds Remaining (Line 1 minus Line 2.c.)	4,788.12	

B. Cost Share Amount	Amount	This Column for DNR Use Only
4. Total Eligible Project Costs this Period. Transfer data from "Total Project Costs" field on Worksheet (Form 8700-002)	\$ 3,339.05	
5. Your Share of Costs. See Line 5 instructions on reverse.	\$ 834.76	
6. State Share of Costs (Line 4 minus Line 5) NOTE: This line cannot exceed the amount in Line 1.	\$ 2,504.29	

C. This Payment Request and Grant Balance Remaining	Amount	This Column for DNR Use Only
7. Amount of Advance Payment Received (from Line 2a) (if no advance payment received or already accounted for, enter \$0)	\$ 0.00	
8. Amount Eligible this Claim (Line 6 minus Line 7) NOTE: This line cannot exceed the amount in Line 3.	\$ 2,504.29	Amount approved this claim →
9. Grant Balance Remaining (Line 3 minus Line 8)	\$ 2,283.83	

Lake & River Grants Only: Does project include State Lab of Hygiene Sample Analysis? Yes No

Certification

I certify that, to the best of my knowledge and belief, the eligible costs requested are in accordance with the terms of the grant agreement and that all expenditures are based on actual payments of record. This reimbursement represents the grant share due that has not been previously requested.

Name of Authorized Representative - type or print Gary Ovick (Chairman)	(Area Code) Telephone Number (715) 417-1770
Signature of Authorized Representative	(Area Code) FAX Number
Date Signed 12/31/2017	Email Address Garyovick@aol.com

Space Below this Line for DNR Use Only	
Grant Specialist Signature	Reimbursement Approval Date

Appendix A

Herbicide Treatment Analysis for *Potamogeton crispus* (CLP)

Big Lake

Polk County, WI

2017

Abstract

On April 25, 2017 12.96 acres of *Potamogeton crispus*-curly leaf pondweed (CLP) were treated with the herbicide endothall at a target concentration of 1.5-2.5 ppm. The water temperature at the time of treatment was between 53 degrees F. A pretreatment survey was conducted on April 21 and a post treatment survey was conducted on June 6, 2017. A chi-square analysis was used to determine the significance of any reductions in frequency of occurrence. The frequency of occurrence from the pretreatment to the post treatment survey showed a statistically significant reduction (from 61.6% to 1.2%). A comparison of the post treatment survey of 2016 and the post treatment survey of 2017 showed a decrease from 3.1% to 1.2% which was not significant. Comparing the pretreatment survey of 2016 to the pretreatment survey of 2017 a small increase occurred. A chi-square analysis revealed a statistically significant reduction in two native plant species. A turion analysis resulted in a mean turion density reduction from 2016 to 2017. The mean turion density went from 18.7 turions/m² to 7.5 turions/m².

Introduction

On April 25, 2017 seven beds totaling 12.96 acres of *Potamogeton crispus*-curly leaf pondweed (CLP) beds were treated with herbicide (endothall-K) for the seventh year on Big Lake in Polk County Wisconsin (Township 32,33, Range 18 Section 36). Figure 1 shows the location of the beds.

The treatment comprised of concentrations ranging from 1.5-2.5 ppm of endothall K. Table 1 shows the statistics for each treatment bed.

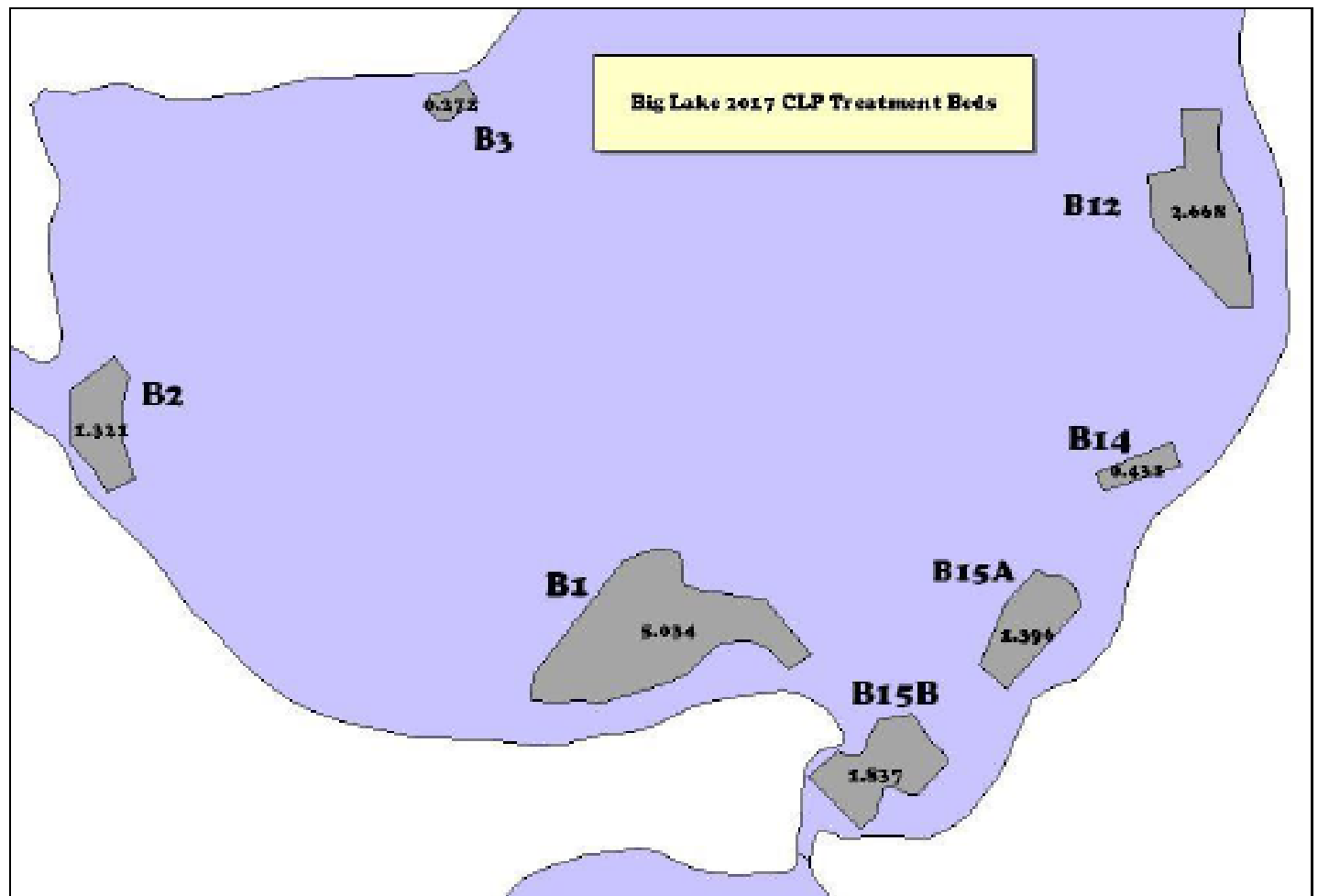


Figure 1: Map showing 2017 CLP treatment beds

Big Lake 2017 CLP 4/25/17					
	Winds calm	Water temp:53°F			
Big Lake	Acres	Mean Depth(ft)	Acre- feet	Gallons applied*	Target conc.* (ppm)
B1	5.03	6.40	32.19	HTR	Not
B2	1.32	6.10	8.05	Available	
B3	0.27	8.00	2.16	Will	
B12	2.67	7.20	19.22	Be	
B14	0.43	5.80	2.49	Added	
B15A	1.40	7.00	9.80	Later...	
B15B	1.84	4.4	8.10		
Big Lake Total	12.96		82.02		

*As reported by applicator

Table 1: Summary of 2017 treatment bed statistics.

Bed	Description
B1	Bed B1 is just north of the narrows between Big Lake and Round Lake, This is the second largest bed and was very dense from the start of the treatment in 2011. The bed ranges from 3.5 feet to 11 feet in depth. The density/frequency has been declining each year but has had quite high turion densities. The pretreatment frequency is starting to go down, largely along the bed edges.
B2	This bed is on the western shoreline of Big Lake. It is 1.9 acres in size. The bed transitions quickly from a high nutrient, muck sediment to a hard, sandy substrate on the western edge of the bed. The CLP growth stops abruptly here. In 2010, this bed was quite dense in the middle portions of the bed, but has responded well to treatment.
B3	Bed B3 is on the northern shoreline of Big Lake. It originally had high density pockets of CLP with scattered growth between the pockets. The lake side edge borders very deep water and drops fast. There is no growth in this deeper water and defines the lake side boundary abruptly.
B12	Bed B12 came about from combining B12 and B13 from previous treatment years. CLP growing between these beds that was observed in quite high density in May 2013 warranted changing this bed (it is back to its original size from 2011). This bed responded less to treatment than other beds and had the highest frequency of CLP in 2013. It is a wider bed than ½ of the beds and ranges from about 4 ft to 11 ft in depth. The most CLP growth in this bed is the outer ½ of the bed in 7-10 feet of water depth.
B14	B14 is on the eastern shore. This narrow bed has been responding to treatment well, but keeps having CLP return, warranting more treatment. It ranges from 4 ft to about 7.5 feet in depth.
B15(A and B)	B15 is the largest bed treated. It encompasses much of the southeastern shoreline and extends out to Bed B1 and into the channel between Big Lake and Round Lake. This bed has a history of dense CLP and high turion production. The CLP density and turion density have both declined steadily. Due to distinct differences in CLP growth in this bed, it was labeled as two beds (A and B) in 2016 and were completely separated in 2017.

Table 2: Description of treatment beds.

Methods

To conduct and analyze the treatment, two surveys are conducted following the Wisconsin DNR treatment protocol outlined in 2009 by the Wisconsin DNR. The first survey is referred to a pretreatment survey. This involves going to predetermined GPS coordinates within the proposed treatment area. A high definition underwater camera as well as a rake is used to determine the presence of CLP at that sample point. Density is not measured as the plants are typically very small and density is very subjective. The presence of CLP is simply determined. There are many points checked outside of the bed delineation to assure the boundary is correct.

The second survey is referred to as the post treatment survey. This survey involves going to the same GPS coordinates as the pre-treatment survey and doing a rake sample at the point. If any CLP is on the rake, the density of the CLP is recorded (see fig 2 for reference). All other species are also recorded from the rake sample in order to verify no damage to the native plants.



Figure 2: Density rating system and example CLP rake sample.

When the surveys are complete, the frequency of occurrence is determined as well as the mean density for each bed as well as all beds combined. The frequency of occurrence for each native plant species sampled is also calculated. A chi-square analysis is then used to determine if the change in frequency is statistically significant ($p < 0.05$). The goal is to find the chi-square analysis show that the frequency of CLP is significantly reduced and the native plants are not significantly reduced.

The comparison for reduction is three-fold. First, the result from the previous year's post treatment survey is compared to the present year post treatment survey. This reflects a long-term effectiveness. As more treatments are done in annual succession, these frequency values can become very similar since the CLP growth is reduced so much. This can make it appear the treatment is not progressing successfully since the frequency appears to not be reduced. Each year, new turions can germinate in the fall/winter creating new growth. The result is a low

frequency in the post treatment survey, but in the next spring the CLP has grown immensely, and results in a high frequency.

In order to reflect that new growth and the effect the treatment has on it, a second comparison is done. This compares the frequency of CLP in the spring, pre-treatment survey to the post treatment results in that same year. This shows what the CLP growth really was just before treating and the result after treatment. To show long-term reduction, the pretreatment frequency can be compared between treatment years. If the pretreatment frequency is going down from year to year, then the CLP is being reduced through turion reductions, thus resulting in less growth that spring.

In the end, we want to see a statistically significant reduction when comparing the pre-treatment frequency to the post treatment frequency. We would also like to see a consistent frequency reduction from year to year, depending on how low it is. If the frequency in any post treatment survey is very low (less than 10% as an example), then lowering it even more may not be realistic, but is the goal. Turions can remain viable for several years, which can affect reduction amounts achieved.

In order to further reflect potential future growth and the cumulative success of treatments, a turion analysis is conducted. This analysis involves going to sample points near the middle of the CLP bed (assuming this will reflect the highest density). At each sample point a sediment sampler is lowered to the lake sediment and a sediment sample is obtained. Two samples are obtained from each side of the boat at each location. The samples are then separated with a screened bucket to isolate the turions. The turions are then counted and the density of turions is calculated in turions/square meter. Consistently successful treatments should so a trend of reduced turion density each year. This way it is known the treatments are killing plants prior to turion production, resulting in overall reduction in CLP in those beds.

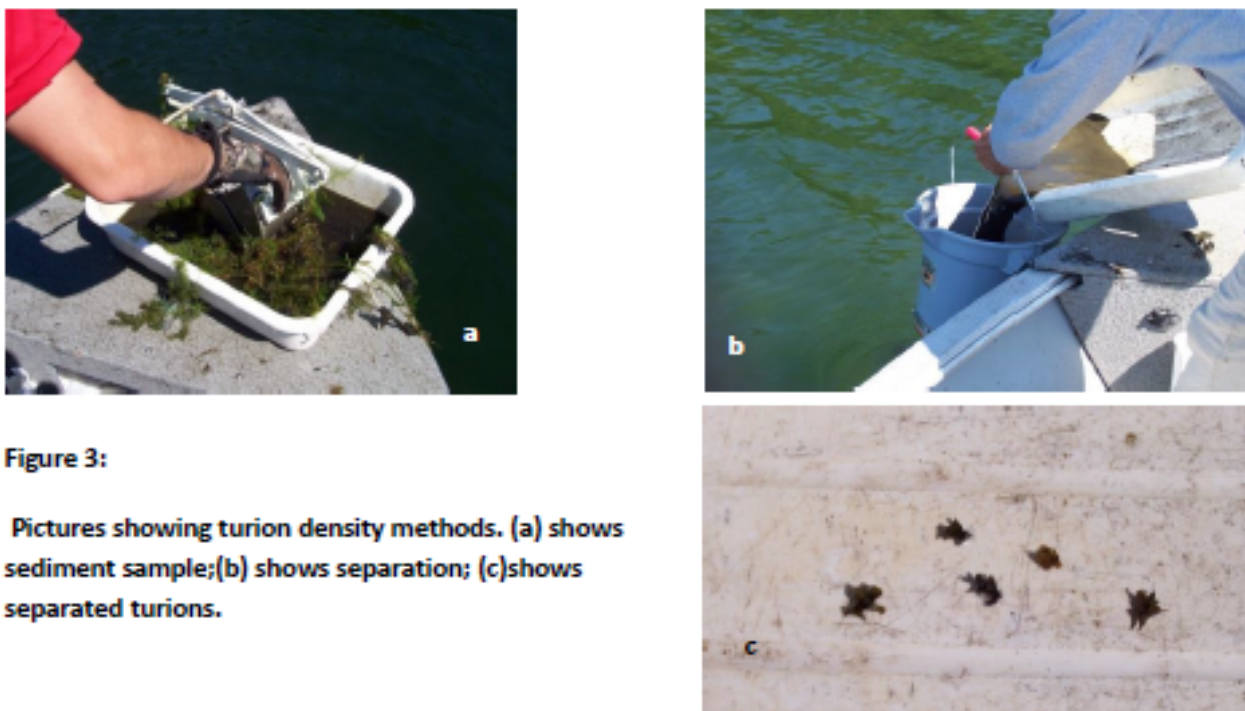


Figure 3:

Pictures showing turion density methods. (a) shows sediment sample;(b) shows separation; (c)shows separated turions.

Results

A pretreatment survey was conducted on April 21, 2017. This survey found CLP growing in 61.6% of the sample points within the proposed treatment beds. A few changes were made in the bed borders, with the most dramatic separating Bed 15 into two beds. These beds (15A and 15B) are combined in the frequency summary chart in order to more easily compare from previous years. Table 2 shows the frequency summary from 2016 and 2017.

Bed	2016 pre treat freq (0-100%)	2016 post treat freq (0-100%)	2017 pre freq. (0-100%)	2017 post freq. 0-100%	2016 mean Density (0-3)	2017 mean density (0-3)
B1	57.1%	2.8%	70.0%	0.0%	0.03	0.0
B2	55.6%	0%	77.8%	11.1%	0.01	0.11
B3	50%	0%	67.0%	0.0%	0.0	0.0
B12	66.7%	11.1%	75.0%	0.0%	0.11	0.0
B14	60%	0%	67%	0.0%	0.0	0.0
B15(A/B)	47.8%	0%	60.0%	0.0%	0.0	0.0
All beds	56.25%	3.12%	61.6%	1.2%	0.03	0.01

Table 2: Frequency data from pre/post treatment surveys in 2016 and 2017.

Bed	Pre to post (2017) reduction and significance?	Post 2016 to Post 2017 reduction significance?	Pre 2016 to Pre 2017 Reduction Significance?	Mean Density Change 2016-2017 (post)
All beds	Yes(P=1.3X10 ⁻¹⁷)	No (P=0.37)	increase	-0.02

Table 3: Chi-square analysis results for pre/post treatment surveys.

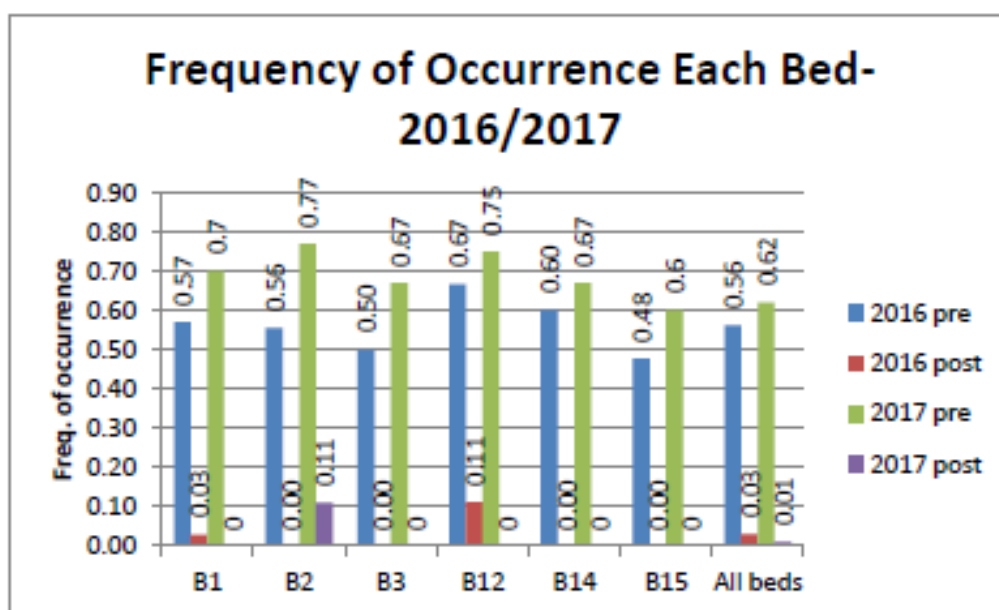


Figure 4: Graph showing the CLP frequency from pre/post treatment surveys for each bed 2016-2017.

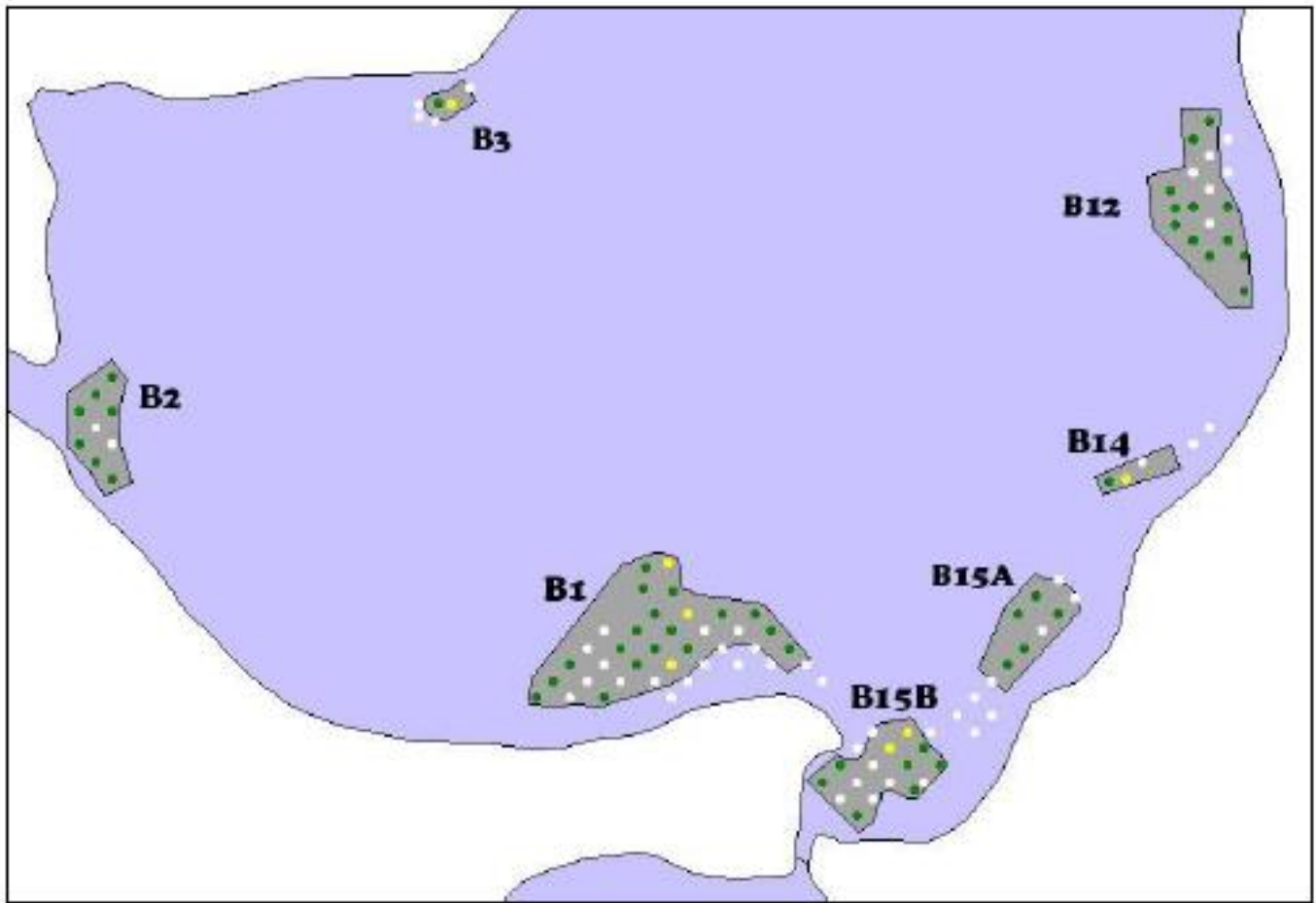


Figure 5: Map of CLP frequency from 2017 pretreatment survey.

Following treatment, a post treatment survey was conducted on June 6, 2017. This time corresponds with dense growth of CLP on other area lakes (can't compare untreated areas in Big Lake as no CLP growth was occurring). CLP was present in only 1.2% of the sample points. Figures 5 and 6 show the distribution of CLP within the treatment beds.

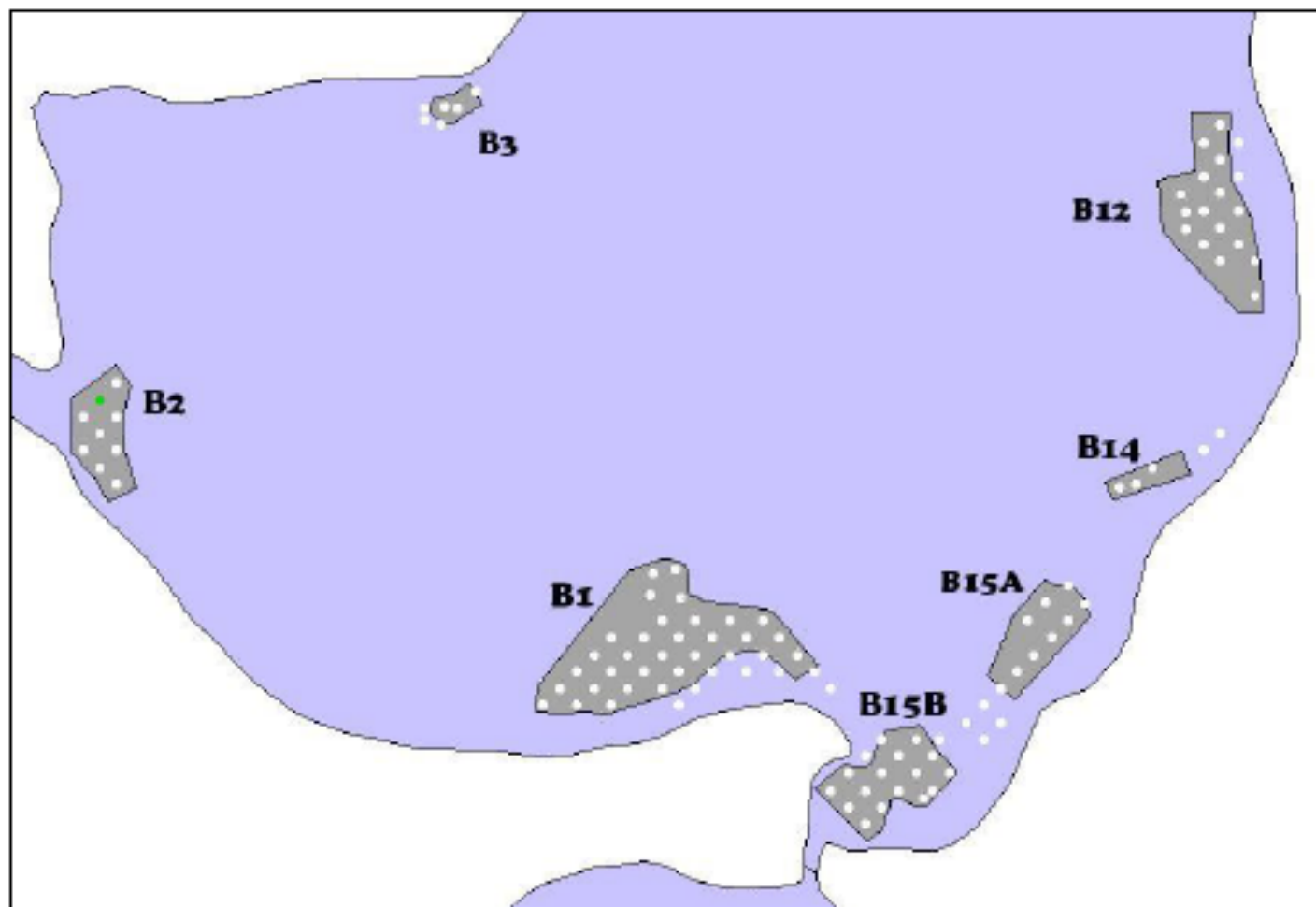


Figure 6: Map of CLP frequency from 2017 post treatment survey.

The data shows a significant reduction in CLP growth from before treatment occurred (pretreatment survey) and after treatment occurred (post treatment). The CLP frequency before treatment was 56.25 and was reduced to 1.2% after treatment. A chi-square analysis showed this was statistically significant. Comparing the 2016 frequency results to 2017 can show if an overall reduction occurred between those years. The post treatment frequency change was a very small reduction from 2016 to 2017, but is not statistically significant. It is difficult to reduce such small frequency results. Statistics are calculated on all beds combined, but figure 4 graphically reflects frequencies in various surveys for each treatment bed.

Comparing pretreatment surveys show long-term changes as these surveys are conducted after CLP growth has resulted from turion germination in the winter/spring. There was a small increase from 2016 to 2017 (56.25% to 61.2%), but this increase could be from reducing size of bed 15 making more sample points only in areas with CLP. Figure 7 graphically demonstrates the changes in overall frequency from 2012 to 2017.

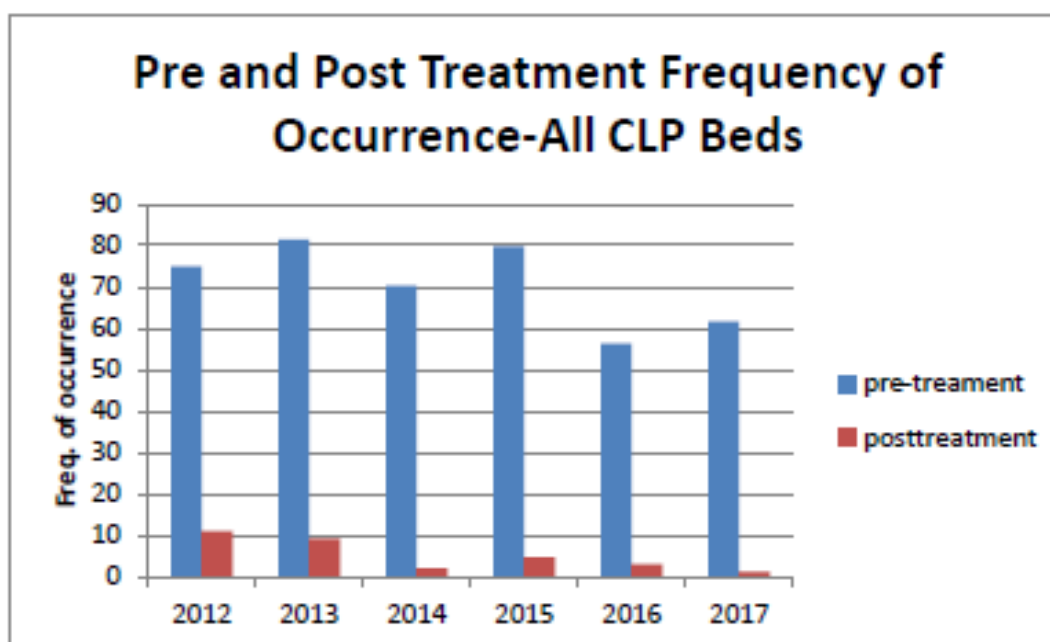


Figure 7: Graph showing CLP frequency changes from 2012 to 2017.

Another goal of herbicide treatment for invasive species is to target the invasive species with little adverse effect on native plant species. The native species are also surveyed within the treatment beds and a chi-square analysis is used to evaluate if the native species are reduced significantly.

The 2017 chi-square analysis indicates there were two statistically significant reductions in native plant species (*Elodea canadensis* and *Lemna trisulca*). There was one significant increase in native species (*Ceratophyllum demersum*). The cause of the reductions could be due to herbicide use. It is also possible that natural variation and/or sampling variation could be a factor. Plants that are not dormant at the time of treatment are susceptible. Table 4 shows a summary of the native plant frequencies for 2016 and 2017, along with the significance of any changes.

Species	2016 freq	2017 freq	change	Significant Reduction?
<i>Ceratophyllum demersum</i> (coontail)	0.62	0.81	+	n/a (increase significant)
<i>Elodea canadensis</i> (waterweed)	0.64	0.40	-	Yes
<i>Heteranthera dubia</i> (stargrass)	0.05	0.02	-	No
<i>Lemna trisulca</i> (forked duckweed)	0.11	0.00	-	Yes
<i>Myriophyllum sibiricum</i> (northern water-milfoil)	0.16	0.22	+	n/a
<i>Nymphae odorata</i> (white lily)	0.06	0.05	-	No
<i>Potamogeton illinoensis</i> (Illinois pondweed)	0.02	0.01	-	No
<i>Potamogeton praelongus</i> (whitestem pondweed)	0.07	0.09	+	n/a
<i>Potamogeton amplifolius</i> (large-leaf pondweed)	0.01	0.00	-	No
<i>Vallesnaria americana</i> (wild celery)	0.01	0.00	-	No
<i>Najas guadalupensis</i> (southern naiad)	0.06	0.02	-	No
<i>Stuckenia pectinata</i> (sago pondweed)	0.07	0.03	-	No
<i>Schaeonoplectus acutus</i> (hardstem bulrush)	0.01	0.00	-	No

Table 4: Frequency data of native plants from post treatment survey and chi-square analysis results.

Turion analysis

Each year a turion analysis is conducted to look for long-term trends in CLP reduction. The turion analysis was conducted on October 17 when some plant growth has subsided. The turions are release when the CLP plants die in July. These turions can remain viable for several years, so turion density can be used to predict the potential for future CLP growth in the subsequent spring.

Turions/m ²						
Bed	2012	2013	2014	2015	2016	2017
B1	30.7	27	12.4	18.4	6.2	6.1
B2	32.28	4	10.9	0.0	28.7	0.0
B3	7.1	15	21.7	0.0	0.0	0.0
B8	0	6.7	n/a	n/a	n/a	n/a
B12	28.7	39.7	0	129	34.4	4.4
B14	0	20	0	0.0	21.5*	11.0
B15	30.7	16.7	0	8.6	17.2*	17.7
R1	0	20	n/a	n/a	n/a	n/a
All Treated	12.8	13.6	6.4	24.3	18.7	7.5

Table 5: Turion density summary from 2012 to 2016.

*These two beds were adjusted from 2015 so samples slightly different.

The overall turion density decreased from 2016 to 2017, 18.7 turions/m² to 7.5 turions/m² respectively. Figure 8 shows the mean turion density is back down near the lowest point. This suggests less CLP will be growing in the spring. Since some turions remain, some growth can be expect in spring, 2018.

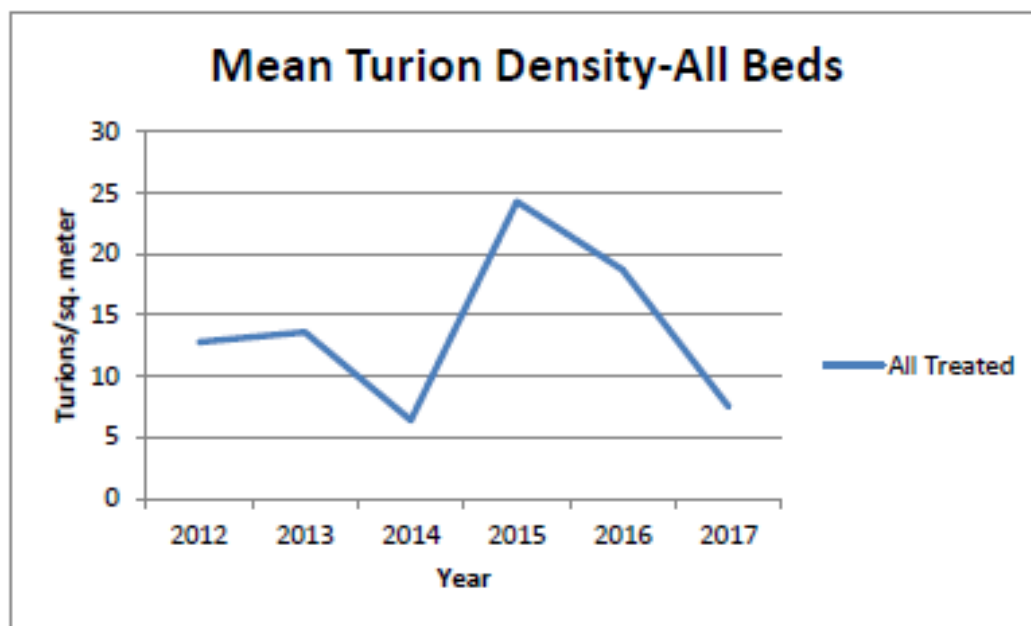


Figure 8: Graph showing turion density changes from 2012 to 2016.

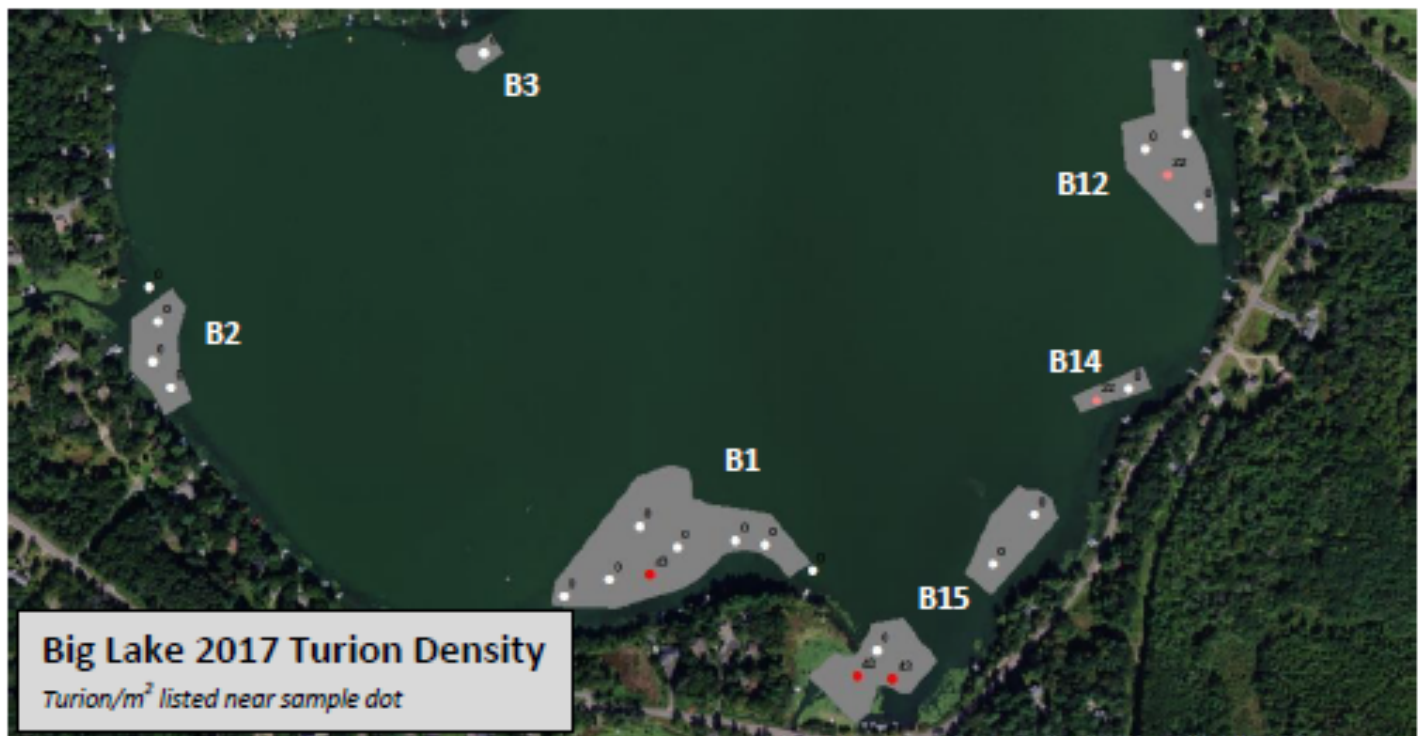


Figure 9: Map of turion density from turion analysis October, 2017.

Discussion

The 2017 herbicide treatment of CLP on Big Lake was found to be successful. A significant reduction occurred in all beds when frequency is compared before and after treatment in 2017. A comparison between the 2016 post treatment and 2017 post treatment revealed a small decrease from 3.1% frequency of occurrence in 2016 to 1.2% in 2017. The comparison of the pretreatment surveys from 2016 and 2017 showed a small increase. This may be due to adjustment of the beds, eliminating sample points with no CLP. This increase is not an indication of increased CLP growth.

The October turion analysis resulted in an overall density reduction from 2016 to 2017. This should result in less CLP growth for spring 2018. The CLP treatments have been successful seven years, and yet turion density is remaining although is lower than the two previous years. It is unknown how long treatments would need to continue to get nearly zero turion density.

The post treatment showed reduction in two native species following treatment. The goal is for no native species to be reduced. One native species had a significant increase in frequency and is a native plant that is often times actively growing at the time of treatment, and would then be susceptible.

With seven consecutive successful herbicide treatments and so little CLP sampled in each post treatment survey, it would seem that the CLP would eventually be very limited in the spring pretreatment survey. However, 2017 still showed over 50% of the sample points within the treatment areas had CLP growth in the pretreatment survey. A decision will need to be made about continued treatment of CLP in Big Lake for 2018 and beyond.

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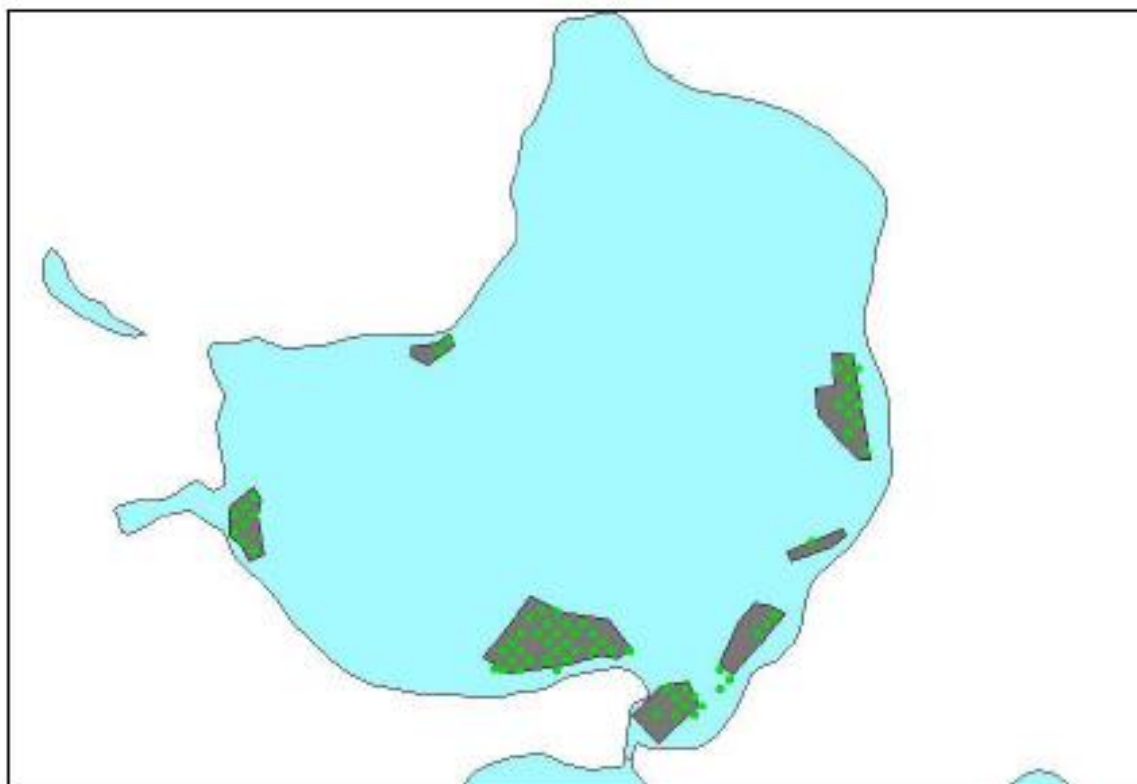
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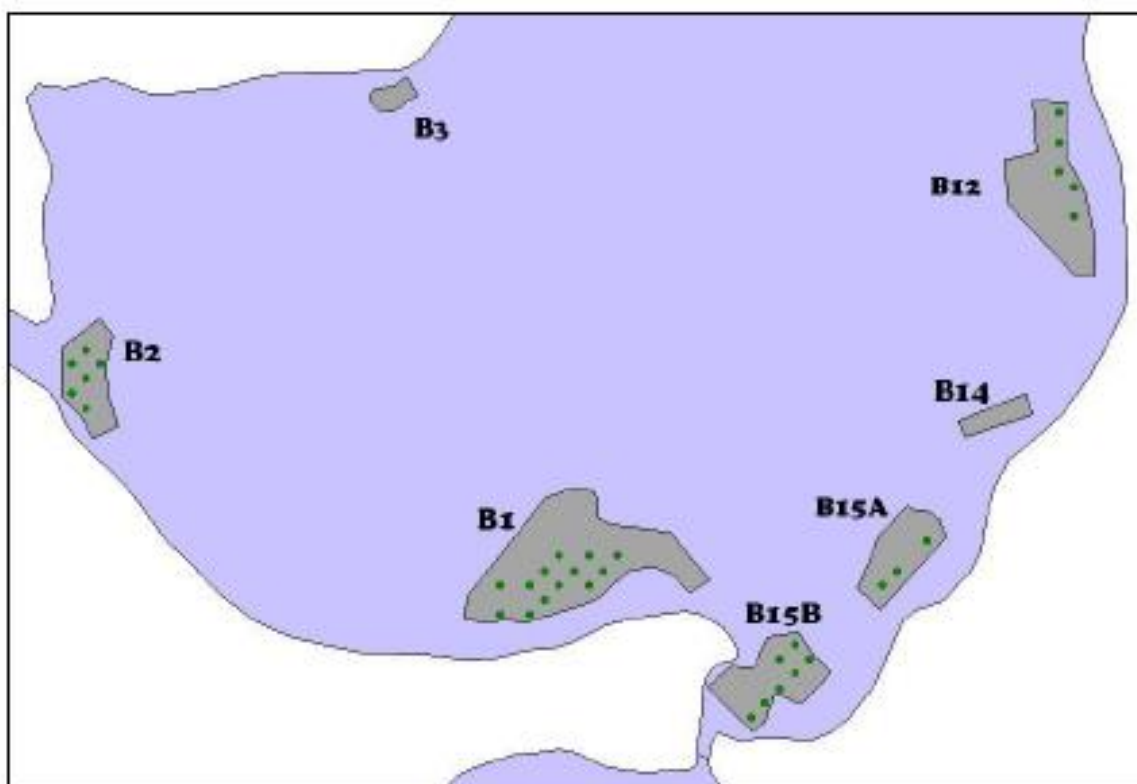
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<http://www4.uwsp.edu/cnr/uwexlakes/ecology/apmguide.asp> appendix D.

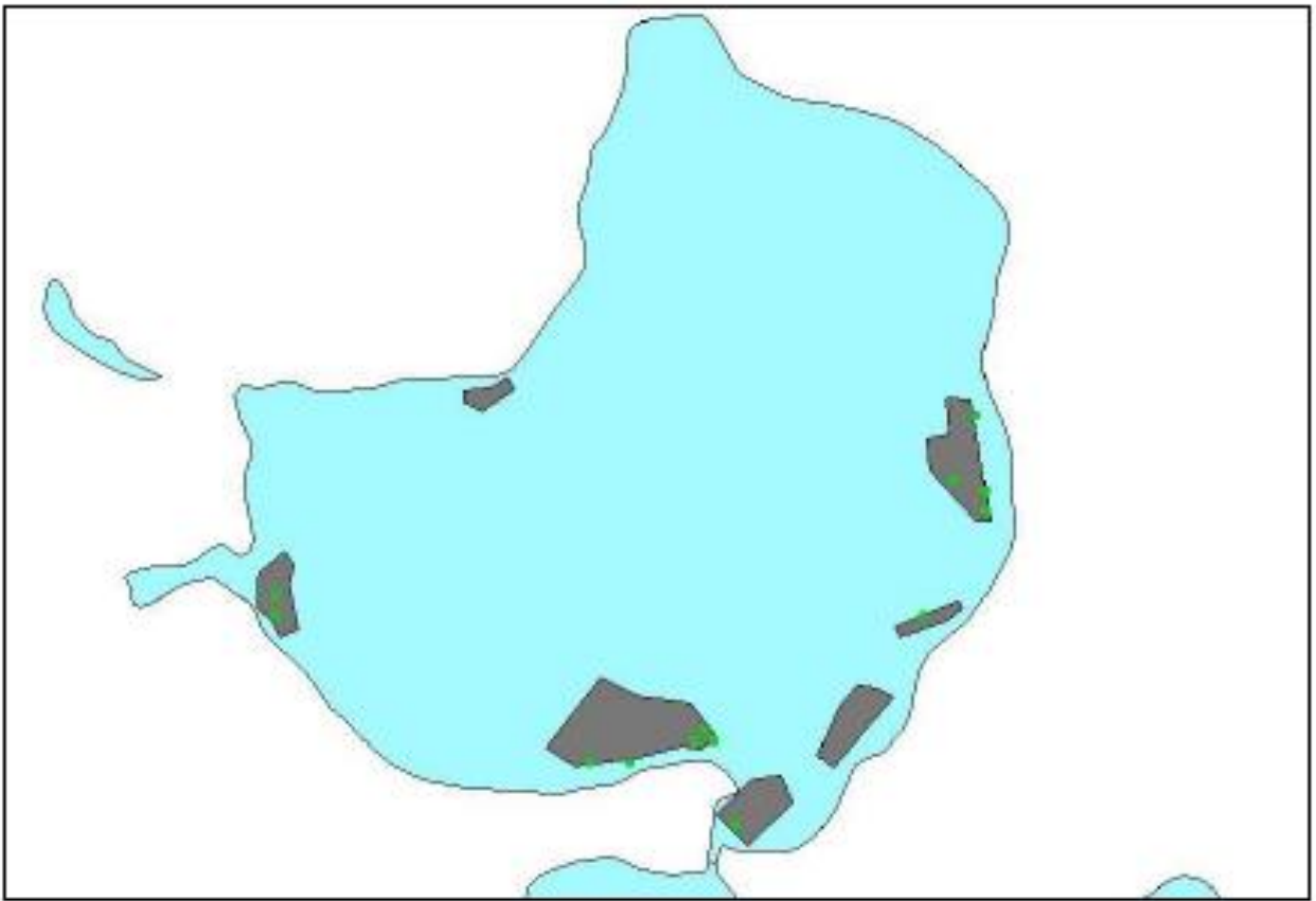
Appendix: Maps of native plant distributions from post treatment of significantly reduced species.



Waterweed or elodea-*Elodea Canadensis*-2016



Waterweed or elodea-*Elodea Canadensis*-2017



Forked duckweed-*Lemna trisulca*-2016

Not sampled in 2017
