A

APPENDIX A

Public Participation Materials

Planning Process

Planning Committee Meetings

Study Results (including a stakeholder survey)
Conclusions & Initial Recommendations
Management Goals
Management Actions
Timeframe
Facilitator(s)

Implementation Plan

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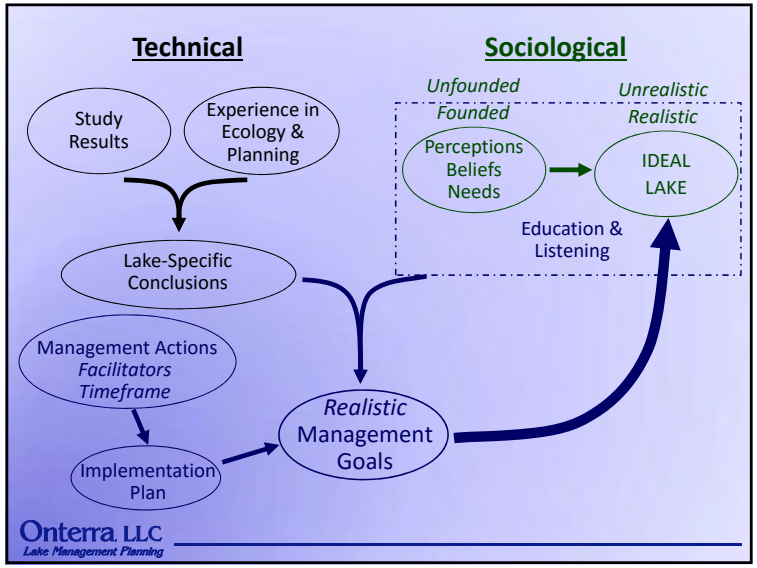

Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Pretreatment Survey
  - Early Season AIS Survey
  - Point-intercept Survey
  - Floating-leaf and Emergent Community Mapping Survey
  - Late-Summer EWM Survey

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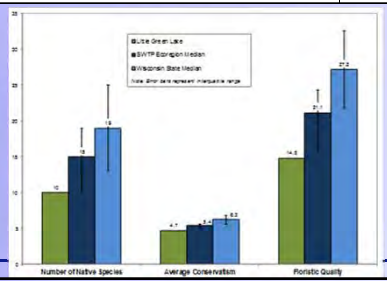
Species List

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2016 (Onterra)
Emergent	*Bolboschoenus fluviatilis*	River bulrush	5	I
	Phalaris arundinacea	Reed canary grass	Exotic	I
	Phragmites australis subsp. australis	Giant reed	Exotic	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Sparganium eurycarpum	Common bur-reed	5	I
FL	*Nuphar variegata*	Spatterdock	6	I
	Nymphaea odorata	White water lily	6	I
Submergent	*Chara spp.*	Muskgrasses	7	X
	Ceratophyllum demersum	Coontail	3	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum spicatum	Eurasian water milfoil	Exotic	X
	Najas flexilis	Slender naiad	6	X
	Potamogeton foliosus	Leafy pondweed	6	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	X
	Stuckenia pectinata	Sago pondweed	3	X
FF	*Lemna turionifera*	Turion duckweed	2	X
	Lemna trisulca	Forked duckweed	6	X
	Wolffia spp.	Watermeal spp.	N/A	X

15 Native Species in 2016 (10 on rake)

- 4 non-native species (2 submergent)



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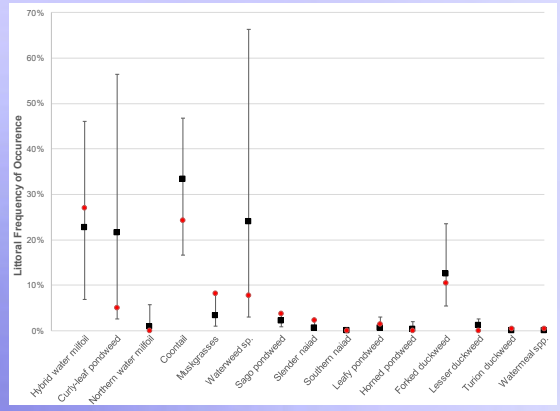
2005 – 2016 Littoral Frequency of Occurrence



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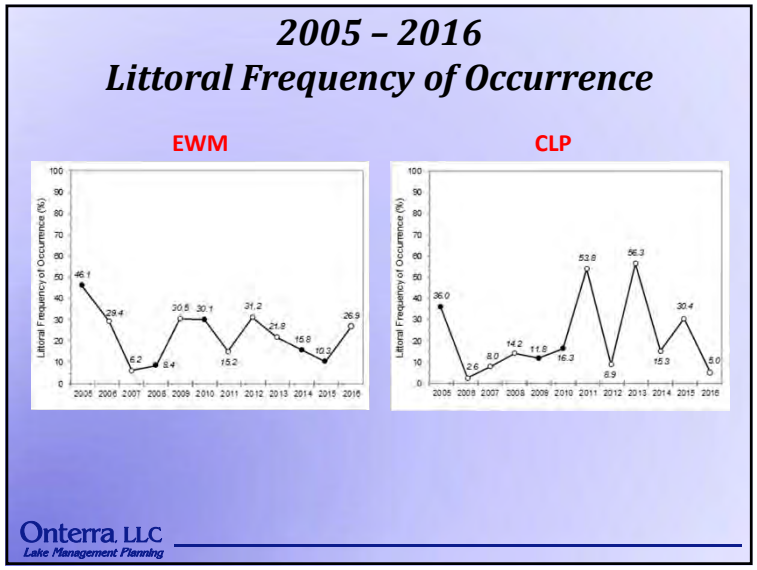
2005 – 2016
Littoral Frequency of Occurrence
EWM
CLP
Littoral Frequency of Occurrence (%)
46.1
29.4
6.2
8.4
30.5
30.1
15.2
31.2
24.8
15.8
10.3
26.9
36.0
2.6
8.0
14.2
11.6
16.3
53.8
8.9
56.3
15.3
30.4
5.0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
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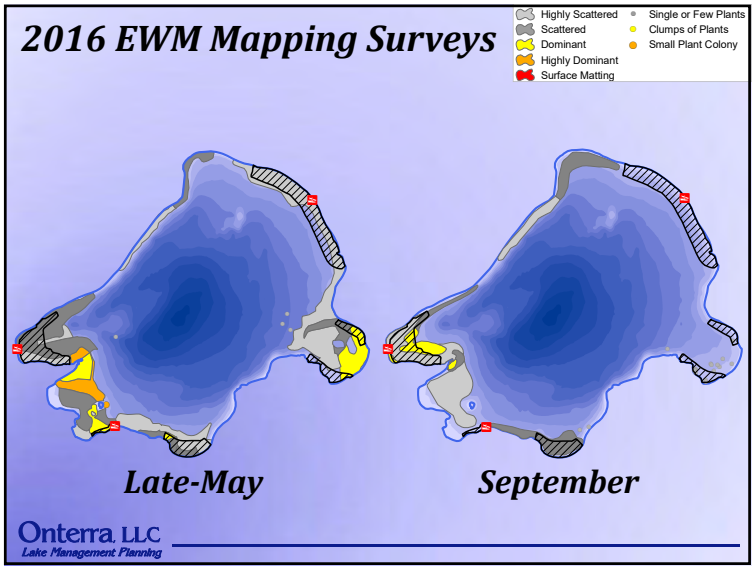
2016 EWM Mapping Surveys
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony
Late-May
September
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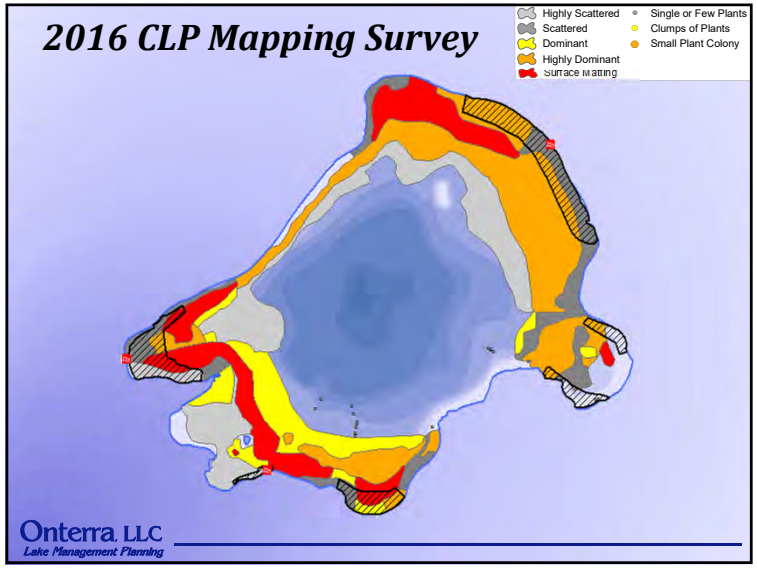
2016 CLP Mapping Survey
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony
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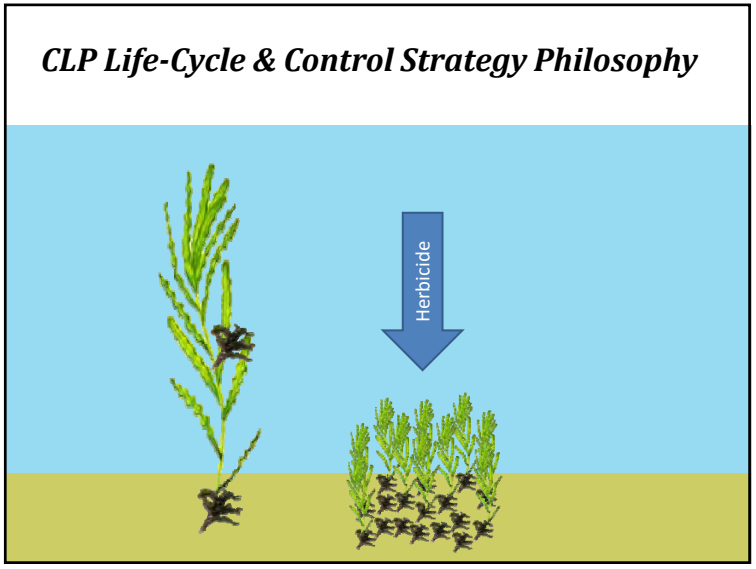
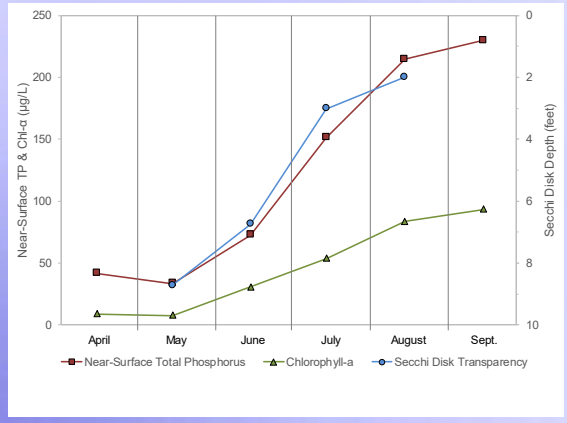

CLP Life-Cycle & Control Strategy Philosophy
Herbicide

Total Phosphorus Concentrations



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Aquatic Plant Management

Ecosystem Restoration

- Target AIS population so native ecosystem can function as it did prior to AIS
- Aimed at the entire AIS population
- Applicable to WDNR AIS Grant funding
- An ecosystem restoration plan may restore ecosystem services

Restore Ecosystem Services

- Target plants (AIS and/or natives) so they do not cause recreational, navigational, or aesthetic issues
- Aimed only at the portion of the plant population interfering with human use
- No grant funding available
- A plan to restore ecosystem services does not lead to ecosystem restoration

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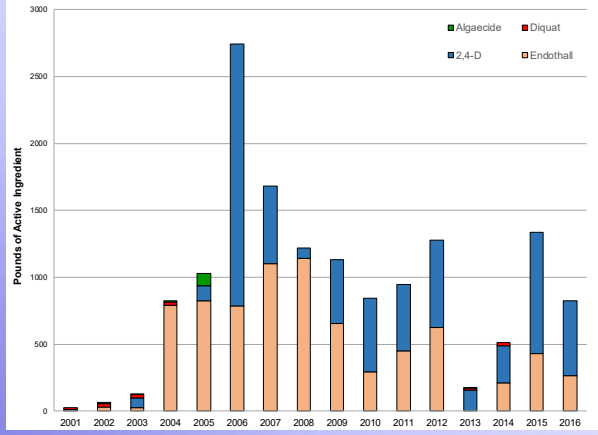
Historic Control Actions



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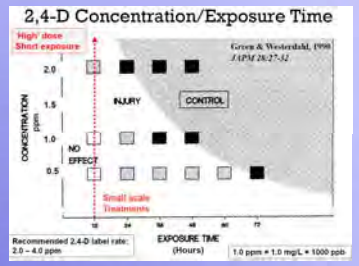
Herbicide Spot Treatment

- **Ecological Definition:** Herbicide applied at a scale where dissipation will not result in significant lake wide concentrations; impacts are anticipated to be localized to in/around application area.



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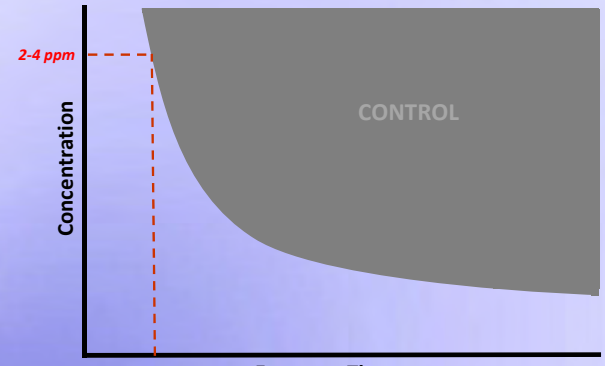
Herbicide Use Patterns



High Concentration ► Short Exposure Time

Treatment Type
Spot

Spot Treatment Specifications

- Treatments size (>5 acres), shape (broad vs narrow), and location (protected vs exposed) are important design components
- Winds within 6hrs of treatment greatly impact outcomes
- Consider using herbicides with short CETs
  - Diquat
  - Diquat + endothall

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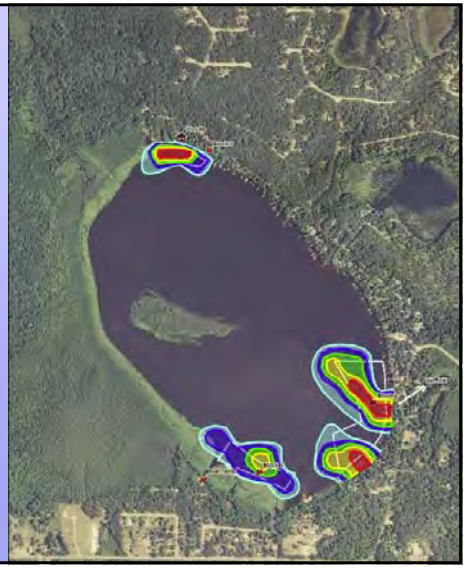
2015 Treatment on Loon Lake

- **Diquat (2 gallons per surface acre of application area)**
- ~24 acres of 305 acre lake (7.8%)
- Tracer Dye (Rhodamine WT) Survey
- Pre (spring) & post (late-summer) point-intercept sub-sampling

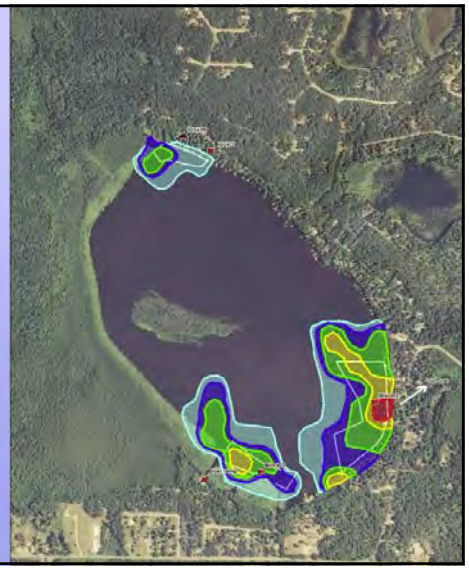
1 HAT

75-100%
50-75%
25-50%
10-25%
5-10%



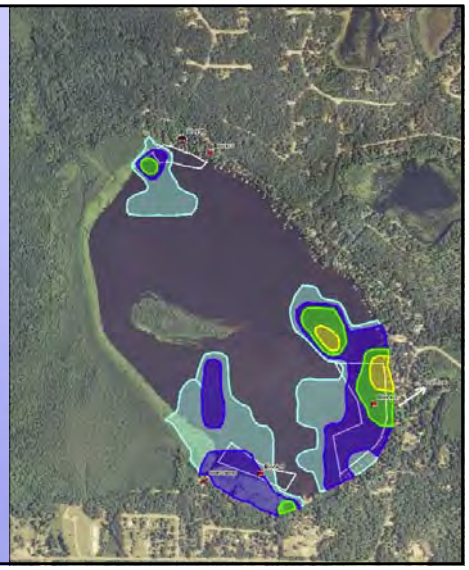
2.5 HAT

75-100%
50-75%
25-50%
10-25%
5-10%



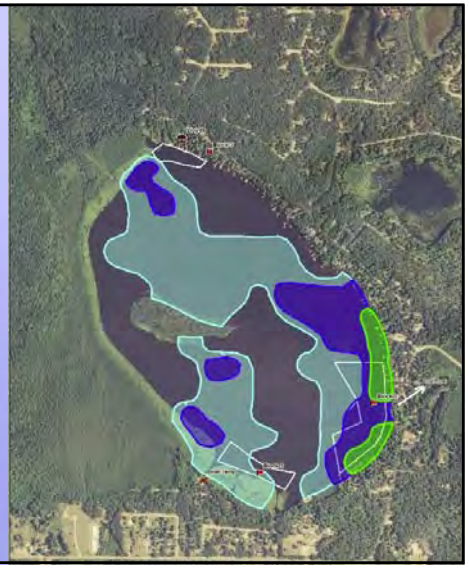
4 HAT

75-100%
50-75%
25-50%
10-25%
5-10%



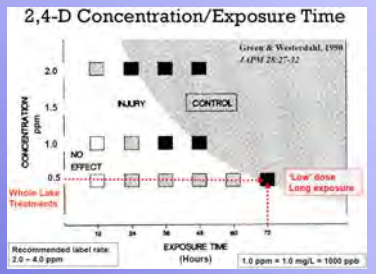
6 HAT

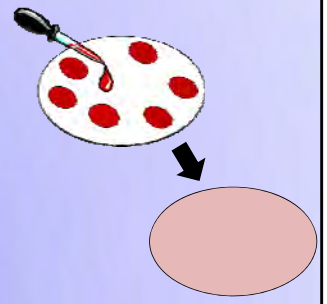
75-100%
50-75%
25-50%
10-25%
5-10%



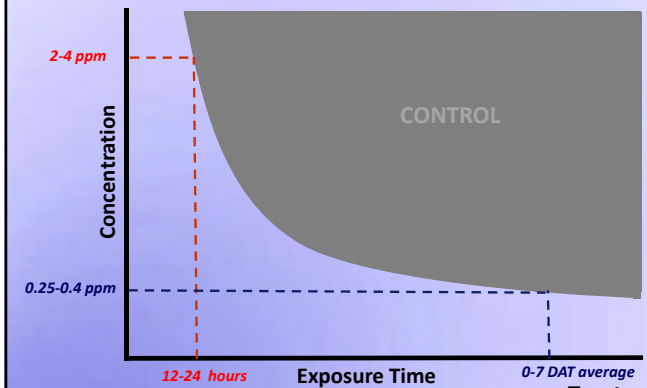
Large-Scale (Whole-lake) Treatment

- Ecological Definition: *Herbicide applied at a scale where dissipation will result in significant lake wide concentrations; impacts are anticipated to be on a lake wide scale*





Herbicide Use Patterns



	Treatment Type
High Concentration ▶ Short Exposure Time	*Spot*
Low Concentration ▶ Long Exposure Time	*Whole-lake*

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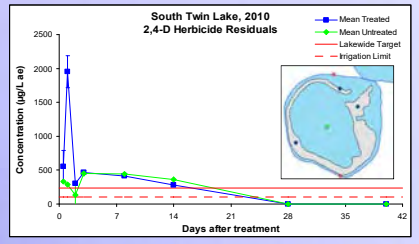
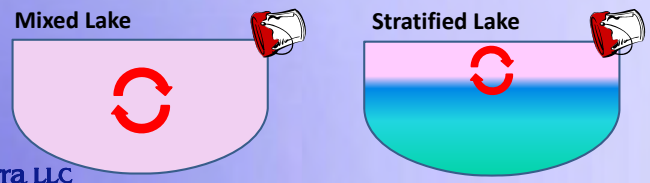
Large-Scale (Whole-lake) Treatment

- Herbicide Mixing
  - Horizontal
  - Vertical





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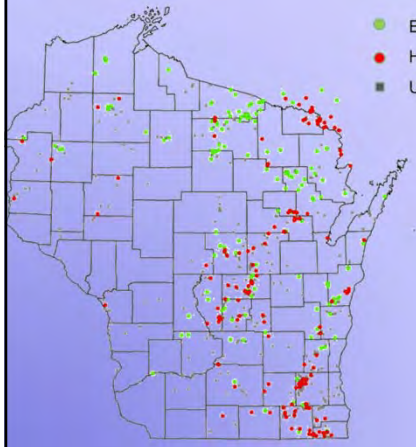
Hybrid Watermilfoil – (*M. spicatum X sibiricum*)



- Many misconceptions and misinformation regarding HWM
- ~150 lakes in WI have HWM confirmed
- There is not one 'single' hybrid watermilfoil, but it is rather a genetically diverse group that reflects recurrent hybridization
- Not <u>all</u> HWM appear to be tolerant to herbicides, but majority show statistically significant differences in % control when compared to pure EWM

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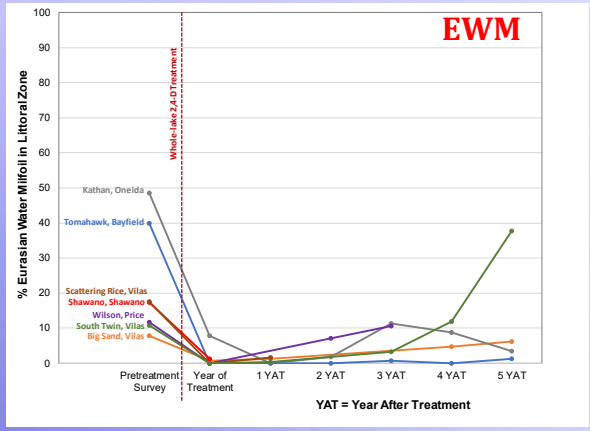
Results – Long-term Efficacy



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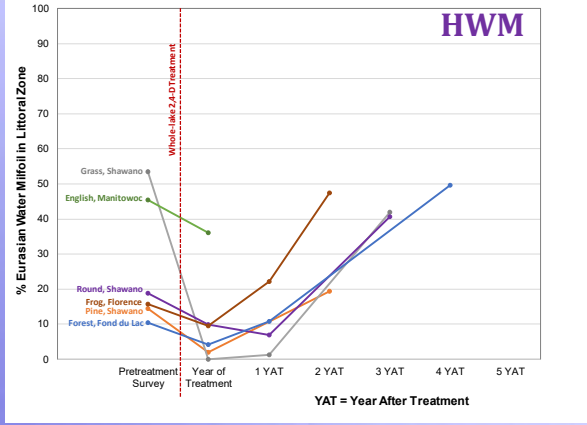
Results – Long-term Efficacy



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Large-Scale (Whole-lake) Treatment Specifications

- Planning is required to understand fate of herbicide mixing to achieve target concentrations
  - Bathymetry
  - Stratification depth
  - Water exchange (flow)
- If achieve target 2,4-D CETs, EWM control can be sustained for 5+ years
- Even if achieve target 2,4-D CETs, HWM control is variable and often short-lived
  - Consider aquaria sensitivity screening, mesocosom challenge testing, or trial field studies
  - Consider alternative herbicide use patterns

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2016 Strategy

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Potential Strategy

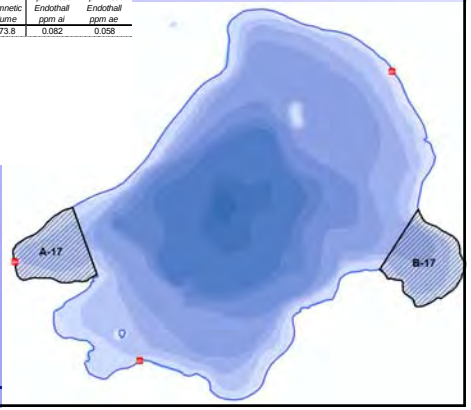
Site	Acres	Ave Depth	Total Volume (acre-feet)	Endothall PPM ai	Aquathol K (gallons)
A-17	20.2	5	101.0	2.0	130
B-17	23.8	5	119.0	2.0	153
Total	44.0		220.0		283.0

Method	Area (acres)	Whole-Lake Volume	Epilimnetic Volume	Epilimnetic Endothall ppm ai	Epilimnetic Endothall ppm ae
1965 WDNR Bathy Map (Trapezoidal)	477.7	5460.2	5373.8	0.082	0.058

Epilimnetic Depth (ft) 20

$70.00 per gallon endothall
$200.00 per acre application

$19,810.00 Herbicide Cost
$8,800.00 Application Cost
$1,000.00 Mobilization Cost
$29,610.00 Total Herbicide Application Costs



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Presentation Outline

- Project Overview
  - Study Lake/Watershed ⇨ Determine Realistic Solutions ⇨ Create Plan to Implement Solutions
- Water Quality and Watershed Assessment Results
  - Introduction to Water Quality
  - Trophic Parameters in the Lake
  - Seasonal Trends in Phosphorus, Algae, and Water Clarity
  - Internal Loading
  - Phosphorus Inputs
  - Destratification System
- Conclusions

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Introduction to Lake Water Quality

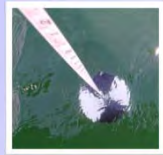
Phosphorus
Naturally occurring & essential for all life
Regulates phytoplankton biomass in **most** WI lakes
Most often 'limiting plant nutrient' (shortest supply)
Human activity often increases P delivery to lakes

Chlorophyll-*a*
Pigment used in photosynthesis
Used as surrogate for phytoplankton biomass

Algae not always P limited

Secchi Disk Transparency
Measure of water clarity
Measured using a Secchi disk

Clarity not always directly related to algal levels



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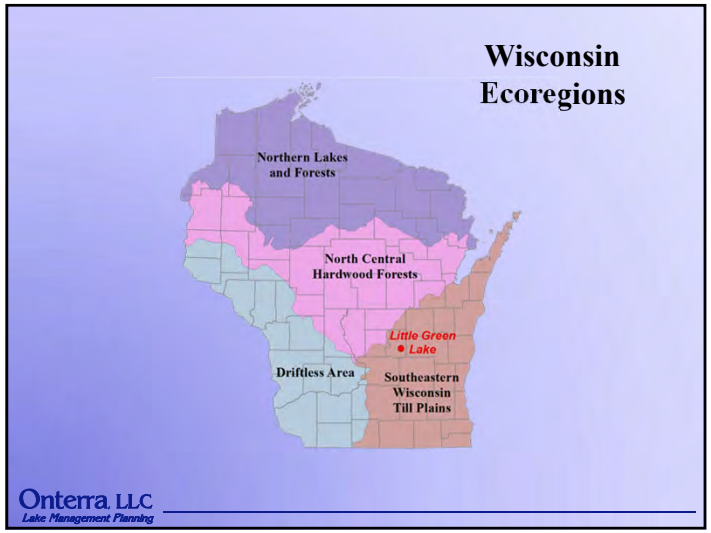
Phosphorus as Limiting Nutrient


Wisconsin Ecoregions
Northern Lakes and Forests
North Central Hardwood Forests
Little Green Lake
Driftless Area
Southeastern Wisconsin Till Plains
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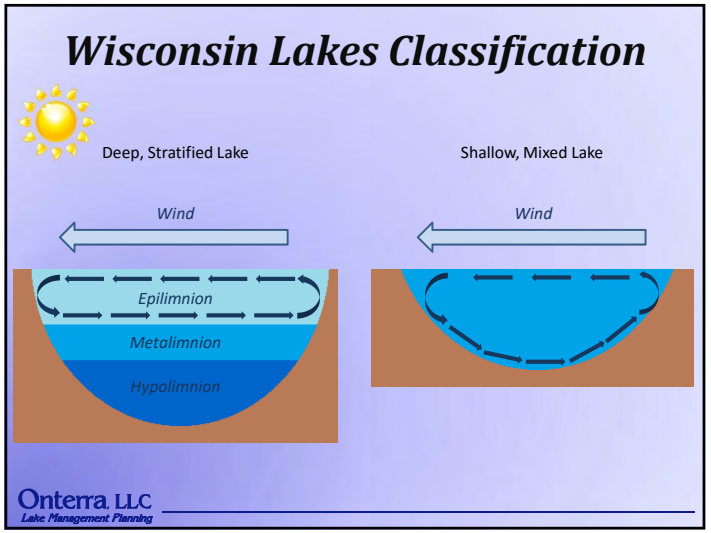
Wisconsin Lakes Classification
Deep, Stratified Lake
Shallow, Mixed Lake
Wind
Wind
Epilimnion
Metalimnion
Hypolimnion
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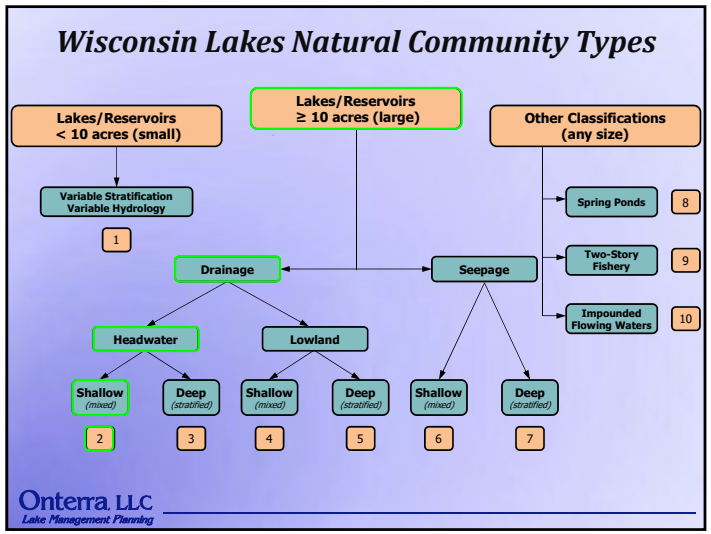
Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Drainage
Seepage
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Headwater
Lowland
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
2
3
4
5
6
7
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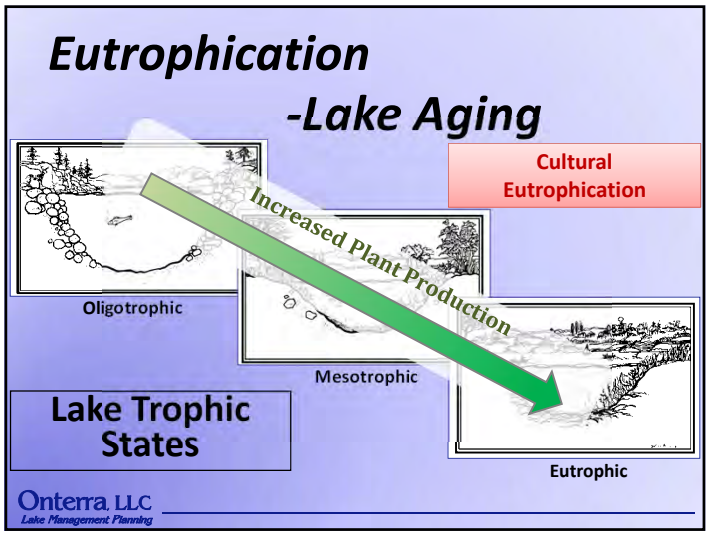
Eutrophication
-Lake Aging
Cultural Eutrophication
Increased Plant Production
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
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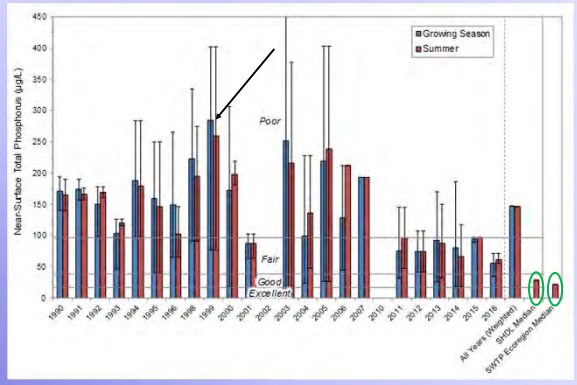
Phosphorus



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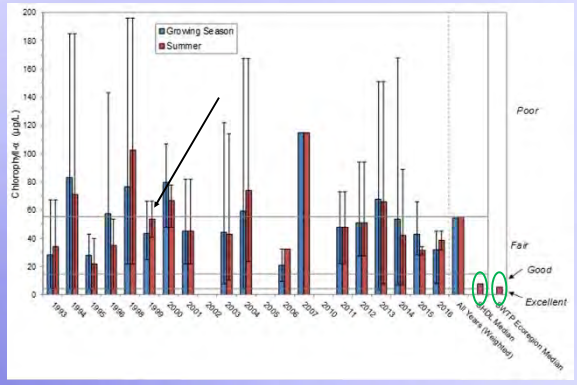
Algae



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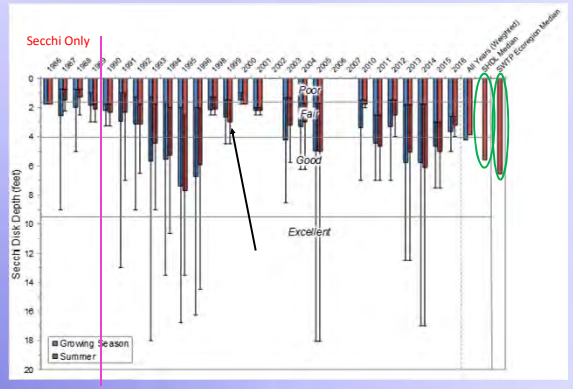
Secchi Disc Transparency



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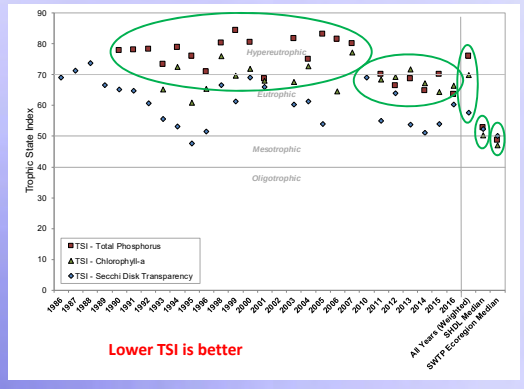
Trophic State Index



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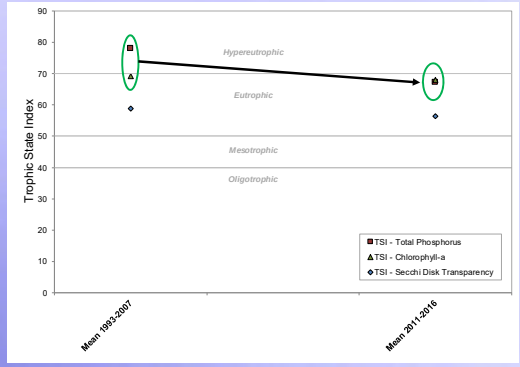
Trophic State Index



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Potential Sources of Phosphorus

Internal Sources
Deep Sediments
Dying Aquatic Vegetation (Curly-Leaf Pondweed)
Shallow Sediment in Dense Plant Beds

External Sources
Watershed
- Agricultural
- Shoreland Properties

Atmosphere

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Potential Internal Sources of Phosphorus

Deep Sediment Release
Bottom waters become anoxic
Dissolution of iron bound phosphorus

Dying Aquatic Vegetation (CLP)
Plants die late June early July
Dying plants release bound phosphorus

Shallow Sediment in Dense Plant Beds
Water immediately above the sediments becomes anoxic
As surface water cools at night, current moves bottom water towards the deep part of the lake.

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2000 Study

- Measured dissolved oxygen, temperature, and phosphorus profiles twice per week from May through early September
- Found that when the lake stratified, bottom waters became anoxic, and phosphorus concentrations built up in the bottom waters.
- The lake also occasionally mixed during the summer allowing phosphorus in the deep waters to be transported to the upper waters where it fueled algal blooms.

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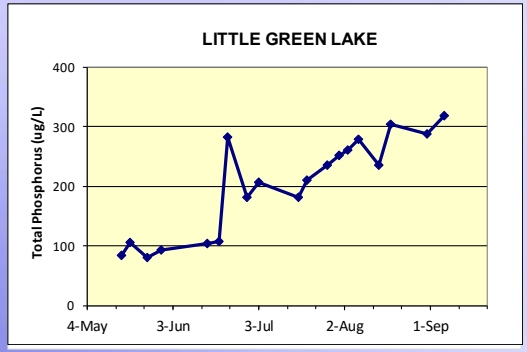
2000 Phosphorus Concentration



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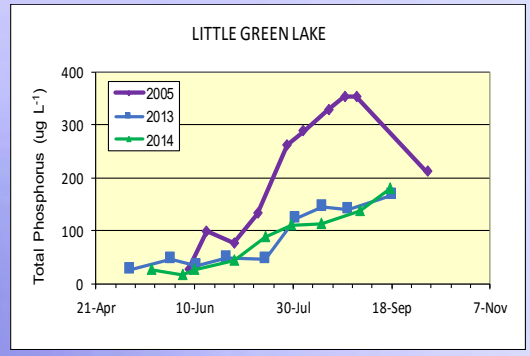
Phosphorus Concentration



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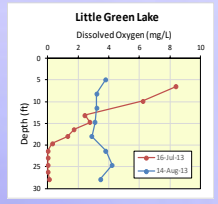
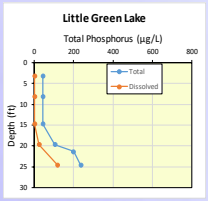
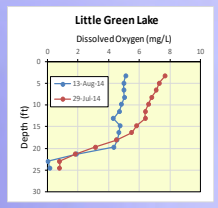
Sediments as Phosphorus Source

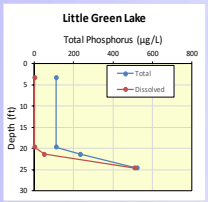
2013
Unit in Operation





2014
Unit Not in Operation





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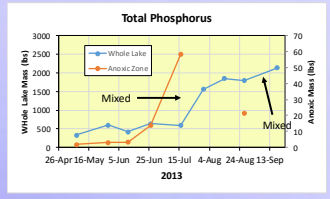
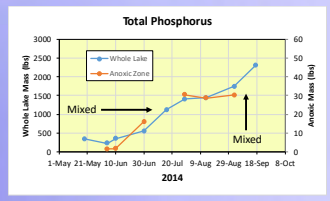
PHOSPHORUS MASS

2013
Unit in Operation



2014
Unit Not in Operation



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Potential Internal Sources of Phosphorus

Deep Sediment Release

Dying Aquatic Vegetation (CLP)

Shallow Sediment in Dense Plant Beds

These sources were not quantified

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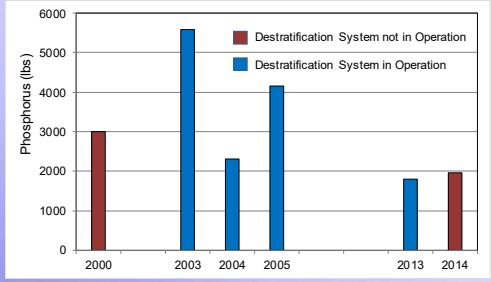
Internal Load



Load is a combination multiple sources

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Destratification is Not Functioning as Intended

- **Does not destratify the lake**
- **Even with more disturbance, system would still not significantly reduce sediment release because there is not enough iron.**
- **The ratio of iron to phosphorus (Fe:P) needs to greater than 3.6. In 2013-14 it was less than 2.5 and sometimes less than 1.0**

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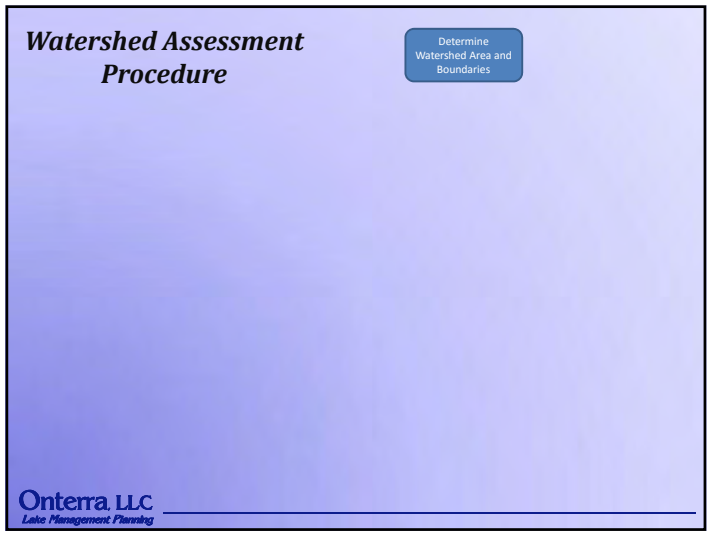
EXTERNAL LOADING


Watershed


Watershed Assessment Procedure
Determine Watershed Area and Boundaries
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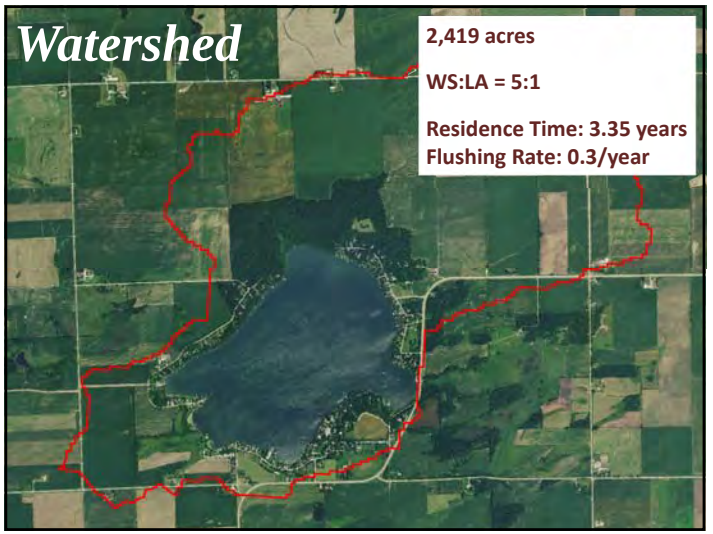
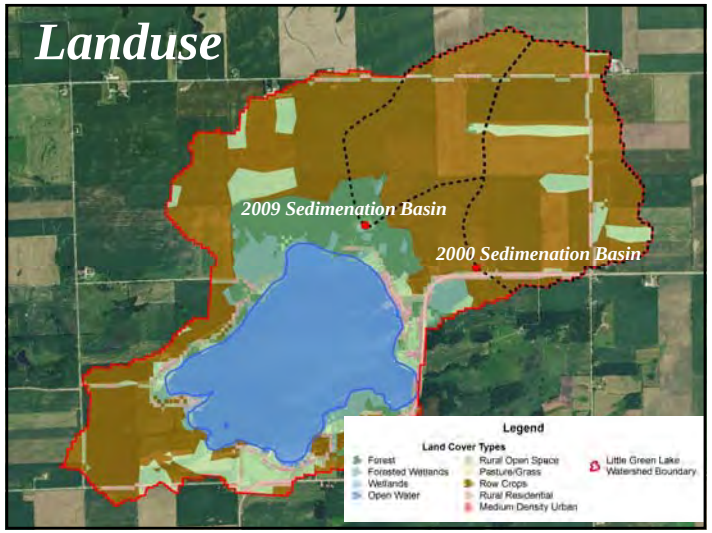
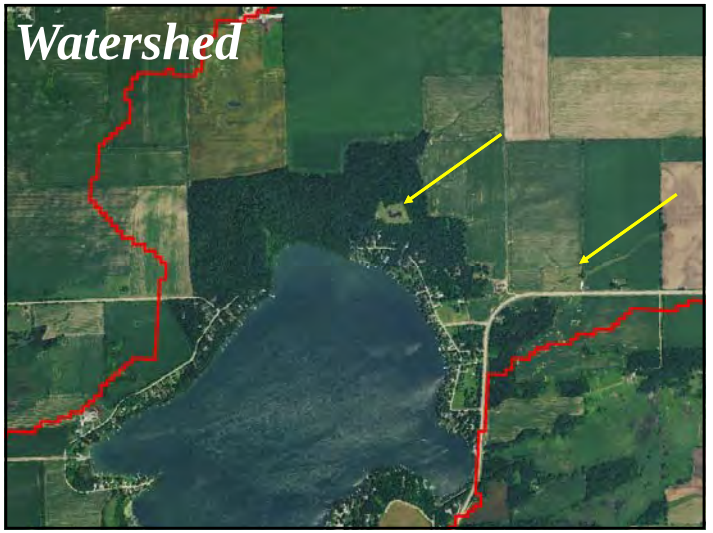
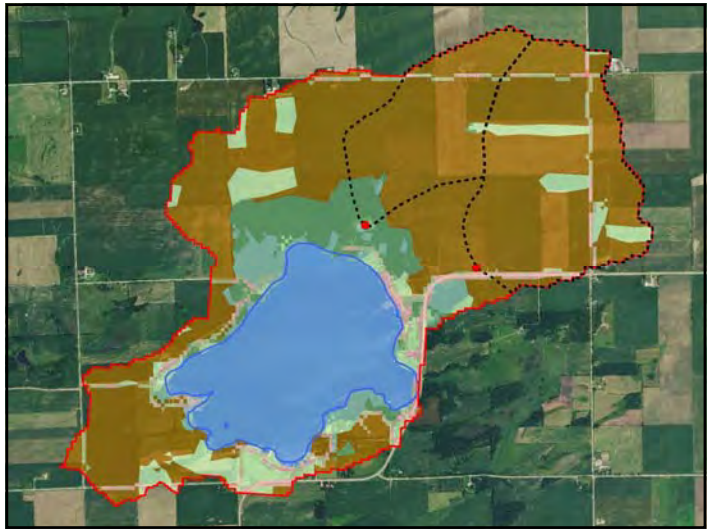
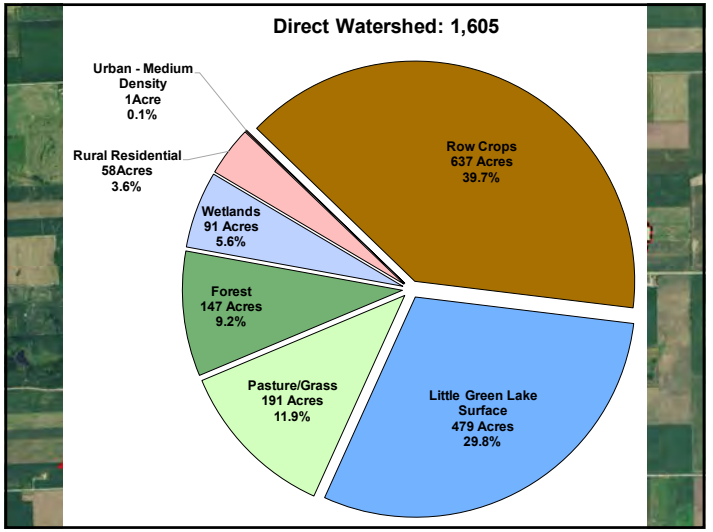
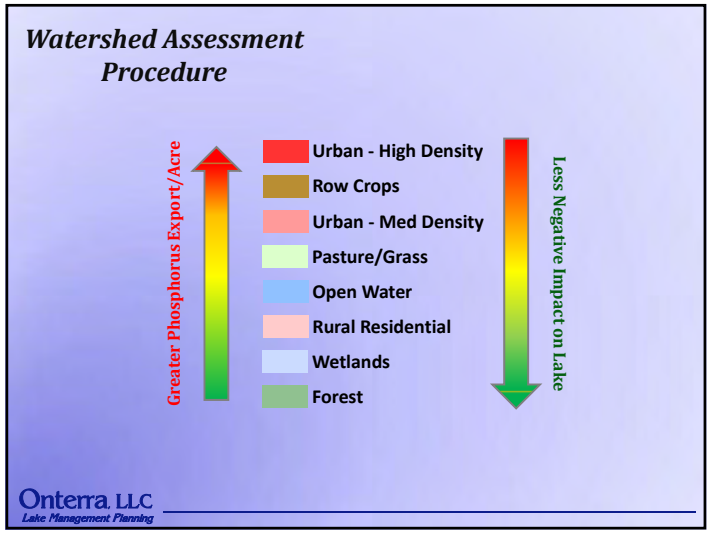

Watershed
2,419 acres
WS:LA = 5:1
Residence Time: 3.35 years
Flushing Rate: 0.3/year


Landuse
2009 Sedimenation Basin
2000 Sedimenation Basin
Legend
Land Cover Types
Forest
Forested Wetlands
Wetlands
Open Water
Rural Open Space
Pasture/Grass
Row Crops
Rural Residential
Medium Density Urban
Little Green Lake Watershed Boundary


Watershed




Direct Watershed: 1,605
Urban - Medium Density 1Acre 0.1%
Rural Residential 58Acres 3.6%
Wetlands 91 Acres 5.6%
Forest 147 Acres 9.2%
Pasture/Grass 191 Acres 11.9%
Row Crops 637 Acres 39.7%
Little Green Lake Surface 479 Acres 29.8%


Watershed Assessment Procedure
Greater Phosphorus Export/Acre
Urban - High Density
Row Crops
Urban - Med Density
Pasture/Grass
Open Water
Rural Residential
Wetlands
Forest
Less Negative Impact on Lake
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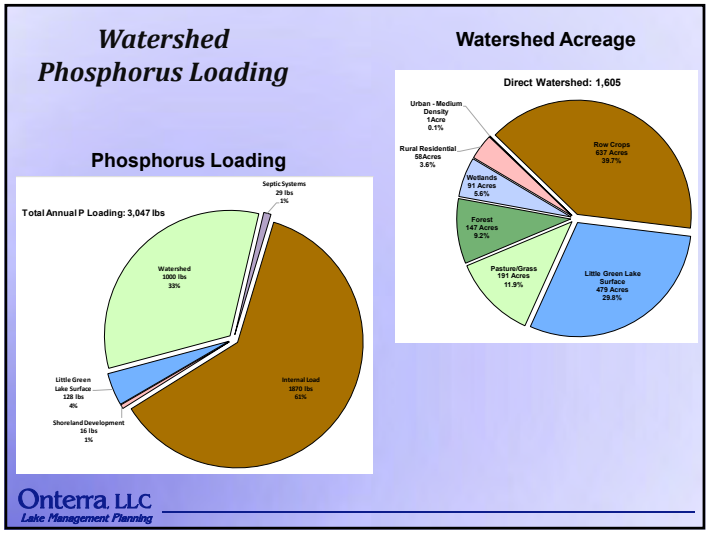
Watershed Phosphorus Loading
Watershed Acreage
Phosphorus Loading
Total Annual P Loading: 3,047 lbs
Direct Watershed: 1,605
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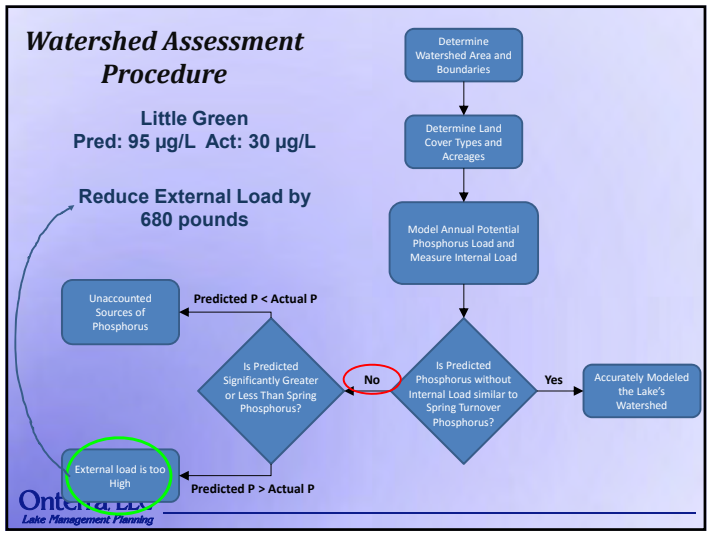
Watershed Assessment Procedure
Little Green
Pred: 95 µg/L Act: 30 µg/L
Reduce External Load by 680 pounds
Determine Watershed Area and Boundaries
Determine Land Cover Types and Acreages
Model Annual Potential Phosphorus Load and Measure Internal Load
Is Predicted Phosphorus without Internal Load similar to Spring Turnover Phosphorus?
No
Yes
Accurately Modeled the Lake's Watershed
Is Predicted Significantly Greater or Less Than Spring Phosphorus?
Predicted P < Actual P
Unaccounted Sources of Phosphorus
Predicted P > Actual P
External load is too High
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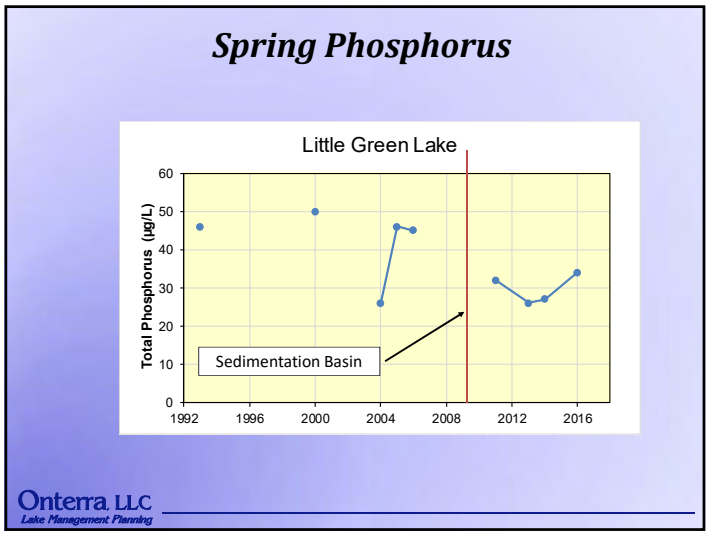
Spring Phosphorus
Little Green Lake
Total Phosphorus (µg/L)
Sedimentation Basin
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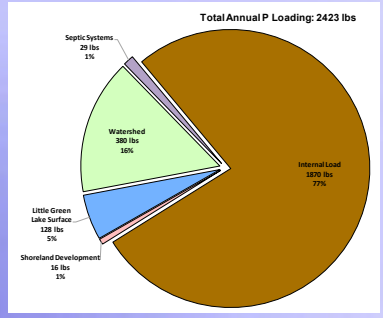
Watershed Phosphorus Loading



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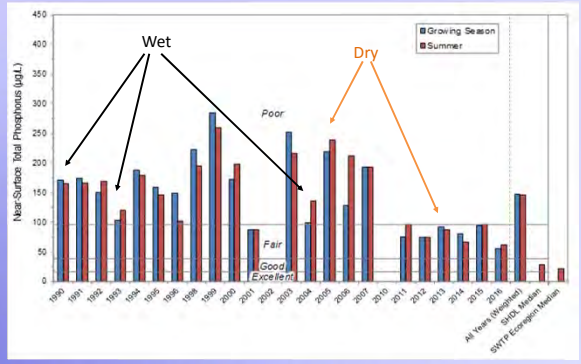
Overview



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Conclusions

- Water quality in the lake was poor prior to 2007 but now it is fair
  - This was known, but these studies helped quantify levels
- The 2009 sedimentation basin has reduced spring phosphorus concentrations
  - Reduction is from 45 to 30 µg/L
- The lake experiences a large amount of internal loading
  - We can quantify the total load but can not accurately compartmentalize the specific sources
  - The internal load is about 75% of the total load
- The destratification system is not reducing the internal load

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Thank You

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Presentation Outline

- Fisheries
- Aquatic Plan Survey Results
  - Native and Non-native
- CLP Life Cycle and Control with Herbicides
- AIS Control – Spot and Whole-Lake Treatments
- Eurasian Watermilfoil and Hybrid Watermilfoil Control
- Mechanical Harvesting?
- Conclusions
- 2017 Strategy

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General Fishery

- Prior to 1955, common carp & white bass were dominant fish species in LGL
- Algal bloom in 1955 resulted in massive fish kill, then was followed up by toxaphene treatment to kill off the rest
- Originally managed(and stocked) for walleye, large-mouth bass, and bluegill. Muskellunge also currently being stocked
- Periodic fish kills noted (one in 2012 affecting hundreds of walleye)

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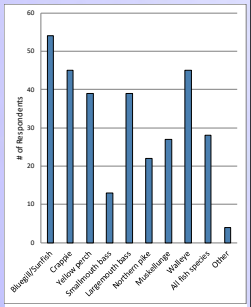
General Fishery

- 2013 WDNR Survey Reports the following:

Fish Species	Fish Sampled	Size Structure	Avg Length (inches)	Growth
Walleye	325	Good	20	N/A
Northern Pike	124	Fair	25.6	N/A
Muskellunge	22	N/A	38	N/A
Largemouth Bass	N/A	Good	12.4	N/A
Bluegills	N/A	Fair	5.5	Slightly Above Average
Yellow Perch	2,706	Poor	6.3	Above Average
Black Crappie	327	N/A	9.5	Slightly Above Average



#7. What species of fish do you like to catch on Little Green Lake?

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Fish Stocking

- Muskellunge
  - Stocked most years since 1972
  - Transitioned to large fingerlings in ~2000
  - Stocked 466 (~1 fish/acre) in 2013, 2014, 2016
- Tiger Musky
  - Stocked from 1974-2002
- Walleye
  - Stocked periodically since 1972
  - Small fingerlings stocked every-other year since 2000
  - Stocked 16-23K (~40-50 fish/acre) since 2000
- Miscellaneous (largely from Fishing Friends Forever Club)
  - Supplemental stocking of walleye and muskellunge
  - 168 northern pike in 2015
  - 1000 crappie in 2015
  - 100 lbs of fathead minnow in 2015

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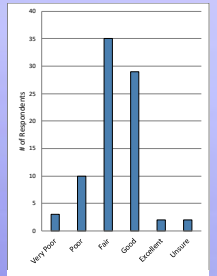
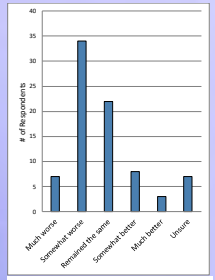
Fishing Experience



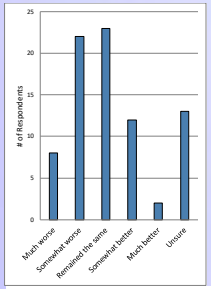
#8. How would you describe the current quality of fishing?

- 16% very poor or poor
- 38% good or excellent
- 43% fair



#9. How has the quality of panfish (i.e. bluegill, crappie, perch) fishing changed?

- 51% much or somewhat worse
- 14% somewhat or much better
- 27% remained the same



#10. How has the quality of game fish (i.e. bass, walleye, northern pike, musky) fishing changed

- 38% much or somewhat worse
- 18% somewhat or much better
- 29% remained the same

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Pretreatment Survey
  - Early Season AIS Survey
  - Point-intercept Survey
  - Floating-leaf and Emergent Community Mapping Survey
  - Late-Summer EWM Survey

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Species List

15 Native Species in 2016 (10 on rake)

- 4 non-native species (2 submergent)

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2016 (Onterra)
Emergent	*Bolboschoenus fluviatilis*	River bulrush	5	I
	Phalaris arundinacea	Reed canary grass	Exotic	I
	Phragmites australis subsp. australis	Giant reed	Exotic	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Sparganium eurycarpum	Common bur-reed	5	I
FL	*Nuphar variegata*	Spatterdock	6	I
	Nymphaea odorata	White water lily	6	I
Submergent	*Chara spp.*	Muskgrasses	7	X
	Ceratophyllum demersum	Coontail	3	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum spicatum	Eurasian water milfoil	Exotic	X
	Najas flexilis	Slender naiad	6	X
	Potamogeton foliosus	Leafy pondweed	6	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	X
	Stuckenia pectinata	Sago pondweed	3	X
FF	*Lemna turionifera*	Turion duckweed	2	X
	Lemna trisulca	Forked duckweed	6	X
	Wolffia spp.	Watermeal spp.	N/A	X

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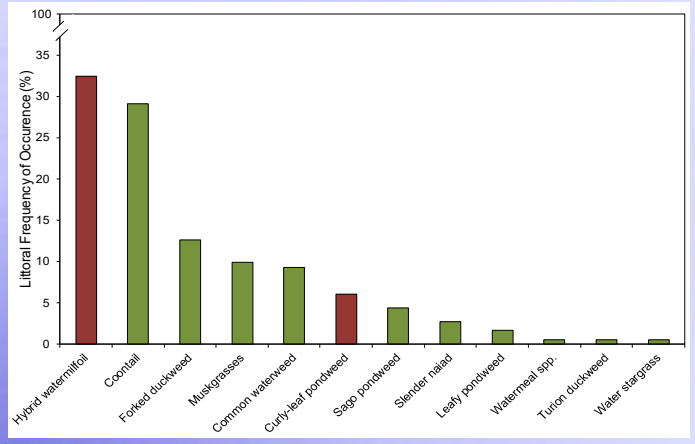
Frequency of Occurrence



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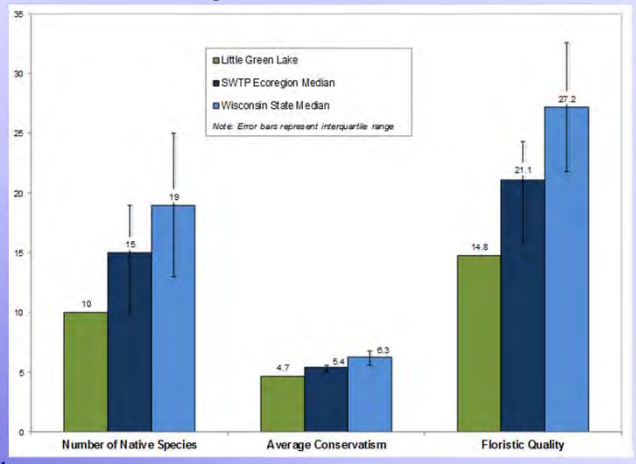
Floristic Quality



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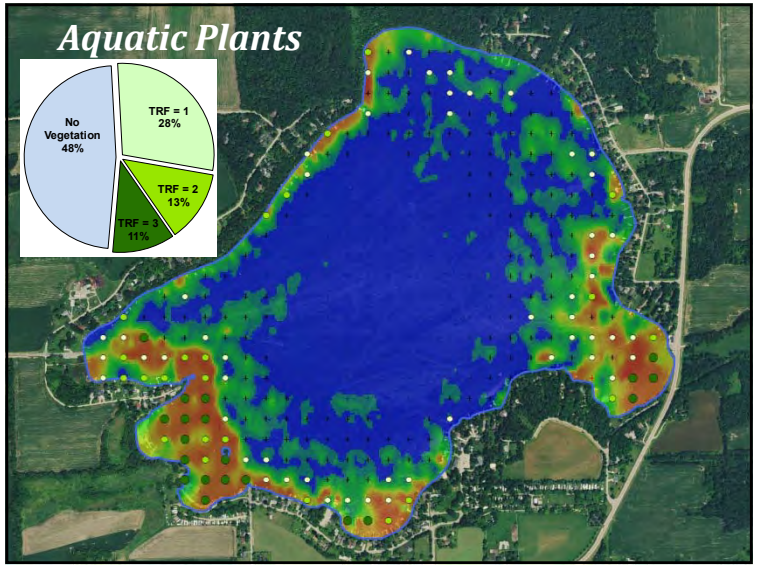
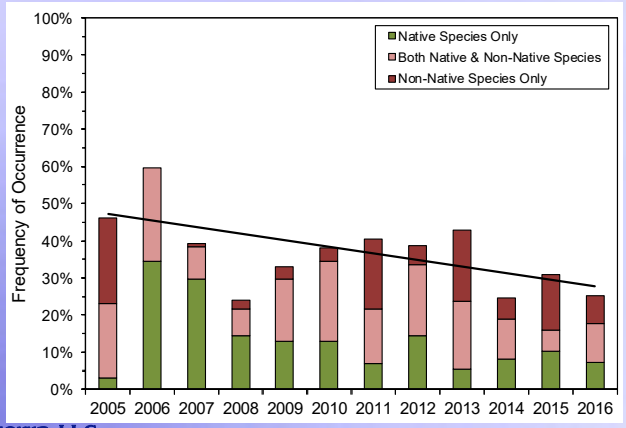
Aquatic Plants



2005 – 2016 Littoral Frequency of Occurrence



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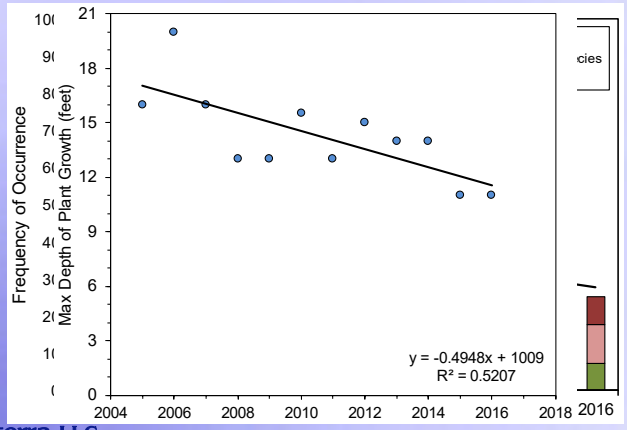
2005 – 2016
Littoral Frequency of Occurrence



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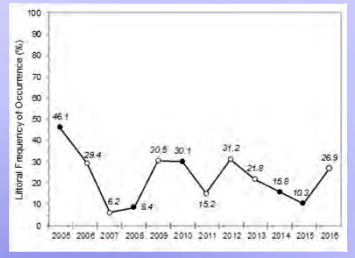
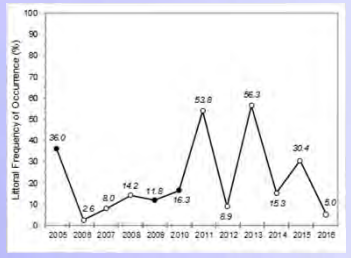
2005 – 2016
Littoral Frequency of Occurrence

EWM



CLP



Considering only PI survey data completed in June – CLP occurrences have remained unchanged in Little Green Lake

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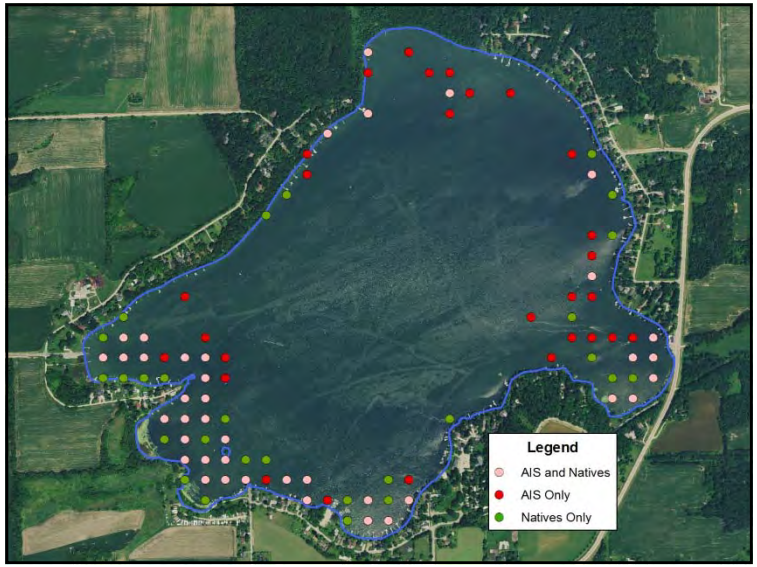

2016 EWM Mapping Surveys

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

CLP likely has a large impact on HWM growth in Little Green Lake each year

Late-May

September

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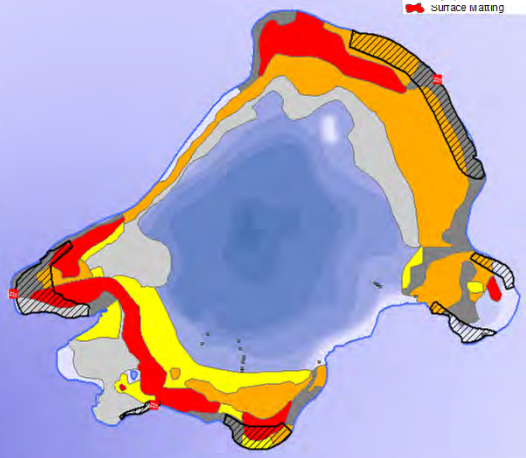
2016 CLP Mapping Survey



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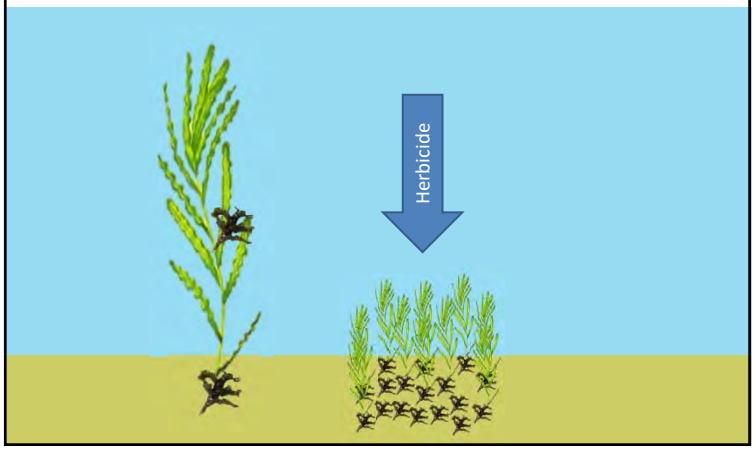
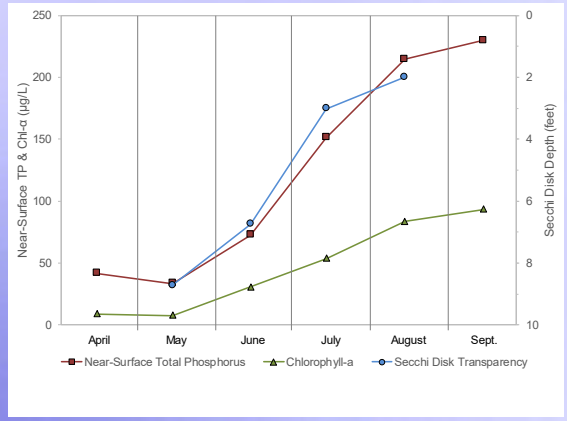
CLP Life-Cycle & Control Strategy Philosophy



Total Phosphorus Concentrations



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Aquatic Plant Management

Ecosystem Restoration

- Target AIS population so native ecosystem can function as it did prior to AIS
- Aimed at the entire AIS population
- Applicable to WDNR AIS Grant funding
- An ecosystem restoration plan may restore ecosystem services

Restore Ecosystem Services

- Target plants (AIS and/or natives) so they do not cause recreational, navigational, or aesthetic issues
- Aimed only at the portion of the plant population interfering with human use
- No grant funding available
- A plan to restore ecosystem services does not lead to ecosystem restoration

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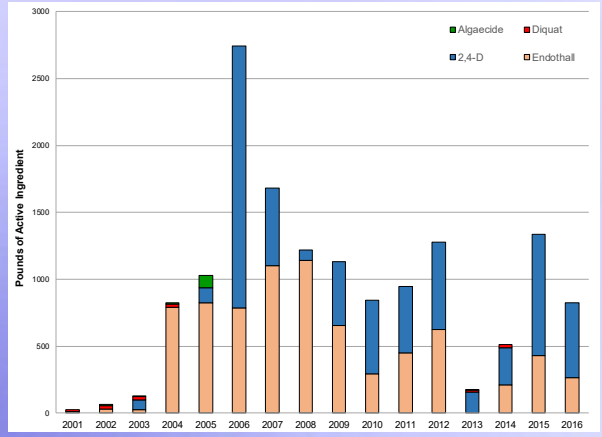
Historic Control Actions



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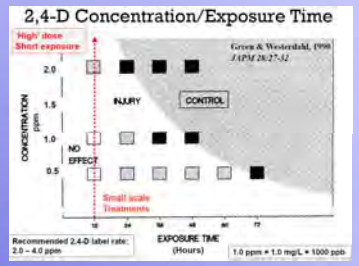
Herbicide Spot Treatment

- **Ecological Definition:** Herbicide applied at a scale where dissipation will not result in significant lake wide concentrations; impacts are anticipated to be localized to in/around application area.



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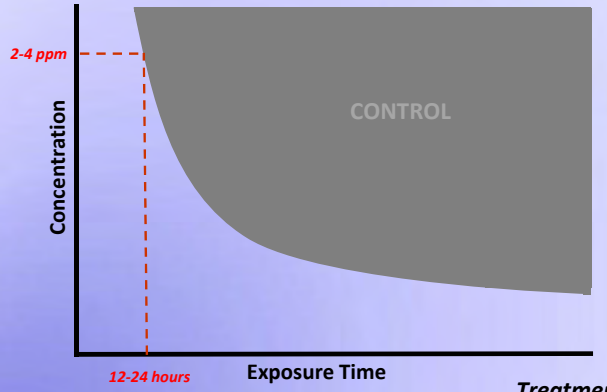
Herbicide Use Patterns



High Concentration ► Short Exposure Time

Treatment Type
Spot

Spot Treatment Specifications

- Treatments size (>5 acres), shape (broad vs narrow), and location (protected vs exposed) are important design components
- Winds within 6hrs of treatment greatly impact outcomes
- Consider using herbicides with short CETs
  - Diquat
  - Diquat + endothall

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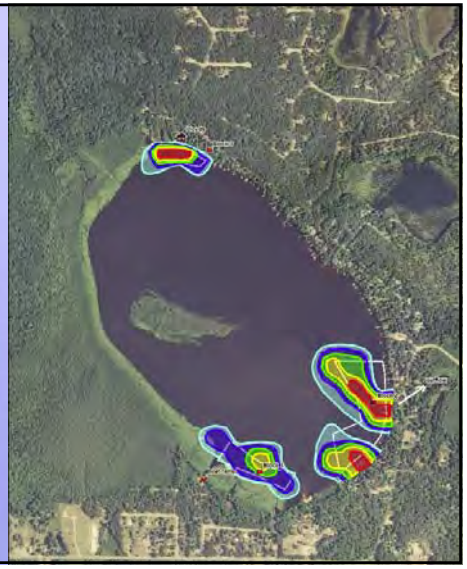
2015 Treatment on Loon Lake

- **Diquat (2 gallons per surface acre of application area)**
- ~24 acres of 305 acre lake (7.8%)
- Tracer Dye (Rhodamine WT) Survey
- Pre (spring) & post (late-summer) point-intercept sub-sampling

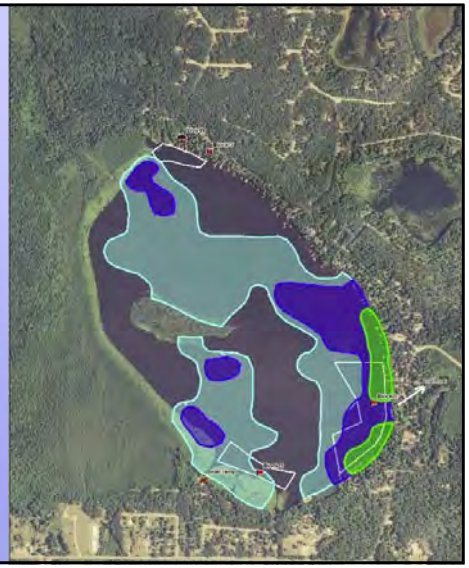
1 HAT

75-100%
50-75%
25-50%
10-25%
5-10%



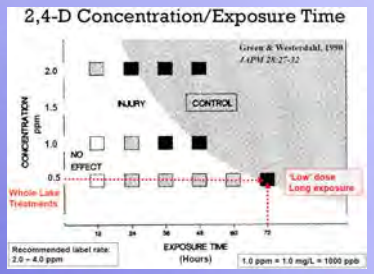
6 HAT

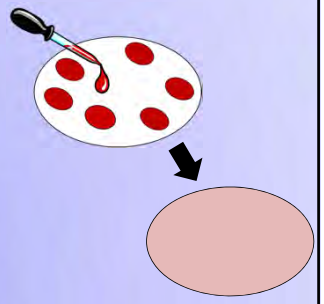
75-100%
50-75%
25-50%
10-25%
5-10%



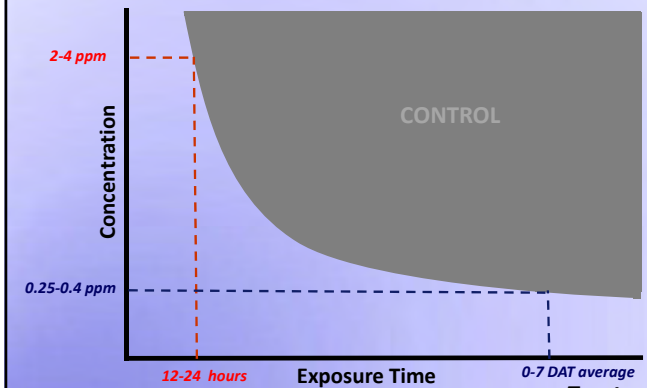
Large-Scale (Whole-lake) Treatment

- Ecological Definition: *Herbicide applied at a scale where dissipation will result in significant lake wide concentrations; impacts are anticipated to be on a lake wide scale*





Herbicide Use Patterns



	Treatment Type
High Concentration ▶ Short Exposure Time	*Spot*
Low Concentration ▶ Long Exposure Time	*Whole-lake*

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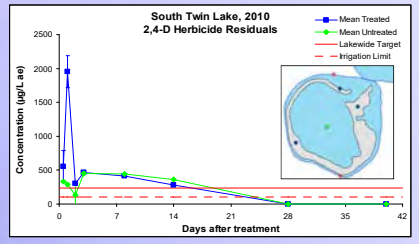
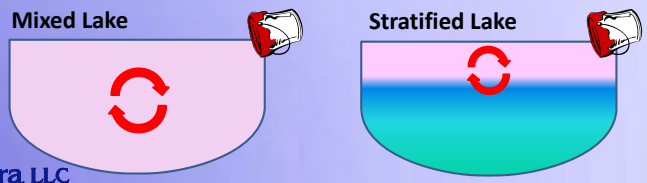
Large-Scale (Whole-lake) Treatment

- Herbicide Mixing
  - Horizontal
  - Vertical





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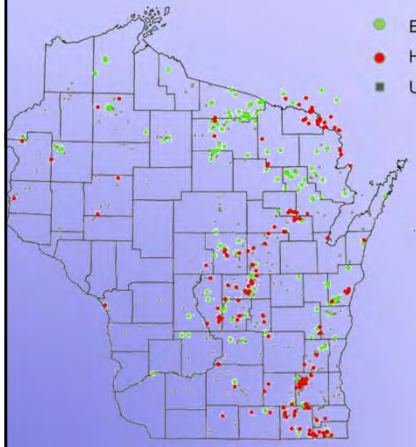
Hybrid Watermilfoil – (*M. spicatum X sibiricum*)



- Many misconceptions and misinformation regarding HWM
- ~150 lakes in WI have HWM confirmed
- There is not one 'single' hybrid watermilfoil, but it is rather a genetically diverse group that reflects recurrent hybridization
- Not <u>all</u> HWM appear to be tolerant to herbicides, but majority show statistically significant differences in % control when compared to pure EWM

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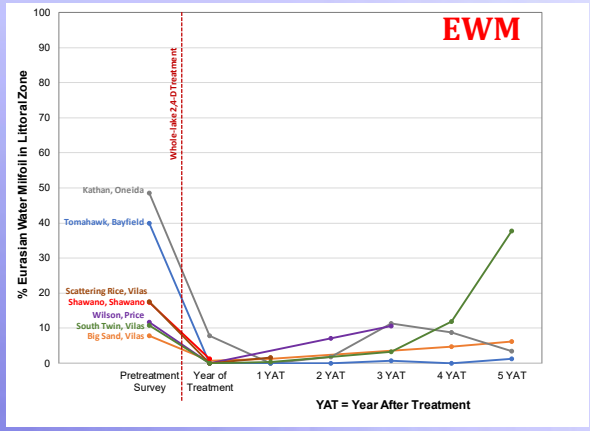
Results – Long-term Efficacy



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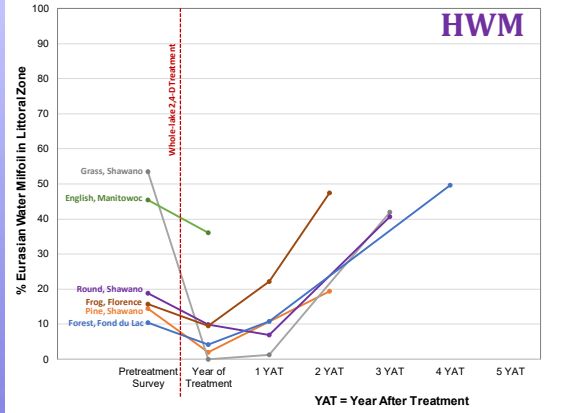
Results – Long-term Efficacy



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Large-Scale (Whole-lake) Treatment Specifications

- Planning is required to understand fate of herbicide mixing to achieve target concentrations
  - Bathymetry
  - Stratification depth
  - Water exchange (flow)
- If achieve target 2,4-D CETs, EWM control can be sustained for 5+ years
- Even if achieve target 2,4-D CETs, HWM control is variable and often short-lived
  - Consider aquaria sensitivity screening, mesocosom challenge testing, or trial field studies
  - Consider alternative herbicide use patterns

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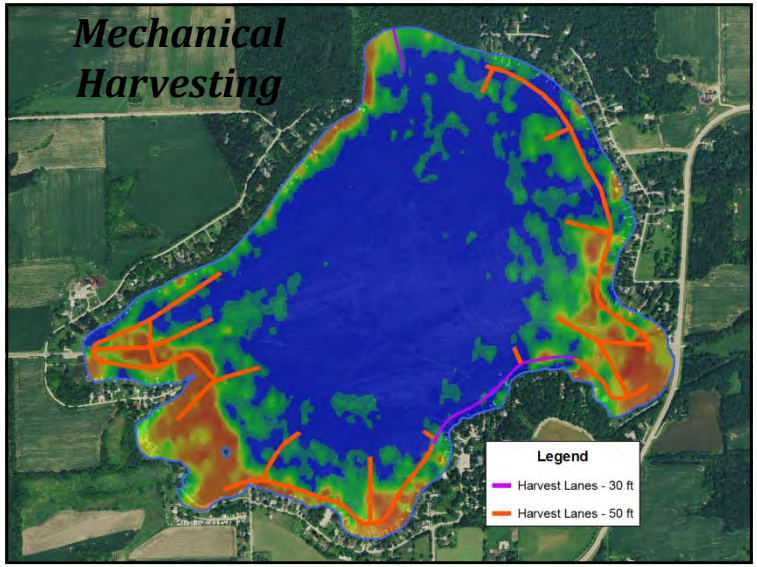
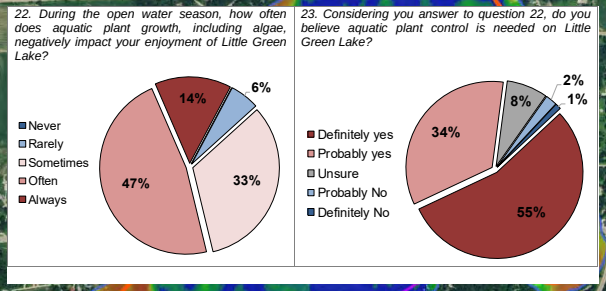
Mechanical Harvesting



Mechanical Harvesting



Conclusions

- Since 2005 at least, the aquatic plant population of Little Green Lake has been of poor quality.
- Aquatic plant population in Little Green Lake has decreased over the past decade
  - Over that time period, exotic species have made up a larger portion of the population
- Curly-leaf pondweed abundances likely have a large part in dictating annual plant make-up and water quality
  - Reduction of CLP on a lake-wide basis may help alleviate these issues

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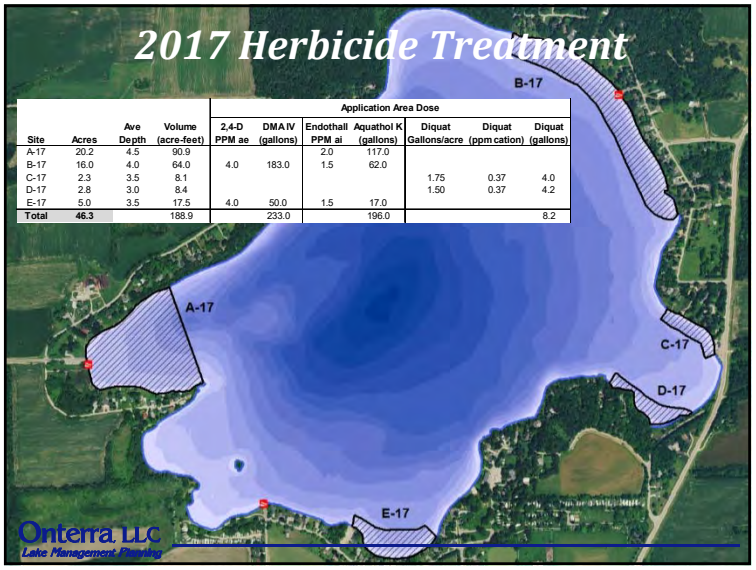
2017 Herbicide Treatment



Site	Acres	Ave Depth	Volume (acre-feet)	Application Area Dose: 2,4-D PPM ae	DMA IV (gallons)	Endothall PPM ai	Aquathol K (gallons)	Diquat Gallons/acre	Diquat (ppm cation)	Diquat (gallons)
A-17	20.2	4.5	90.9			2.0	117.0			
B-17	16.0	4.0	64.0	4.0	183.0	1.5	62.0			
C-17	2.3	3.5	8.1					1.75	0.37	4.0
D-17	2.8	3.0	8.4					1.50	0.37	4.2
E-17	5.0	3.5	17.5	4.0	50.0	1.5	17.0			
Total	46.3		188.9		233.0		196.0			8.2

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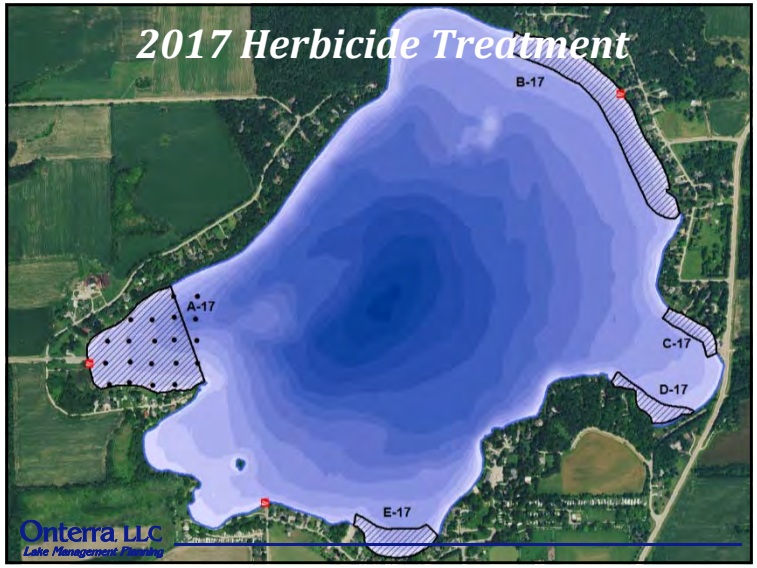
2017 Herbicide Treatment



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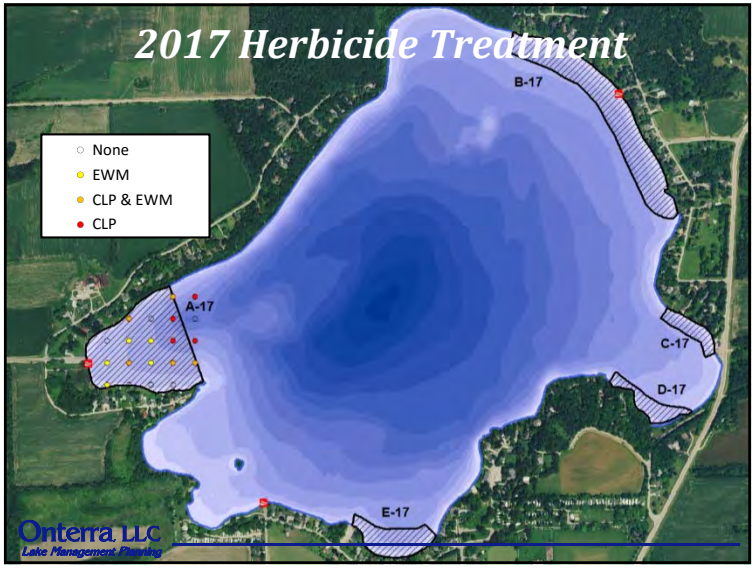
2017 Herbicide Treatment



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LGLPRD Annual Meeting

Lake Management Planning Update
May 20, 2017

Lake Management Planning Project

- Project initiated with Onterra at Special Meeting on September 3, 2015
- Project Grant Submitted to Wisconsin DNR for partial funding
- WDNR approved grant on March 9, 2016
  - WDNR Funding for $22,718
  - LGLPRD Estimated Costs for $11,189
- Planning Committee formed in May 2016
- Project officially launched at May 21, 2016 LGLPRD Annual Meeting

Lake Management Planning Project

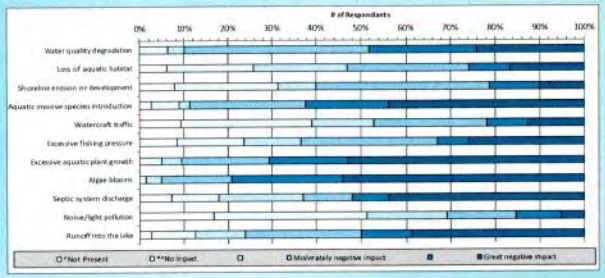
- Onterra Lake Surveys/Testing Completed
  - Water Quality Testing – Phosphorus, Chlorophyll-a, Secchi Disk Transparency
  - Other Samples – Nitrogen, Dissolved Oxygen, Alkalinity, Calcium, Iron, Temperature
  - Aquatic Plant Surveys
    - Four invasive plants confirmed and mapped
    - Fourteen native plants confirmed and mapped
  - Shoreland Condition Survey
  - Coarse Woody Habitat Survey
  - Acoustic Survey of Substrate Hardness (Lake Bottom)
- Additional Research and Consulting
  - Watershed, Fisheries, and other topics
  - Best Management Practices (BMP's)
- Property Owner Survey Completed
  - Survey notices sent to all property owners (289)
  - 96 surveys completed
  - Results compiled and reported
- Management Report under-development
  - Draft Report Sections produced by Onterra
  - Two Planning Committee Meetings Conducted (April 24th and May 9th)

Little Green Lake Property Owner Survey

How would you describe the current water quality of Little Green Lake?

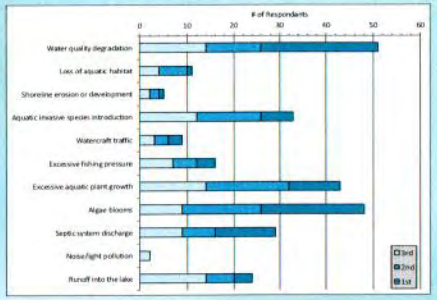
Little Green Lake Property Owner Survey

To what level do you believe each of the following factors may currently be negatively impacting Little Green Lake?



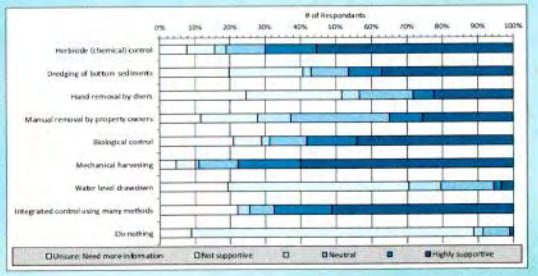
Little Green Lake Property Owner Survey

Please rank your top three concerns regarding Little Green Lake.



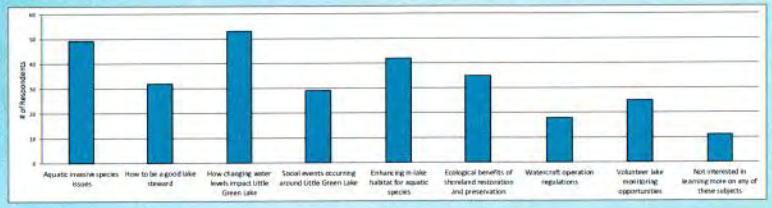
Little Green Lake Property Owner Survey

What is your level of support for the responsible use of the following techniques on Little Green Lake?



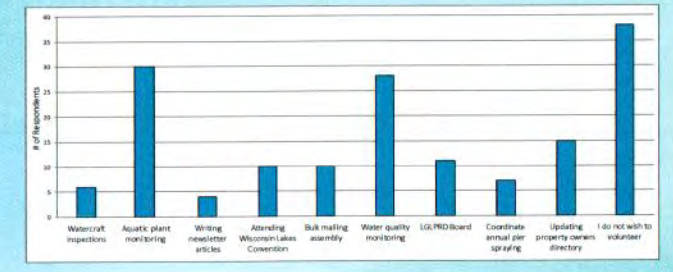
Little Green Lake Property Owner Survey

Property owner education is an important component of every lake management planning effort. Which of these subjects would you like to learn more about?



Little Green Lake Property Owner Survey

Please select the activities you would be willing to participate in if the LGLPRD requires additional assistance.



Lake Management Planning Project

- Additional Project Activities to reach Project Completion
  - Complete Report Sections
  - Complete additional meetings of the Planning Committee
  - Develop a Multi-year Implementation Plan
  - Conduct two post-treatment surveys of CLP and HWM plants to assess effectiveness
  - Board Approval of Final Lake Management Plan
  - Submit final plan and all associated information to the WDNR
  - Obtain approved funds from WDNR
  - Present the Final Lake Management Plan to the LGLPRD Property Owners (possible special district meeting in the Fall)
- The project is on-schedule and on-budget

Meeting Outline

- Iron and Alum to Inactive Phosphorus - Costs
- 2017 Early-Season AIS Survey Results
  - Post treatment PI sub-set results
- Review & Discussion of Proposed AIS Control Program
- Little Green Lake and LGLPRD Challenges Discussion
  - Pier treatments
  - Mechanical Harvesting
- Develop Lake Management Goals

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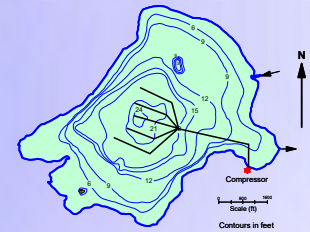
Destratification System – General Conclusions

- Destratification system has not consistently or significantly reduced internal phosphorus loading
- Likely a combination of insufficient destratification and low iron:phosphorus ratio
  - Should be greater than 3.6, it is actually 2.5 and as low as 1



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In-lake Phosphorus Inactivation

- Two realistic possibilities exist for inactivating (locking) phosphorus in the sediment:
  1. Addition of iron to increase iron:phosphorus ratio above 3.6:1
  2. Addition of aluminum (alum treatment)
- **Iron**
  - Requires destratification to keep hypolimnion oxic
    - Adjustments/additions to current system required
  - Iron has not been used this way in WI
    - Does not rule-out grant funding, but complicates process
    - Treatments in MN were for CLP control
    - Treatments in Canada were in mesocosms with no mixing
  - Some sort of pre-testing will likely be required
    - Dose, acidity impacts, other unknowns
  - Theoretically, it should work

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In-lake Phosphorus Inactivation

- **Alum (aluminum sulfate)**
  - Aluminum binds with sediment phosphorus, preventing it from being released to the overlaying water – under both oxic and anoxic conditions (no destratification needed)
  - Pre-test will be needed (core analysis for dosing)
  - This has been used around the world and the WDNR has funded many in WI through Lake Protection Grants
    - Onterra planned East Alaska, Kewaunee County Project in 2011
- **Alum & Iron**
  - Longevity of both treatments will be extended by minimizing external sources of phosphorus
    - WDNR will want to be assured of this prior to funding being considered

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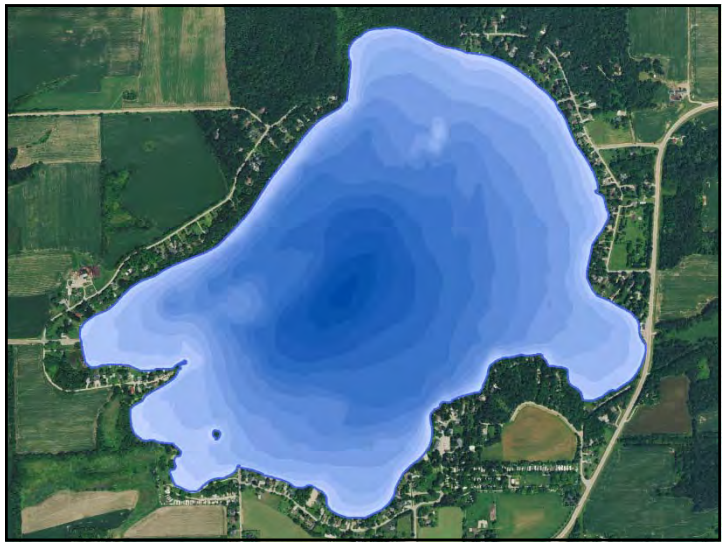

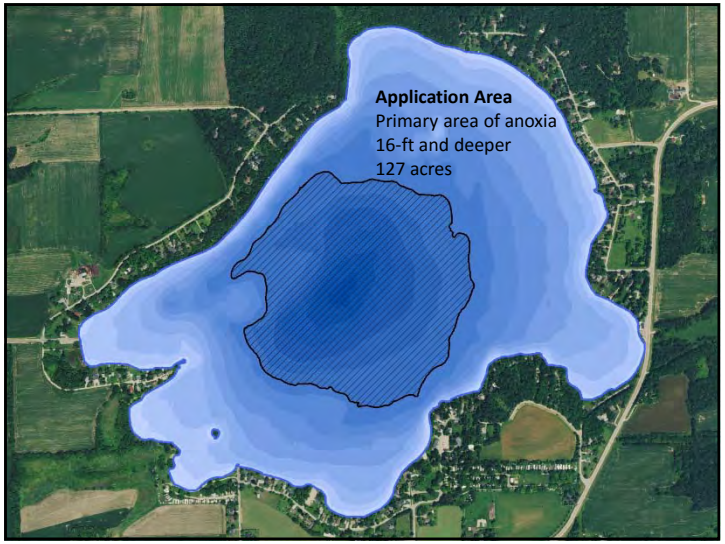

Cost Estimate

Alum
Dose: 50 g/m^2
Al: 56,658 lbs
Alum: 1,349,000 lbs
Alum: 121,532 gal
HAB (applicator): $1.76/gal
Total Cost: $213,900

Alum
Dose: 100 g/m^2
Al: 113,316 lbs
Alum: 2,698,000 lbs
Alum: 243,064 gal
HAB (applicator): $1.76/gal
Total Cost: $427,800

Iron (Ferric Chloride)
Dose: 200 g/m^2
Fe: 226,633 lbs
$FeCl_3$: 1,743,330 lbs
$FeCl_3$: 145,277 gal
Hydrite delivered: $0.12/lbs
$FeCl_3$ delivered: $209,200
Appl. from Alum: $0.81/gal
Application: $118,620
Total Cost: $327,820

Iron (Refined Powder)
Dose: 200 g/m^2
Fe: 226,633 lbs
Iron Powder: 348,666 lbs
Est from MN+: $100/ton
Iron Powder: $17,430
Delivery: $14,400
Application: ?
Total Cost: $?

Working AIS Control Plan

Task	LPL Amendment 2017 W	Sp	Su	F	2018 W	Sp	Su	F	AIS-EPC Phase I 2019 W	Sp	Su	F	2020 W	Sp	Su	F	AIS-EPC Phase II 2021 W	Sp	Su	F	2022 W	Sp	Su	F	2023 W	Sp	Su	F	W
Pretreatment Survey																													
Spot Treatment Trial																													
Large-Scale CLP Treatment																													
Trial Treatment Sub-Set PI Survey																													
Early-Season AIS Survey																													
Whole-Lake Point-Intercept Survey																													
EWM/HWM Peak-biomass Survey																													
Annual Committee Mtg																													
Annual AIS Monitoring Reporting																													

= Not Covered by WDNR Grant
= Partial Coverage by LPL Amendment
= Potential AIS-EPC Phase I Grant
= Potential AIS-EPC Phase II Grant

- Trial spot treatment in 2017 & 2018
- Large-scale CLP treatments in 2019-2022
  - 0.65 ppm ai lake-wide

2018 AIS Monitoring	$9,520.00
2018 Active Management Costs (Year 2 of Trial CLP Treatment)	$13,520.00
2019 AIS Monitoring	$9,715.00
2019 Active Management Costs (Year 1 of Large-Scale CLP Treatment)	$198,321.00
2020 AIS Monitoring	$9,715.00
2020 Active Management Costs (Year 2 of Large-Scale CLP Treatment)	$198,321.00
	$439,112.00
State Share Requested	$200,000.00
Local Match Cash Costs (if all in-kind is met)	**$239,112.00**

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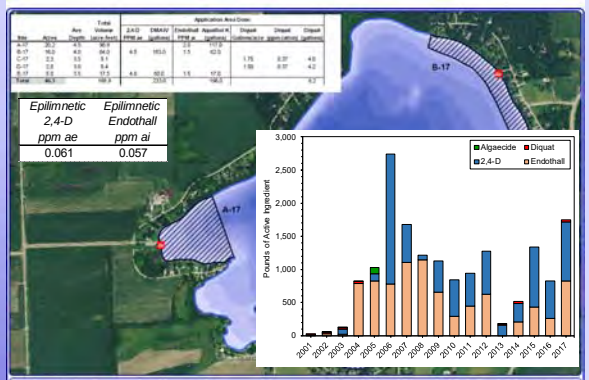
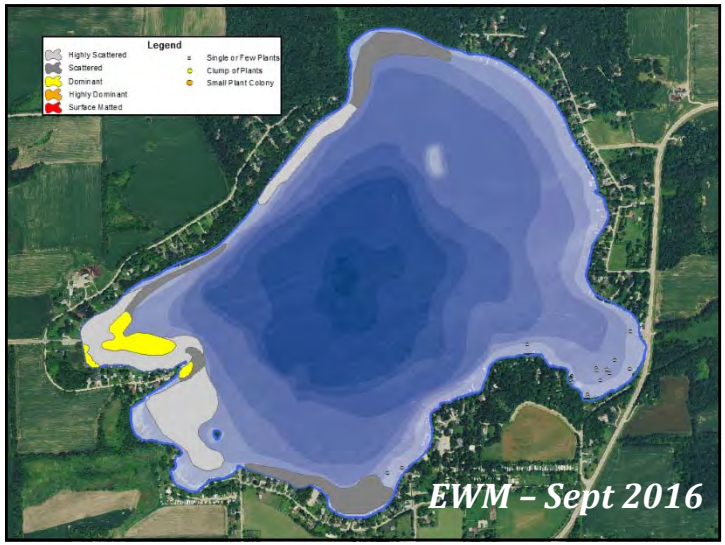
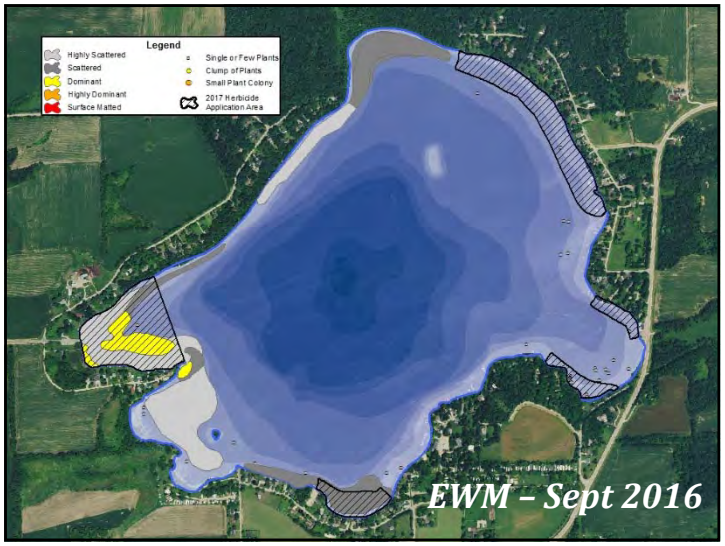
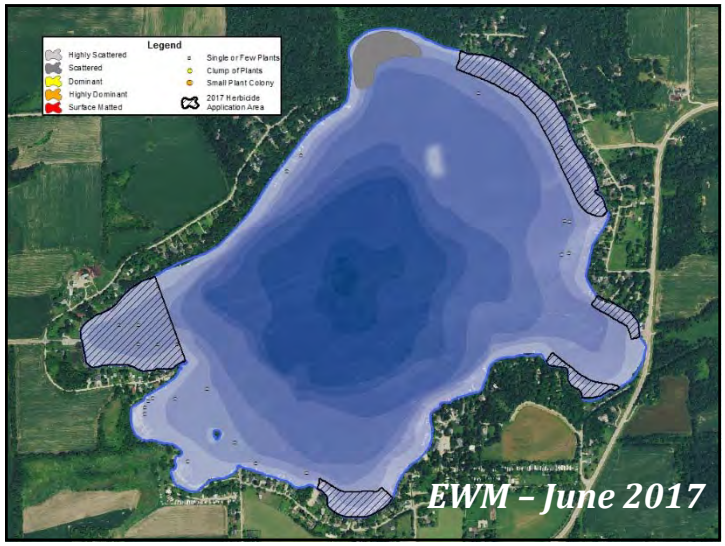
2017 Treatment Program

2017 Treatment Program






Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matted
Single or Few Plants
Clump of Plants
Small Plant Colony
2017 Herbicide Application Area
EWM – Sept 2016


Legend
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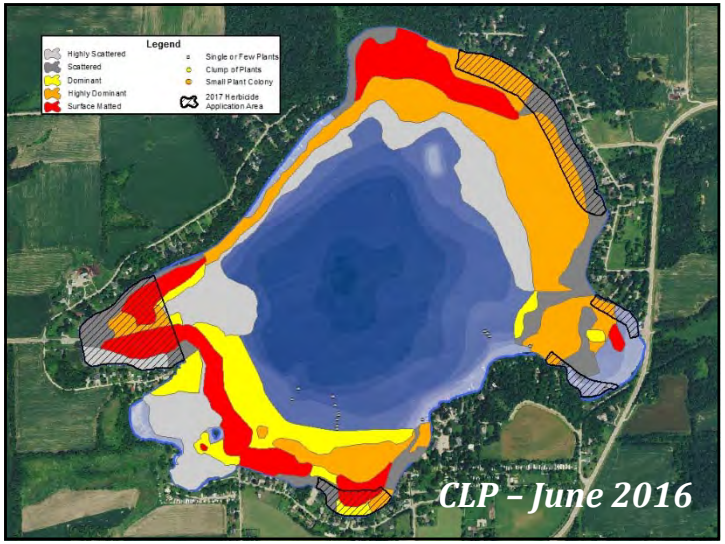
Scattered
Dominant
Highly Dominant
Surface Matted
Single or Few Plants
Clump of Plants
Small Plant Colony
2017 Herbicide Application Area
EWM – June 2017


Legend
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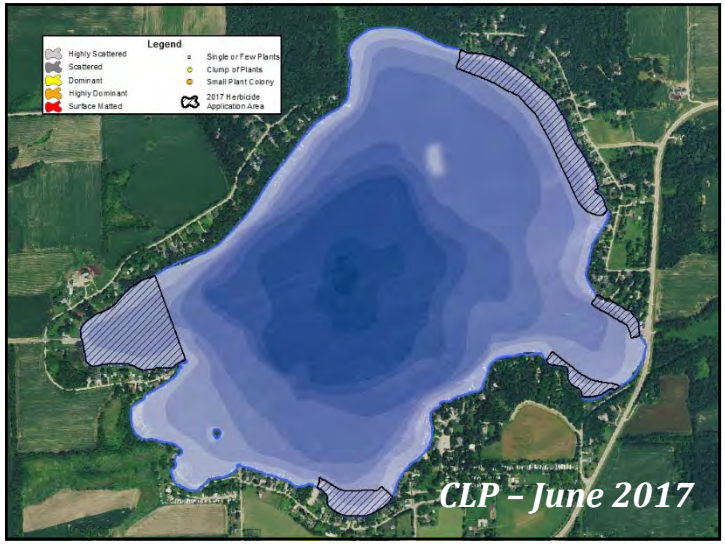
Scattered
Dominant
Highly Dominant
Surface Matted
Single or Few Plants
Clump of Plants
Small Plant Colony
2017 Herbicide Application Area
CLP – June 2016


Legend
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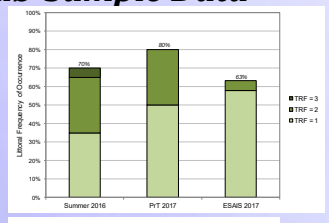
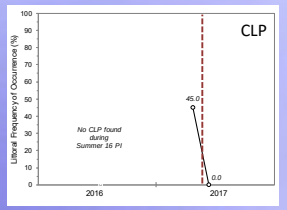
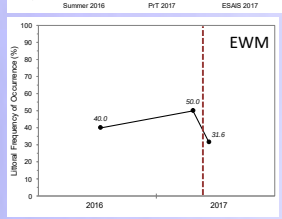
Scattered
Dominant
Highly Dominant
Surface Matted
Single or Few Plants
Clump of Plants
Small Plant Colony
2017 Herbicide Application Area
CLP – June 2017

Point-Intercept Sub-Sample Data

- July 2016
- April PrT 2017
- June PostT 2017







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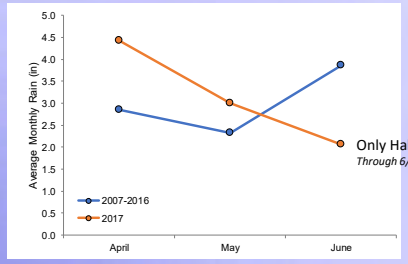
Precipitation



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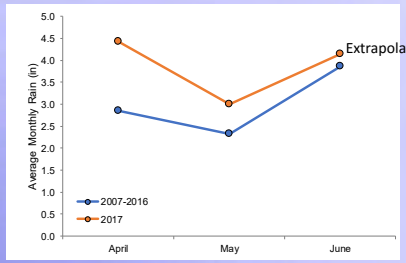
Precipitation



Using extrapolated data, equals 28% more rain (2.55in) in 2017 than 2007-2016 average

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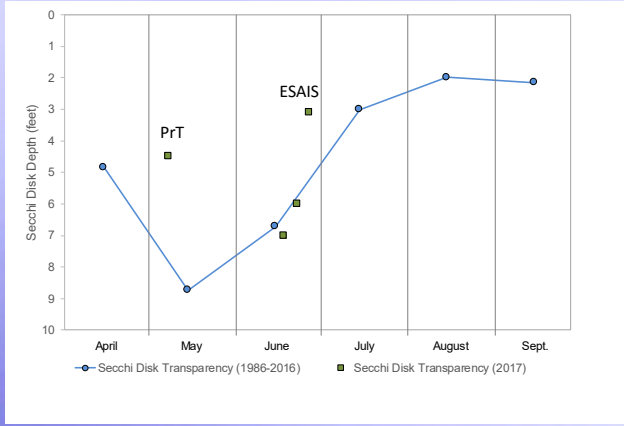
Transparency



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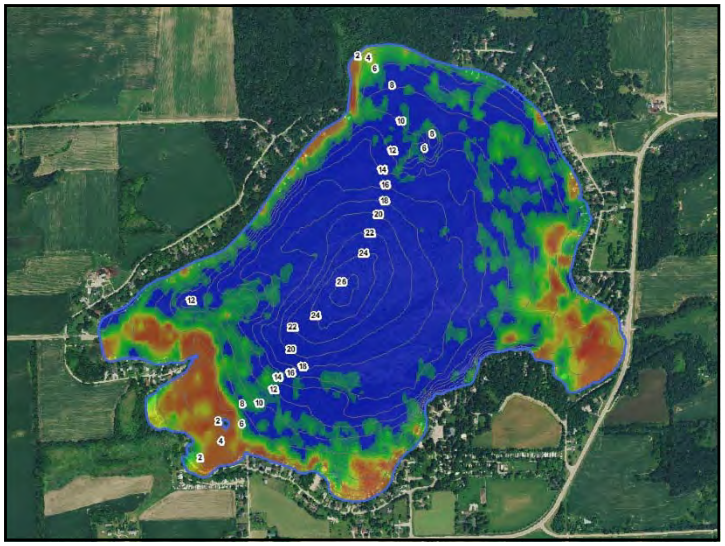

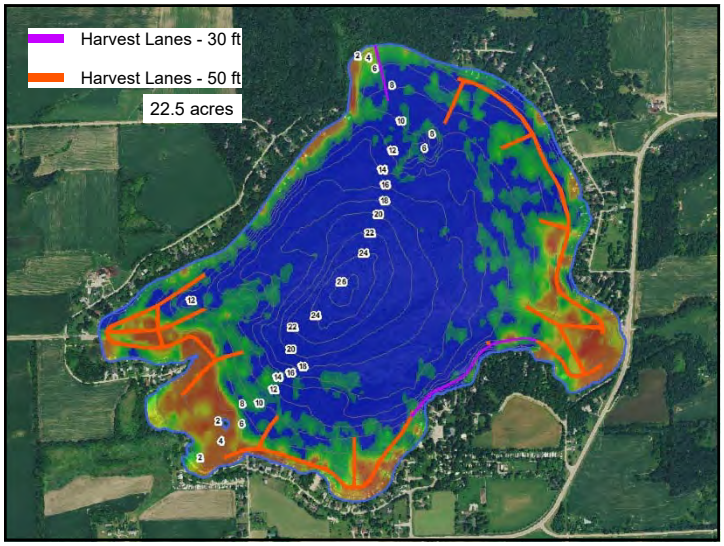

Current Mechanical Harvest Plan

- Harvest lanes outlined (24 acres on permit)
- Between 3ft and 12ft of water, with harvester operating at half or less of water column
- Also "top cut" AIS outside of lanes
- Also remove "floaters"
- Start after Memorial Day

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Lake Management Planning

Current Nuisance "Pier" Treatments

- Treatment occurs around July 1
- Potential of 90 piers @ 30ft shoreline length X 100 ft
- Diquat at half label rate (1 gallon/surface acre)
- Under a single permit by district (i.e. no individual permits)

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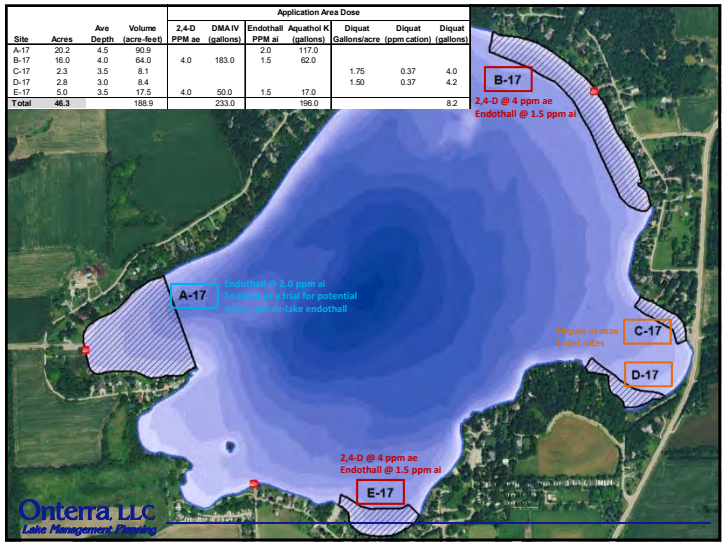
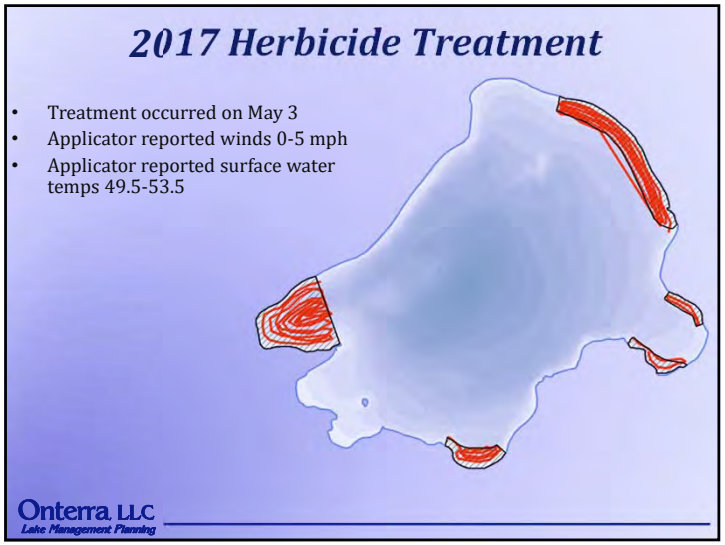
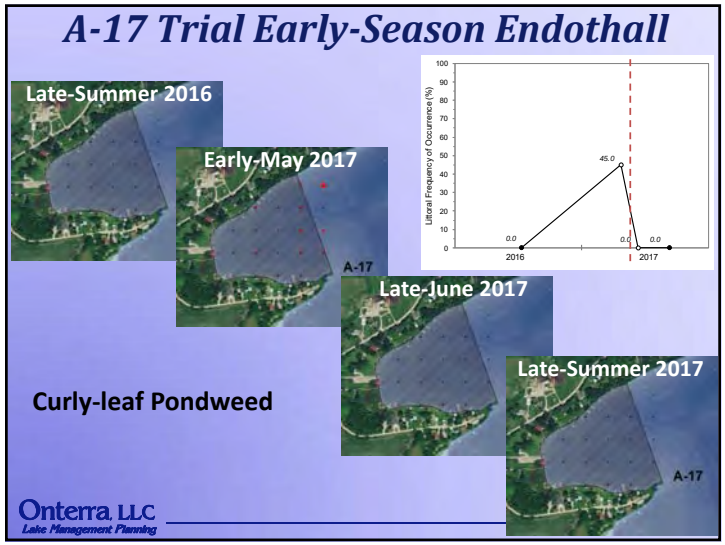
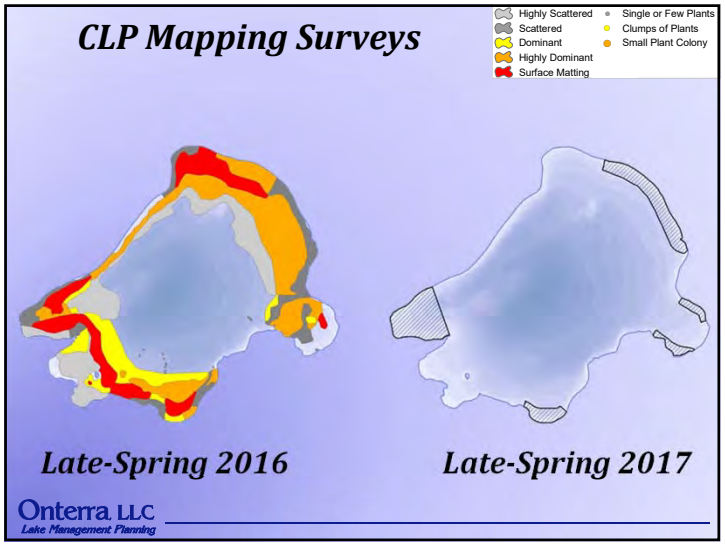
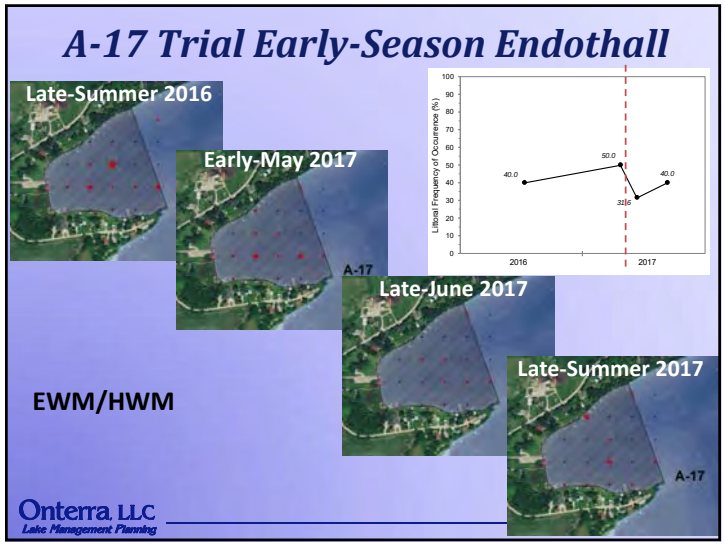
Site	Acres	Ave Depth	Volume (acre-feet)	Application Area Dose 2,4-D PPM ae	2,4-D (gallons)	DMA IV	Endothall PPM ai	Aquathol K (gallons)	Diquat Gallons/acre	Diquat (ppm cation)	Diquat (gallons)
A-17	20.2	4.5	90.9				2.0	117.0			
B-17	16.0	4.0	64.0	4.0	183.0		1.5	62.0			
C-17	2.3	3.5	8.1						1.75	0.37	4.0
D-17	2.8	3.0	8.4						1.50	0.37	4.2
E-17	5.0	3.5	17.5	4.0	50.0		1.5	17.0			
Total	46.3		188.9		233.0			196.0			8.2

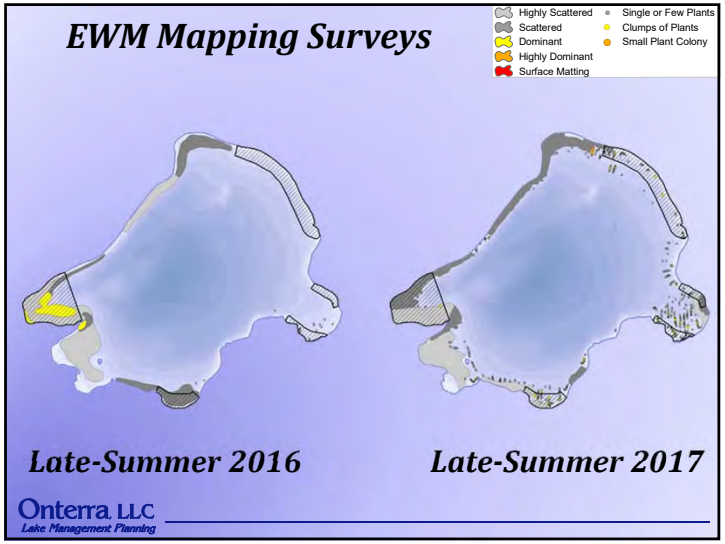


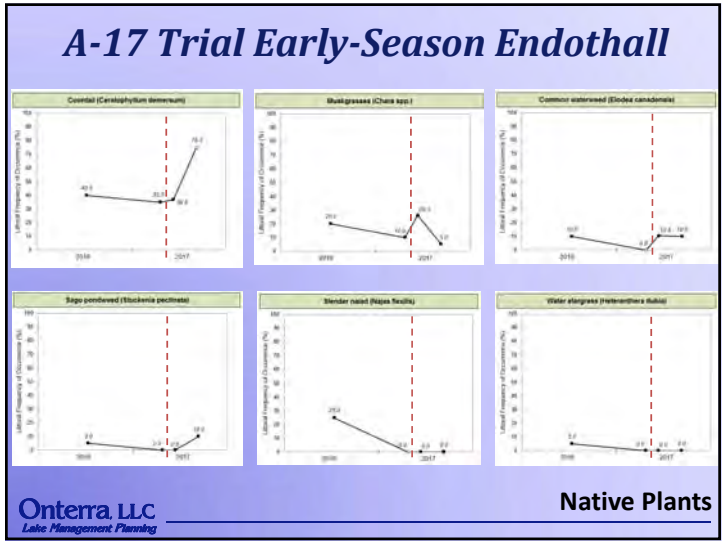





CLP Mapping Surveys
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony
Late-Spring 2016
Late-Spring 2017
Onterra LLC
Lake Management Planning


A-17 Trial Early-Season Endothall
Late-Summer 2016
Early-May 2017
A-17
Late-June 2017
Late-Summer 2017
EWM/HWM
A-17
Onterra LLC
Lake Management Planning


EWM Mapping Surveys
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony
Late-Summer 2016
Late-Summer 2017
Onterra LLC
Lake Management Planning


A-17 Trial Early-Season Endothall
Native Plants
Onterra LLC
Lake Management Planning

2017 Treatment Results

- CLP was prevalent during the pretreatment survey and then crashed lake-wide by June
  - High precipitation from April-June
    - Result in CLP senescencing early
    - Historic accounts exist of early CLP senescence, potentially driving WQ changes
  - Lake-wide reductions cannot be attributed to the treatment program
- EWM reductions were observed within A-17
  - EWM appeared to rebound by end of summer, but slightly less dense than late-summer 2016
  - Lake-wide EWM populations are relatively similar to 2016 even after being lower in June, possibly related to the WQ changes
- Some native plant impacts observed

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2017 Treatment Conclusions

- Unable to draw conclusions about efficacy on CLP
- EWM impacts observed, but control not achieved
- Some native plants observed declines

- Options moving forward
  1. 2018 to serve as another trial, primarily for CLP control
  2. Abandon/postpone attempt to control CLP or EWM/HWM lake-wide and revise nuisance control program

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Lake Management Planning

LGLPRD Annual Meeting

Lake Management Planning Update
May 19, 2018

Lake Management Planning Project Accomplishments

- Project initiated with Onterra at Special District Meeting on September 3, 2015
- Project Grant Submitted to Wisconsin DNR for partial funding
- WDNR approved grant on March 9, 2016
  - WDNR Funding for $22,718
  - LGLPRD Estimated Out-of-Pocket Costs of $7,773
- Planning Committee formed in May 2016
  - Harlan Barkley, Tom Bartz, Larry Charles, Jim Clark, Aaron Gruenewald, Derek Kavanaugh (GLC), Pete Piotrowski, Mike Ross, and Dick Schneider
- Project officially launched at May 21, 2016 LGLPRD Annual Meeting
- Property Owner Survey completed in August/September 2016
- Onterra conducted several surveys and water quality testing in 2016

Lake Management Planning Project Accomplishments

- Project update provided at May 20, 2017 LGLPRD Annual Meeting
- Extensive research and analysis was conducted in 2016/2017 on a wide range of topics:
  - Whole lake herbicide treatments for HWM and CLP
  - Aluminum Sulfate and Iron Nitrate treatments
  - Watershed and shoreland restoration
  - Aquatic Plants and Fisheries
- WDNR approved request for additional funding on May 8th, 2017
  - WDNR Funding increased from $22,718 to $25,000
  - LGLPRD Estimated Out-of-Pocket Costs increased from $7,773 to $10,311
  - Purpose was to have Onterra accomplish two additional aquatic plant surveys
- WDNR approved project extension request to December 31st, 2018 as of April 5, 2018

Lake Management Planning Project Accomplishments

- AIS Control Strategy & Planning Meeting Conducted on February 20, 2017
- Four Planning Committee Meetings Conducted in 2017
  - April 24th, May 9th, June 16th and October 17th
- Full draft of Lake Management Plan and Appendices from Onterra was distributed to the Planning Committee on March 28, 2018
- Consolidated feedback from the Planning Committee was submitted to Onterra on April 18, 2018
- Onterra updated the draft plan on May 16, 2018 based on Planning Committee feedback
- Onterra submitted the "First Official Draft" plan on May 17, 2018 to our WDNR and GLC resources for additional review
- Lake Management Plan Summary presented at the May 19, 2018 LGLPRD Annual Meeting

Lake Management Planning Project – Final Steps

- Additional Project Activities to reach Project Completion
  - Property owner vote of confidence for the LGLPRD Board and Planning Committee on the draft implementation plan at the May 19, 2018 annual meeting
  - Onterra updates the "First Official Draft" with any changes from the WDNR and GLC review and submits to the Planning Committee
  - Planning Committee conducts final review and submits the plan (unless additional changes are needed) to the LGLPRD Board for review and approval
  - Board approval of the Final Lake Management Plan
  - Onterra submits the final plan and all associated project information to the WDNR to fulfill the requirements of the grant
  - LGLPRD receives the approved grant funds from the WDNR
  - The Final Lake Management Plan is posted on the LGLPRD Web Site

Lake Management Plan Highlights

- "State of the Lake"
  - Little Green Lake is on the WDNR's 2014 303(d) impaired waterbodies listing for a number of impairments including low dissolved oxygen, eutrophication, water quality use restrictions, degraded habitat and elevated pH
  - Degradation of the Little Green Lake native plant community is continuing
  - 2017 was the best year in recent history regarding the lack of navigation and algae issues
  - What will the summer of 2018 bring?

Lake Management Plan Highlights

- Core Plan Content Scope
  - Introduction
  - Property Owner Participation
  - Results & Discussion
    - Lake Water Quality
    - Watershed Assessment
    - Shoreland Condition
    - Aquatic Plants
    - Aquatic Invasive Species in Little Green Lake
    - Fisheries Data Integration
  - Summary and Conclusions
  - Implementation Plan
  - Methods
  - Literature Cited
- Appendices and Maps
  - Seven Appendices
  - Seven Maps

LMP Implementation Plan – Management Goals

- Goal #1
  - Improve Current Water Quality Conditions in Little Green Lake
- Action #1
  - Monitor water quality through WDNR Citizens Lake Monitoring Network
    - Expand water quality testing – more tests on higher frequency
    - Purchase Van Dorn bottle for total phosphorus and total iron analysis
    - Explore possibility of obtaining a Small-Scale Lake Planning Grant for additional water quality sampling
- Action #2
  - Work with GLC Land Conservation Department to Make Improvements in LGL Watershed
    - Make improvements to retention ponds constructed in 2000 and 2009
    - Explore funding opportunities
    - Address water flow issues on Lake Shore Drive and Melmar Drive
    - Correct erosion issue near culvert on East Little Green Road
    - Determine feasibility of resurrecting the retention pond built in 1992 on Degner property
    - Address water flow issue on N. Kearley Road due to recent road rebuild

LMP Implementation Plan – Management Goals

- Goal #1
  - Improve Current Water Quality Conditions in Little Green Lake
- Action #3
  - Continue to improve and monitor the effectiveness of the destratification system
    - 1,000' of new ½" tubing was installed in August 2017 for each of the five existing tube lines
    - The lease agreement with Fernwood Campground was extended in April 2018 for two years through December 2020
    - Evaluate additional improvements to the Destratification System
    - Review and analyze the results of expanded water quality testing
    - Determine if operation of the Destratification System beyond 2020 is warranted
      - Options if operation beyond 2020 is decided:
        - Another lease agreement extension with Fernwood Campground, LLC
        - Constructing a new building on LGLPRD property for the Destratification System
  - Special Note: If an alum treatment is conducted on LGL in the future the Destratification System operation will need to be permanently stopped
  - Special Note: If an iron treatment is conducted on LGL in the future the Destratification System operation will be needed long-term

LMP Implementation Plan – Management Goals

- Goal #2
  - Assure Navigation and other Recreational Opportunities on Little Green Lake
- Action #1
  - Utilize mechanical harvesting to provide access to open water areas of LGL
    - Continue mechanical harvesting effort with updated harvesting map
    - Obtain a new 5-year WDNR permit in 2019
- Action #2
  - Conduct nuisance plant treatments using herbicides on an as-needed basis in common use areas of Little Green Lake
    - New chemical dosing strategy was implemented in 2017
    - Pursue annual Herbicide Treatment Plans as-needed
    - A WDNR permit is required each time
    - Re-evaluate the lake-wide Curly Leaf Pondweed (CLP) control option in 2020 and determine suitable funding options

LMP Implementation Plan – Management Goals

- Goal #2
  - Assure Navigation and other Recreational Opportunities on Little Green Lake
- Action #3
  - Establish a program for Aquatic Invasive Species (AIS) Prevention
    - Create an AIS Prevention and Containment Strategy/Plan
    - Raise awareness about the threats and risks of AIS for Little Green Lake
    - Consider partnering with such organizations as WDNR, Golden Sands, Wisconsin Lakes, Green Lake County and the Clean Boats & Clean Lakes Program
    - Consider such activities as boat launch signage, articles on specific AIS threats, education events, tool boards, awareness materials and state programs
- Action #4
  - Conduct nuisance plant treatments around piers using herbicides on an as-needed basis
    - Pier area spraying was not accomplished in 2017 due to lack of navigation issues and high cost estimates
    - Pier treatment costs have risen from $35/pier in 2016 to estimated costs in 2017 and 2018 of $100 - $150 per pier depending on the number of piers treated
    - Continue to pursue lower cost solutions

LMP Implementation Plan – Management Goals

- Goal #2
  - Assure Navigation and other Recreational Opportunities on Little Green Lake
- Action #5
  - Coordinate periodic aquatic vegetation monitoring
    - Conduct a Point-Intercept Survey every 3-5 years to understand the sub-mergent aquatic plant community dynamics
    - Conduct a Community Mapping Survey every 6-10 years to understand the emergent and floating-leaf aquatic plant communities in LGL

LMP Implementation Plan – Management Goals

- Goal #3
  - Increase LGLPRD's Capacity to Communicate with Lake Property Owners and Facilitate with Other Management Entities
- Action #1
  - Use education & communications to promote lake protection and enjoyment with property owners
    - Create an Education & Communication Committee
      - Coordinate education efforts and opportunities
      - Create and distribute a periodic district newsletter
      - Improve or replace the district website
- Action #2
  - Continue LGLPRD involvement with other entities that have responsibilities in managing Little Green Lake
    - Actively engage with all management entities to enhance the district's effectiveness and success
    - These entities include WDNR, Green Lake County, Town of Green Lake, Golden Sands, City of Markesan, Fishing Friends Forever Club, UW-Extension, and Wisconsin Lakes

LMP Implementation Plan – Management Goals

- Goal #4
  - Improve Lake and Fishery Resources by Protecting and Restoring Little Green Lake Shoreland Conditions
- Action #1
  - Educate property owners on the importance of shoreland condition and shoreland restoration on Little Green Lake
    - Educate property owners on the benefits of this initiative
    - Recruit a facilitator for this initiative
    - Solicit 1-3 property owners to participate in pilot project
    - Seek assistance from Green Lake County Land Conservation and the Healthy Lakes Program
- Action #2
  - Coordinate with WDNR and private landowners to expand coarse woody habitat in Little Green Lake
    - Seek assistance and guidance from the WDNR (Dave Bartz)
    - Recruit a facilitator for this initiative
    - Educate property owners on the benefits of this initiative
    - Identify demonstration sites and potential improvement sites

Lake Management Plan – Additional Topic

- Sewer and Septic Systems
  - Property Owner Survey Feedback
    - Many comments about the negative impact that current septic systems have on LGL water quality
    - Many comments about the original expectation that the Sewer System was going to be extended to the two remaining areas of the lake
    - Some property owners feel the monthly costs for current sewer system customers will go down if the system is extended to the other areas of the lake
      - This would need an extensive study to determine
  - State of the current septic systems
    - Each of the septic systems are required by Green Lake County to be inspected and pumped at least every three years.
    - Each of the septic systems are currently in compliance with the county regulations
    - We monitor this compliance on an annual basis with a report from Green Lake County
  - Onterra estimates the amount of phosphorus reaching LGL from the current septic systems is negligible
  - Extension of the current Sewer System is not warranted from a water quality risk standpoint

Lake Management Plan Implementation

- **Key Success Factors for Implementation**
  - **Property Owner support and engagement**
  - **Volunteers are critical for most of our strategic initiatives**
    - Water Quality Testing – Brian Paddock
    - Education & Communication Committee Facilitator and Members
    - Watershed Improvement Volunteers
    - AIS Prevention Volunteers
    - Shoreland Restoration Volunteers
    - Coarse Woody Habitat Volunteers
  - **Partnering with numerous state, county and local organizations**
  - **Securing available funding for critical initiatives**
  - **Don't treat the Final Lake Management Plan and Implementation Plan as fixed in stone for the next five to seven years**
    - We will periodically review the plan and make improvements/adjustments as we go forward to make a bigger impact on the "State of the Lake".

LMP Implementation Plan

- Open Discussion
- "Vote of Confidence" on the Draft Lake Management Implementation Plan for the LGLPRD Board
  - Motion and second are needed for vote to be called

B

APPENDIX B

Property Owner Survey Response Charts and Comments

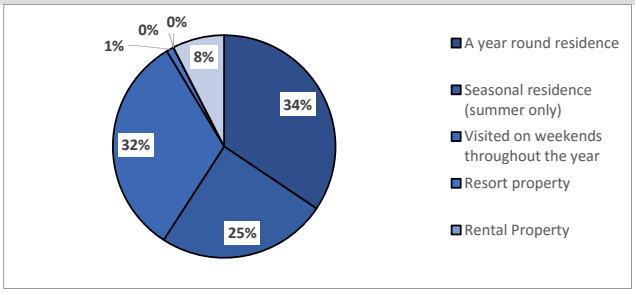
Little Green Lake - Anonymous Property Owner Survey

Surveys Distributed: 289
Surveys Returned: 93
Response Rate: 32%

Little Green Lake Property

1. How is your property on Little Green Lake utilized?

Answer Options	Response Percent	Response Count
A year round residence	34.4%	32
Seasonal residence (summer only)	24.7%	23
Visited on weekends throughout the year	32.3%	30
Resort property	1.1%	1
Rental Property	0.0%	0
Undeveloped	0.0%	0
Other (please specify)	7.5%	7
answered question		93
skipped question		0

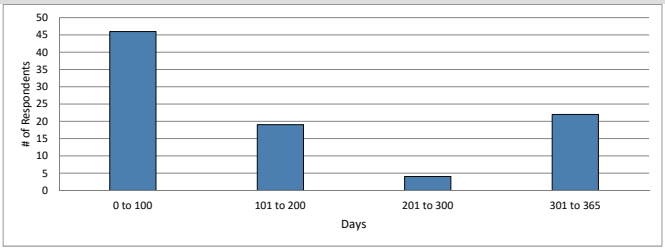


Number	Other (please specify)
1	weekends throughout the year
2	Frequently in summer, occasionally the rest of the year
3	A combination of family usage during weekends (throughout the year) AND summer time, as well as a part-time rental property
4	Snowbirds...here May thru October
5	Visit throughout the year (not just weekends)
6	year round visits both weekdays/weekends
7	EVERY WEEKEND + MORE

2. How many days each year is your property used by you or others?

Answer Options	Response Count
	91
answered question	91
skipped question	2

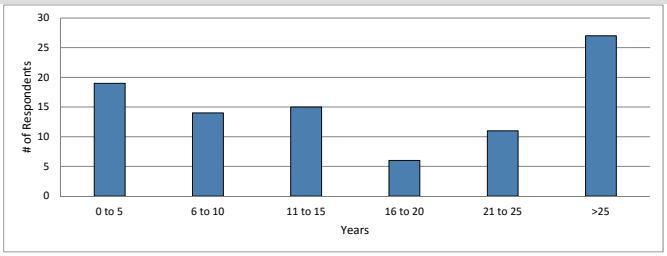
Category (# of Days)	% Response	Response Count
0 to 100	50.5%	46
101 to 200	20.9%	19
201 to 300	4.4%	4
301 to 365	24.2%	22



3. How long have you owned your property on Little Green Lake?

Answer Options	Response Count
	93
answered question	93
skipped question	0

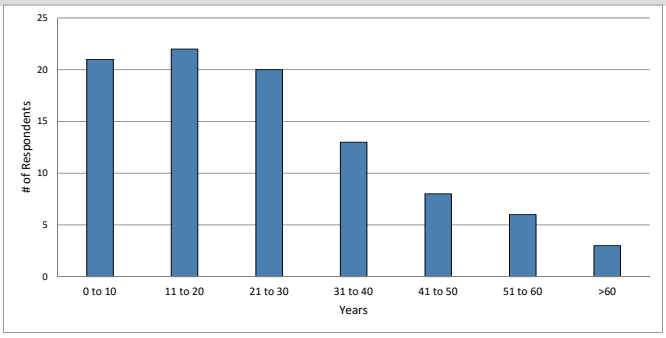
Category (# of Years)	% Response	Response Count
0 to 5	20.4%	19
6 to 10	15.1%	14
11 to 15	17.2%	16
16 to 20	6.5%	6
21 to 25	11.8%	11
>25	29.0%	27



4. How many years ago did you first visit Little Green Lake?

Answer Options	Response Count
	93
answered question	93
skipped question	0

Category (# of Years)	% Response	Response Count
0 to 10	22.6%	21
11 to 20	23.7%	22
21 to 30	21.5%	20
31 to 40	14.0%	13
41 to 50	8.6%	8
51 to 60	6.5%	6
>60	3.2%	3



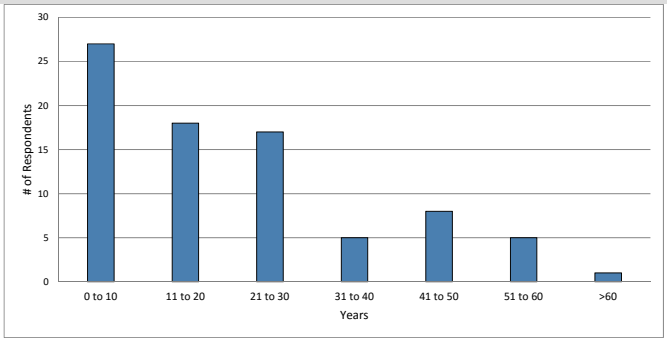
5. Have you personally fished on Little Green Lake in the past three years?

Answer Options	Response Percent	Response Count
Yes	87.1%	81
No	12.9%	12
answered question		**93**
skipped question		**0**

6. For how many years have you fished Little Green Lake?

Answer Options	Response Count
	81
answered question	**81**
skipped question	**12**

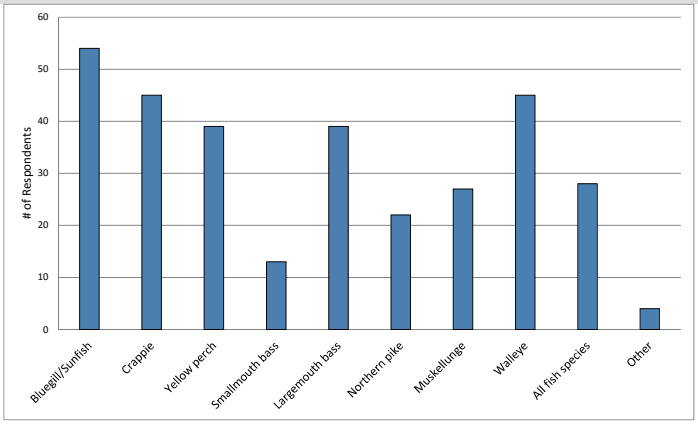
Category (# of Years)	Response Percent	Response Count
0 to 10	33.3%	27
11 to 20	22.2%	18
21 to 30	21.0%	17
31 to 40	6.2%	5
41 to 50	9.9%	8
51 to 60	6.2%	5
>60	1.2%	1



7. What species of fish do you like to catch on Little Green Lake?

Answer Options	Response Percent	Response Count
Bluegill/Sunfish	66.7%	54
Crappie	55.6%	45
Yellow perch	48.1%	39
Smallmouth bass	16.0%	13
Largemouth bass	48.1%	39
Northern pike	27.2%	22
Muskellunge	33.3%	27
Walleye	55.6%	45
All fish species	34.6%	28
Other (please specify)	4.9%	4
answered question		**81**
skipped question		**12**

Number	Other (please specify)
1	Bullheads
2	bluegill crappie pike
3	Bullheads
4	Bullheads

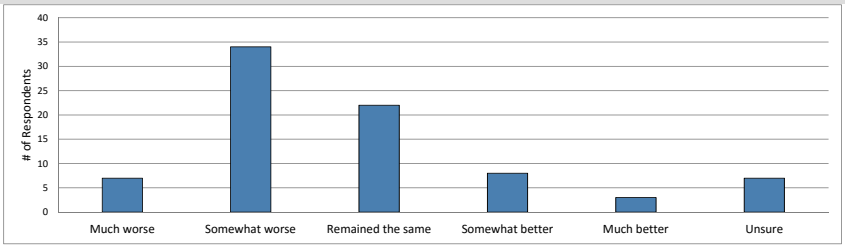


8. How would you describe the current quality of fishing on Little Green Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	3	10	35	29	2	2	81
answered question							**81**
skipped question							**12**

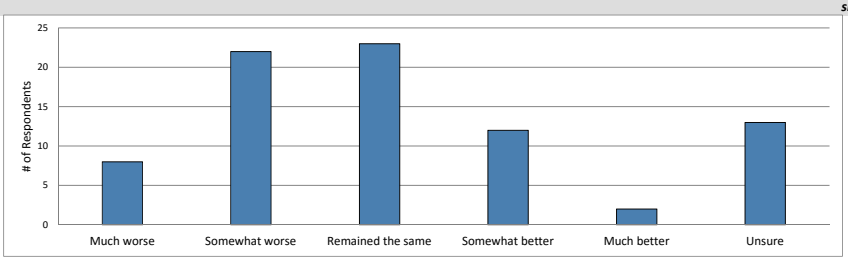
9. How has the quality of panfish (i.e. bluegill, crappie, perch) fishing changed on Little Green Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	7	34	22	8	3	7	81
						answered question	81
						skipped question	12



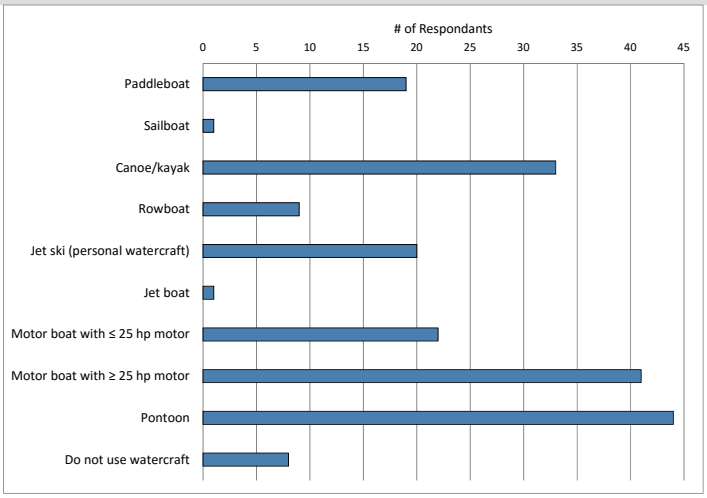
10. How has the quality of game fish (i.e. bass, walleye, northern pike, musky) fishing changed on Little Green Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	8	22	23	12	2	13	80
						answered question	80
						skipped question	13



11. What types of watercraft do you currently use on Little Green Lake?

Answer Options	Response Percent	Response Count
Paddleboat	20.4%	19
Sailboat	1.1%	1
Canoe/kayak	35.5%	33
Rowboat	9.7%	9
Jet ski (personal watercraft)	21.5%	20
Jet boat	1.1%	1
Motor boat with 25 hp or less motor	23.7%	22
Motor boat with greater than 25 hp motor	44.1%	41
Pontoon	47.3%	44
Do not use watercraft	8.6%	8
answered question		93
skipped question		0

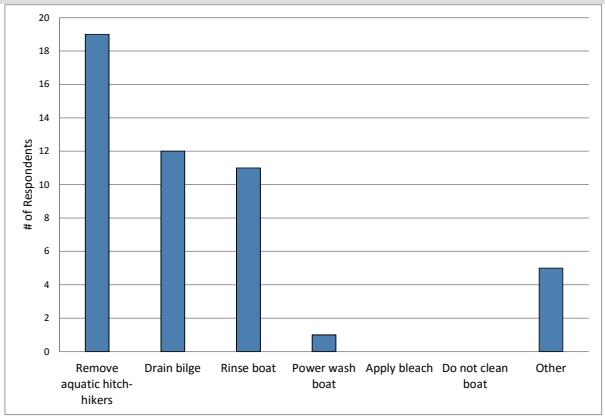


12. Do you use your watercraft on waters other than Little Green Lake?

Answer Options	Response Percent	Response Count
Yes	27.5%	25
No	73.6%	67
answered question		92
skipped question		1

13. What is your typical cleaning routine after using your watercraft on waters other than Little Green Lake?

Answer Options	Response Percent	Response Count
Remove aquatic hitch-hikers	76.0%	19
Drain bilge	48.0%	12
Rinse boat	44.0%	11
Power wash boat	4.0%	1
Apply bleach	0.0%	0
Do not clean boat	0.0%	0
Other (please specify)	20.0%	5
answered question		25
skipped question		68

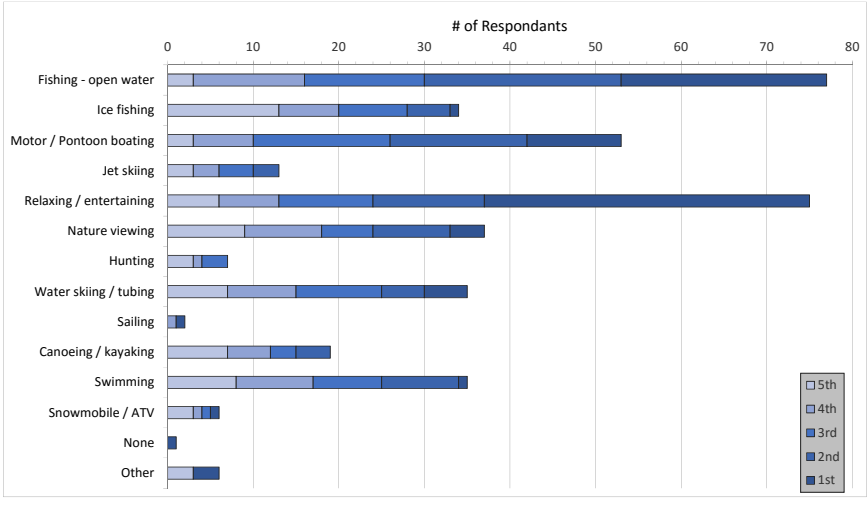


Number	Other (please specify)
1	remove plants drain bilge
2	The boat I use elsewhere is never in Little Green
3	There was no visible signs of hitch-hikers or plants on boat or trailer.
4	We only take our jet skis to other lakes
5	Boats are lake specific

14. Please rank up to five activities that are important reasons for owning your property on Little Green Lake.

Answer Options	1st	2nd	3rd	4th	5th	Rating Average	Response Count
Fishing - open water	24	23	14	13	3	2.32	77
Ice fishing	1	5	8	7	13	3.76	34
Motor / Pontoon boating	11	16	16	7	3	2.53	53
Jet skiing	0	3	4	3	3	3.46	13
Relaxing / entertaining	38	13	11	7	6	2.07	75
Nature viewing	4	9	6	9	9	3.27	37
Hunting	0	0	3	1	3	4.00	7
Water skiing / tubing	5	5	10	8	7	3.20	35
Sailing	1	0	0	1	0	2.50	2
Canoeing / kayaking	0	4	3	5	7	3.79	19
Swimming	1	9	8	9	8	3.40	35
Snowmobile / ATV	1	0	1	1	3	3.83	6
None of the activities are important to me	1	0	0	0	0	1.00	1
Other (please specify)	3	0	0	0	3	3.00	6
Please specify "Other" response here							7
answered question							93
skipped question							0

Number	Please specify "Other" response here
1	fishing, relaxing
2	Paddle board
3	cross country skiing
4	the sheet would not let me pick 5 topics.(swimming/pontoon)
5	domicile residence
6	ALL in water summer activities, swimming, rafting, ect
7	Visiting with neighbors

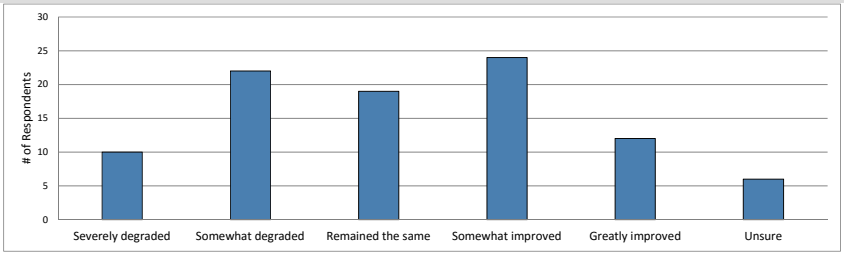


15. How would you describe the current water quality of Little Green Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	6	26	40	19	0	1	92
						answered question	92
						skipped question	1

16. How has the current water quality changed in Little Green Lake since you first visited the lake?

Answer Options	Severely degraded	Somewhat degraded	Remained the same	Somewhat improved	Greatly improved	Unsure	Response Count
	10	22	19	24	12	6	93
						answered question	93
						skipped question	0



17. Before reading the statement above, had you ever heard of aquatic invasive species?

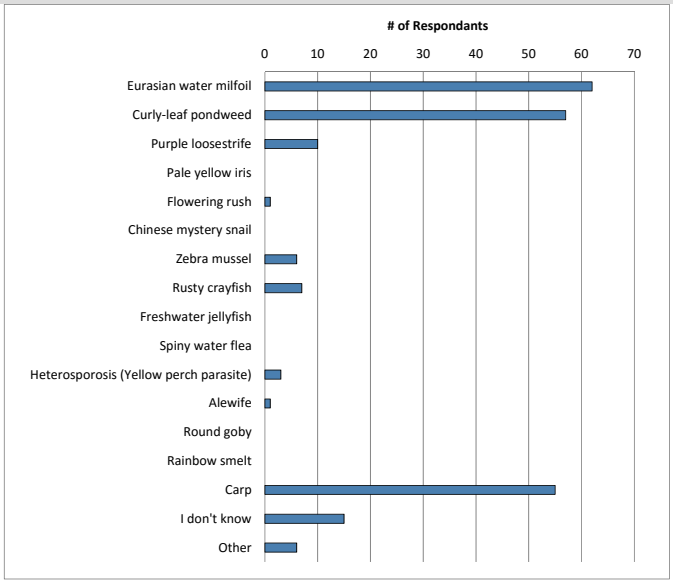
Answer Options	Response Percent	Response Count
Yes	97.8%	91
No	2.2%	2
answered question		93
skipped question		0

18. Do you believe aquatic invasive species are present within Little Green Lake?

Answer Options	Response Percent	Response Count
Yes	91.0%	81
No	9.0%	8
answered question		89
skipped question		4

19. Which aquatic invasive species do you believe are in Little Green Lake?

Answer Options	Response Percent	Response Count
Eurasian water milfoil	74.7%	62
Curly-leaf pondweed	68.7%	57
Purple loosestrife	12.0%	10
Pale yellow iris	0.0%	0
Flowering rush	1.2%	1
Chinese mystery snail	0.0%	0
Zebra mussel	7.2%	6
Rusty crayfish	8.4%	7
Freshwater jellyfish	0.0%	0
Spiny water flea	0.0%	0
Heterosporosis (Yellow perch parasite)	3.6%	3
Alewife	1.2%	1
Round goby	0.0%	0
Rainbow smelt	0.0%	0
Carp	66.3%	55
I don't know but presume AIS to be present	18.1%	15
Other (please specify)	7.2%	6
answered question		83
skipped question		10



Number	Other (please specify)
1	milfoil loosestrife zebra mussel carp
2	blue green algae
3	I believe there are other invasive plants and insects but I do not know what they are
4	Rusty crayfish spit out by bass id'd by DNR
5	don't the name but we've been spraying for years
6	Bullheads

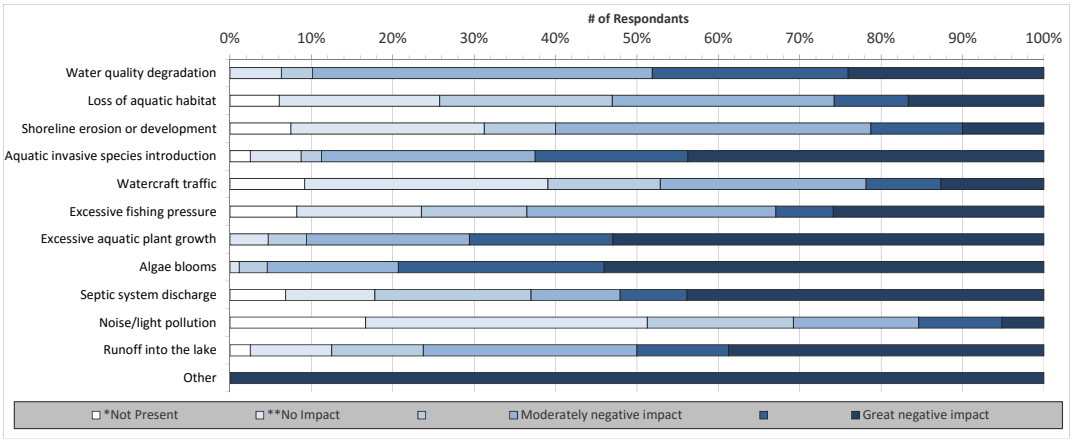
20. To what level do you believe each of the following factors may currently be negatively impacting Little Green Lake?

*** Not Present means that you believe the issue does not exist on Little Green Lake.**

**** No Impact means that the issue may exist on Little Green Lake but it is not negatively impacting the lake.**

Answer Options	*Not Present	**No Impact		Moderately negative impact		Great negative impact	Unsure: Need more information	Rating Average	Response Count
Water quality degradation	0	5	3	33	19	19	10	3.16	89
Loss of aquatic habitat	4	13	14	18	6	11	17	2.10	83
Shoreline erosion or development	6	19	7	31	9	8	8	2.30	88
Aquatic invasive species introduction	2	5	2	21	15	35	10	3.41	90
Watercraft traffic or unsafe watercraft practices	8	26	12	22	8	11	3	2.26	90
Excessive fishing pressure	7	13	11	26	6	22	3	2.81	88
Excessive aquatic plant growth (excluding algae)	0	4	4	17	15	45	5	3.87	90
Algae blooms	0	1	3	14	22	47	5	4.04	92
Septic system discharge	5	8	14	8	6	32	17	2.71	90
Noise/light pollution	13	27	14	12	8	4	6	1.70	84
Runoff into the lake	2	8	9	21	9	31	8	3.18	88
Other (please specify)	0	0	0	0	0	5	3	3.13	8
Other (please specify)									9
								answered question	**93**
								skipped question	**0**

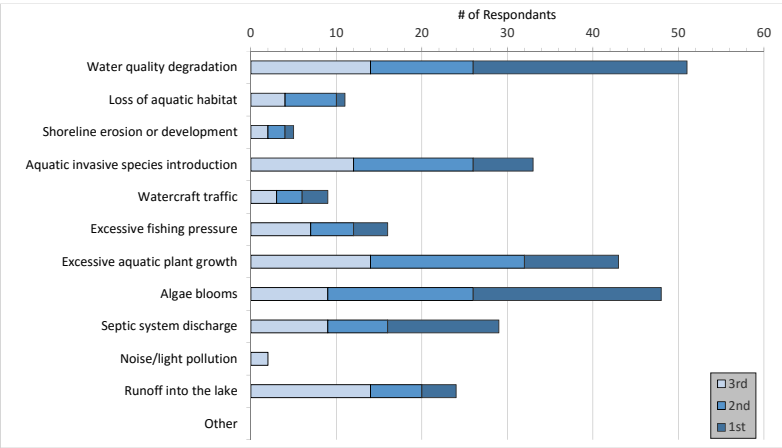
Number	Other (please specify)
1	Septics need to be cleaned out every 3 years
2	Eutrophication
3	phase 2 & 3 of the sewer project NEVER implemented! south side property owners got ROYALLY screwed on that deal!
4	Major run off on bluff side of lake. Opposite side of bait shop. During ice fishing we have seen the ice coming out of the bluff.
5	All residences should have city sewer.
6	Over fishing / Unsustainable Fishing activity / Keeping everything they catch
7	pumping phosphorus by airators
8	lack of interest from residents small business on the lake pursuing their own business interests at the expense of the lake's water quality and fish habitat and the attitude of the DNR
9	Use of fertilizers on the lawns



21. From the list below, please rank your top three concerns regarding Little Green Lake, with 1 being your greatest concern.

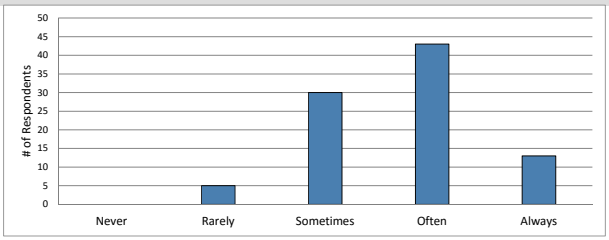
Answer Options	1st	2nd	3rd	Response Count
Water quality degradation	25	12	14	51
Loss of aquatic habitat	1	6	4	11
Shoreline erosion or development	1	2	2	5
Aquatic invasive species introduction	7	14	12	33
Watercraft traffic or unsafe watercraft practices	3	3	3	9
Excessive fishing pressure	4	5	7	16
Excessive aquatic plant growth (excluding algae)	11	18	14	43
Algae blooms	22	17	9	48
Septic system discharge	13	7	9	29
Noise/light pollution	0	0	2	2
Runoff into the lake	4	6	14	24
Other (please specify)	0	0	0	0
Please specify "Other" response here				1
			answered question	**91**
			skipped question	**2**

Number	Please specify "Other" response here
1	water quality degradation



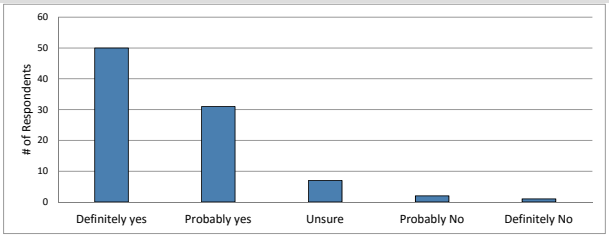
22. During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of Little Green Lake?

Answer Options	Never	Rarely	Sometimes	Often	Always	Response Count
	0	5	30	43	13	91
					answered question	**91**
					skipped question	**2**



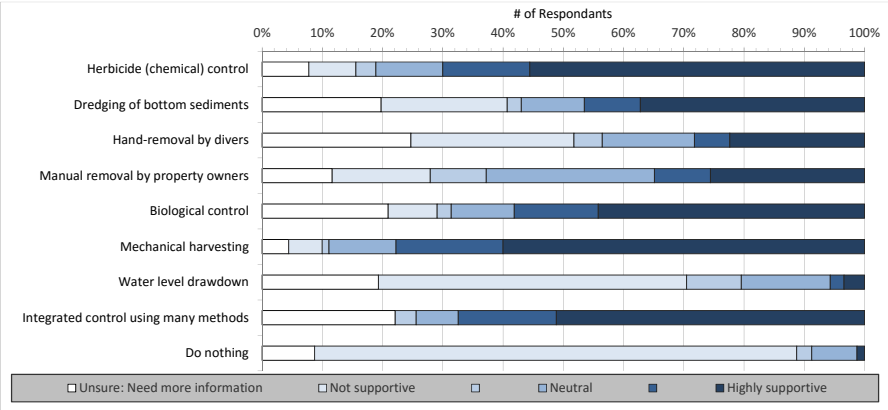
23. Considering your answer to the question above, do you believe aquatic plant control is needed on Little Green Lake?

Answer Options	Definitely yes	Probably yes	Unsure	Probably No	Definitely No	Response Count
	50	31	7	2	1	91
					answered question	**91**
					skipped question	**2**



24. Aquatic plants can be managed using many techniques. What is your level of support for the responsible use of the following techniques on Little Green Lake?

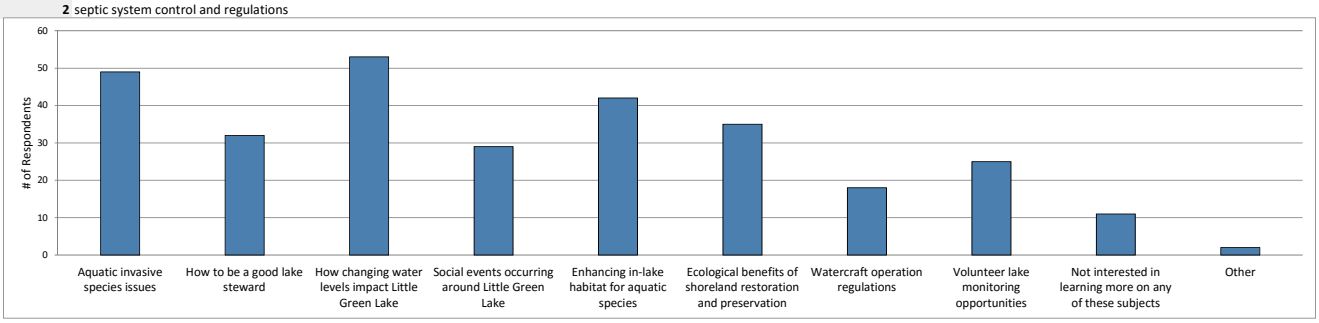
Answer Options	Not supportive		Neutral		Highly supportive	Unsure: Need more information	Rating Average	Response Count
Herbicide (chemical) control	7	3	10	13	50	7	3.83	90
Dredging of bottom sediments	18	2	9	8	32	17	2.80	86
Hand-removal by divers	23	4	13	5	19	21	2.18	85
Manual removal by property owners	14	8	24	8	22	10	2.84	86
Biological control (milfoil weevil, loosestrife beetle, etc)	7	2	9	12	38	18	3.21	86
Mechanical harvesting	5	1	10	16	54	4	4.12	90
Water level drawdown	45	8	13	2	3	17	1.40	88
Integrated control using many methods	0	3	6	14	44	19	3.49	86
Do nothing (do not manage plants)	64	2	6	0	1	7	1.14	80
							answered question	91
							skipped question	2



25. Property owner education is an important component of every lake management planning effort. Which of these subjects would you like to learn more about?

Answer Options	Response Percent	Response Count
Aquatic invasive species impacts, means of transport, identification, control options, etc.	55.1%	49
How to be a good lake steward	36.0%	32
How changing water levels impact Little Green Lake	59.6%	53
Social events occurring around Little Green Lake	32.6%	29
Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species	47.2%	42
Ecological benefits of shoreland restoration and preservation	39.3%	35
Watercraft operation regulations – lake specific, local and statewide	20.2%	18
Volunteer lake monitoring opportunities (Clean Boats Clean Waters, Citizens Lake Monitoring Network, Loon Watch, Little Green Lake programs, etc.)	28.1%	25
Not interested in learning more on any of these subjects	12.4%	11
Some other topic (please specify)	2.2%	2
	answered question	89
	skipped question	4

Number	Some other topic (please specify)
1	Reasons some homes do not have city sewer or at least 3-year checkups of their septic systems
2	septic system control and regulations

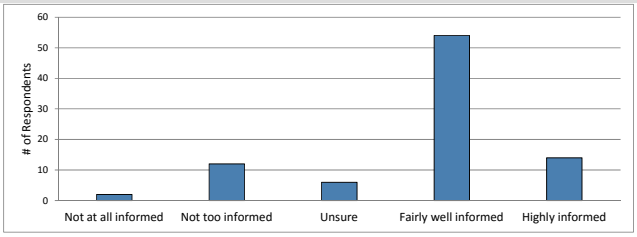


26. Before receiving this mailing, have you ever heard of the LGLPRD?

Answer Options	Response Percent	Response Count
Yes	96.7%	89
No	3.3%	3
	answered question	92
	skipped question	1

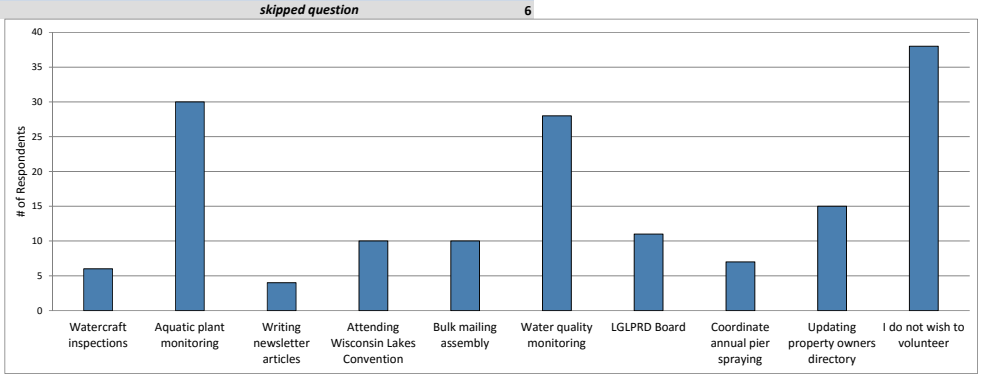
27. How informed has the LGLPRD kept you regarding issues with Little Green Lake and its management?

Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	2	12	6	54	14	88
					answered question	88
					skipped question	5



28. The effective management of your lake will require the cooperative efforts of numerous volunteers. Please select the activities you would be willing to participate in if the LGLPRD requires additional assistance.

Answer Options	Response Percent	Response Count
Watercraft inspections at boat landings	6.9%	6
Aquatic plant monitoring	34.5%	30
Writing newsletter articles	4.6%	4
Attending Wisconsin Lakes Convention	11.5%	10
Bulk mailing assembly	11.5%	10
Water quality monitoring	32.2%	28
LGLPRD Board	12.6%	11
Coordinate annual pier spraying	8.0%	7
Updating property owners directory	17.2%	15
I do not wish to volunteer	43.7%	38
	answered question	87
	skipped question	6



29. Please feel free to provide written comments regarding what you think are the most important areas and actions to include in a long term Lake Management Plan for Little Green Lake.

Answer Options	Response Count
	45
answered question	45
skipped question	48

Number	Response Text
1	I am not a big fisherman, but I feel the lake is being over fished and exploited by Vandy's & The Landing with weekly & weekend tournaments year round. The lake has improved it's water quality over the past years with sewer going to Markesan, regular inspections of septic systems, run off changes, aerators, weed cutting and spraying. The LGLPO have been doing a very good job to improve the lake. A new issue now developing the past couple years are inexperienced PWC drivers and noise pollution, making it dangerous and annoying.
2	I'm a property owner on LGL and the bay by Welk's Landing "never" gets weeded by the machine. It's gotten so bad that boats can't get in or out of their own piers. We need to have more weed eaters in our area. The runoff and water/sewerage is been an issue with 1/2 of the lake NOT getting switched over as planned and charged to city pipes for sewer/water. That's unfair and costly to the lake life.
3	I could not answer many of the questions because of either computer failure or the survey error.
4	Better monitoring and management efforts so that the lake can be better used by property owners who support and pay taxes into the LGL Rehabilitation District
5	Pier weed control and algae control. Septic systems around the lake need to be periodical checked. Sewers around the whole lake would be helpful for water quality and the weed bloom.
6	It's a wonderful lake. Just not much fun when the weeds/algae (& smell) really boost up in the summer
7	Controlling the algae bloom. Nothing ruins a week-end at the lake like the slimy green algae.
8	consideration for sewers around the entire lake -continued monitoring water quality & of aquatic plants & algae
9	Continue and expand aeration of Little Green Lake; The lake continues to naturally fill with sediments and becomes more shallow resulting in eutrophication, which I believe is the biggest, but most difficult problem.
10	Weed harvesting and pier spraying needs to begin 3 weeks earlier.Until pier spraying and weed harvesting is done,I cannot use my pier
11	It's very upsetting when you fish off of a pier your line get caught every time you cast. No pleasure at all. They need to dredge along the southwest end,
12	Work on proper destrat operation
13	the DNR will not allow us to operate mechanical harvester before June 1st...after ice out...their are a lot of floating weeds in Kearley Bay...why can't we...without cutting...collect all the floating weeds? Ice out is typically early April.
14	LGLPRD refuses to send ME any notice or information (including THIS survey) because I am a co-owner and "my name is not listed first on the title". You need to send notices to ALL listed owners!!
15	Sewer all around the lake lower sewer bill!!!
16	Spray piers so people can enjoy the water where they live
17	Something needs to be done to get rid of the weeds in the lake. It is getting just terrible. This is our 3rd year on the lake and our first summer there were tons of boats out on the lake every weekend we were there and even more on holidays. This year on the 4 of July there weren't even a handful of boats out on the lake. We haven't even taken our boat out this summer because they are so bad. We only have a 25 hp motor and it gets stuck in the weeds easily. Last summer they were bad as well. Something really needs to be done to get rid of them

Number	Response Text
18	The mechanical harvesting program is utmost in removal of the bio-mass which has been the largest contributor to the algae bloom, it also keeps the lake area open to water traffic and swimming. The De-stratification system has also shown to have helped in the improvement of the water quality since it installation. Looking into upgrading this system to more effective and efficient application methods and equipment is important.
19	The lake has so much intense traffic for the majority of daylight hours that it never has time to recover. On weekends the lake is roiling almost all day. Feel sorry for the fish who don't have weeds to take up the impact and to seek refuge in.The noise level under water is intense all day long on weekends.The lake is not even close to what is has been and could be for fishing. There needs to be a no wake regulation set up so that the lake can recover. Suggested times would be no wake before 10am and after 6pm. This could be self-monitored with proper education and signs at all landings. Works great on Random Lake, maybe contact them for how they instituted this.
20	Get this lake back to the clarity it had in the 1960s. Homes should have perfect-running septic systems OR they should be hooked up to the city sewer.
21	Have noticed water quality decline in the past two years. Up until then we have seen great improvement in water quality especially over the last 10 years or so, but now noticeably poorer.
22	Thank you for this survey and getting feedback from the property owners around the lake. I believe a long term integrated plan of many tactics will be required to keep the lake healthy and it appears to me based on this survey that this is the direction we are going
23	Continue cutting! They've done a wonderful job this year!!!
24	The biggest issue is algae. I don't understand the biology of it and how it gets addressed and understanding there are farms next to the lake that likely cause run-off, is there not some process, product (natural/organic or otherwise), or approach that can be used to avoid seeing algae buildup along the shore, and in particular on the northeast shore of the lake? We sign up every year for weed removal but it's never bad by our pier....but the algae is, and makes a lot of people not want to swim, hence loss of enjoyment of the lake.
25	15 years ago we were told that the septic systems and area farm land was the cause of the lake issues. 1/4 of the lake has paid for sewer. If all properties benefit from the sewer then ALL property owners should contribute to the fixed costs (not usage) of the sewer system. Or, install sewer at the remaining properties and make the farmlands put in run-off basins. If the sewer was not necessary, give us the option to install septic system and get off of the sewer system and save the money.
26	We feel the airators gave a definite improvement on the quality of the water in the lake..wonder why they stopped using them..
27	shut off aerators. Install sewers on the whole lake to stop nitrate from septic systems going into the lake.
28	weed cutting at a deeper level and picking up of the cut weeds along with more chemical control
29	Meaningful interaction between the DNR and lake management Increased involvement with the county..(land conservation) and the TOWN help , cooperation and support from the TOWN,County in pursuing grants informative and meaningful dialogue between the DNR fish biologists and lake management regarding controlling carp population and fish habitat
30	Changeover from septic to sewer system. Control of weeds
31	The invasive and noninvasive plants are being "fertilized" by runoff from the farm fields. Maybe planting plants that would filter (use) the chemicals and water along the common runoff sites would help to "heal" the lake. Prudent use of fertilizers and pesticides could also save farmers money.
32	Do not let water quality decrease or go backwards. People expect a lake they live on to be useable for swimming and all the lake activities. Without that people will sell and it will affect the entire community. It is such a beautiful lake before the algue sets in each yr exactly when good vacation weather begins, and then it makes it embarrassing to even entertain quests if we cannot swim or even walk in it. Thanks for the survey and your work on little green.
33	We need to assess the homes that may not have adequate septic system with risk of contaminating the lake and force necessary corrections.
34	It is pointless to require septic systems on one side and not the other. It also breeds distrust of the board.
35	1. Earlier annual herbicide spraying on the lake. 2. Earlier annual spraying around the piers. 3. Creation of a Little Green Lake historical timeline to show past actions and accomplishments. 4. More frequent communications via email and the web site. 5. Better Carp control 6. LGLPRD support and funding for increased annual fish stocking, multiple varieties of fish 7. Stop band on stocking muskie 8. Extensive plan for improving water quality and weed control 9. Research what Lake Management Improvement methods and actions have been successful at other lakes.
36	Identify actions to be taken and expected results. Show actual measured results for each action against expected to show the success of plan.
37	We had the understanding that, in 1999, that the South shore would be phase 1 for the sewer district & that phase 2 would be completed within 10 years after phase 1 was completed. There was NEVER a mention of a phase 3, which cover the Northwest shore line. We feel that from Lakeview Inn to & all of Little Green Road, & continue into North Lake Shore Drive to the end of the road. When the sewer goes into this area, we KNOW the lake will be very much better off than it is now. The booklet we receive says & I quote: 'Dedicated To The Well Being AND Preservation Of Little Green Lake'. There is NO meaning to that phrase unless we finish what was started with the sewer.
38	I am against any fertilizers being used on lawns on Little Green Lake. Also, I am against people being able to landscape their lawns - it does nothing good for the lake. I believe all shorelines should be natural habitat and absolutely no fertilizers should be used. I believe the use of fertilizer and landscaping degrades the lake greatly!! Please consider making a rule around the lake for people not to fertilize or landscape lake front property. We are losing many of our wild animals, birds, ducks and aquatic species.
39	Based on my answer to question #14, you can tell that the beauty of the lake and the scenery on the shores are important to me. When Ben Welk owned the property on the NW shore of the lake, he was willing to pay to have the lake dredged on that end. The DNR would not allow it. Since that time the weeds are growing farther into the lake, more green "scum" is covering the lake, the area looks neglected, and the view is spoiled. Granted, the fish need a place to spawn. However, the weed eating machine can't get close enough to that area because the people in charge have waited too long to take responsibility and address the problem. Having areas on the lake with green "scum" look unhealthy and uninviting. Weed eating machines are necessary. However, is money being borrowed from the sewer accounts which would make it difficult for some land owners to pay off those old sewer bills?
40	I think it is unfair when attending a meeting once a year, that we can't have items placed on the agenda.
41	North side of lake to get sewer.
42	#1 - There should be a boat launch fee and a ice fishing shanty fee. We taxpayers who own property on the lake should get a free annual sticker - the rest of the public should pay to launch - have an annual sticker of $25 for up to a 15' boat and $40 for bigger boats or pontoons. Also, ice fishing shanty's should pay a fee to use our lake. They practically fish it out - they catch many walleyes and thousands of pan fish each winter. And we lake front property owners pay big taxes - what do we get? No fish left - water quality is not the best - lots of weeds. I think it's time to disband the LGLPRD. Let the lake go whichever way it goes. My taxes would be less and we would have the lake to ourselves. And stop the silly DNR muskie program. The lake is too small, too shallow and has not structure to support them.
43	Blue Green Algae is public enemy #1 on Little Green -- for goodness sake -- it's poison. 45 years ago we had NO Blue Green Algae -- every bay was choked solid with weeds - nearly every shoreline had extensive weed beds. About the 1st week of August, a green algae bloom would occur -- it always cleared off 100% after a cold night or two in October. The green algae bloom did not affect the fishes flavor - dogs could swim in it - it had no foul odor. Blue Green Algae made it appearance when people decided the appearance of the lake was of utmost importance. People were looking at the cosmetics - wanting instant gratification - open water. The people I've talked with in both Horicon and "no brainer" - rather having weeds and healthy water than poison and indescribable stench? Our channel in the northwest corner of Welk's bay is cut off from the lake by a fine crop of cattails. The channel used to be 4' deep - sediments blown in and rotted leaves, weeds, etc. - now have it at about 1' deep. No chemicals are ever applied and no weeds harvested - part the topwater duckweed and you see healthy water - part the weeds in the bay's far shallows and you see healthy water - go out to where the weeds thin out - you see scum and pea green water with that odor that comes right before a blue green bloom. We need a weed choked lake again -- people will always find a method to get their outboard craft to open water. The shallows used to be loaded with fish during even the hottest weather - weeds shading the water is no different that a shade tree on your lawn. Fish never had that weedy after taste years ago - and that included always scaling them and eating the skin. Best wishes for Healthy Water.
44	Properties around the lake should not be able to use lawn chemicals.
45	Quit experimenting on the lake! Please use proven techniques. The Aerator is an example of a really bad experiment. Since it has been off, we don't have the blue mold or the really bad smell.

C

APPENDIX C

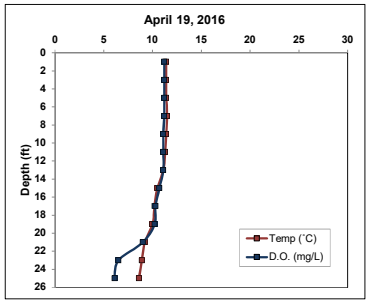
Water Quality Data

Little Green Lake

Date: 4/19/2016
Time: 10:25
Weather: 50F, 100% clouds
Entry: EEH

Max Depth: 26.0
LS Depth (ft): 3.0
LB Depth (ft): 23.0
Secchi Depth (ft): 5.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	11.4	11.2		
3	11.4	11.2	8.7	
5	11.4	11.2		
7	11.5	11.2		
9	11.4	11.1		
11	11.3	11.1		
13	11.1	11.1	8.6	
15	10.5	10.7		
17	10.2	10.3		
19	10.0	10.2		
21	9.2	9.0		
23	8.9	6.5	8.4	
25	8.6	6.1		



Parameter	LS	LB
Total P (µg/L)	34.20	26.50
Dissolved P (µg/L)	3.10	3.40
Chl-a (µg/L)	7.97	NA
TKN (µg/L)	1020.00	949.00
$NO_3 + NO_2$-N (µg/L)	267.00	260.00
NH_3-N (µg/L)	29.10	27.80
Total N (µg/L)	1287.00	1209.00
Lab Cond. (µS/cm)	367.00	371.00
Lab pH	8.39	8.19
Alkalinity (mg/L $CaCO_3$)	148.00	150.00
Total Susp. Solids (mg/L)	NA	4.80
Calcium (mg/L)	29.40	NA
Magnesium (mg/L)	23.80	NA
Hardness (mg/L)	172.00	NA
Color (SU)	5.00	NA
Turbidity (NTU)	NA	NA

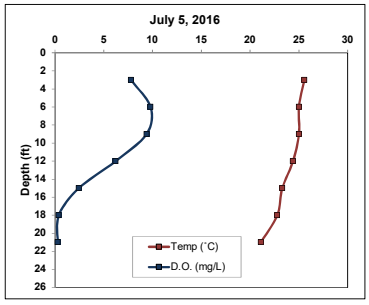
Data collected by TWH (Onterra).

Little Green Lake

Date: 7/5/2016
Time: 15:36
Weather: 0% clouds, 27.2C
Entry: EEH

Max Depth:
LS Depth (ft):
LB Depth (ft):
Secchi Depth (ft): 4.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
3	25.6	7.8		
6	25.0	9.8		
9	25.0	9.4		
12	24.4	6.2		
15	23.3	2.4		
18	22.8	0.4		
21	21.1	0.3		



Parameter	LS	LB
Total P (µg/L)	59.10	NA
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	39.50	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	1190.00	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

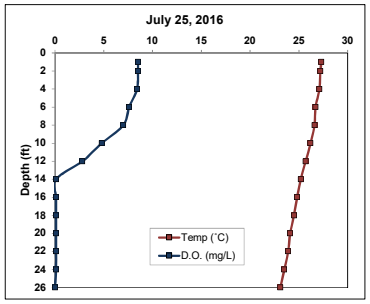
Data collected by Michael Ross (CLMN).

Little Green Lake

Date: 7/25/2016
Time: 11:20
Weather: 0% clouds, 77F
Entry: JLW

Max Depth: 26.1
LS Depth (ft): 3.0
LB Depth (ft): 23.0
Secchi Depth (ft): 2.6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	27.3	8.5		
2	27.2	8.5		
4	27.1	8.4		
6	26.7	7.6		
8	26.6	7.0		
10	26.2	4.8		
12	25.7	2.8		
14	25.2	0.1	8.2	
16	24.8	0.1		
18	24.5	0.1		
20	24.1	0.1		
22	23.9	0.1	7.9	
24	23.5	0.1		
26	23.1	0.0		



Parameter	LS	LB
Total P (µg/L)	71.10	262.00
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	31.90	NA
TKN (µg/L)	1050.00	NA
$NO_3 + NO_2$-N (µg/L)	ND	NA
NH_3-N (µg/L)	16.80	NA
Total N (µg/L)	1050.00	NA
Lab Cond. (µS/cm)	318.00	356.00
Lab pH	8.88	7.64
Alkalinity (mg/L $CaCO_3$)	134.00	152.00
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	15.00	NA
Turbidity (NTU)	NA	NA

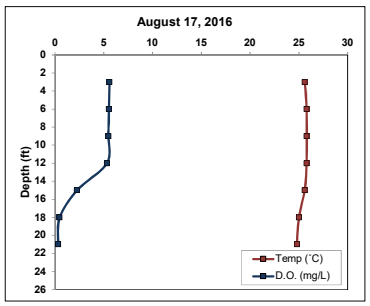
Aerators were running. Data collected by BTB & LJS (Onterra).

Little Green Lake

Date: 8/17/2016
Time: 15:30
Weather: 0% clouds, 28.3C
Entry: EEH

Max Depth:
LS Depth (ft):
LB Depth (ft):
Secchi Depth (ft): 3.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
3	25.6	5.6		
6	25.8	5.5		
9	25.8	5.5		
12	25.8	5.3		
15	25.6	2.3		
18	25.0	0.5		
21	24.8	0.3		



Parameter	LS	LB
Total P (µg/L)	55.50	NA
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	45.00	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	1480.00	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

Data collected by Michael Ross (CLMN).

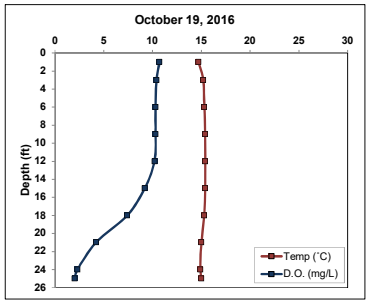
17-Sep

Little Green Lake

Date: 10/19/2016
Time: 9:06
Weather: 75% clouds, 60F
Entry: JMB

Max Depth: 27.1
LS Depth (ft): 3.0
LB Depth (ft): 25.0
Secchi Depth (ft): 3.6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	14.7	10.7		
3	15.2	10.4		
6	15.3	10.3		
9	15.4	10.3		
12	15.4	10.2		
15	15.4	9.2		
18	15.3	7.4		
21	15.0	4.2		
24	14.9	2.3		
25	15.0	2.0		



Parameter	LS	LB
Total P (µg/L)	59.20	103.00
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	34.70	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	10.20	12.00
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

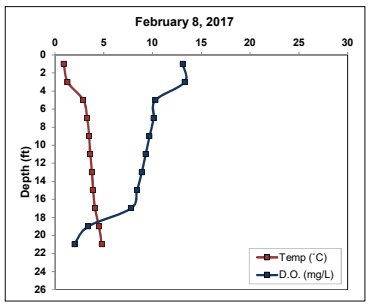
Data collected by Onterra.

Little Green Lake

Date: 2/8/2017
Time: 11:10
Weather: 90% clouds 18F
Entry: JMB

Max Depth: 22.1
LS Depth (ft): 3.0
LB Depth (ft): 19.0
Secchi Depth (ft): 7.9

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	0.9	13.1		
3	1.3	13.3		
5	2.9	10.3		
7	3.3	10.1		
9	3.5	9.7		
11	3.6	9.3		
13	3.8	8.9		
15	3.9	8.4		
17	4.1	7.8		
19	4.5	3.4		
21	4.8	2.0		



Parameter	LS	LB
Total P (µg/L)	25.50	31.90
Dissolved P (µg/L)	2.60	10.80
Chl-a (µg/L)	NA	NA
TKN (µg/L)	1000.00	1070.00
$NO_3 + NO_2$-N (µg/L)	112.00	149.00
NH_3-N (µg/L)	118.00	275.00
Total N (µg/L)	1112.00	1219.00
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

Data collected by TWH & LJS (Onterra). Ice depth: 1.3ft.

Water Quality Data

2016-2017	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	6	4.4	NA	NA
Total P (µg/L)	6	50.8	4	105.9
Dissolved P (µg/L)	2	2.9	2	7.1
Chl a (µg/L)	5	31.8	0	NA
TKN (µg/L	3	1023.3	2	1009.5
NO_3+NO_2-N (µg/L)	3	189.5	2	204.5
NH_3-N (µg/L)	3	54.6	2	151.4
Total N (µg/L)	5	1223.8	2	1214.0
Lab Cond. (µS/cm)	2	342.5	2	363.5
Alkal (mg/l $CaCO_3$)	2	141.0	2	151.0
Total Susp. Solids (mg/l)	1	10.2	2	8.4
Calcium (mg/L)	1	29.4	0	NA
Magnesium (mg/L)	1	23.8	0	NA
Hardness (mg/L)	1	172.0	0	NA
Color (SU)	2	10.0	0	NA
Turbidity (NTU)	0	NA	0	NA

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1986			69.1
1987			71.3
1988			73.7
1989			66.5
1990	77.8		65.1
1991	77.9		64.9
1992	78.1		60.8
1993	73.3	65.2	55.6
1994	78.9	72.4	53.2
1995	76.0	60.9	47.7
1996	70.9	65.5	51.4
1997			
1998	80.2	76.0	66.5
1999	84.3	69.6	61.3
2000	80.4	71.8	69.1
2001			
2002			
2003	81.7	67.5	60.3
2004	75.0		61.3
2005	83.1		
2006	81.4	64.7	
2007			
2008			
2009			
2010			69.1
2011	70.0	68.5	54.9
2012	66.3	69.2	63.9
2016	63.6	66.5	60.4
All Years (Weighted)	77.4	65.6	58.6
SHDL Median	52.7	50.4	52.4
SWTP Ecoregion Median	48.7	47.0	50.0
Mean 1993-2007	78.7	68.2	58.5
Mean 2011-2016	66.7	68.1	62.1

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1993	73.3	65.2	55.6
1994	78.9	72.4	53.2
1995	76.0	60.9	47.7
1996	70.9	65.5	51.4
1998	80.2	76.0	66.5
1999	84.3	69.6	61.3
2000	80.4	71.8	69.1
2001	68.5	67.9	66.0
2003	81.7	67.5	60.3
2004	75.0	72.8	61.3
2005	83.1		53.9
2011	70.0	68.5	54.9
2012	66.3	69.2	63.9
2013	68.6	71.7	53.8
2014	64.8	67.3	51.1
2015	70.0	64.4	53.9
2016	63.6	66.5	60.4
All Years	73.9	68.6	57.9

	Secchi (feet)				Chlorophyll-*a* (µg/L)				Total Phosphorus (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1986	1	1.8	1	1.8								
1987	22	2.5	7	1.5								
1988	15	2.0	12	1.3								
1989	8	1.8	6	2.1								
1990	14	2.2	9	2.3					4	171.1	2	165.0
1991	14	2.9	11	2.3					3	174.3	2	166.5
1992	14	3.1	9	3.1					4	150.0	2	169.0
1993	15	5.7	10	4.5	5	28.4	3	34.0	5	103.0	3	120.7
1994	19	5.5	11	5.3	5	83.3	3	71.1	5	188.0	3	178.7
1995	21	7.4	12	7.7	4	28.0	2	21.9	5	158.8	3	146.3
1996	18	6.7	11	5.9	5	57.5	3	34.9	5	148.8	3	102.7
1997	0		0		0		0		0		0	
1998	5	2.2	3	2.1	5	76.4	3	102.7	5	222.4	3	195.0
1999	4	2.6	2	3.0	4	43.5	2	53.4	5	284.4	3	260.0
2000	5	1.5	3	1.8	5	79.6	3	67.0	7	172.3	3	197.7
2001	3	2.2	3	2.2	3	45.0	3		3	87.0	3	
2002	0		0		0		0		0		0	
2003	14	4.2	8	3.2	10	44.2	7	43.1	7	251.9	6	216.2
2004	12	3.3	9	3.0	14	59.2	11		6	99.8	4	135.8
2005	10	5.0	9	5.0	0		0		10	219.1	9	238.3
2006	0		0		2	20.9	1	32.2	2	128.5	1	212.0
2007	0		0		1	115.0	1		1	193.0	1	
2008	0		0		0		0		0		0	
2009	0		0		0		0		0		0	
2010	4	3.4	2	1.8	0		0		0		0	
2011	7	4.4	3	4.7	2	47.8	2	47.8	3	75.0	2	96.5
2012	5	3.3	3	2.5	3	51.1	3	51.1	2	74.5	2	74.5
2013												
2014												
2015												
2016	5	3.6	3	3.2	5	31.8	3	38.8	5	55.8	3	61.9
All Years (Weighted)		4.0		3.6		53.2		35.6		166.2		160.8
SHDL Median				5.6				7.5				29.0
SWTP Ecoregion				6.6				5.3				22.0
2013-14 wted mean		3.9		3.2		47.8		47.8		75.0		96.5
1993-2007 wted mean				4.7				34.5				177.3
2011-2016 wted mean				3.1				45.7				75.4

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 1/24/2017 Scenario: Little Green Current

Lake Id: Little Green Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 1939.0 acre
Total Unit Runoff: 9.30 in.
Annual Runoff Volume: 1502.7 acre-ft
Lake Surface Area <As>: 479.0 acre
Lake Volume <V>: 5446.0 acre-ft
Lake Mean Depth <z>: 11.4 ft
Precipitation - Evaporation: 3.1 in.
Hydraulic Loading: 1626.5 acre-ft/year
Areal Water Load <qs>: 3.4 ft/year
Lake Flushing Rate <p>: 0.30 1/year
Water Residence Time: 3.35 year
Observed spring overturn total phosphorus (SPO): 35.6 mg/m^3
Observed growing season mean phosphorus (GSM): 86.24 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre	Low	Most Likely	High	Loading %	Low	Most Likely	High
	(ac)	Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	637	0.50	1.00	3.00	32.2	129	258	773
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	191	0.10	0.30	0.50	2.9	8	23	39
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	1	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	58	0.05	0.10	0.25	0.3	1	2	6
Wetlands	91.0	0.10	0.10	0.10	0.5	4	4	4
Forest	147.0	0.05	0.09	0.18	0.7	3	5	11
2009 Sedimentation Basin	294	0.00	0.00	0.00	0.0	0	0	0
2000 Sedimentation Basin	520	0.00	0.00	0.00	0.0	0	0	0
Lake Surface	479.0	0.10	0.30	1.00	7.3	19	58	194

POINT SOURCE DATA

Point Sources	Water Load	Low	Most Likely	High	Loading %
	(m^3/year)	(kg/year)	(kg/year)	(kg/year)	
2009 Sedimentation Basin	0.0	0.0	160	0.0	20.0
2000 Sedimentation Basin	0.0	0.0	276	0.0	34.5

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	266.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		1.60	13.30	42.56	1.7

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	365.0	1763.7	2356.8	100.0
Total Loading (kg)	165.6	800.0	1069.0	100.0
Areal Loading (lb/ac-year)	0.76	3.68	4.92	
Areal Loading (mg/m^2-year)	85.41	412.72	551.49	
Total PS Loading (lb)	0.0	961.2	0.0	54.5
Total PS Loading (kg)	0.0	436.0	0.0	54.5
Total NPS Loading (lb)	318.7	645.0	1835.6	43.8
Total NPS Loading (kg)	144.6	292.6	832.6	43.8

Phosphorus Prediction and Uncertainty Analysis Module

Date: 1/24/2017 Scenario: 47
Observed spring overturn total phosphorus (SPO): 35.6 mg/m^3
Observed growing season mean phosphorus (GSM): 86.2 mg/m^3
Back calculation for SPO total phosphorus: 0.0 mg/m^3
Back calculation GSM phosphorus: 0.0 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	18	87	116	1	1
Canfield-Bachmann, 1981 Natural Lake	25	68	82	-18	-21
Canfield-Bachmann, 1981 Artificial Lake	23	54	62	-32	-37
Rechow, 1979 General	7	32	43	-54	-63
Rechow, 1977 Anoxic	49	235	314	149	173
Rechow, 1977 water load<50m/year	15	72	96	-14	-16
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	164	220	128	360
Vollenweider, 1982 Combined OECD	25	90	114	29	48
Dillon-Rigler-Kirchner	20	95	127	59	166
Vollenweider, 1982 Shallow Lake/Res.	20	79	102	18	30
Larsen-Mercier, 1976	29	141	188	105	295
Nurnberg, 1984 Oxic	17	85	113	-1	-1

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	39	123	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	21	196	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	17	156	FIT	1	GSM
Rechow, 1979 General	14	47	FIT	0	GSM
Rechow, 1977 Anoxic	106	327	FIT	0	GSM
Rechow, 1977 water load<50m/year	31	104	P Pin	0	GSM

Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	62	266	FIT	0	SPO
Vollenweider, 1982 Combined OECD	34	153	FIT	0	ANN
Dillon-Rigler-Kirchner	43	133	P qs	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	30	132	FIT	0	ANN
Larsen-Mercier, 1976	65	191	P Pin	0	SPO
Nurnberg, 1984 Oxic	33	132	P	0	ANN

Water and Nutrient Outflow Module

Date: 1/24/2017 Scenario: 23
Average Annual Surface Total Phosphorus: 86.24mg/m^3
Annual Discharge: 1.63E+003 AF => 2.01E+006 m^3
Annual Outflow Loading: 365.3 LB => 165.7 kg

E

APPENDIX E

Aquatic Plant Survey Data

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
1	43.735570	-88.996910	286	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	1	3	Muck	Pole	SAMPLED			1			1									
2	43.734939	-88.996921	1	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	2	3	Muck	Pole	SAMPLED			1	1		1									
3	43.734309	-88.996931	19	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	3	2	Sand	Pole	SAMPLED			1			1	1			1		1			
4	43.736192	-88.996031	272	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	4	3	Sand	Pole	SAMPLED			2			2									
5	43.735562	-88.996041	285	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	5	4	Muck	Pole	SAMPLED			1	1		1									
6	43.734932	-88.996052	2	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	6	4	Muck	Pole	SAMPLED			2	2		1									
7	43.734302	-88.996062	18	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	7	2	Sand	Pole	SAMPLED			2				2		1			1			
8	43.736185	-88.995161	273	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	8	7	Muck	Pole	SAMPLED			0												
9	43.735554	-88.995172	284	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	9	6	Muck	Pole	SAMPLED			3	3				1							
10	43.734924	-88.995182	3	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	10	5	Muck	Pole	SAMPLED			1	1		1									
11	43.734294	-88.995193	17	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	11	3	Sand	Pole	SAMPLED			2				2			1		1			
12	43.736807	-88.994282	271	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	12	6	Muck	Pole	SAMPLED			0												
13	43.736177	-88.994292	274	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	13	9	Muck	Pole	SAMPLED			0												
14	43.735547	-88.994303	283	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	14	7	Muck	Pole	SAMPLED			0												
15	43.734917	-88.994313	4	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	15	5	Muck	Pole	SAMPLED			1	1											
16	43.734286	-88.994324	16	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	16	3	Muck	Pole	SAMPLED			2				1					2			
17	43.733026	-88.994345	38	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	17	4	Muck	Pole	SAMPLED		YES	3	1		3		1		1					
18	43.732396	-88.994356	39	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	18	4	Muck	Pole	SAMPLED			2			2				1				1	
19	43.736799	-88.993413	270	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	19	8	Muck	Pole	SAMPLED			1	1											
20	43.736169	-88.993423	275	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	20	12	Muck	Pole	SAMPLED			0												
21	43.735539	-88.993434	282	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	21	8	Muck	Pole	SAMPLED			0												
22	43.734909	-88.993444	5	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	22	5	Muck	Pole	SAMPLED			2	2		1		1				1		1	
23	43.733649	-88.993465	20	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	23	4	Muck	Pole	SAMPLED			3	1		2				1					
24	43.733018	-88.993476	37	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	24	4	Muck	Pole	SAMPLED		YES	3	1		3				1					
25	43.732388	-88.993486	40	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	25	4	Muck	Pole	SAMPLED			3	1		2				1				1	
26	43.731758	-88.993497	65	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	26	3	Muck	Pole	SAMPLED			3	1		2				1				1	
27	43.731128	-88.993508	66	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	27	1	Muck	Pole	SAMPLED		YES	3			3				1	1				1
28	43.737422	-88.992533	259	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	28	7	Sand	Pole	SAMPLED			0												
29	43.736792	-88.992543	269	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	29	12	Muck	Pole	SAMPLED			0												
30	43.736162	-88.992554	276	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	30	13	Muck	Pole	SAMPLED			0												
31	43.735531	-88.992565	281	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	31	8	Muck	Pole	SAMPLED			1	1											
32	43.734901	-88.992575	6	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	32	6	Muck	Pole	SAMPLED			2	1		2				1					
33	43.734271	-88.992586	15	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	33	3	Rock	Pole	SAMPLED			2	2				1		1					
34	43.733641	-88.992596	21	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	34	5	Muck	Pole	SAMPLED			3	3		1				1					
35	43.733011	-88.992607	36	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	35	5	Muck	Pole	SAMPLED		YES	3	3		1				1					
36	43.732381	-88.992617	41	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	36	5	Muck	Pole	SAMPLED			2			2				1					
37	43.731750	-88.992628	64	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	37	4	Muck	Pole	SAMPLED			2	1	1	2				1				1	
38	43.731120	-88.992639	67	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	38	4	Muck	Pole	SAMPLED			3	1		2				1				2	
39	43.730490	-88.992649	68	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	39	3	Muck	Pole	SAMPLED		YES	3			3				1					
40	43.737414	-88.991664	260	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	40	12	Muck	Pole	SAMPLED			0												
41	43.736784	-88.991674	268	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	41	15			DEEP															

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
42	43.736154	-88.991685	277	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	42	11	Muck	Pole	SAMPLED			0												
43	43.735524	-88.991695	280	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	43	11	Muck	Pole	SAMPLED			0												
44	43.734894	-88.991706	7	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	44	10	Muck	Pole	SAMPLED			1	1											
45	43.734263	-88.991717	14	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	45	9	Muck	Pole	SAMPLED			1	1											
46	43.733633	-88.991727	22	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	46	8	Muck	Pole	SAMPLED			0												
47	43.733003	-88.991738	35	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	47	7	Muck	Pole	SAMPLED			1			1									
48	43.732373	-88.991748	42	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	48	6	Muck	Pole	SAMPLED		YES	2	2		1				1					
49	43.731743	-88.991759	63	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	49	5	Muck	Pole	SAMPLED		YES	3	1		3		1		1					
50	43.731112	-88.991769	69	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	50	5	Muck	Pole	SAMPLED		YES	3	1		3		1		1					
51	43.738037	-88.990784	258	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	51	12	Sand	Pole	SAMPLED			0												
52	43.737407	-88.990795	261	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	52	17			DEEP															
53	43.736776	-88.990805	262	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	53	15	Muck	Pole	SAMPLED			0												
54	43.736146	-88.990816	267	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	54	11	Muck	Pole	SAMPLED			0												
55	43.735516	-88.990826	279	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	55	14	Muck	Pole	SAMPLED			0												
56	43.734886	-88.990837	8	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	56	14	Muck	Pole	SAMPLED			0												
57	43.734256	-88.990848	13	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	57	12	Muck	Pole	SAMPLED			0												
58	43.733626	-88.990858	23	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	58	12	Muck	Pole	SAMPLED			0												
59	43.732995	-88.990869	34	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	59	9	Muck	Pole	SAMPLED			0												
60	43.732365	-88.990879	43	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	60	8	Muck	Pole	SAMPLED			0												
61	43.731735	-88.990890	62	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	61	7	Muck	Pole	SAMPLED			1			1				1					
62	43.731105	-88.990900	70	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	62	6	Muck	Pole	SAMPLED			3	2		1	1			1					
63	43.739289	-88.989894	253	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	63	3	Sand	Pole	SAMPLED			2	V			2							1	
64	43.738659	-88.989904	254	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	64	13	Sand	Pole	SAMPLED			0												
65	43.738029	-88.989915	257	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	65	16			DEEP															
66	43.737399	-88.989925	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	66	0			DEEP															
67	43.736769	-88.989936	263	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	67	14	Muck	Pole	SAMPLED			0												
68	43.736139	-88.989947	266	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	68	13	Muck	Pole	SAMPLED			0												
69	43.735508	-88.989957	278	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	69	17			DEEP															
70	43.734878	-88.989968	9	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	70	16		Rope	SAMPLED			0												
71	43.734248	-88.989978	12	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	71	14	Muck	Pole	SAMPLED			0												
72	43.733618	-88.989989	24	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	72	13	Muck	Pole	SAMPLED			0												
73	43.732988	-88.990000	33	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	73	11	Muck	Pole	SAMPLED			0												
74	43.732358	-88.990010	44	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	74	10	Muck	Pole	SAMPLED			0												
75	43.731727	-88.990021	61	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	75	9	Muck	Pole	SAMPLED			1			1									
76	43.731097	-88.990031	71	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	76	7	Muck	Pole	SAMPLED			1	1											
77	43.739912	-88.989014	247	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	77	5	Sand	Pole	SAMPLED			2				2								
78	43.739282	-88.989025	252	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	78	14	Sand	Pole	SAMPLED			0												
79	43.738652	-88.989035	255	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	79	17			DEEP															
80	43.738021	-88.989046	256	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	80	18			DEEP															
81	43.737391	-88.989056	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	81	0			DEEP															
82	43.736761	-88.989067	264	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	82	16			DEEP															

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
83	43.736131	-88.989078	265	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	83	17			DEEP															
84	43.735501	-88.989088	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	84	0			DEEP															
85	43.734871	-88.989099	10	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	85	18			DEEP															
86	43.734240	-88.989109	11	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	86	17			DEEP															
87	43.733610	-88.989120	25	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	87	15	Muck	Pole	SAMPLED			0											
88	43.732980	-88.989131	32	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	88	12	Muck	Pole	SAMPLED			0											
89	43.732350	-88.989141	45	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	89	10	Muck	Pole	SAMPLED			0											
90	43.731720	-88.989152	60	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	90	10	Muck	Pole	SAMPLED			0											
91	43.731089	-88.989162	72	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	91	8	Muck	Pole	SAMPLED			1	1		1								
92	43.741165	-88.988124	239	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	92	2	Sand	Pole	SAMPLED			1	1										
93	43.740534	-88.988134	246	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	93	6	Sand	Pole	SAMPLED			1	1										
94	43.739904	-88.988145	248	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	94	15	Muck	Pole	SAMPLED			0											
95	43.739274	-88.988155	251	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	95	17			DEEP															
96	43.738644	-88.988166	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	96	0			DEEP															
97	43.738014	-88.988177	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	97	0			DEEP															
98	43.737384	-88.988187	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	98	0			DEEP															
99	43.736753	-88.988198	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	99	0			DEEP															
100	43.736123	-88.988208	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	100	0			DEEP															
101	43.735493	-88.988219	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	101	0			DEEP															
102	43.734863	-88.988230	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	102	0			DEEP															
103	43.734233	-88.988240	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	103	0			DEEP															
104	43.733602	-88.988251	26	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	104	15			DEEP															
105	43.732972	-88.988261	31	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	105	13	Muck	Pole	SAMPLED			0											
106	43.732342	-88.988272	46	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	106	12	Muck	Pole	SAMPLED			0											
107	43.731712	-88.988283	59	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	107	10	Muck	Pole	SAMPLED			0											
108	43.731082	-88.988293	73	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	108	8	Muck	Pole	SAMPLED			1		1	1								
109	43.730452	-88.988304	84	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	109	4	Sand	Pole	SAMPLED			2	1		2	1							
110	43.741787	-88.987244	238	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	110	3	Sand	Pole	SAMPLED			2	1		2							1	1
111	43.741157	-88.987254	240	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	111	10	Sand	Pole	SAMPLED			0											
112	43.740527	-88.987265	245	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	112	16			DEEP															
113	43.739897	-88.987276	249	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	113	16			DEEP															
114	43.739266	-88.987286	250	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	114	17			DEEP															
115	43.738636	-88.987297	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	115	0			DEEP															
116	43.738006	-88.987307	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	116	0			DEEP															
117	43.737376	-88.987318	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	117	0			DEEP															
118	43.736746	-88.987329	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	118	0			DEEP															
119	43.736115	-88.987339	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	119	0			DEEP															
120	43.735485	-88.987350	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	120	0			DEEP															
121	43.734855	-88.987361	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	121	0			DEEP															
122	43.734225	-88.987371	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	122	0			DEEP															
123	43.733595	-88.987382	290	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	123	0			DEEP															

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124	43.732965	-88.987392	27	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	124	13	Muck	Pole	SAMPLED			0												
125	43.732334	-88.987403	47	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	125	13	Muck	Pole	SAMPLED			0												
126	43.731704	-88.987414	58	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	126	11	Muck	Pole	SAMPLED			0												
127	43.731074	-88.987424	74	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	127	9	Muck	Pole	SAMPLED			0												
128	43.730444	-88.987435	83	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	128	4	Rock	Pole	SAMPLED			1	1											
129	43.741779	-88.986374	237	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	129	9	Sand	Pole	SAMPLED			0												
130	43.741149	-88.986385	241	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	130	14	Muck	Pole	SAMPLED			0												
131	43.740519	-88.986396	244	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	131	15			DEEP															
132	43.739889	-88.986406	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	132	0			DEEP															
133	43.739259	-88.986417	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	133	0			DEEP															
134	43.738628	-88.986428	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	134	0			DEEP															
135	43.737998	-88.986438	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	135	0			DEEP															
136	43.737368	-88.986449	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	136	0			DEEP															
137	43.736738	-88.986460	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	137	0			DEEP															
138	43.736108	-88.986470	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	138	0			DEEP															
139	43.735478	-88.986481	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	139	0			DEEP															
140	43.734847	-88.986491	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	140	0			DEEP															
141	43.734217	-88.986502	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	141	0			DEEP															
142	43.733587	-88.986513	291	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	142	0			DEEP															
143	43.732957	-88.986523	28	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	143	13	Muck	Pole	SAMPLED			0												
144	43.732327	-88.986534	48	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	144	14	Muck	Pole	SAMPLED			0												
145	43.731697	-88.986545	57	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	145	12	Muck	Pole	SAMPLED			0												
146	43.731066	-88.986555	75	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	146	9	Muck	Pole	SAMPLED			0												
147	43.730436	-88.986566	82	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	147	6	Rock	Pole	SAMPLED			1				1								
148	43.729806	-88.986576	85	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	148	3	Sand	Pole	SAMPLED			3			3	1								
149	43.744292	-88.985463	224	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	149	2	Sand	Pole	SAMPLED			2	1		2									
150	43.743662	-88.985473	225	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	150	2	Sand	Pole	SAMPLED			1	1											
151	43.743032	-88.985484	230	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	151	3	Sand	Pole	SAMPLED			0	V											
152	43.742402	-88.985495	231	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	152	6	Sand	Pole	SAMPLED			1	1		1	1								
153	43.741772	-88.985505	236	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	153	13	Muck	Pole	SAMPLED			0												
154	43.741141	-88.985516	242	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	154	15			DEEP															
155	43.740511	-88.985527	243	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	155	15			DEEP															
156	43.739881	-88.985537	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	156	0			DEEP															
157	43.739251	-88.985548	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	157	0			DEEP															
158	43.738621	-88.985558	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	158	0			DEEP															
159	43.737991	-88.985569	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	159	0			DEEP															
160	43.737360	-88.985580	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	160	0			DEEP															
161	43.736730	-88.985590	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	161	0			DEEP															
162	43.736100	-88.985601	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	162	0			DEEP															
163	43.735470	-88.985612	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	163	0			DEEP															
164	43.734840	-88.985622	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	164	0			DEEP															

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
165	43.734210	-88.985633	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	165	0			DEEP															
166	43.733579	-88.985644	292	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	166	0			DEEP															
167	43.732949	-88.985654	29	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	167	15	Muck	Pole	SAMPLED			0												
168	43.732319	-88.985665	49	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	168	15	Muck	Pole	SAMPLED			0												
169	43.731689	-88.985676	56	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	169	11	Muck	Pole	SAMPLED			0												
170	43.731059	-88.985686	76	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	170	9	Muck	Pole	SAMPLED			0												
171	43.730428	-88.985697	81	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	171	7	Muck	Pole	SAMPLED			1		1	1									
172	43.729798	-88.985707	86	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	172	5	Muck	Pole	SAMPLED			3	1		3									
173	43.744285	-88.984593	223	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	173	6	Muck	Pole	SAMPLED			0												
174	43.743654	-88.984604	226	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	174	8	Muck	Pole	SAMPLED			0												
175	43.743024	-88.984615	229	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	175	9	Muck	Pole	SAMPLED			0												
176	43.742394	-88.984625	232	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	176	11	Muck	Pole	SAMPLED			0												
177	43.741764	-88.984636	235	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	177	14	Muck	Pole	SAMPLED			0												
178	43.741134	-88.984647	296	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	178	0			DEEP															
179	43.740504	-88.984657	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	179	0			DEEP															
180	43.739873	-88.984668	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	180	0			DEEP															
181	43.739243	-88.984679	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	181	0			DEEP															
182	43.738613	-88.984689	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	182	0			DEEP															
183	43.737983	-88.984700	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	183	0			DEEP															
184	43.737353	-88.984711	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	184	0			DEEP															
185	43.736723	-88.984721	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	185	0			DEEP															
186	43.736092	-88.984732	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	186	0			DEEP															
187	43.735462	-88.984743	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	187	0			DEEP															
188	43.734832	-88.984753	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	188	0			DEEP															
189	43.734202	-88.984764	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	189	0			DEEP															
190	43.733572	-88.984775	293	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	190	0			DEEP															
191	43.732941	-88.984785	30	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	191	15			DEEP															
192	43.732311	-88.984796	50	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	192	14	Muck	Pole	SAMPLED			0												
193	43.731681	-88.984806	55	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	193	10	Rock	Pole	SAMPLED			0												
194	43.731051	-88.984817	77	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	194	9	Muck	Pole	SAMPLED			1			1									
195	43.730421	-88.984828	80	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	195	8	Muck	Pole	SAMPLED			1			1									
196	43.729791	-88.984838	87	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	196	5	Sand	Pole	SAMPLED			2	2		1	1								
197	43.744277	-88.983724	222	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	197	7	Muck	Pole	SAMPLED			1		1										
198	43.743647	-88.983735	227	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	198	9	Muck	Pole	SAMPLED			0												
199	43.743017	-88.983746	228	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	199	10	Muck	Pole	SAMPLED			0												
200	43.742386	-88.983756	233	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	200	11	Muck	Pole	SAMPLED			0												
201	43.741756	-88.983767	234	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	201	12	Muck	Pole	SAMPLED			0												
202	43.741126	-88.983778	295	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	202	13	Muck	Pole	SAMPLED			0												
203	43.740496	-88.983788	297	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	203	0			DEEP															
204	43.739866	-88.983799	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	204	0			DEEP															
205	43.739236	-88.983810	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	205	0			DEEP															

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
206	43.738605	-88.983820	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	206	0			DEEP															
207	43.737975	-88.983831	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	207	0			DEEP															
208	43.737345	-88.983841	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	208	0			DEEP															
209	43.736715	-88.983852	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	209	0			DEEP															
210	43.736085	-88.983863	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	210	0			DEEP															
211	43.735454	-88.983873	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	211	0			DEEP															
212	43.734824	-88.983884	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	212	0			DEEP															
213	43.7341941	-88.98389478	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	213	0			DEEP															
214	43.73356393	-88.98390543	91	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	214	16			DEEP															
215	43.73293375	-88.98391609	90	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	215	15			DEEP															
216	43.73230357	-88.98392674	51	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	216	14	Muck	Pole	SAMPLED			0											
217	43.7316734	-88.9839374	54	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	217	10	Muck	Pole	SAMPLED			0											
218	43.73104322	-88.98394805	78	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	218	8	Sand	Pole	SAMPLED			1	1										
219	43.73041305	-88.98395871	79	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	219	4	Sand	Pole	SAMPLED			2	1		1	1						1	
220	43.74426917	-88.982855	221	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	220	7	Muck	Pole	SAMPLED			0											
221	43.743639	-88.98286567	215	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	221	8	Muck	Pole	SAMPLED			1		1									
222	43.74300882	-88.98287634	214	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	222	9	Muck	Pole	SAMPLED			0											
223	43.74237865	-88.98288701	200	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	223	10	Muck	Pole	SAMPLED			0											
224	43.74174847	-88.98289768	199	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	224	11	Muck	Pole	SAMPLED			0											
225	43.7411183	-88.98290835	183	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	225	11	Rock	Pole	SAMPLED			0											
226	43.74048812	-88.98291901	289	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	226	0			DEEP															
227	43.73985795	-88.98292968	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	227	0			DEEP															
228	43.73922777	-88.98294035	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	228	0			DEEP															
229	43.7385976	-88.98295102	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	229	0			DEEP															
230	43.73796742	-88.98296169	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	230	0			DEEP															
231	43.73733725	-88.98297235	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	231	0			DEEP															
232	43.73670707	-88.98298302	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	232	0			DEEP															
233	43.7360769	-88.98299369	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	233	0			DEEP															
234	43.73544672	-88.98300435	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	234	0			DEEP															
235	43.73481655	-88.98301502	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	235	0			DEEP															
236	43.73418637	-88.98302569	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	236	0			DEEP															
237	43.7335562	-88.98303635	92	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	237	16			DEEP															
238	43.73292602	-88.98304702	89	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	238	15	Muck	Pole	SAMPLED			0											
239	43.73229584	-88.98305768	52	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	239	12	Sand	Pole	SAMPLED			0											
240	43.73166567	-88.98306834	53	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	240	7	Sand	Pole	SAMPLED			0											
241	43.74426143	-88.98198576	220	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	241	5	Sand	Pole	SAMPLED			0											
242	43.74363126	-88.98199644	216	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	242	8	Muck	Pole	SAMPLED			1		1									
243	43.74300108	-88.98200712	213	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	243	9	Muck	Pole	SAMPLED			1		1			1						
244	43.74237091	-88.9820178	201	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	244	10	Muck	Pole	SAMPLED			1		1									
245	43.74174074	-88.98202848	198	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	245	11	Muck	Pole	SAMPLED			0											
246	43.74111056	-88.98203915	184	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	246	8	Rock	Pole	SAMPLED			0											

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
247	43.74048039	-88.98204983	182	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	247	15			DEEP															
248	43.73985021	-88.98206051	167	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	248	15			DEEP															
249	43.73922004	-88.98207119	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	249	0			DEEP															
250	43.73858986	-88.98208186	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	250	0			DEEP															
251	43.73795969	-88.98209254	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	251	0			DEEP															
252	43.73732951	-88.98210322	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	252	0			DEEP															
253	43.73669934	-88.98211389	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	253	0			DEEP															
254	43.73606916	-88.98212457	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	254	0			DEEP															
255	43.73543899	-88.98213524	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	255	0			DEEP															
256	43.73480881	-88.98214592	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	256	0			DEEP															
257	43.73417863	-88.98215659	294	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	257	0			DEEP															
258	43.73354846	-88.98216727	93	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	258	15	Muck	Pole	SAMPLED			0												
259	43.73291828	-88.98217794	88	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	259	11	Rock	Pole	SAMPLED			1			1									
260	43.74362351	-88.98112721	217	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	260	6	Muck	Pole	SAMPLED			0												
261	43.74299334	-88.9811379	212	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	261	8	Muck	Pole	SAMPLED			1		1										
262	43.74236316	-88.98114859	202	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	262	9	Muck	Pole	SAMPLED			0												
263	43.74173299	-88.98115928	197	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	263	10	Rock	Pole	SAMPLED			0												
264	43.74110282	-88.98116996	185	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	264	14	Muck	Pole	SAMPLED			0												
265	43.74047264	-88.98118065	181	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	265	15	Muck	Pole	SAMPLED			0												
266	43.73984247	-88.98119134	166	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	266	15	Muck	Pole	SAMPLED			0												
267	43.73921229	-88.98120202	165	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	267	15			DEEP															
268	43.73858212	-88.98121271	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	268	0			DEEP															
269	43.73795194	-88.9812234	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	269	0			DEEP															
270	43.73732177	-88.98123408	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	270	0			DEEP															
271	43.73669159	-88.98124477	0	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	271	0			DEEP															
272	43.73606142	-88.98125545	125	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	272	16			DEEP															
273	43.73543124	-88.98126614	124	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	273	16			DEEP															
274	43.73480107	-88.98127682	99	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	274	15			DEEP															
275	43.73417089	-88.9812875	98	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	275	15			DEEP															
276	43.73354072	-88.98129819	94	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	276	13	Sand	Pole	SAMPLED			0												
277	43.74361576	-88.98025798	218	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	277	7	Sand	Pole	SAMPLED			0												
278	43.74298559	-88.98026868	211	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	278	7	Muck	Pole	SAMPLED			0												
279	43.74235541	-88.98027938	203	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	279	9	Muck	Pole	SAMPLED			0												
280	43.74172524	-88.98029008	196	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	280	11	Muck	Pole	SAMPLED			0												
281	43.74109506	-88.98030077	186	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	281	13	Muck	Pole	SAMPLED			0												
282	43.74046489	-88.98031147	180	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	282	13	Muck	Pole	SAMPLED			0												
283	43.73983472	-88.98032217	168	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	283	14	Muck	Pole	SAMPLED			0												
284	43.73920454	-88.98033286	164	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	284	15	Muck	Pole	SAMPLED			0												
285	43.73857437	-88.98034356	151	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	285	15			DEEP															
286	43.73794419	-88.98035425	150	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	286	15			DEEP															
287	43.73731402	-88.98036495	139	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	287	15			DEEP															

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
288	43.73668384	-88.98037564	138	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	288	15			DEEP															
289	43.73605367	-88.98038633	126	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	289	15			DEEP															
290	43.73542349	-88.98039703	123	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	290	15	Muck	Pole	SAMPLED			0											
291	43.73479332	-88.98040772	100	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	291	14	Muck	Pole	SAMPLED			0											
292	43.73416314	-88.98041841	97	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	292	14	Muck	Pole	SAMPLED			0											
293	43.73353297	-88.98042911	95	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	293	8	Sand	Pole	SAMPLED			0											
294	43.743608	-88.97938876	219	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	294	5	Sand	Pole	SAMPLED			0											
295	43.74297783	-88.97939946	210	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	295	7	Muck	Pole	SAMPLED			1	1										
296	43.74234765	-88.97941017	204	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	296	8	Muck	Pole	SAMPLED			0											
297	43.74171748	-88.97942088	195	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	297	10	Muck	Pole	SAMPLED			0											
298	43.74108731	-88.97943158	187	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	298	11	Muck	Pole	SAMPLED			0											
299	43.74045713	-88.97944229	179	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	299	12	Muck	Pole	SAMPLED			0											
300	43.73982696	-88.97945299	169	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	300	12	Muck	Pole	SAMPLED			0											
301	43.73919678	-88.9794637	163	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	301	14	Muck	Pole	SAMPLED			0											
302	43.73856661	-88.9794744	152	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	302	14	Muck	Pole	SAMPLED			0											
303	43.73793643	-88.97948511	149	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	303	15	Muck	Pole	SAMPLED			0											
304	43.73730626	-88.97949581	140	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	304	15	Muck	Pole	SAMPLED			0											
305	43.73667608	-88.97950651	137	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	305	14	Muck	Pole	SAMPLED			0											
306	43.73604591	-88.97951722	127	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	306	14	Muck	Pole	SAMPLED			0											
307	43.73541573	-88.97952792	122	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	307	14	Muck	Pole	SAMPLED			0											
308	43.73478556	-88.97953862	101	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	308	13	Sand	Pole	SAMPLED			0											
309	43.73415539	-88.97954932	96	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	309	3	Rock	Pole	SAMPLED			0											
310	43.74297006	-88.97853025	209	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	310	6	Muck	Pole	SAMPLED			0											
311	43.74233989	-88.97854096	205	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	311	8	Muck	Pole	SAMPLED			0											
312	43.74170971	-88.97855168	194	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	312	9	Muck	Pole	SAMPLED			0											
313	43.74107954	-88.97856239	188	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	313	10	Muck	Pole	SAMPLED			0											
314	43.74044937	-88.97857311	178	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	314	11	Muck	Pole	SAMPLED			0											
315	43.73981919	-88.97858382	170	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	315	11	Muck	Pole	SAMPLED			0											
316	43.73918902	-88.97859454	162	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	316	13	Muck	Pole	SAMPLED			0											
317	43.73855884	-88.97860525	153	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	317	13	Muck	Pole	SAMPLED			0											
318	43.73792867	-88.97861596	148	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	318	13	Muck	Pole	SAMPLED			0											
319	43.7372985	-88.97862667	141	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	319	13	Muck	Pole	SAMPLED			0											
320	43.73666832	-88.97863739	136	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	320	13	Muck	Pole	SAMPLED			0											
321	43.73603815	-88.9786481	128	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	321	13	Muck	Pole	SAMPLED			1	1										
322	43.73540797	-88.97865881	121	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	322	12	Muck	Pole	SAMPLED			0											
323	43.7347778	-88.97866952	102	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	323	10	Muck	Pole	SAMPLED			0											
324	43.74296229	-88.97766103	208	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	324	4	Sand	Pole	SAMPLED			0											
325	43.74233212	-88.97767175	206	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	325	7	Muck	Pole	SAMPLED			0											
326	43.74170194	-88.97768248	193	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	326	8	Muck	Pole	SAMPLED			0											
327	43.74107177	-88.9776932	189	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	327	9	Muck	Pole	SAMPLED			0											
328	43.7404416	-88.97770393	177	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	328	10	Muck	Pole	SAMPLED			0											

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
329	43.73981142	-88.97771465	171	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	329	10	Muck	Pole	SAMPLED			0												
330	43.73918125	-88.97772537	161	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	330	11	Muck	Pole	SAMPLED			0												
331	43.73855107	-88.9777361	154	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	331	11	Muck	Pole	SAMPLED			0												
332	43.7379209	-88.97774682	147	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	332	12	Muck	Pole	SAMPLED			0												
333	43.73729072	-88.97775754	142	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	333	12	Muck	Pole	SAMPLED			0												
334	43.73666055	-88.97776826	135	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	334	12	Muck	Pole	SAMPLED			0												
335	43.73603038	-88.97777898	129	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	335	11	Muck	Pole	SAMPLED			0												
336	43.7354002	-88.9777897	120	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	336	10	Muck	Pole	SAMPLED			0												
337	43.73477003	-88.97780042	103	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	337	8	Muck	Pole	SAMPLED			1	1											
338	43.74232434	-88.97680255	207	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	338	3	Sand	Pole	SAMPLED			0												
339	43.74169416	-88.97681328	192	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	339	7	Muck	Pole	SAMPLED			0												
340	43.74106399	-88.97682401	190	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	340	8	Muck	Pole	SAMPLED			1		1										
341	43.74043382	-88.97683475	176	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	341	9	Muck	Pole	SAMPLED			0												
342	43.73980364	-88.97684548	172	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	342	9	Muck	Pole	SAMPLED			0												
343	43.73917347	-88.97685621	160	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	343	9	Muck	Pole	SAMPLED			0												
344	43.7385433	-88.97686694	155	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	344	10	Muck	Pole	SAMPLED			0												
345	43.73791312	-88.97687767	146	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	345	10	Muck	Pole	SAMPLED			0												
346	43.73728295	-88.9768884	143	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	346	10	Muck	Pole	SAMPLED			0												
347	43.73665277	-88.97689914	134	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	347	10	Muck	Pole	SAMPLED			1	1											
348	43.7360226	-88.97690987	130	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	348	10	Muck	Pole	SAMPLED			1			1		1							
349	43.73539242	-88.9769206	119	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	349	9	Muck	Pole	SAMPLED			1	1											
350	43.73476225	-88.97693133	104	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	350	8	Muck	Pole	SAMPLED			0												
351	43.74105621	-88.97595482	191	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	351	5	Rock	Pole	SAMPLED			1					1							
352	43.74042603	-88.97596557	175	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	352	7	Muck	Pole	SAMPLED			1	1	1			1							
353	43.73979586	-88.97597631	173	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	353	7	Muck	Pole	SAMPLED			0												
354	43.73916569	-88.97598705	159	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	354	8	Muck	Pole	SAMPLED			0												
355	43.73853551	-88.97599779	156	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	355	9	Muck	Pole	SAMPLED			1	1											
356	43.73790534	-88.97600853	145	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	356	9	Muck	Pole	SAMPLED			1	1											
357	43.73727516	-88.97601927	144	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	357	9	Sand	Pole	SAMPLED			1	1				1							
358	43.73664499	-88.97603001	133	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	358	7	Rock	Pole	SAMPLED			2	2											
359	43.73601482	-88.97604075	131	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	359	9	Muck	Pole	SAMPLED			0												
360	43.73538464	-88.97605149	118	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	360	8	Muck	Pole	SAMPLED			1	1											
361	43.73475447	-88.97606223	105	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	361	7	Muck	Pole	SAMPLED			1			1									
362	43.73412429	-88.97607297	112	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	362	0			DOCK															
363	43.73978807	-88.97510714	174	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	363	4	Sand	Pole	SAMPLED			2					2							
364	43.73915789	-88.97511789	158	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	364	6	Muck	Pole	SAMPLED			0												
365	43.73852772	-88.97512864	157	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	365	6	Muck	Pole	SAMPLED			1			1									
366	43.73600703	-88.97517163	132	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	366	6	Rock	Pole	SAMPLED			0												
367	43.73537685	-88.97518238	117	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	367	7	Muck	Pole	SAMPLED			1	1											
368	43.73474668	-88.97519313	106	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	368	7	Muck	Pole	SAMPLED			0												
369	43.7341165	-88.97520388	111	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	369	6	Muck	Pole	SAMPLED			1			1	1								

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole; Rope	Comments	Notes	Nuisance	Total Rake Fullness	Myriophyllum sibiricum X spicatum	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Najas flexilis	Potamogeton follosus	Stuckenia pectinata	Wolffia spp.
370	43.73348633	-88.97521462	113	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	370	4	Muck	Pole	SAMPLED			2	1		1	2	1		1					
371	43.73536906	-88.97431328	116	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	371	7	Muck	Pole	SAMPLED			1	1											
372	43.73473888	-88.97432403	107	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	372	6	Muck	Pole	SAMPLED			1	1				1							
373	43.73410871	-88.97433479	110	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	373	5	Muck	Pole	SAMPLED		YES	3	V		3	1	1							
374	43.73347853	-88.97434555	114	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	374	3	Muck	Pole	SAMPLED			3	1		1	1	3							
375	43.73536125	-88.97344417	115	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	375	4	Sand	Pole	SAMPLED			2	1		1	2								
376	43.73473108	-88.97345494	108	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	376	4	Sand	Pole	SAMPLED			3	3		1									
377	43.7341009	-88.9734657	109	Little Green Lake	Green Lake	7/12/2016	BTB & LJS	377	4	Muck	Pole	SAMPLED		YES	3	3		1		1					1		

F

APPENDIX F

Fish Stocking Records from LGLPRD & Fishing Friends Forever

Little Green Lake - Fish Stocking Records by Fishing Friends Forever and LGLPRD						
Year	Species	Age Class	# Fish Stocked	Lbs Stocked	Avg Fish Length (in)	Fish Source
2002	Walleye	N/A	875		N/A	N/A
2003	Northern Pike	N/A	250		N/A	Wisconsin Fish Farms
2003	Walleye	N/A	2,000		N/A	Wisconsin Fish Farms
2004	Northern Pike	N/A	250		N/A	Wisconsin Fish Farms
2004	Walleye	N/A	3,400		N/A	Gollon Bait & Fish Farm
2004	Walleye	N/A	2,223		N/A	Wisconsin Fish Farms
2005	Fathead Minnows	N/A		50#	N/A	Gollon Bait & Fish Farm
2005	Muskellunge	Large Fingerling	100		N/A	Gollon Bait & Fish Farm
2005	Northern Pike	N/A	340		N/A	Wisconsin Fish Farms
2005	Walleye	N/A	286		11"	Hoover's Live Bait
2005	Walleye	N/A	715		6"	Hoover's Live Bait
2005	Walleye	N/A	1,034		N/A	Wisconsin Fish Farms
2006	Fathead Minnows	N/A		125#	N/A	Hoover's Live Bait
2006	Muskellunge	Large Fingerling	200		N/A	Gollon Bait & Fish Farm
2006	Northern Pike	N/A	100		N/A	Gollon Bait & Fish Farm
2006	Walleye	N/A	100		5-8"	Gollon Bait & Fish Farm
2007	Fathead Minnows	N/A		50#	N/A	N/A
2007	Muskellunge	Large Fingerling	100		N/A	N/A
2007	Walleye	N/A	500		N/A	Hoover's Live Bait
2008	Northern Pike	N/A	100		N/A	N/A
2008	Walleye	N/A	2,450		N/A	Gollon Bait & Fish Farm
2009	Walleye	N/A	306		7"	Keystone Hatcheries
2009	Walleye	N/A	1,360		6"	Keystone Hatcheries
2009	Walleye	N/A	1,500		N/A	Central Wisc Fish Farms
2010	Fathead Minnows	N/A		500#	N/A	N/A
2010	Northern Pike	N/A	100		N/A	N/A
2010	Walleye	N/A	2,500 est.		N/A	N/A
2011	Fathead Minnows	N/A		500#	N/A	Gollon Bait & Fish Farm
2011	Muskellunge	Large Fingerling	100		N/A	Gollon Bait & Fish Farm
2011	Walleye	N/A	1,200 est		N/A	Gollon Enterprises
2012	Muskellunge	Large Fingerling	100		N/A	N/A
2012	Walleye	N/A	1,300		N/A	N/A
2013	Walleye	N/A	1,500		N/A	N/A
2014	Northern Pike	N/A	65		12"	Central Wisc Fish Farms
2014	Walleye	N/A	775		6"	Central Wisc Fish Farms
2015	Walleye	N/A	1,500		5-8"	Central Wisc Fish Farms
2015	Walleye	N/A	900		10-12"	Hoover's Live Bait
2016	Black Crappie	N/A	1,000		N/A	Hoover's Live Bait
2016	Fathead Minnows	N/A		100#	N/A	Hoover's Live Bait
2016	Northern Pike	N/A	168		13"	Central Wisc Fish Farms
2016	Walleye	N/A	1,000		N/A	Hoover's Live Bait
2017	Black Crappie	N/A	2,000		3-5"	Woods & Waters Fish Farm

G

APPENDIX G

Iron and Alum Additional Information for Little Green Lake

Iron cycling and interactions with sulfur and phosphorus in lakes

Iron cycling in lakes and its interaction with phosphorus is strongly influenced by sulfur. This means that the amount of phosphorus released from sediments during anoxic conditions is strongly influenced by multiple factors including concentrations of iron, phosphorus, sulfur, and the level of productivity in lakes. Furthermore, mechanisms can be different in calcareous and noncalcareous lakes. This has strong implications of how lakes can be managed to improve water quality.

The concept known as the "ferrous wheel" has been developed to describe the cycling of iron and phosphorus in lakes with anoxic hypolimnions (Campbell and Torgersen 1980). In freshwater systems, under low productivity conditions, sulfate concentrations are low meaning that much less iron is bound with sulfide which permanently removes iron from recycling. With anoxia, iron (FeII) and phosphorus are released from the sediment-water interface into the overlying waters. With subsequent mixing, either during fall turnover or entrainment events during the summer, there is sufficient ferric iron (FeIII) to bind with phosphorus to remove most of the phosphorus from the water column. This occurs when the Fe:P exceeds 3.6:1 on a mass basis (2:1 molar basis) (Blomqvist et al. 2004). This cycling results in low phosphorus concentrations even though there is a significant amount of internal loading occurring during the stratification period. In eutrophic lakes, the "ferrous wheel" is broken because of the increased concentration of sulfate. Higher concentrations of sulfate are the result of increased loading from the watershed as well as the atmosphere. With the higher amounts of sulfur and productivity, during anoxic conditions phosphorus is released from the sediments but less iron is released and more of this released iron combines with sulfur to the form FeS_x which permanently removes iron from the overlying waters resulting in less Fe(III) available to bind with phosphorus. Also, the higher productivity results in a higher rate of deposition of organic phosphorus, some of which is converted to inorganic phosphorus. (The importance of sulfur in the efficiency of P scavenging by Fe may explain why freshwaters (high in Fe) tend to be phosphorus limited and coastal, sulfate-rich waters (low Fe) tend to be nitrogen limited (Blomqvist et al. 2004).)

An excellent article by Hoffman et al. (2013) discusses iron cycling and its relationship with sulfur and phosphorus in four Wisconsin lakes. Two of the lakes are calcareous (Mendota, Fish), one of which is eutrophic and one is mesotrophic. The other two lakes are noncalcareous (Devil's, Sparkling) and they are mesotrophic and oligotrophic. In the calcareous lakes, e.g. CalMan lakes, most of the phosphorus in the anoxic hypolimnion is the result of the regeneration of phosphorus that sedimented from epilimnion during the spring and early summer. This probably explains why epilimnetic phosphorus levels decline in these lakes during the summer. By contrast, in the noncalcareous lakes, e.g. Kentuck Lake, the major source of hypolimnetic phosphorus during anoxia is from within the sediments. This would be phosphorus that was deposited in earlier years and, along with iron, diffuses from the deeper sediments.

In the case of eutrophic Lake Mendota, sulfate concentrations are high and iron levels are low. Therefore, as phosphorus is regenerated in the anoxic hypolimnion, the iron is inactivated by the sulfide following the reduction of sulfate. With subsequent mixing, either in the fall or during entrainment during the summer, e.g. Little Green Lake, there is insufficient Fe(III) to scavenge the phosphorus and large algal blooms occur. In a dimictic lake, e.g. CalMan lakes, the phosphorus is not utilized until the following year but this probably fuels a large part of the spring algal bloom and the subsequent summer blooms. Fish Lake which is mesotrophic, has lower concentrations of sulfate and moderate iron levels. Therefore, there is sufficient iron available to scavenge much of the phosphorus during turnover. Not all of the phosphorus is removed which is why the lake is mesotrophic and not oligotrophic. Mesotrophic Fish Lake (low sulfate, moderate Fe) is an analog of Lake Mendota.

In the case of noncalcareous, mesotrophic Devil's Lake with moderate sulfate and high iron levels, Fe (II) release into the anoxic hypolimnion exceeds sulfide production through sulfate reduction and concentrations of Fe(II) accumulate in anoxic hypolimnetic waters. If the Fe:P ratio is greater than 3.6:1, efficient scavenging of P from the lake waters by Fe(III) occurs. Oligotrophic Sparkling Lake (high Fe, low SO_4) is an early analog of Devil's Lake. It is likely that Devil's Lake is more productive than Sparkling because of higher P loading which has resulted in higher P concentrations in the sediments and the higher sulfur levels result in more inactivation of iron as FeS_x.

For lake management purposes, when Fe:P ratios are less than 3.6:1 enhancing iron concentrations should increase phosphorus scavenging. The purpose of the iron addition would be to overcome the loss of iron from entering the hypolimnetic waters caused by the formation of FeS_x. In other words, in lakes with sulfate-rich waters, enough iron would be added to increase the ratio above 3.6:1 on a mass basis. Theoretically this would not require a destratification system in polymictic lakes because during the entrainment of bottom waters there would be sufficient iron to scavenge all of the phosphorus that is entrained into the upper waters. Kleeberg et al. (2013) argues that this is in fact true and cites as an example of a lake in Germany that found no difference in internal loading with aeration and without it following the addition of iron. During aeration, the phosphorus release rate was lower but the resulting higher water temperature in the bottom waters stimulated oxidative P mineralization which counteracted the desired effects of the aeration. In this lake, Groβ-Glienicke, iron in the form of solid ferric hydroxide and dissolved ferric chloride was added in December 1992 and February 1993 each at a rate of 250 g/m^2 at depths greater than 12 feet. This lake with a maximum depth of 36 feet. Twenty years later internal loading is still very much reduced. During the last 20 years external phosphorus loading has also been significantly reduced. Prior to the addition of iron, the ratio of Fe:P was less than 3.6:1 and now it is over 5:1. It appears that when the lake mixes now, even though there are high levels of P in

the hypolimnion there is enough Fe to scavenge most of the phosphorus that is released from the sediments.

This paper also presents a formula to calculate the amount of iron that should be added. There are 4 factors that must be considered: 1) external P input, 2) all in lake P mobilizing and Fe consuming processes (ratio of Fe:P> 3.6), 3) proportion of Fe associated with organic carbon (OC) since this will bind with Fe (assume 25%), and 4) the Fe proportion consumed in binding existing soluble sulfides (HS^-, H_2S). Thus, the dosage (FerroDo) is

$$\text{FerroDo [g Fe/m}^2\text{]} = ((TP_{ext} + TP_{int} \text{ x } 9\text{Fe:P}) + \text{OC-Fe} + H_2S\text{-Fe}$$

where

TP_{ext} = external 'excess' P load ([g/m^2/yr];

TP_{int} = annual internal P loading [g/m^2] deduced from mobile P content of sediment;

Fe:P = mass Fe:P ratio multiplied by 9;

OC-Fe = equivalent of Fe [g/m^2] consumed in organic carbon binding = OC x 0.25 which is determined from organic matter (loss on ignition) content of surface sediment;

H_2S-Fe = equivalent of Fe [g/m^2] consumed by FeS_x. An average sulfate reduction rate is multiplied by the duration of thermal stratification. Since 1.5 moles of S are consumed per mole of Fe, the SRR is divided by 1.5.

Kleeberg et al. (2013) recommends either using the above formula or applying iron at a rate exceeding 200 g/m^2.

Although Kleeberg et al. (2013) do not think aeration is necessary, they conclusively showed that more mobile FeP is found in the sediments following the addition of iron. I would interpret this to mean that if the Fe:P ratio is reduced to below 3.6:1 on a mass basis, internal loading would occur at a higher rate than it did prior to the iron treatment.

Little Green Lake

My research into past iron additions leads me to conclude that this could be successful in reducing the internal loading from the deep-water sediments. The iron addition essentially restores the 'ferrous wheel' as it was prior to the mid-1800s. It may be that the reduction in measured internal loading between the mid-2000s and 2013-14 is because the construction of the large sedimentation basin reduced phosphorus and sulfur loading to the lake. With less sulfur, the sulfate reduction rate would have decreased allowing more iron (even though it remains low) to bind with phosphorus. This might indicate that internal loading from deep water sediments is more important

than other sources, e.g. CLP, littoral zone, since these do not seem to have changed much since the mid-2000s.

If an iron application proceeds in LGL I recommend NOT upgrading the destratification system and not running it at all would be best. If the desired results are not achieved (sufficient P reduction in the lake) then upgrade and use the destratification system. Although I think an application rate of 200 g/m^2 is the correct dose, the sediment chemistry should be measured. This would include fractionating the forms of phosphorus, and measuring the concentration of sulfur, organic matter, and iron in the surface sediments. This should be done before and following the treatment.

Literature Cited

Blomqvist, S., A. Gunnars, and R. Elgren. 2004. Why the limiting nutrient differs between termperate coastl seas and frewshwater laeks: a matter of salt. Limnol. Ocdeanogr. 46:2236-2241.

Campbell, P. and t. Torgeren. 1980. Maintenance of iron meromixis by iron redepositionin a rapidly flushed monimolimmion. Can. J. Fish Aquat. Sci. 37:1303-1313.

Hoffman, A.R., D.E. Armstrong, R.C. Lathrop. 2013. Influence of phosphorus scavenging by iron in contrasting dimictic lakes. Can. J. Fish. Aquat. Sci. 70:941-952.

Kleeberg, A, C.Herzog, and M Hupfer. 2013. Redox sesitivity of iron in phosphorus binding does not impede lake restortation. Water Research. 47:1491-1502.

Potential Treatment of Alum in Little Green Lake

Little Green Lake experiences summer algal blooms which are caused by high phosphorus concentrations. The source of much of this phosphorus is from within the Lakethe hypolimnion can become devoid of oxygen both in the water column and within the sediment. When this occurs, iron changes from a form that normally binds phosphorus within the sediment to a form that releases it to the overlaying water. This can result in very high concentrations of phosphorus in the hypolimnion. Then, during turnover events, these high concentrations of phosphorus are mixed within the lake and utilized by algae and some macrophytes. In lakes that mix periodically during the summer (polymictic lakes such as Little Green Lake), this cycle can *pump* phosphorus from the sediments into the water column during the growing season.

Addition of aluminum salt, usually in the form of aluminum sulfate (alum), is a useful technique for reducing internal phosphorus loading in lakes. It has been used for many years including the first lake that was treated in the USA, Horseshoe Lake, WI, which was treated in 1970. Alum is effective because after binding with phosphorus, the bond of the aluminum and phosphorus is not sensitive to dissolved oxygen levels like iron is. In other words, even under anoxic conditions the phosphorus remains bound with the aluminum and does not move from the sediments into the lake water. Lake sediments contain elevated levels of phosphorus, some of which are bound with iron. When the sediments become anoxic, the iron and phosphorus bond is broken and these elements migrate upward towards the bottom water of the lake. If the bottom waters are anoxic (absence of oxygen), phosphorus and iron migrate into the water column and when the lake mixes, or during summer wind events in shallow lakes, these elements move to the surface waters. Alum can be applied to a lake as a slurry where it precipitates to the lake bottom. This alum layer on the sediments acts a barrier to phosphorus moving into the bottom waters of the lake even in the absence of oxygen. Alum is effective because it permanently binds with the phosphorus. Unlike iron, the aluminum-phosphorus bond is not affected by anoxic conditions.

In Wisconsin over 18 lakes have been treated with alum, while over 26 lakes in Minnesota and Michigan have been treated with alum. Alum is usually applied as aluminum sulfate which reacts quickly with water to form an aluminum hydroxide floc with a high affinity for phosphate and dissolved organic P compounds. The floc quickly settles to the bottom within 24 hours and sooner in shallower lakes. Immediately after settling to the bottom, the floc is susceptible to redistribution but within months it gets mixed into the surface sediment.

One of the lakes in Wisconsin that has been treated with alum is East Alaska Lake in Kewaunee Co. Onterra was involved in the design and oversaw the project. The treatment occurred in October 2011 and to date has been very successful. The cost of the alum treatment was about $165,000 and the application rate was 132 g/m^2 Al.

Many other lakes in Wisconsin that have been treated with alum have been successful in the sense that phosphorus and algal concentrations are much less than they were prior to treatment. Treatments that have not been successful did not have enough alum applied. There was not enough aluminum to combine with most of the mobile sediment phosphorus. Some lakes did not add enough alum because for financial reasons. A couple other lakes were under dosed because the dosage was incorrectly determined. Calculations to determine the appropriate dose are much advanced now compared to early years when alum treatments were first done. Now the amount of mobile sediment phosphorus is determined and this aids in calculating the amount of alum that should be added. Since elements other than phosphorus bind with aluminum more alum is added than just what is needed to combine with all of the phosphorus.

Although we won't know how much alum should be added to Little Green Lake until the amount of mobile sediment phosphorus in the upper 10 cm of sediment is known, a reasonable estimate of what is required is 50 g/m^2. This is the application rate that has been successful in other hardwater Wisconsin lakes. Using a model developed by Brian Huser and colleagues based upon the experiences with 83 alum treated lakes in USA and Europe, it is predicted that an application rate of 50 g/m^2 would last about 20 years. Of course, all lakes are unique and the actual period of success in Little Green Lake may not be 20 years. The presence of moderate to high levels of carp will reduce the longevity because these fish disturb the sediments with their feeding activity. This can be overcome with a higher dose of alum. Also, if the amount of phosphorus entering the lake from the watershed increases, the life span of an alum treatment would be reduced as the increased phosphorus loading would combine with the aluminum at a higher rate than expected and associated sediment would bury the alum layer.

It is not possible to give an accurate estimate of the cost of an alum treatment until the correct dosage has been determined. Determining the dosage would be done by collecting 6 to 8 cores throughout the area to be treated and measuring the amount of mobile phosphorus in the upper 10 cm of the sediments. If we assume that the application rate is 50 g/m^2 and the area to be treated is that part of the lake deeper than 16 feet (127 acres), then a total of 121,532 gallons of alum would be applied to the lake. Only the area deeper than 16 feet would be treated as this is the part of the lake that becomes anoxic in the bottom waters. Onterra staff have contacted an applicator, HAB Aquatic Solutions, who has recently done alum applications in Wisconsin and they gave an application cost of $1.76/gal. This cost would include the alum. The total cost estimate of the alum addition would be **$213,900**. If a greater dose of alum were needed, e.g. 100 g/m^2, the cost would be **$427,800**.

H

APPENDIX H

Green Lake County & LGLPRD Watershed Planning Meeting Notes – April 5, 2018

Notes from Little Green Lake Watershed Planning Meetings

July 10, 2017 Attendees: Derek Kavanaugh, Dick Schneider, Mike Ross, Andy Ross, and Harlan Barkley

April 5, 2018 Attendees: Derek Kavanaugh and Harlan Barkley

Last updated on April 16, 2018

2000 Retention Pond on Highway 44

Notes:

- The east side of pond has experienced significant sediment build-up over the last 18 years
- The wooden structure on the inlet site needs to be replaced
- Tree growth removal and bush cleanup activities are needed

Actions:

- Remove tree growth around the hooded culvert on the inlet side
    - Routine maintenance for 2018
- Fix the wooden structure on the inlet side
    - Derek will re-analyze the height of the wooden structure and define any design changes for better flow from the inlet side
    - Accomplish in 2018
- Cleanup brush – spray chemicals in the fall when the ground is dried out
    - Routine maintenance for 2018
- Dig out right side of the pond – Use a long-reach machine to clean out the necessary areas; May have to pump the deeper areas dry if it stays wet all summer.
    - Derek will estimate the amount of soil to be removed
    - Costs range from $2 - $8 per yard depending on the quality of the soil (rocks, garbage, etc.) and the location where the soil will be dumped (on-site or the need to truck it off-site). This project should not cost more than $5,000.
    - Accomplish in 2018 or 2019

2009 Retention Pond on Lake Shore Drive

Notes:

- The outlet pipes are 24” and 8”
- Intake size is 36”
- Bush cleanup activities are needed

Actions:

- Cleanup the bushes by the outlet and in the emergency runoff area
    - Routine maintenance for 2018

- Cleanup the vines on the intake cage
    - Routine maintenance for 2018

Spillway on N3141 North Lake Shore Drive

Notes:

- Water frequently runs next to the yellow garage on the south side of the road
    - N3135 property owner is Bill & Mary Cornelis
    - N3141 property owner is Lois/Angela Graff
- The township and Mark Minning own the two closest properties on the north side of the road
- Is there a way to reduce the water volumes?
    - Not realistically.

Actions:

- Derek to check on the possibility of an upstream diversion
    - Upstream diversion is not realistic because the land on the north side of the road is heavily wooded and steep in places
    - The two property owners on the south side of the road would have to be willing to do something on their adjourning property lines to control the water flow better.
- No further action is planned at this time

N3044 East Little Green Road

Notes:

- There is a 10’ culvert on the north side of the road
    - N3044 property owner is Steven & Lona Thurk
    - N3036 property owner is Leon Ploszaj
- The ground is sagging on the road edge
- The water is not flowing into the center of the culvert; It is flowing to the right of the culvert and is causing erosion

Actions:

- Redirect water flow to the center of the culvert
    - Doing any upstream work to redirect the water flow could be an issue with the landowner due to the disruption of their property (grounds and trees) to get the needed equipment in the appropriate area.
    - The current recommendation is to work with the Township and Derek to install a rock line on both sides of the culvert to improve water flow and stop further erosion of the road edge
    - Coordinate with the Township to determine if this can be addressed in 2018
- Repair erosion areas
    - Fill in the eroded areas when the rock line is installed (Township)

N3041 East Little Green Road

Notes:

- There is a 10' culvert on the north side of the road
- The runoff area on the south side of the road from the culvert to the lake is experiencing significant sediment buildup
    - The N3041 property owner (Craig & Constance Ghinazzi) has contacted the county about the possibility of dredging the flow area
    - The N3047 property owner is Sandra Sargent

Actions:

- Investigate feasibility, potential costs, appropriate timing and benefits
    - Derek will estimate the amount of soil to be removed
    - Costs range from $2 - $8 per yard depending on the quality of the soil (rocks, garbage, etc.) and the location where the soil will be dumped (on-site or the need to truck it off-site). This project should not cost more than $5,000.
    - A WDNR permit would be required

Melmar Drive

Notes:

- The culvert on Melmar Drive between W2120 and W2114 creates some runoff issues

Actions:

- Investigate and document current runoff issues
- Investigate the possibility of creating a retention pond on the vacant lot to the south of Melmar Drive. This property is owned by Lori & Dee Evans.

1992 Retention Pond on the Degner Property

Notes:

- This retention pond has not been maintained for at least 16 years
- The outline of the retention pond is still visible on the most recent satellite images

Actions:

- Determine feasibility of resurrecting this retention pond
    - Contact the property owner (Harriet Degner/Dawn Baird) to determine support for this project
    - Derek will talk to Paul Gunderson to obtain more information about the original retention pond build project
    - Determine if the existing flow pipe would need to be replaced
    - Determine potential costs, funding options and possible timing
    - Determine if a perpetual maintenance agreement is appropriate

North Kearley Road Area

Notes:

- The North Kearley Road spillway is okay – no actions are required
- North Kearley Road was re-built by the Township in August/September 2017
- The area North of the road and directly across from N3044 (property owner is Dave & Dana Hembo) is holding water after significant rains
    - The excess water washes over the road to the south
    - This has caused freezing water over the road on at least two occasions this winter and some wash out on the new road shoulder on the south side
    - This will likely continue to be an ongoing problem during the other seasons whenever we get heavy rains

Actions:

- Resolve the current water flow issue near N3044 N. Kearley Road
    - Work with the Township and Derek to assess the current situation and determine a plan of action.
    - An alternative to the traditional culvert option could be a Hickenbottom Pipe

Funding Options

- Targeted Runoff Management (TRM) Grant from WDNR
    - Possibility for 2019 – work with Derek as part of GLC efforts
- Lake Protection Grant
- Green Lake County Funding (very limited)
- Possible landowner funding for conservation practices
    - EQIP (Environmental Quality Incentive Program) Grant from NRCS (Natural Resources Conservation Service)
    - CRP (Conservation Reserve Program)
    - CREP (Conservation Reserve Enhancement Program)
    - Green Lake County

APPENDIX I

Official Comments on Draft Documents

Comments and Questions – Ted Johnson, WDNR – 8-22-18
Comments and Responses – Tim Hoyman following phone conversation with Ted Johnson; 10-11-18

Thank you for submitting the draft Lake Management Plan. I've reviewed the document and have a few comments and questions:

1. It is mentioned that each lake property owner can manually remove a 35 feet width of vegetation for better access. The width we allow for manual removal is 30 feet not 35. Please make this correction.

Could not find reference discussed here within report. May have been referring to shoreland removal, which is 35-feet as opposed to aquatic removal, which is 30-feet.

2. I like that watershed work is one of the top goals listed for plan implementation. Besides benefitting lake water quality, detailed watershed work is imperative to successfully be awarded future state grants for management actions such as alum treatments. In other words, we need to be able to demonstrate that external loading sources have been largely dealt with prior to applying for alum etc.

Included for the reasons mentioned above.

3. We may need to see improvement in water quality first but I'd like to see a future goal that focuses on the reintroduction / restoration of native plants to the system. As noted in the plan there are few emergent and floating leaf aquatic plants left in Little Green (water lilies, arrowhead, bulrush, etc). Moreover, the submersed aquatic plant species present lack diversity. At some point planting tubers or rhizomes of native plants species could be very beneficial to the ecosystem and help keep AIS in check by providing competition.

If significant improvements in the water quality are seen, the native plant population would likely respond on its own. Floating-leaf and emergent enhancements may be possible, but availability of quality submergent species is very limited. A paragraph has been added to the Summary and Conclusions Section 4.0 discussing this concept as a future action.

4. I think it is a great idea to conduct annual water quality sampling. Has there been any discussion of possibly turning off the destratification system for another year so more data could be collected. To this point, there isn't much data available, with the system off, to compare to all the years the system has been in operation. A lot of variables can affect the extent of internal loading from the hypolimnion. Perhaps another year with the system shut off would help us more clearly see what influence the system has on water quality.

Monitoring while the system has been shut down has been completed in the past and does not lead to truly clear results due to natural and uncontrollable fluctuations in the lake's water quality. The LGLPRD made some changes to the aeration system and if they do not see improvements to water quality in the next three years, they will look at other options. This keeps it simple. A paragraph has been added to the Summary and Conclusions Section 4.0 detailing that the district needs to see improvements to water quality in the next 3 years, and not just the lake's oxygen regime to truly, determine that the destratification system is meeting the district's ultimate goal of improving water quality.

5. Dock herbicide treatments: I would like to see some language describing what level of nuisance aquatic plants needs to be present for a dock treatment to take place. I've supervised this activity in the past and denied treatment of some docks because there were too few plants present to warrant an herbicide treatment. It should be explained that navigation needs to be seriously impaired before the DNR would allow a dock treatment to take place.

Verbiage laying out a treatment trigger to include only areas with nuisance levels that hinder navigation to a significant level has been added to the action description.

6. Nuisance control of CLP and EWM: The present goals of the District for CLP and EWM management are stated as nuisance control as needed. Nuisance control, as I understand it, is to treat relatively small areas to allow for improved recreation / navigation. Since your goal is not eradication of CLP and EWM, how many acres do you intend to treat annually? Is there a maximum acreage that you would treat in any single year?

Additional verbiage has been added to the action description stating that treatment acreage would likely be limited to less than 35 acres and proposed acreages above that would be scrutinized by the department and district. Further, verbiage has been added discussing treatment timing.