A

APPENDIX A

Public Participation Materials

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of a Lake Management Planning Project
  - Data & Information
  - Planning Process

Onterra LLC
Lake Management Planning

Onterra, LLC

- Founded in 2005
- Staff
  - Four full-time ecologists
  - One part-time ecologist
  - One field technician
  - Two summer interns
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

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Why create a lake management plan?

A goal without a plan is just a wish!

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Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

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Data and information gathering

- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Shoreline Assessment
  - Stakeholder Survey

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Water Quality Analysis

- General water chemistry (current & historic)
  - Citizens Lake Monitoring Network
- Nutrient analysis
  - Lake trophic state (Eutrophication)
  - Limiting plant nutrient
- Supporting data for watershed modeling

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Watershed Assessment

- Delineation of drainage basin
- Modeling
  - Land cover
  - Phosphorus loading
  - Scenario development

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early Season AIS Survey

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Non-native Aquatic Plants

Curly-leaf Pondweed

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Lake Management Planning

Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early Season AIS survey
  - Point-intercept survey

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Lake Management Planning

Mann Lake

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Lake Management Planning

Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early Season AIS survey
  - Point-intercept survey
  - Aquatic plant community mapping

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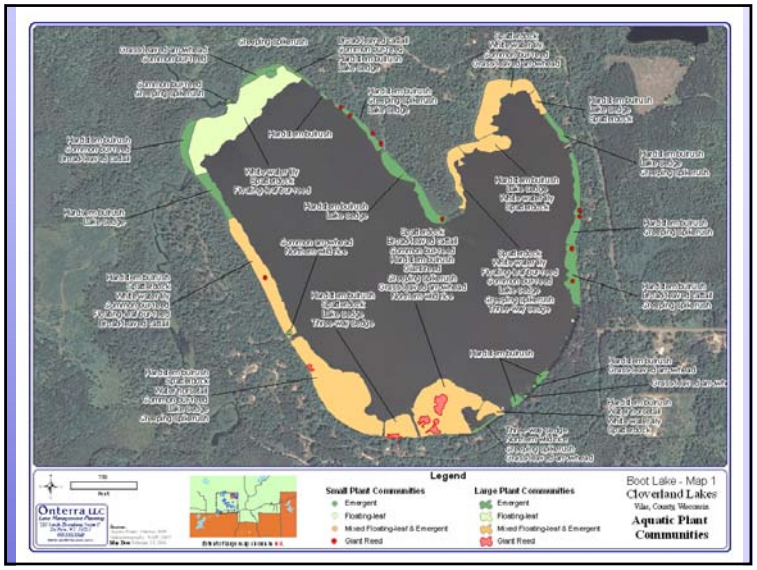

Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early Season AIS survey
  - Point-intercept survey
  - Aquatic plant community mapping

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Fisheries Data Integration

- No fish sampling completed
- Assemble data from WDNR, USGS, USFWS, & GLIFWC
- Fish survey results summaries (if available)
- Use information in planning as applicable

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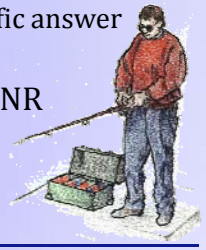
Stakeholder Survey

- Standard survey used as base
  - Planning committee potentially develops additional questions and options
  - Must not lead respondent to specific answer through a "loaded" question
- Survey must be approved by WDNR



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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- Assessment ranks shoreland area from shoreline back 35 feet
- Assess shoreland development and habitat
  - Coarse woody habitat

Urbanized Range **Natural**

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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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Thank You

Many of the graphics used in this presentation were supplied by:

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

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Mann Lake Management Planning Project

September 2014 Update
Submitted by: Dan Cibulka, Onterra, LLC

With the help of a Lake Management Planning Grant totaling over $19,000 from the Wisconsin Department of Natural Resources (WDNR), a project is underway to create a lake management plan for Mann Lake. The lake management plan will contain historic and current data from the lake as well as provide guidance for its management by integrating stakeholder perceptions and goals with what is ecologically beneficial for the lake.

As described further below, numerous field studies are being carried out upon Mann Lake during 2014-2015. Because much of the data was collected within just the past few months, a full analysis has yet to be completed. This update intends to bring Mann Lake property owners up-to-date on the scientific studies that have occurred, provide some initial observations on the ecology of Mann Lake and project a rough timeline for the remaining actions that will be taken as a part of this planning project.

In May of 2014, Onterra staff had their first glimpse of Mann Lake with a water quality sampling visit. The lake is sampled during the spring and fall to analyze water chemistry during the lake's mixing, or *turnover* events. When a lake turns over, many physical and chemical constituents (temperature, dissolved oxygen, nutrients, etc.) are mixed within the water column. This gives ecologists an idea of what the nutrient balance is within the lake and supports computer modeling efforts of the lake's pollutant load. Water quality samples were also collected in June, July and August. These results help ecologists understand how the constituents behave if the lake *stratifies*. Stratification is when a lake develops two separate layers of water – a warmer, upper layer and a cold lower layer of water. During each water quality visit, dissolved oxygen and temperature profiles of the water column are collected. Several of these profiles are displayed in Figure 1.

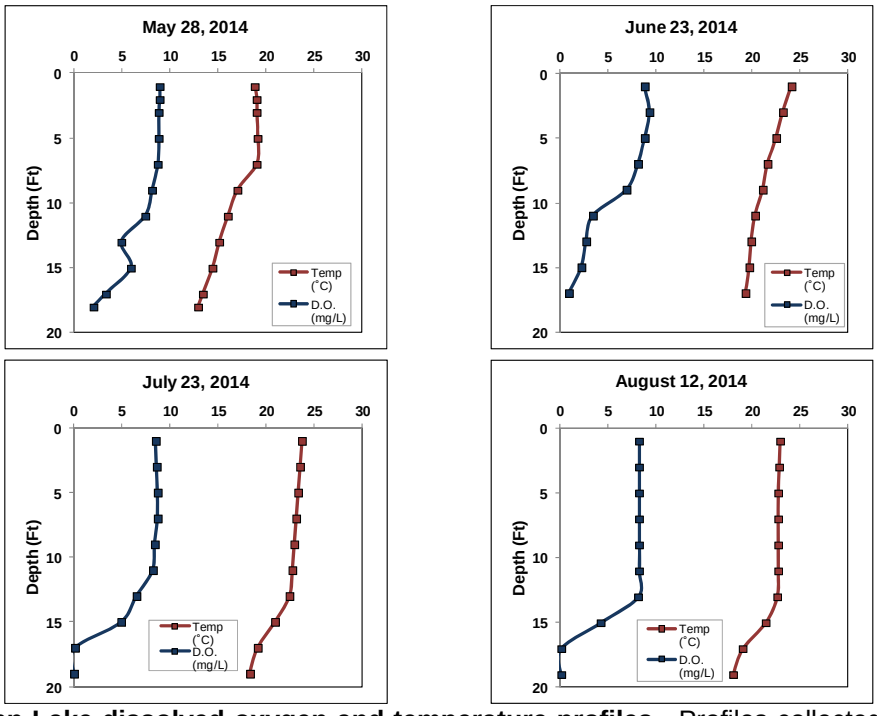

Figure 1. Mann Lake dissolved oxygen and temperature profiles. Profiles collected in October and February of 2015 will indicate how these variables are fairing during fall turnover and winter ice cover.

All aquatic plant surveys were conducted as scheduled, first by visiting the lake on June 12, 2014 to complete the Early Season Aquatic Invasive Species (ESAIS) survey. This survey's purpose is to search the lake for invasive species that typically reach their peak growth during this time (curly-leaf pondweed and pale yellow iris). On July 23, Onterra ecologists visited Mann Lake to complete the point-intercept survey. This is a grid-based survey designed to sample aquatic plants within the lake. Additionally, it provides an opportunity to search the lake for another Wisconsin invasive plant – Eurasian water milfoil. A third aquatic plant survey, the community mapping survey, was completed on July 25. The purpose of this survey is to map the floating-leaf and emergent species that are found within the lake and are typically underestimated in the point intercept survey.

Aquatic plants were found to grow to a depth of 10-11 feet in Mann Lake. During all surveys, no aquatic invasive species were observed. Many interesting native species were observed however. Though roughly 30 native plant species were found during aquatic plant surveys, common waterweed was the most abundant plant observed in Mann Lake. Common waterweed is able to obtain most of its nutrients through the water and thus does not produce extensive root systems. Sometimes, this plant may produce structures similar to roots (rhizoids) or become partially buried in the sediment. Because of this, the plant is susceptible to being easily uprooted and migrated by water-action and movement. Thus, it can easily float to the surface and become problematic in shallow waters. Dense mats of common waterweed and clasping leaf pondweed were observed along some shoreland areas during Mann Lake aquatic plant surveys.

Remaining steps

This fall, an Onterra crew will visit Mann Lake to conduct the shoreline assessment survey. During this survey, the lake's shoreline is examined and classified into one of five development categories, based upon its level of human disturbance. Additionally, areas of ecologically important habitat are identified and counted. The results of this survey may be used to prioritize areas for shoreland or habitat restoration, if the Friends of Mann Lake wish to pursue this.

In addition to collected ecological data from Mann Lake, sociological data will be collected from the people who use and care for Mann Lake. This is currently being approached in the form of a stakeholder survey, which was developed by Onterra staff and a planning committee comprised of Friends of Mann Lake volunteers. A postcard advertising the survey was distributed on September 5th to all Friends of Mann Lake members as well as non-member riparian property owners. Data will be collected through an online survey, though a paper version of the survey will be available for those who request it.

In the coming months, Onterra will be sorting through the immense amount of water quality, aquatic plant, shoreline assessment and stakeholder survey data that has been collected. Additionally, we will be looking at the watershed surrounding the lake and using a modeling program to estimate the amount of nutrients the lake receives on an annual basis. We will also be working with local WDNR fisheries biologist Steve Gilbert to collect data and report upon the management of the fishery.

In summary, all project components are on schedule and proceeding as planned. Following data analysis and report creation, the Mann Lake Planning Committee and Onterra staff will tentatively meet next spring/summer to discuss the project results and begin creation of management goals and actions the Friends of Mann Lake will pursue to manage their lake in both a recreationally enjoyable and ecologically sound manner.

Friends of Mann Lake, Inc.

Mann Lake
Management Planning Project
Planning Meeting I
June 19, 2015

Dan Cibulka
Onterra LLC
Lake Management Planning

Presentation Outline

- **Lake Management Planning Project Overview**
- **Study Results**
  - Water Quality
  - Watershed
  - Shoreland
  - Aquatic Plants
  - Fishery

  Stakeholder Survey
- **"Big Picture"**

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Study and Plan Goals

- Collect & Analyze Data
- Construct Long-Term & Useable Plan

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Wisconsin Ecoregions

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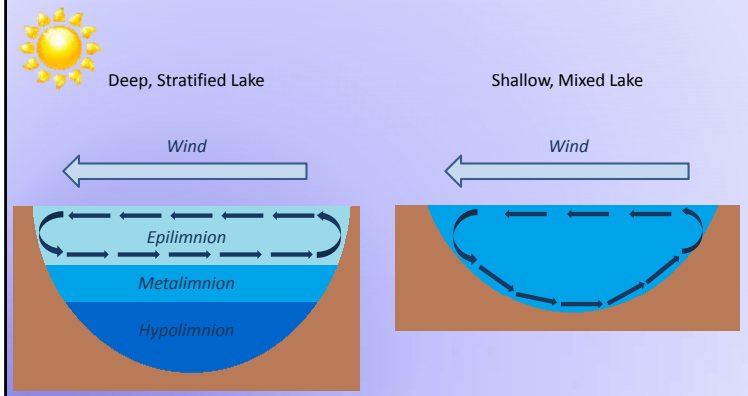
Wisconsin Lakes Classification



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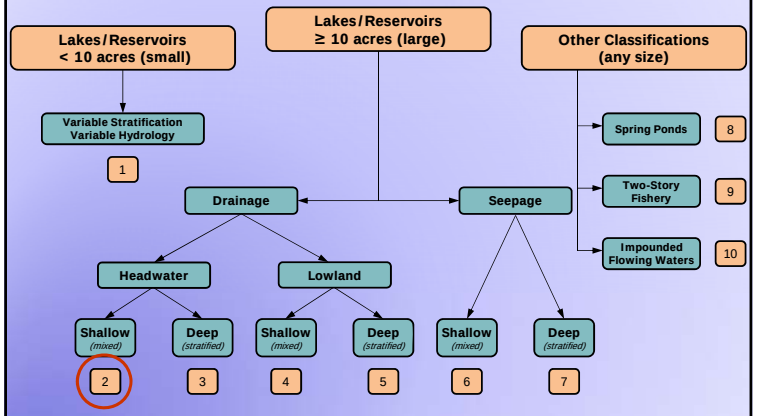
Wisconsin Lakes Natural Community Types



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Water Quality

- **Phosphorus (Limiting Plant Nutrient)**
  Primarily phosphorus
- **Chlorophyll-*a* (Algal Abundance)**
  Low – moderate abundance
- **Water Clarity (Secchi Disk)**
  Moderate water clarity

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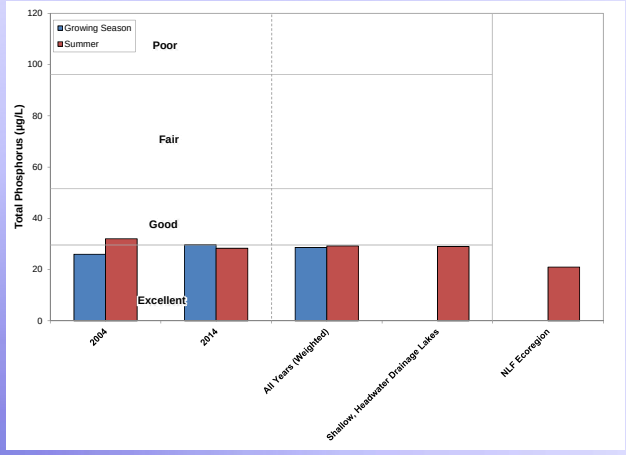
Average Annual Total Phosphorus



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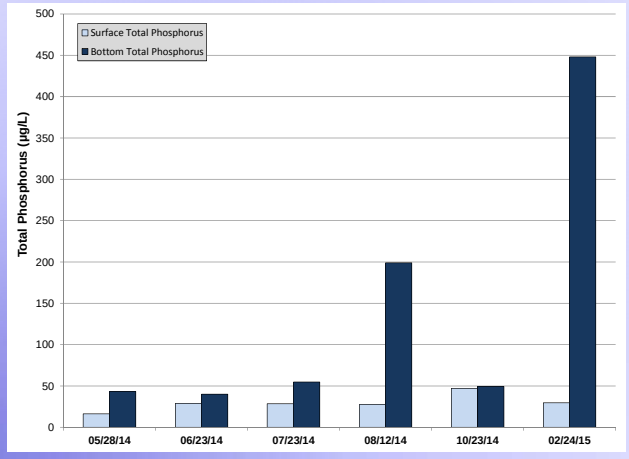
2014-2015 Total Phosphorus



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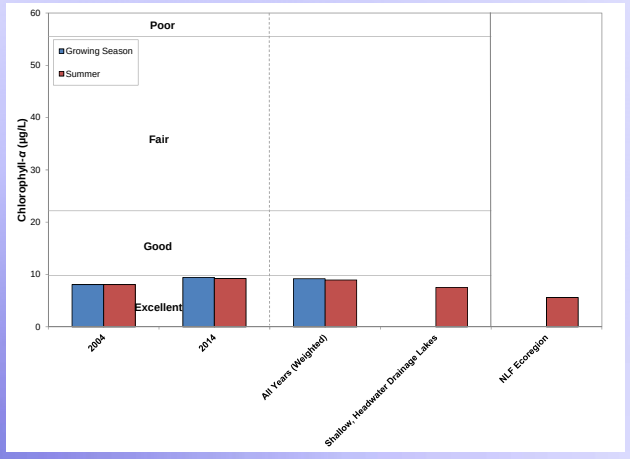
Average Annual Chlorophyll-α



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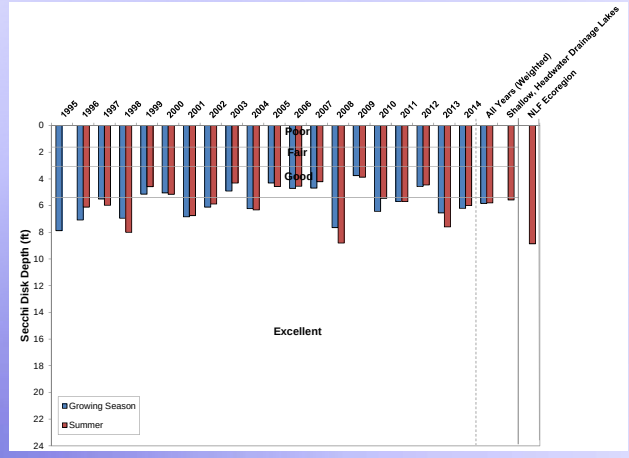
Average Annual Secchi Disk Clarity



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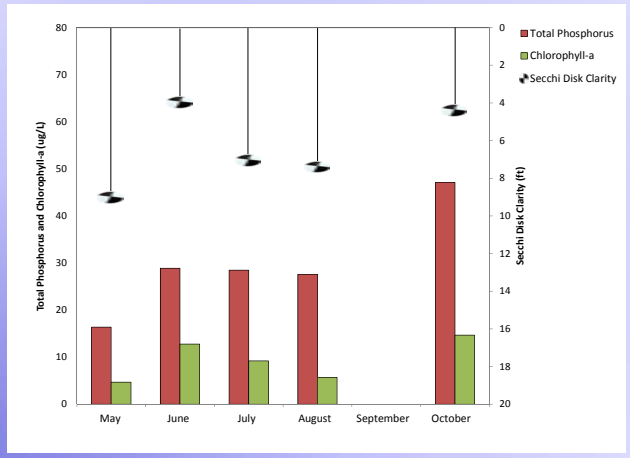
2014 Water Quality Summary



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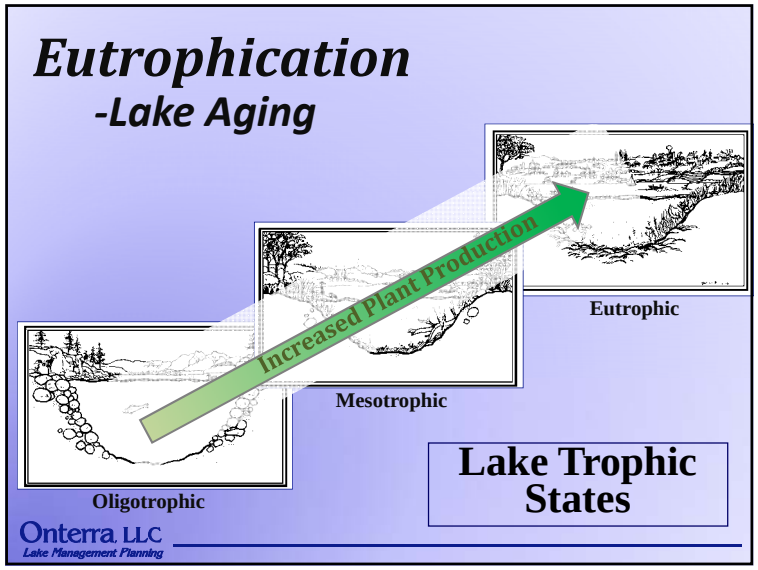
Eutrophication
-Lake Aging
Increased Plant Production
Eutrophic
Mesotrophic
Oligotrophic
Lake Trophic States
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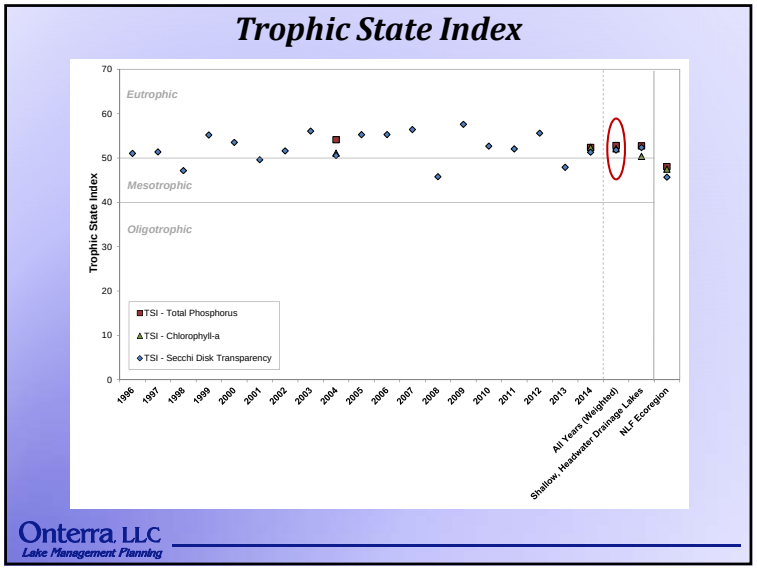
Trophic State Index
Eutrophic
Mesotrophic
Oligotrophic
Trophic State Index
TSI - Total Phosphorus
TSI - Chlorophyll-a
TSI - Secchi Disk Transparency
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
All Years (Weighted)
Shallow, Headwater Drainage Lakes
NLF Ecoregion
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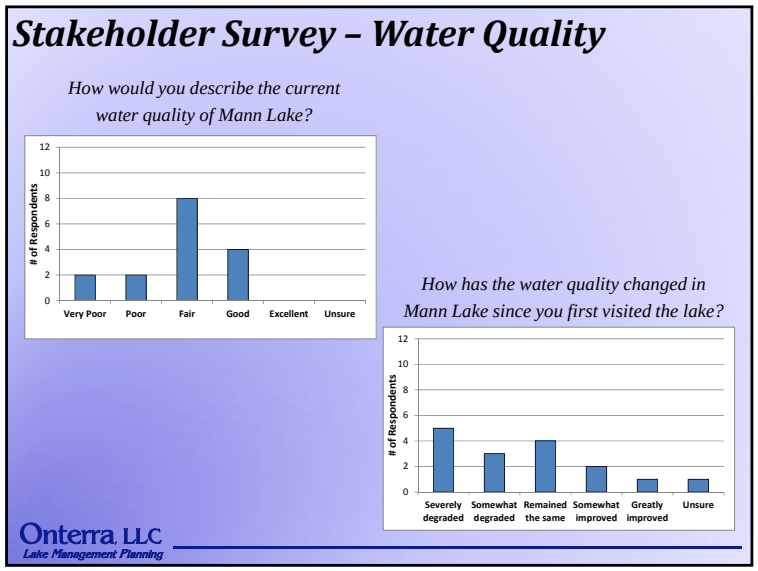
Stakeholder Survey – Water Quality
How would you describe the current water quality of Mann Lake?
# of Respondents
Very Poor
Poor
Fair
Good
Excellent
Unsure
How has the water quality changed in Mann Lake since you first visited the lake?
# of Respondents
Severely degraded
Somewhat degraded
Remained the same
Somewhat improved
Greatly improved
Unsure
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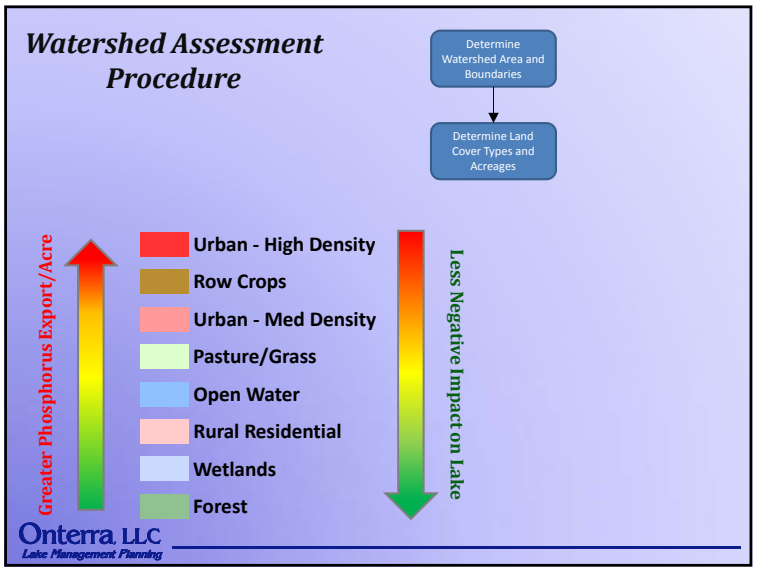
Watershed Assessment Procedure
Determine Watershed Area and Boundaries
Determine Land Cover Types and Acreages
Greater Phosphorus Export/Acre
Urban - High Density
Row Crops
Urban - Med Density
Pasture/Grass
Open Water
Rural Residential
Wetlands
Forest
Less Negative Impact on Lake
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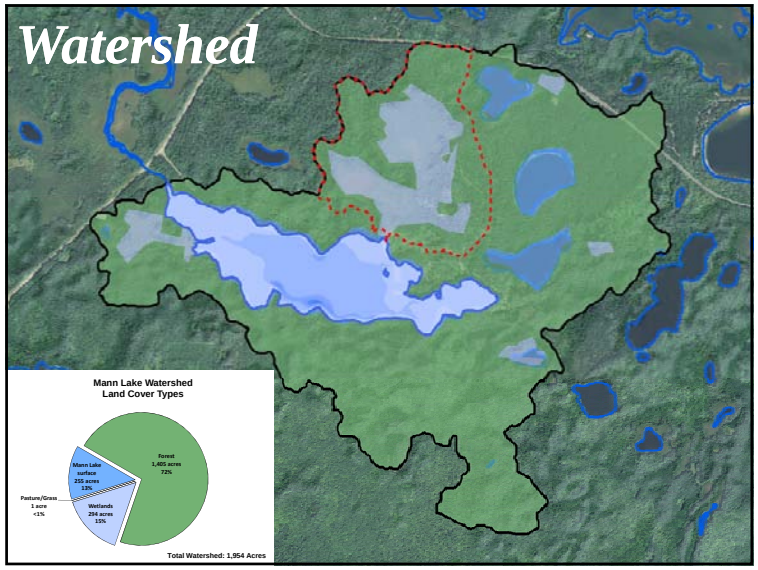
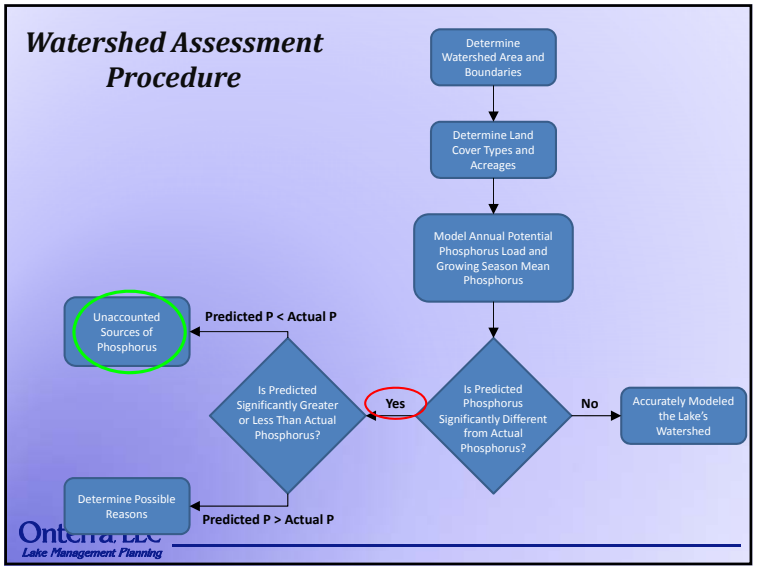

Watershed
Mann Lake Watershed
Land Cover Types
Forest
1,405 acres
72%
Mann Lake surface
255 acres
13%
Pasture/Grass
1 acre
<1%
Wetlands
294 acres
15%
Total Watershed: 1,954 Acres


Watershed Assessment Procedure
Determine Watershed Area and Boundaries
Determine Land Cover Types and Acreages
Model Annual Potential Phosphorus Load and Growing Season Mean Phosphorus
Is Predicted Phosphorus Significantly Different from Actual Phosphorus?
No
Accurately Modeled the Lake's Watershed
Yes
Is Predicted Significantly Greater or Less Than Actual Phosphorus?
Predicted P < Actual P
Unaccounted Sources of Phosphorus
Predicted P > Actual P
Determine Possible Reasons
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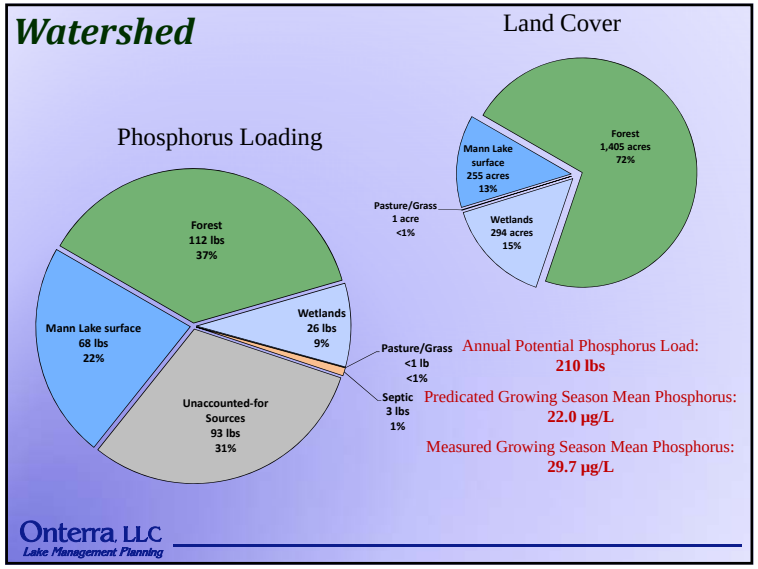
Watershed
Land Cover
Phosphorus Loading
Forest
1,405 acres
72%
Mann Lake surface
255 acres
13%
Pasture/Grass
1 acre
<1%
Wetlands
294 acres
15%
Forest
112 lbs
37%
Wetlands
26 lbs
9%
Mann Lake surface
68 lbs
22%
Unaccounted-for Sources
93 lbs
31%
Pasture/Grass
<1 lb
<1%
Septic
3 lbs
1%
Annual Potential Phosphorus Load:
210 lbs
Predicated Growing Season Mean Phosphorus:
22.0 µg/L
Measured Growing Season Mean Phosphorus:
29.7 µg/L
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Lake Management Planning


Shoreland Assessment
Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
It does not look at lake shoreline on a property-by-property basis.
Assessment ranks shoreland area from shoreline back 35 feet
Urbanized
Natural
Range
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Shoreline Assessment Category Descriptions

More Natural Habitat

Urbanized | Developed-Unnatural | Developed-Semi-Natural | Developed-Natural | Natural/Undeveloped

Greater Need for Restoration

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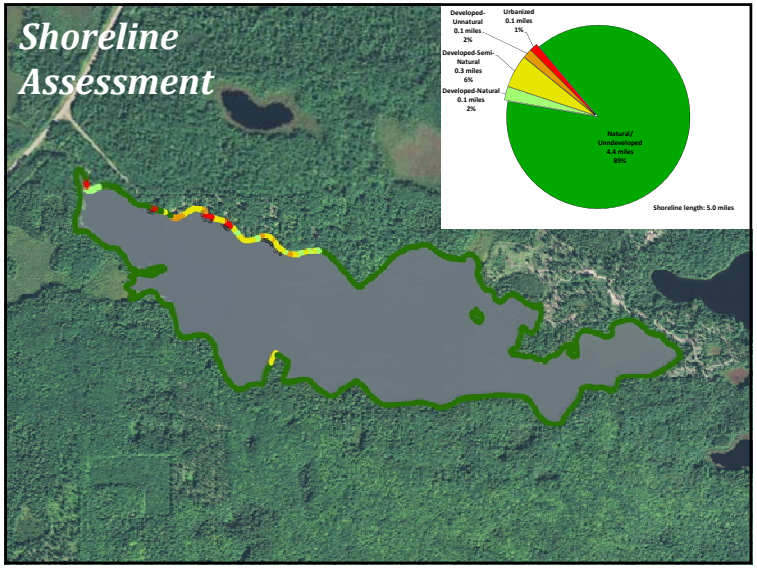

Coarse Woody Habitat

- Provides shoreland erosion control and prevents suspension of sediments.
- Preferred habitat for a variety of aquatic life.
  - Periphyton growth fed upon by insects.
  - Refuge, foraging and spawning habitat for fish.
  - Complexity of CWH important.
- Changing of logging and shoreland development practices = reduced CWH in Wisconsin lakes.
- Survey aimed at quantifying CWH in Mann Lake

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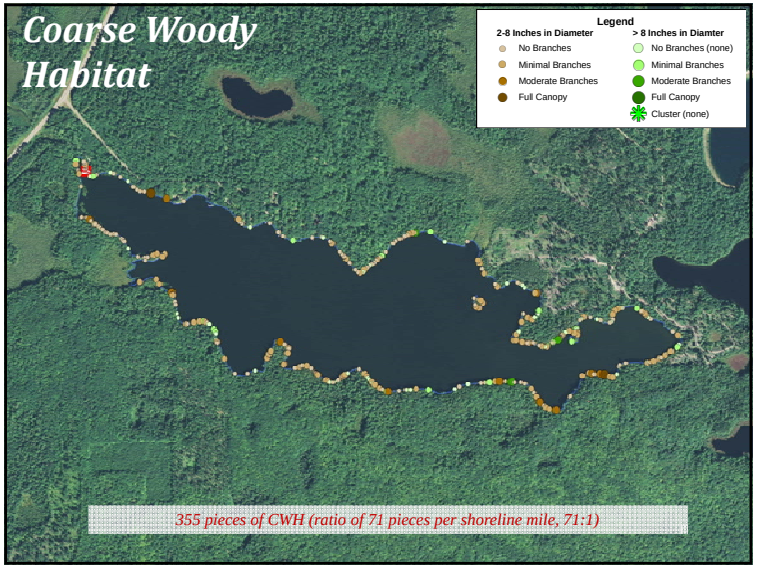

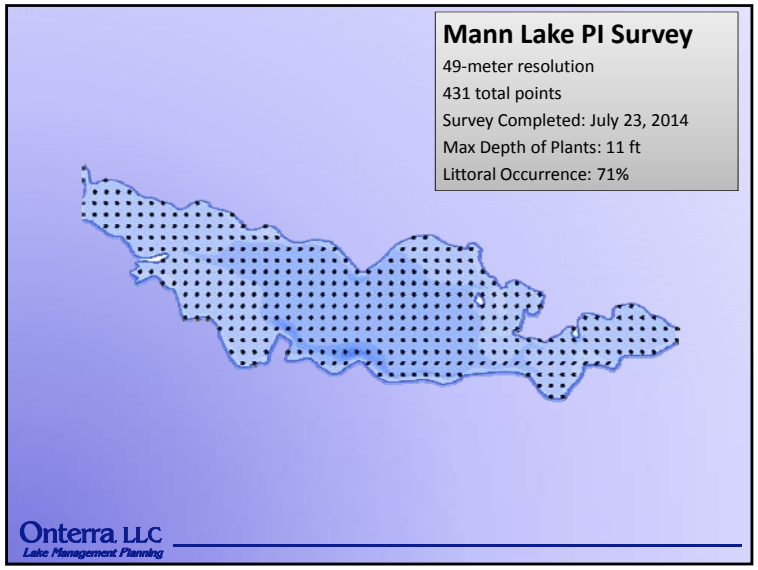

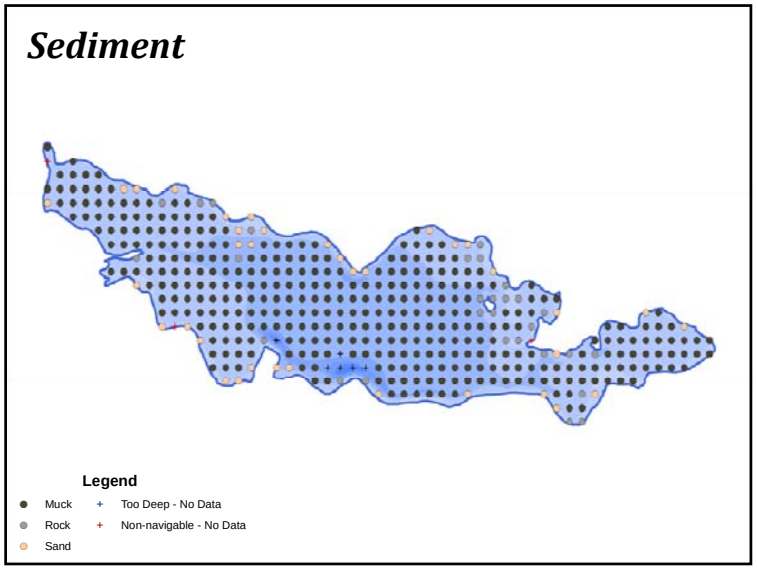

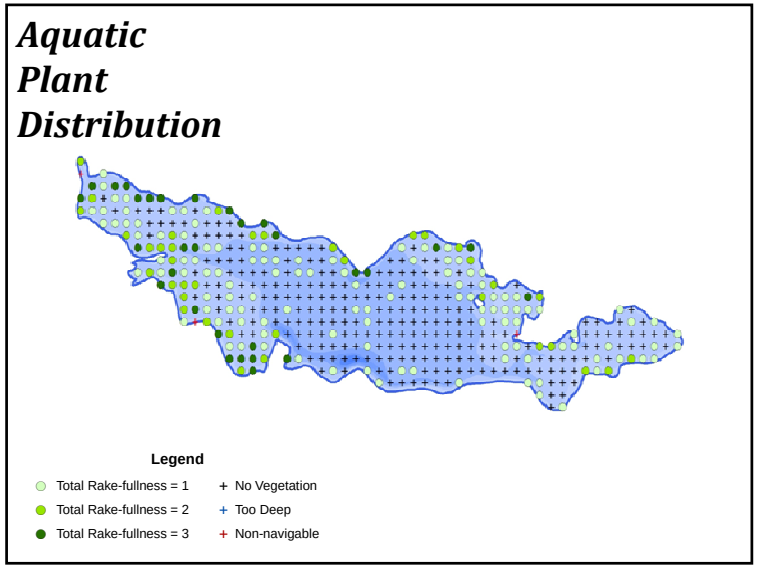

Species List

- 30 Native Species
  - 13 on PI Survey
  - 18 Incidentally found
- 1 Non-native plant
  - Reed canary grass

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2014 (Onterra)
Emergent	*Agrostis scabra*	Rough bent grass	N/A	I
	Calla palustris	Water arum	9	I
	Carex comosa	Bristly sedge	5	I
	Carex diandra	Bog panicled sedge	9	I
	Carex aquatilis	Water sedge	7	I
	Dulichium arundinaceum	Three-way sedge	9	I
	Decodon verticillatus	Water-willow	7	I
	Eleocharis palustris	Creeping spikerush	6	I
	Iris versicolor	Northern blue flag	5	I
	Juncus effusus	Soft rush	4	I
	Phalaris arundinacea	Reed canary grass	Exotic	I
	Rumex crispus	Curly Dock	N/A	I
	Schoenoplectus acutus	Hardstem bulrush	5	I
	Scirpus cyperinus	Wool grass	4	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Sagittaria latifolia	Common arrowhead	3	I
FL	*Nymphaea odorata*	White water lily	6	X
Submergent	*Ceratophyllum demersum*	Coontail	3	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum sibiricum	Northern water milfoil	7	X
	Najas flexilis	Slender naiad	6	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	I
	Potamogeton friesii	Fries' pondweed	8	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton follosus	Leafy pondweed	6	X
	Utricularia vulgaris	Common bladderwort	7	I
	Vallisneria americana	Wild celery	6	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X
FF	*Lemna minor*	Lesser duckweed	5	X
	Spirodela polyrhiza	Greater duckweed	5	X

FL = Floating Leaf; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

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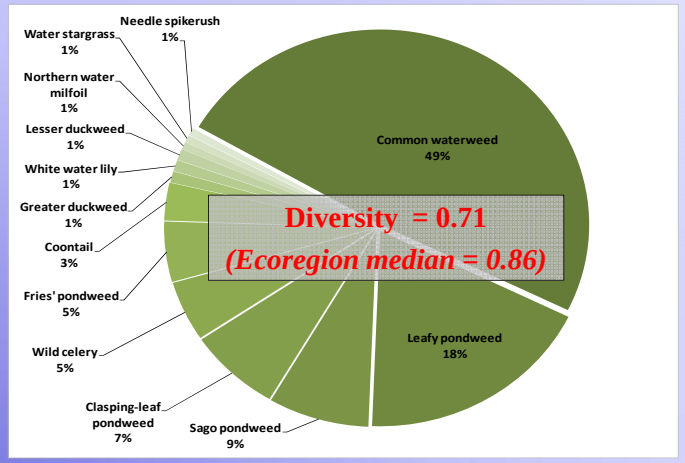
2014 Relative Frequency of Occurrence



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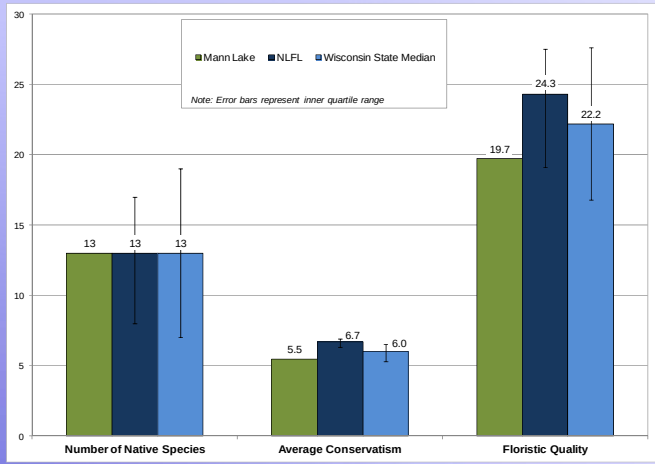
Floristic Quality Analysis



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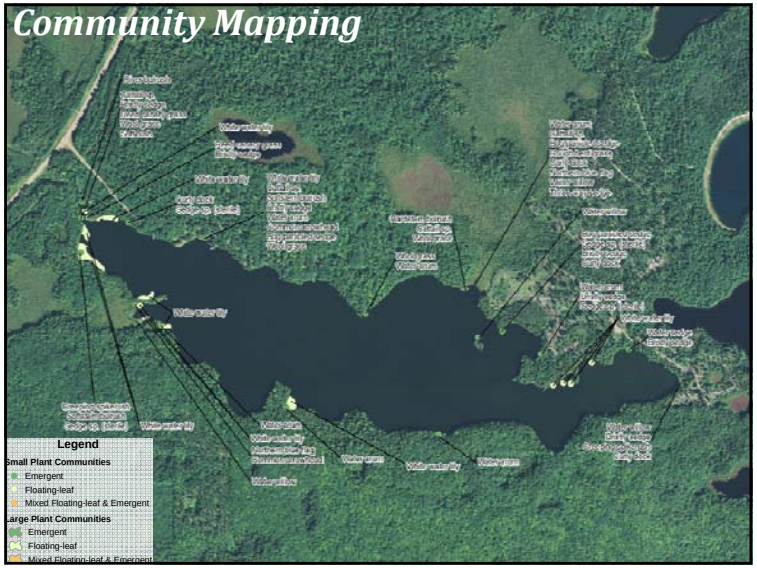
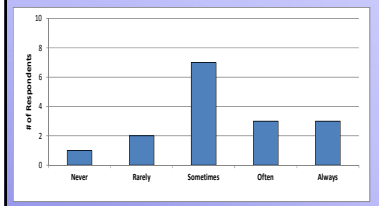
Lake Management Planning

Community Mapping

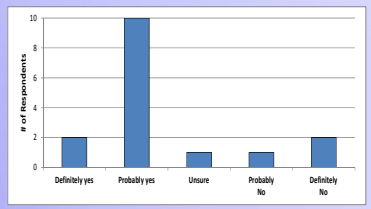


Stakeholder Survey – Aquatic Plants and Algae

During open water season, how often does aquatic plant growth, including algae, negatively impact your enjoyment of the lake?



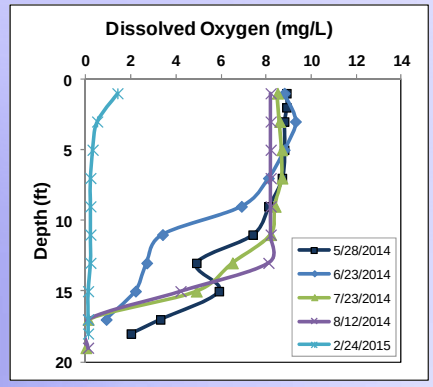
Considering your answer to Question #22, do you believe aquatic plant control is needed on Mann Lake?



Onterra LLC
Lake Management Planning

Mann Lake Fishery

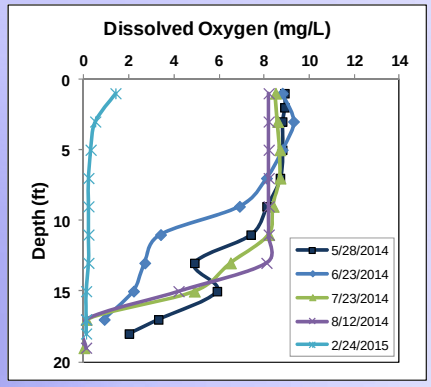
- **Low winter dissolved oxygen = primary concern**
  - Trout, salmonids ~3-5 mg/L
  - Cyprinids ~1-2 mg/L
  - Pike, perch <1 mg/L



Onterra LLC Lake Management Planning

Mann Lake Fishery

- **Factors in lake dissolved oxygen content**
  - Rate of microbial degradation
  - Water volume
  - Duration of ice cover



Onterra LLC Lake Management Planning

Mann Lake Fishery

- **Aeration of lake water**
  - Breaks up ice and circulates water to allow atmospheric oxygen exchange
  - Goal: provide “refuge” of 1+ acres of open water
  - Specifications & design of units vary
    - >5 ft water
    - Electrical source
    - Public land, or private land with permission
    - Maintaining of barricade


Picture courtesy of WDNR

Onterra LLC Lake Management Planning

Mann Lake Fishery

- **Costs of lake aeration**
  - Costs dependent upon:
    - Size (horsepower) of compressor unit
    - Amount (length) of tubing required
    - Number of diffusers
    - Length (time) of running the unit
    - Local kwh rates
  - Costs highly variable
    - Unit cost $1,000-$2,000
    - Electricity $50-$180 per month
    - Barricade materials $100-$200

Onterra LLC Lake Management Planning

Mann Lake Fishery

- **Costs of lake aeration**

Variable	Costs	
	Low estimate	High estimate
Unit cost (compressor, tubing, diffusers)	$1,000	$2,000
Barricade materials	$100	$200
Up front cost:	**$1,100**	**$2,200**
Electricity (monthly cost)	$50	$180
Duration of running unit (months)	3	5
Annual electricity cost:	**$150**	**$900**
Annual maintenance	$25	$100
Total cost, 5 years:	**$1,975**	**$7,200**

- **Grant funding a possibility (Lake Protection Grant)**
  - WDNR must agree aeration unit warranted
  - Limited funding: actual equipment costs only, must be depreciated over the useful life of equipment and annual value paid only during duration of grant

Onterra LLC Lake Management Planning

Conclusions

- Water quality for shallow, headwater drainage lake is good to excellent.
  - Limited historic data, but no apparent trends detected.
  - Lake is productive, but ecologically healthy.
  - Modeling of lake/watershed indicates some unaccounted-for nutrients
    - Internal nutrient recycling.
    - Impacts of flushing wetland?
- Overall watershed is in excellent condition.
  - Land cover exports minimal phosphorus.
  - Shoreland zone is mostly undeveloped.

Onterra LLC Lake Management Planning

Conclusions continued

- Aquatic plant community
  - Based upon analysis, native plant community is of average quality.
    - Low species diversity
    - Few sensitive species present
  - Conditions are optimal for common waterweed and leafy pondweed.
    - Limits available space for other species
    - Lesser quality plant community likely due to overabundance of these species, more so than environmental disturbance
- Fisheries
  - Productive lake could produce good fishery
  - Oxygen content will regulate presence/growth of fish in lake system
  - Aeration a good option for alleviating winterkill conditions

Onterra LLC Lake Management Planning

Thank You

Many of the graphics used in this presentation were supplied by:

Wisconsin Lakes Partnership

UWEX Extension

Wisconsin Dept. of Natural Resources

Onterra LLC Lake Management Planning

B

APPENDIX B

Stakeholder Survey Response Charts and Comments

Friends of Mann Lake Anonymous Stakeholder Survey

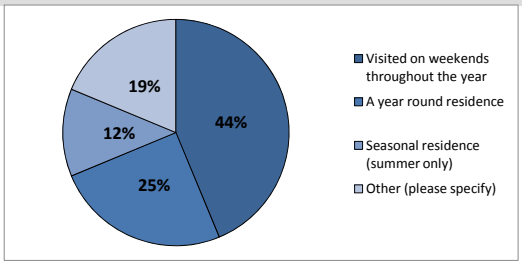
Surveys Distributed:	36
Surveys Returned:	16
Response Rate:	44%

Mann Lake Property

1. How is your property on Mann Lake utilized?
If you own more than one property, please circle the type of property you have owned the longest. Please refer to this property as you answer the remaining questions in the survey. Please select one choice.

Answer Options	Response Percent	Response Count
Visited on weekends throughout the year	43.8%	7
A year round residence	25.0%	4
Seasonal residence (summer only)	12.5%	2
Resort property	0.0%	0
Rental property	0.0%	0
Undeveloped	0.0%	0
I am a renter and do not own the property	0.0%	0
Other (please specify)	18.8%	3
answered question		16
skipped question		0

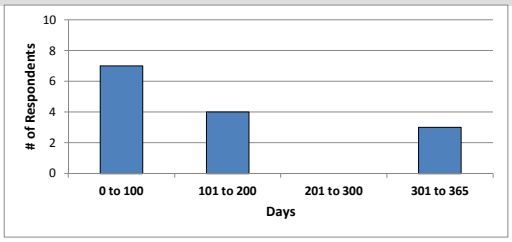
Number	Other (please specify)
1	It is a year round residence and are there very frequently but it is not our primary residence
2	I do not own property. However, Uncles own property on Lake
3	Second resitence but used in winter as well as summer



2. How many days each year is your property used by you or others?
Refer to the property identified in Question 1. Please answer in approximate number of days.

Answer Options	Response Count
	14
answered question	14
skipped question	2

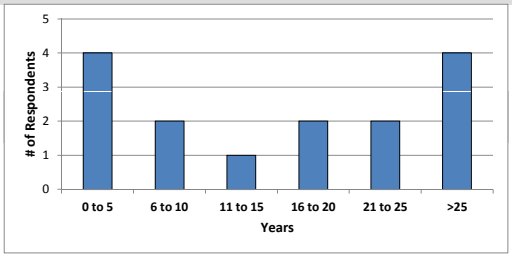
Category (# of days)	Responses	
0 to 100	7	50%
101 to 200	4	29%
201 to 300	0	0%
301 to 365	3	21%
Total	14	



3. How long have you owned or rented your property on Mann Lake?
If less than one year please respond with "1". Please answer in approximate number of years.

Answer Options	Response Count
	15
answered question	15
skipped question	1

Category (# of years)	Responses	% Response
0 to 5	4	27%
6 to 10	2	13%
11 to 15	1	7%
16 to 20	2	13%
21 to 25	2	13%
>25	4	27%
Total	15	

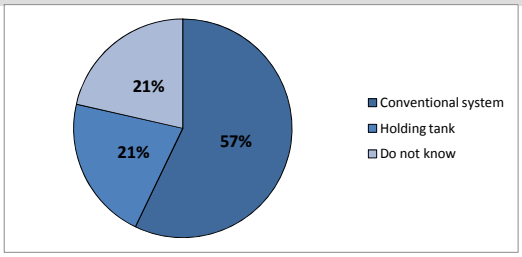


4. Is your property located on the shoreline of Mann Lake (lakefront property) or not located on the lake's shoreline (not lakefront property)?
Please select one answer.

Answer Options	Response Percent	Response Count
Lakefront property	87.5%	14
Not lakefront property	12.5%	2
answered question		16
skipped question		0

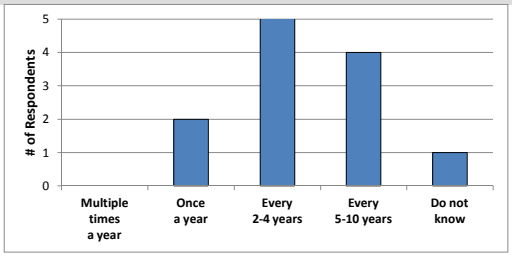
5. What type of septic system does your property utilize?
Please select one choice.

Answer Options	Response Percent	Response Count
Conventional system	57.1%	8
Holding tank	21.4%	3
Do not know	21.4%	3
Mound	0.0%	0
Advanced treatment system	0.0%	0
Municipal sewer	0.0%	0
No septic system	0.0%	0
answered question		14
skipped question		2



6. How often is the septic system on your property pumped?
Please select one choice.

Answer Options	Response Percent	Response Count
Multiple times a year	0.0%	0
Once a year	14.3%	2
Every 2-4 years	50.0%	7
Every 5-10 years	28.6%	4
Do not know	7.1%	1
answered question		14
skipped question		2

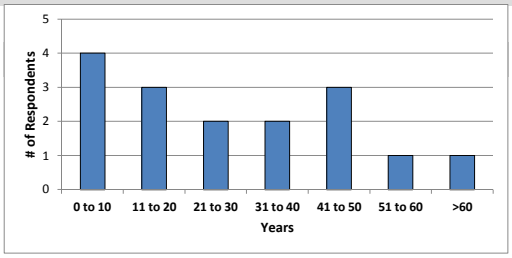


Recreational Activity on Mann Lake

7. How many years ago did you first visit Mann Lake?
Please answer in approximate number of years. If less than 1 year please type "1".

Answer Options	Response Count
	16
answered question	16
skipped question	0

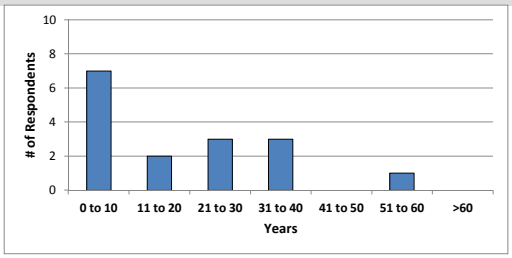
Category (# of days)	Responses	% Response
0 to 10	4	25%
11 to 20	3	19%
21 to 30	2	13%
31 to 40	2	13%
41 to 50	3	19%
51 to 60	1	6%
>60	1	6%
Total	16	



8. For how many years have you fished on Mann Lake?
If this is your first year, please type "1".

Answer Options	Response Count
	16
answered question	**16**
skipped question	**0**

Category (# of days)	Responses	% Response
0 to 10	**7**	**44%**
11 to 20	**2**	**13%**
21 to 30	**3**	**19%**
31 to 40	**3**	**19%**
41 to 50	**0**	**0%**
51 to 60	**1**	**6%**
>60	**0**	**0%**
Total	**16**	

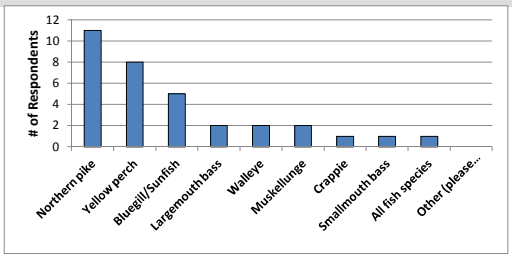


9. Have you personally fished on Mann Lake in the past three years?
Please select one choice.

Answer Options	Response Percent	Response Count
Yes	75.0%	12
No	25.0%	4
answered question		**16**
skipped question		**0**

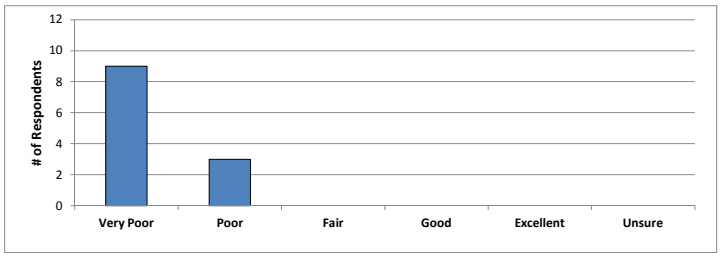
10. What species of fish do you like to catch on Mann Lake?
Please select all that apply.

Answer Options	Response Percent	Response Count
Northern pike	91.7%	11
Yellow perch	66.7%	8
Bluegill/Sunfish	41.7%	5
Largemouth bass	16.7%	2
Walleye	16.7%	2
Muskellunge	16.7%	2
Crappie	8.3%	1
Smallmouth bass	8.3%	1
All fish species	8.3%	1
Other (please specify)	0.0%	0
answered question		**12**
skipped question		**4**



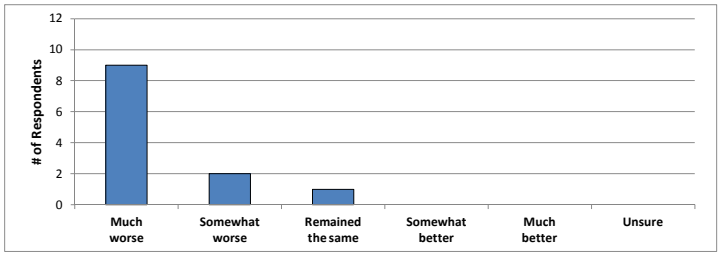
11. How would you describe the current quality of fishing on Mann Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	9	3	0	0	0	0	12
						answered question	***12***
						skipped question	***4***



12. How has the quality of fishing changed on Mann Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	9	2	1	0	0	0	12
						answered question	*12*
						skipped question	*4*



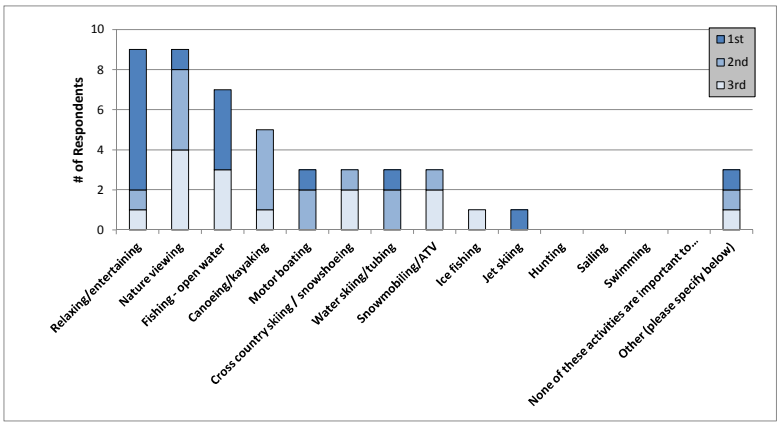
13. What types of watercraft do you currently use on Mann Lake?
Please select all that apply.

Answer Options	Response Percent	Response Count
Canoe/kayak	56.3%	9
Motor boat with greater than 25 hp motor	56.3%	9
Motor boat with 25 hp or less motor	25.0%	4
Paddleboat	18.8%	3
Rowboat	18.8%	3
Jet ski (personal water craft)	12.5%	2
Pontoon	12.5%	2
Sailboat	6.3%	1
Jet boat	0.0%	0
Do not use watercraft	6.3%	1
answered question		16
skipped question		0

14. For the list below, rank your top three activities that are important reasons for owning or renting your property on or near Mann Lake, with 1 being the most important activity.
Enter a 1, 2 and 3 by your top activities below.

Answer Options	1st	2nd	3rd	Rating Average	Response Count
Relaxing/entertaining	7	1	1	1.33	9
Nature viewing	1	4	4	2.33	9
Fishing - open water	4	0	3	1.86	7
Canoeing/kayaking	0	4	1	2.20	5
Motor boating	1	2	0	1.67	3
Cross country skiing / snowshoeing	0	1	2	2.67	3
Water skiing/tubing	1	2	0	1.67	3
Snowmobiling/ATV	0	1	2	2.67	3
Ice fishing	0	0	1	3.00	1
Jet skiing	1	0	0	1.00	1
Hunting	0	0	0	0.00	0
Sailing	0	0	0	0.00	0
Swimming	0	0	0	0.00	0
None of these activities are important to me	0	0	0	0.00	0
Other (please specify below)	1	1	1	2.00	3
				answered question	16
				skipped question	0

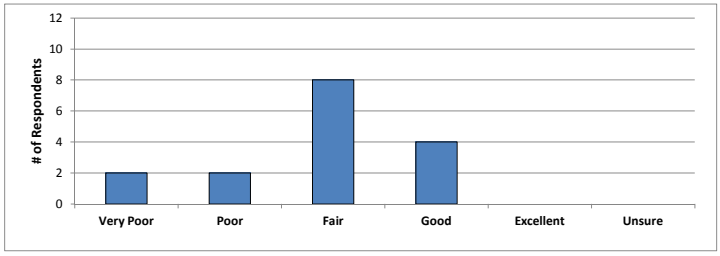
Number	"Other" responses
1	Biking & Hiking
2	Biking
3	biking



Mann Lake Current and Historic Condition, Health and Management

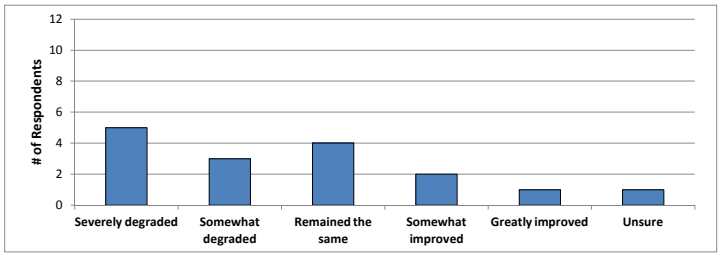
15. How would you describe the current water quality of Mann Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	2	2	8	4	0	0	16
						answered question	*16*
						skipped question	*0*



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

Answer Options	Severely degraded	Somewhat degraded	Remained the same	Somewhat improved	Greatly improved	Unsure	Response Count
	5	3	4	2	1	1	16
						answered question	*16*
						skipped question	*0*



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

Answer Options	Response Percent	Response Count
Yes	87.5%	14
No	12.5%	2
	answered question	**16**
	skipped question	**0**

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

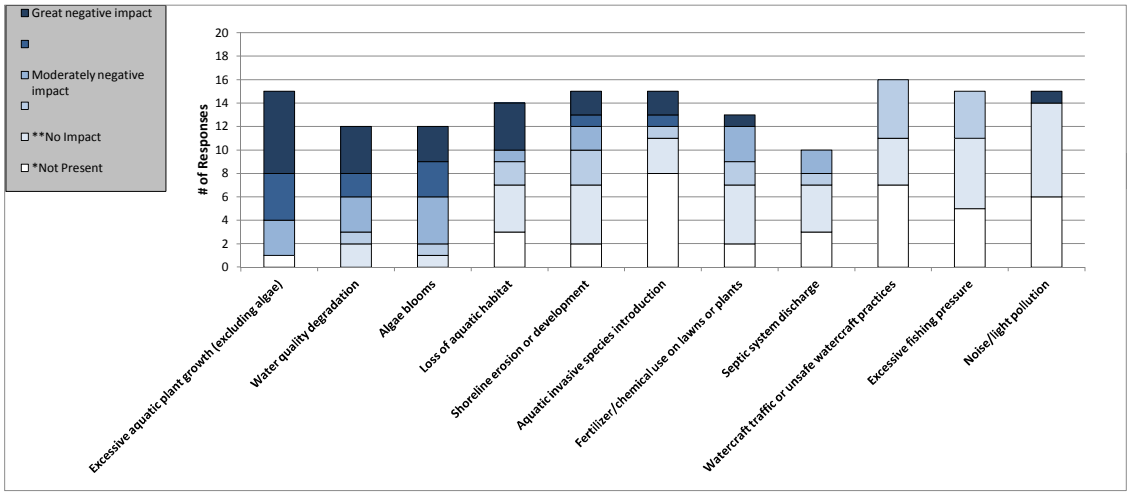
Answer Options	Response Percent	Response Count
Yes	28.6%	4
No	71.4%	10
	answered question	**14**
	skipped question	**2**

19. Which aquatic invasive species do you believe are in Mann Lake?
Please select all that apply.

Answer Options	Response Percent	Response Count
Purple loosestrife	25.0%	1
Eurasian water milfoil	0.0%	0
Curly-leaf pondweed	0.0%	0
Pale yellow iris	0.0%	0
Flowering rush	0.0%	0
Chinese mystery snail	0.0%	0
Zebra mussel	0.0%	0
Rusy crayfish	0.0%	0
Freshwater jellyfish	0.0%	0
Spiny water flea	0.0%	0
Heterosporosis (Yellow perch parasite)	0.0%	0
Alewife	0.0%	0
Round goby	0.0%	0
Rainbow smelt	0.0%	0
Carp	0.0%	0
I don't know but presume that AIS are present in the lake	100.0%	4
Other (please specify)	0.0%	0
answered question		4
skipped question		12

20. Below is a list of possible impacts to Wisconsin lakes. To what level do you believe each of the following factors may currently be negatively impacting Mann Lake?
Please select only one choice for each impact description.
** Not Present means that you believe the issue does not exist on Mann Lake.*
*** No Impact means that the issue may exist on Mann Lake but it is not negatively impacting the lake.*

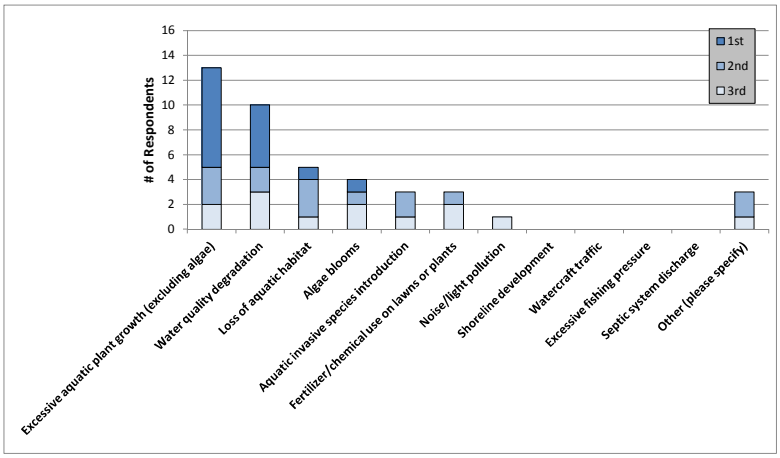
Answer Options	*Not Present	**No Impact		Moderately negative impact		Great negative impact	Unsure: Need more information	Rating Average	Response Count
Excessive aquatic plant growth (excluding algae)	1	0	0	3	4	7	1	2.88	16
Water quality degradation	0	2	1	3	2	4	3	1.93	15
Algae blooms	0	1	1	4	3	3	4	1.88	16
Loss of aquatic habitat	3	4	2	1	0	4	1	1.33	15
Shoreline erosion or development	2	5	3	2	1	2	0	1.20	15
Aquatic invasive species introduction	8	3	1	0	1	2	0	0.80	15
Fertilizer/chemical use on lawns or plants	2	5	2	3	0	1	2	0.80	15
Septic system discharge	3	4	1	2	0	0	5	0.33	15
Watercraft traffic or unsafe watercraft practices	7	4	5	0	0	0	0	0.31	16
Excessive fishing pressure	5	6	4	0	0	0	0	0.27	15
Noise/light pollution	6	8	0	0	0	1	0	0.27	15
Other (please specify)								0	0
								answered question	16
								skipped question	0



21. From the list below, please rank your top three concerns regarding Mann Lake, with 1 being your greatest concern.
Enter a 1, 2 and 3 by your top concerns below.

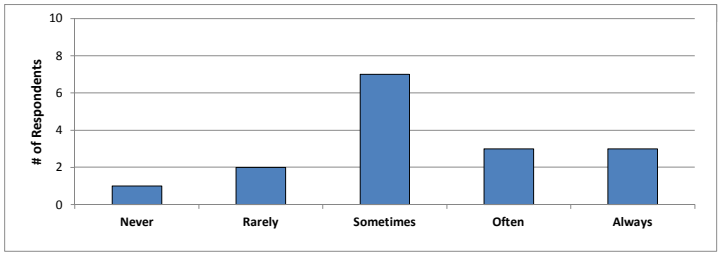
Answer Options	1st	2nd	3rd	Response Count
Excessive aquatic plant growth (excluding algae)	8	3	2	13
Water quality degradation	5	2	3	10
Loss of aquatic habitat	1	3	1	5
Algae blooms	1	1	2	4
Aquatic invasive species introduction	0	2	1	3
Fertilizer/chemical use on lawns or plants	0	1	2	3
Noise/light pollution	0	0	1	1
Shoreline development	0	0	0	0
Watercraft traffic	0	0	0	0
Excessive fishing pressure	0	0	0	0
Septic system discharge	0	0	0	0
Other (please specify)	0	2	1	3
			answered question	15
			skipped question	1

Number	"Other" responses
1	winterkill
2	I have no concerns
3	winter freeze
4	Low Oxygen levels in winter



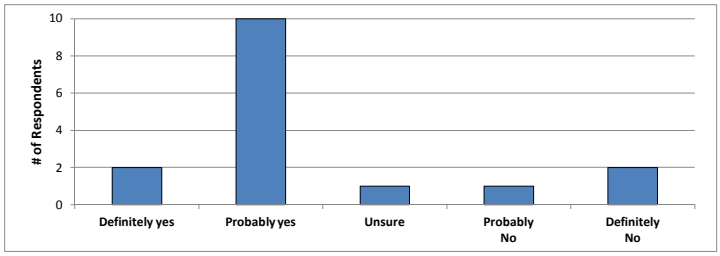
22. During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of Mann Lake?

Answer Options	Never	Rarely	Sometimes	Often	Always	Response Count
	1	2	7	3	3	16
					answered question	*16*
					skipped question	*0*



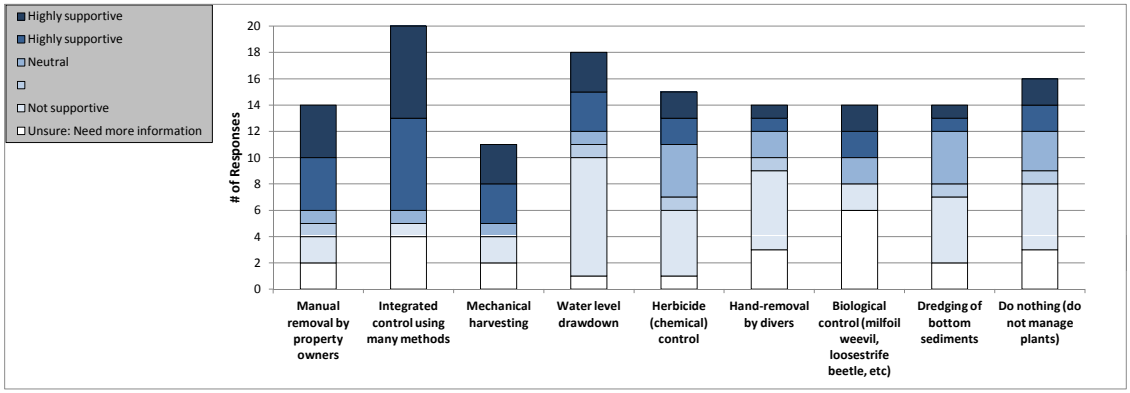
23. Considering your answer to the question above, do you believe aquatic plant control is needed on Mann Lake?

Answer Options	Definitely yes	Probably yes	Unsure	Probably No	Definitely No	Rating Average
	2	10	1	1	2	2.06
					answered question	*16*
					skipped question	*0*



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

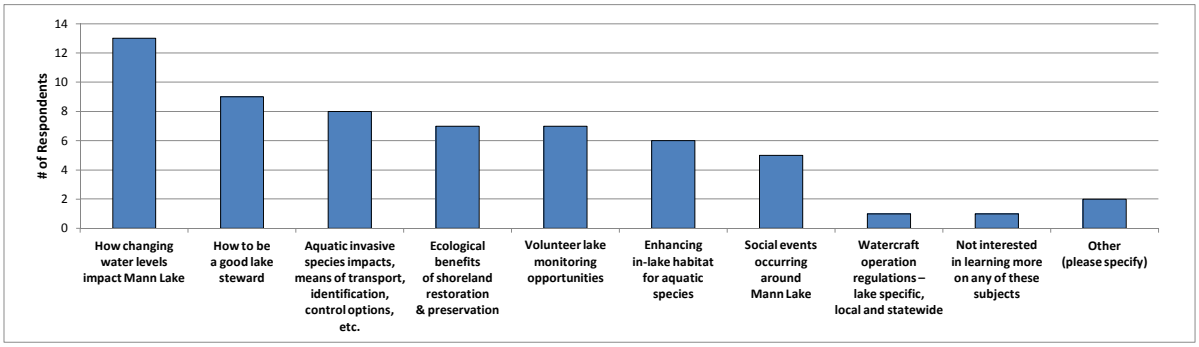
Answer Options	Not supportive		Neutral		Highly supportive	Unsure: Need more information	Rating Average	Response Count
Manual removal by property owners	2	1	1	5	4	2	2.33	15
Integrated control using many methods	1	0	1	2	7	4	2.33	15
Mechanical harvesting	2	0	1	6	3	2	2.29	14
Water level drawdown	9	1	1	0	3	1	1.53	15
Herbicide (chemical) control	5	1	4	3	2	1	1.50	16
Hand-removal by divers	6	1	2	2	1	3	1.20	15
Biological control (milfoil weevil, loosestrife beetle, etc)	2	0	2	2	2	6	1.14	14
Dredging of bottom sediments	5	1	4	2	1	2	1.13	15
Do nothing (do not manage plants)	5	1	3	0	2	3	1.07	14
							answered question	16
							skipped question	0



25. Stakeholder 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
How changing water levels impact Mann Lake	81.3%	13
How to be a good lake steward	56.3%	9
Aquatic invasive species impacts, means of transport, identification, control options, etc.	50.0%	8
Ecological benefits of shoreland restoration and preservation	43.8%	7
Volunteer lake monitoring opportunities (Clean Boats Clean Waters, Citizens Lake Monitoring	43.8%	7
Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species	37.5%	6
Social events occurring around Mann Lake	31.3%	5
Watercraft operation regulations - lake specific, local and statewide	6.3%	1
Not interested in learning more on any of these subjects	6.3%	1
Other (please specify)	12.5%	2
answered question		16
skipped question		0

Number	Other (please specify)
1	water safety
2	fish stocking, aeration system



Friends of Mann Lake, Inc. (FML)

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

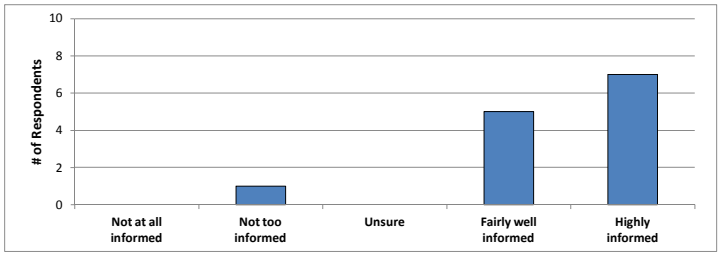
Answer Options	Response Percent	Response Count
Yes	93.8%	15
No	6.3%	1
answered question		16
skipped question		0

27. What is your membership status with the FML?

Answer Options	Response Percent	Response Count
Current member	86.7%	13
Former member	0.0%	0
Never been a member	13.3%	2
answered question		15
skipped question		1

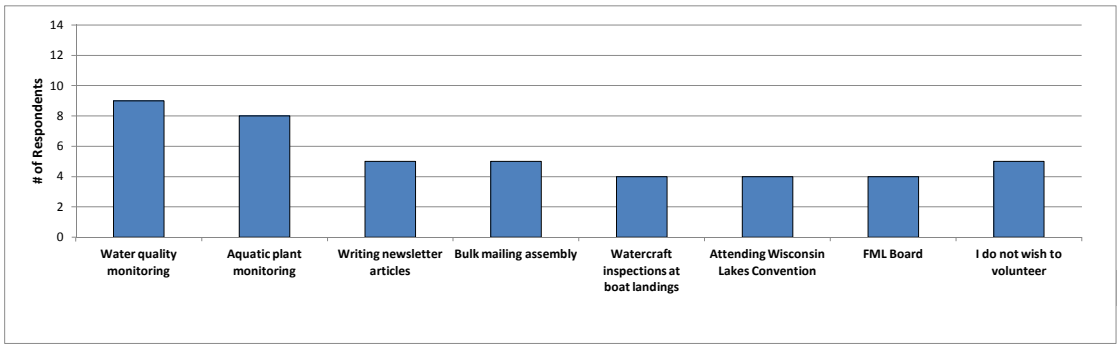
28. How informed has the FML kept you regarding issues with your lake and its management?

Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	0	1	0	5	7	13
					answered question	*13*
					skipped question	*3*



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

Answer Options	Response Percent	Response Count
Water quality monitoring	56.3%	9
Aquatic plant monitoring	50.0%	8
Writing newsletter articles	31.3%	5
Bulk mailing assembly	31.3%	5
Watercraft inspections at boat landings	25.0%	4
Attending Wisconsin Lakes Convention	25.0%	4
FML Board	25.0%	4
I do not wish to volunteer	31.3%	5
answered question		**16**
skipped question		**0**



30. Please feel free to provide written comments concerning Mann Lake, its current and/or historic condition and its management.

Answer Options	Response Count
	7
answered question	**7**
skipped question	**9**

Number	Response Text
1	A couple years ago we witnessed 2 male residents of the lake pulling weeds from the area around his pier and pulling them out to the middle of the lake. Since then we have had more weeds by our pier since many of the weeds floated to us. Also - about 28 years ago the Trout Lake Limnology Center was studying our lake and I am sure they maintain some records.
2	If we get a hard winter there is too much fish kill do to lack of oxygen in the water.
3	Educate, communicate with all property owners the value of being good lake stewards for the betterment of Mann Lake for future generations. Encourage 100% lake owner's participation in FML and raising money to support our mission.
4	I believe Mann Lake is going through its cycle - leave Mann Lake to Mother Nature - thank you
5	Communication and input at all levels is very important. Mann Lake is a special place and it belongs to all of us. Looking forward to great work together!
6	Very little communication beyond annual meetings. Rogue individuals possibly harming water and lake shore quality.
7	I do not reside at the Lake and live outside Wisconsin. However, I would be willing to help in any way possible, including making visits to the Lake to help.

C

APPENDIX C

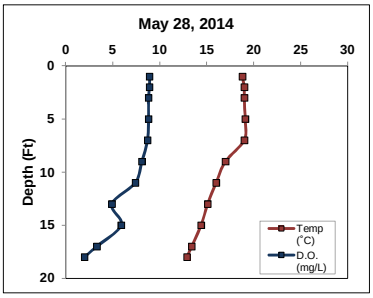
Water Quality Data

Mann Lake

Date: 5/28/2014
Time: 9:10
Weather: 40% clouds, slight breeze, 60F
Entry: EEH

Max Depth: 21.3
MLS Depth (ft): 3.0
MLB Depth (ft): 18.0
Secchi Depth (ft): 8.9

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	18.8	8.9		
2	19.0	8.9		
3	19.0	8.8	8.6	
5	19.1	8.8		
7	19.0	8.7		
9	17.0	8.1	8.5	
11	16.0	7.4		
13	15.1	4.9		
15	14.4	5.9		
17	13.4	3.3		
18	12.9	2.0	7.7	



Parameter	MLS	MLB
Total P (µg/L)	16.40	43.40
Dissolved P (µg/L)	ND	3.00
Chl-a (µg/L)	4.71	NA
TKN (µg/L)	469.00	824.00
NO_3 + NO_2-N (µg/L)	ND	39.40
NH_3-N (µg/L)	ND	227.00
Total N (µg/L)	469.00	863.40
Lab Cond. (µS/cm)	105.00	121.00
Lab pH	7.93	7.21
Alkalinity (mg/L $CaCO_3$)	53.00	61.20
Total Susp. Solids (mg/L)	ND	2.20
Calcium (mg/L)	14.70	NA
Magnesium (mg/L)	3.25	NA
Hardness (mg/L)	50.10	NA
Color (SU)	15.00	NA
Turbidity (NTU)	NA	NA

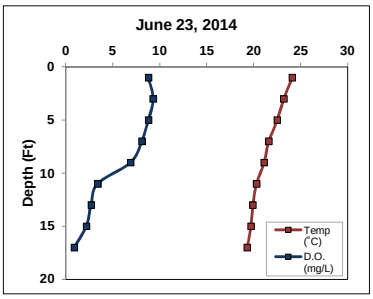
Data collected by EAT, SDF, and EEH (Onterra)

Mann Lake

Date: 6/23/2014
Time: 15:00
Weather: 79F, 75% clouds, no wind
Entry: EEH

Max Depth: 18.5
MLS Depth (ft): 3.0
MLB Depth (ft): 16.0
Secchi Depth (ft): 3.8

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	24.1	8.8		
3	23.2	9.3		
5	22.5	8.8		
7	21.6	8.1		
9	21.1	6.9		
11	20.3	3.4		
13	19.9	2.7		
15	19.7	2.2		
17	19.3	0.9		



Parameter	MLS	MLB
Total P (µg/L)	28.90	40.10
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	12.80	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)	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

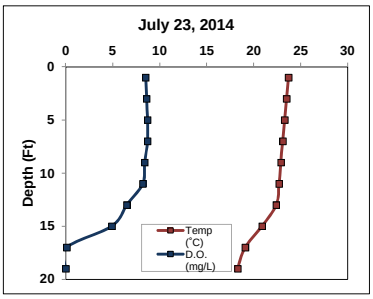
Data collected by TAH (Onterra)

Mann Lake

Date: 7/23/2014
Time: 13:50
Weather: 50% clouds, 70F
Entry: EEH

Max Depth: 20.0
MLS Depth (ft): 3.0
MLB Depth (ft): 17.0
Secchi Depth (ft): 6.8

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	23.7	8.5		
3	23.5	8.6		
5	23.3	8.7		
7	23.1	8.7		
9	22.9	8.4		
11	22.7	8.2		
13	22.4	6.5		
15	20.9	4.9		
17	19.1	0.1		
19	18.3	0.0		



Parameter	MLS	MLB
Total P (µg/L)	28.50	54.90
Dissolved P (µg/L)	ND	ND
Chl-*a* (µg/L)	9.20	NA
TKN (µg/L)	607.00	726.00
$NO_3 + NO_2$-N (µg/L)	ND	ND
NH_3-N (µg/L)	ND	143.00
Total N (µg/L)	607.00	726.00
Lab Cond. (µS/cm)	112.00	121.00
Lab pH	8.25	7.52
Alkalinity (mg/L $CaCO_3$)	55.70	60.90
Total Susp. Solids (mg/L)	ND	4.80
Calcium (mg/L)	15.70	NA
Magnesium (mg/L)	3.72	NA
Hardness (mg/L)	54.60	NA
Color (SU)	20.00	NA
Turbidity (NTU)	NA	NA

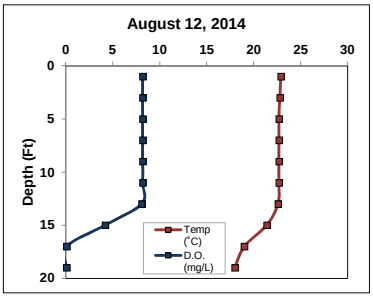
Data collected by TWH and SDF (Onterra)

Mann Lake

Date: 8/12/2014
Time: 15:30
Weather: 68F, 0% clouds
Entry: EEH

Max Depth: 19.5
MLS Depth (ft): 3.0
MLB Depth (ft): 17.0
Secchi Depth (ft): 7.4

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	22.9	8.2		
3	22.8	8.2		
5	22.7	8.2		
7	22.7	8.2		
9	22.7	8.2		
11	22.7	8.2		
13	22.6	8.1		
15	21.4	4.2		
17	19.0	0.1		
19	18.0	0.1		



Parameter	MLS	MLB
Total P (µg/L)	27.60	199.00
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	5.71	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)	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

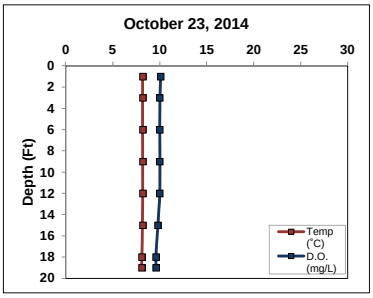
Data collected by TWH and JLW (Onterra)

Mann Lake

Date: 10/23/2014
Time: 12:15
Weather: Rain, 50F, light breeze
Entry: EEH

Max Depth: 19.6
MLS Depth (ft): 3.0
MLB Depth (ft): 17.0
Secchi Depth (ft): 4.1

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	8.2	10.1	8.5	
3	8.2	10.0		
6	8.2	10.0		
9	8.2	10.0		
12	8.2	10.0		
15	8.2	9.8		
18	8.1	9.6		
19	8.1	9.6		



Parameter	MLS	MLB
Total P (µg/L)	47.10	49.30
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	14.70	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)	2.80	4.40
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

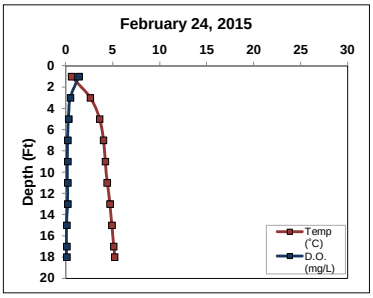
Data collected by TAH and DAC (Onterra)

Mann Lake

Date: 2/24/2015
Time: 12:20
Weather: 20F, very windy 25-30 mph, sunny, 50% clouds
Entry: EEH

Max Depth: 18.3
MLS Depth (ft): 3.0
MLB Depth (ft): 16.0
Secchi Depth (ft): 5.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	0.6	1.4		
3	2.6	0.5		
5	3.6	0.3		
7	4.0	0.2		
9	4.2	0.2		
11	4.4	0.2		
13	4.7	0.2		
15	4.9	0.1		
17	5.1	0.1		
18	5.2	0.1		



Parameter	MLS	MLB
Total P (µg/L)	29.70	448.00
Dissolved P (µg/L)	6.30	251.00
Chl-*a* (µg/L)	NA	NA
TKN (µg/L)	596.00	1520.00
$NO_3 + NO_2$-N (µg/L)	ND	ND
NH_3-N (µg/L)	198.00	1020.00
Total N (µg/L)	596.00	1520.00
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 DAC and TAH (Onterra). Ice thickness: 1.5 feet

Water Quality Data

2014-2015	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	6	6.0	NA	NA
Total P (µg/L)	6	29.7	6	139.1
Dissolved P (µg/L)	3	6.3	3	127.0
Chl a (µg/L)	5	9.4	0	NA
TKN (µg/L	3	557.3	3	1023.3
NO3+NO2-N (µg/L)	3	ND	3	39.4
NH3-N (µg/L)	3	198.0	3	463.3
Total N (µg/L)	3	557.3	3	1036.5
Lab Cond. (µS/cm)	2	108.5	2	121.0
Lab pH	2	8.1	2	7.4
Alkal (mg/l CaCO3)	2	54.4	2	61.1
Total Susp. Solids (mg/l)	3	2.8	3	3.8
Calcium (µg/L)	2	15.2	0	NA
Magnesium (mg/L)	2	3.5	0	NA
Hardness (mg/L)	2	52.4	0	NA
Color (SU)	2	17.5	0	NA
Turbidity (NTU)	0	NA	0	NA

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1995			
1996			51.0
1997			51.4
1998			47.2
1999			55.2
2000			53.5
2001			49.6
2002			51.6
2003			56.1
2004	54.1	51.1	50.5
2005			55.2
2006			55.3
2007			56.4
2008			45.8
2009			57.6
2010			52.7
2011			52.0
2012			55.6
2013			47.9
2014	52.4	52.4	51.3
All Years (Weighted)	52.8	52.1	51.8
Shallow, Headwater Drainage Lakes	52.7	50.4	52.4
NLF Ecoregion	48.1	47.5	45.7

	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
1995	2	7.9	0									
1996	17	7.1	11	6.1								
1997	18	5.5	9	6.0								
1998	13	6.9	7	8.0								
1999	12	5.1	6	4.6								
2000	11	5.0	5	5.2								
2001	11	6.8	5	6.8								
2002	9	6.1	6	5.9								
2003	8	4.9	4	4.3								
2004	11	6.2	7	6.3	1	8.1	1	8.1	2	26.0	1.0	32.0
2005	5	4.3	4	4.6								
2006	7	4.7	5	4.6								
2007	8	4.7	6	4.2								
2008	7	7.6	5	8.8								
2009	7	3.8	4	3.9								
2010	7	6.4	5	5.5								
2011	8	5.7	5	5.7								
2012	7	4.6	5	4.5								
2013	6	6.5	5	7.6								
2014	5	6.2	3	6.0	5	9.4	3	9.2	5	29.7	3.0	28.3
All Years (Weighted)		5.8		5.8		9.2		8.9		28.6		29.3
Shallow, Headwater Drainage Lakes				5.6				7.5				29.0
NLF Ecoregion				8.9				5.6				21.0

July 2014 N: 607.0
July 2014 P: 28.5

Summer 2014 N:P 21 :1

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 3/17/2015 Scenario: Mann Lake Current

Lake Id: Mann Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 1700.0 acre
Total Unit Runoff: 14 in.
Annual Runoff Volume: 1983.3 acre-ft
Lake Surface Area <As>: 255 acre
Lake Volume <V>: 1373.76 acre-ft
Lake Mean Depth <z>: 5.4 ft
Precipitation - Evaporation: 5.5 in.
Hydraulic Loading: 2100.2 acre-ft/year
Areal Water Load <qs>: 8.2 ft/year
Lake Flushing Rate <p>: 1.53 1/year
Water Residence Time: 0.65 year
Observed spring overturn total phosphorus (SPO): 16.4 mg/m^3
Observed growing season mean phosphorus (GSM): 29.7 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	0.0	0.50	1.00	3.00	0.0	0	0	0
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	1	0.10	0.30	0.50	0.1	0	0	0
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	0.0	0.05	0.10	0.25	0.0	0	0	0
Wetlands	294	0.10	0.10	0.10	12.5	12	12	12
Forest	1405	0.05	0.09	0.18	53.7	28	51	102
Lake Surface	255.0	0.10	0.30	1.00	32.5	10	31	103

POINT SOURCE DATA

Point Sources	Water Load	Low	Most Likely	High	Loading %
	(m^3/year)	(kg/year)	(kg/year)	(kg/year)	

SEPTIC TANK DATA

Description	Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)	0.3	0.5	0.8	
# capita-years	23			

% Phosphorus Retained by Soil	98	90	80	
Septic Tank Loading (kg/year)	0.14	1.15	3.68	1.2

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	112.1	210.1	487.9	100.0
Total Loading (kg)	50.8	95.3	221.3	100.0
Areal Loading (lb/ac-year)	0.44	0.82	1.91	0.0
Areal Loading (mg/m^2-year)	49.25	92.35	214.48	0.0
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	89.0	139.3	252.3	98.8
Total NPS Loading (kg)	40.4	63.2	114.4	98.8

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/17/2015 Scenario: 112
Observed spring overturn total phosphorus (SPO): 16.4 mg/m^3
Observed growing season mean phosphorus (GSM): 29.7 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	14	25	59	-5	-17
Canfield-Bachmann, 1981 Natural Lake	13	22	43	-8	-27
Canfield-Bachmann, 1981 Artificial Lake	13	20	37	-10	-34
Rechow, 1979 General	3	6	15	-24	-81
Rechow, 1977 Anoxic	16	30	69	0	0
Rechow, 1977 water load<50m/year	9	18	41	-12	-40
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	12	22	51	6	37
Vollenweider, 1982 Combined OECD	11	18	37	-5	-22
Dillon-Rigler-Kirchner	5	10	22	-6	-37
Vollenweider, 1982 Shallow Lake/Res.	8	14	30	-9	-39
Larsen-Mercier, 1976	11	20	47	4	24
Nurnberg, 1984 Oxic	5	10	23	-20	-67

Lake Phosphorus Model	Confidence	Confidence	Parameter	Back	Model

	Lower Bound	Upper Bound	Fit?	Calculation (kg/year)	Type
Walker, 1987 Reservoir	15	48	FIT	0	GSM
Canfield-Bachmann, 1981 Natural Lake	7	63	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	6	58	FIT	1	GSM
Rechow, 1979 General	3	12	FIT	0	GSM
Rechow, 1977 Anoxic	18	56	FIT	0	GSM
Rechow, 1977 water load<50m/year	10	34	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	11	44	FIT	0	SPO
Vollenweider, 1982 Combined OECD	9	35	FIT	0	ANN
Dillon-Rigler-Kirchner	6	18	L	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	7	27	FIT	0	ANN
Larsen-Mercier, 1976	13	37	P Pin	0	SPO
Nurnberg, 1984 Oxic	5	19	FIT	0	ANN

Water and Nutrient Outflow Module

Date: 3/17/2015 Scenario: 100
Average Annual Surface Total Phosphorus: 23mg/m^3
Annual Discharge: 2.10E+003 AF => 2.59E+006 m^3
Annual Outflow Loading: 125.4 LB => 56.9 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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
1	45.997666	-89.671459	1	Mann Lake	Vilas	7/23/2014	DAC & JLW	1	2	Muck	Pole	SAMPLED			2			1					1	1					
2	45.997225	-89.671462	2	Mann Lake	Vilas	7/23/2014	DAC & JLW	2	0			TERRESTRIAL																	
3	45.997221	-89.670196	8	Mann Lake	Vilas	7/23/2014	DAC & JLW	3	1	Muck	Pole	SAMPLED			1			1		1							1		
4	45.996782	-89.670832	7	Mann Lake	Vilas	7/23/2014	DAC & JLW	4	5	Muck	Pole	SAMPLED			3			3				1							
5	45.996780	-89.670199	9	Mann Lake	Vilas	7/23/2014	DAC & JLW	5	5	Muck	Pole	SAMPLED			1			1											
6	45.996778	-89.669566	16	Mann Lake	Vilas	7/23/2014	DAC & JLW	6	6	Muck	Pole	SAMPLED			3			1						1					
7	45.996776	-89.668933	17	Mann Lake	Vilas	7/23/2014	DAC & JLW	7	4	Muck	Pole	SAMPLED			3			2				1				2		1	
8	45.996343	-89.671467	3	Mann Lake	Vilas	7/23/2014	DAC & JLW	8	3	Muck	Pole	SAMPLED			3			2				1		1		2		1	
9	45.996341	-89.670834	6	Mann Lake	Vilas	7/23/2014	DAC & JLW	9	5	Muck	Pole	SAMPLED			2			2						1					
10	45.996339	-89.670202	10	Mann Lake	Vilas	7/23/2014	DAC & JLW	10	6	Muck	Pole	SAMPLED			0														
11	45.996337	-89.669569	15	Mann Lake	Vilas	7/23/2014	DAC & JLW	11	7	Muck	Pole	SAMPLED			1	1													
12	45.996335	-89.668936	18	Mann Lake	Vilas	7/23/2014	DAC & JLW	12	7	Muck	Pole	SAMPLED			1			1						1					1
13	45.996333	-89.668303	26	Mann Lake	Vilas	7/23/2014	DAC & JLW	13	6	Muck	Pole	SAMPLED			3			1						2					
14	45.996332	-89.667671	27	Mann Lake	Vilas	7/23/2014	DAC & JLW	14	5	Sand	Pole	SAMPLED			3			2				1			1	1		1	
15	45.996330	-89.667038	36	Mann Lake	Vilas	7/23/2014	DAC & JLW	15	3	Sand	Pole	SAMPLED		YES	3			3						2				1	
16	45.996324	-89.665139	59	Mann Lake	Vilas	7/23/2014	DAC & JLW	16	3	Sand	Pole	SAMPLED		YES	3			3						1					
17	45.995902	-89.671470	4	Mann Lake	Vilas	7/23/2014	DAC & JLW	17	2	Sand	Pole	SAMPLED			2			2				1						1	
18	45.995900	-89.670837	5	Mann Lake	Vilas	7/23/2014	DAC & JLW	18	4	Muck	Pole	SAMPLED			1			1						1					
19	45.995898	-89.670204	11	Mann Lake	Vilas	7/23/2014	DAC & JLW	19	6	Muck	Pole	SAMPLED			1										1				
20	45.995896	-89.669571	14	Mann Lake	Vilas	7/23/2014	DAC & JLW	20	7	Muck	Pole	SAMPLED			0														
21	45.995894	-89.668939	19	Mann Lake	Vilas	7/23/2014	DAC & JLW	21	7	Muck	Pole	SAMPLED			1			1											
22	45.995892	-89.668306	25	Mann Lake	Vilas	7/23/2014	DAC & JLW	22	7	Muck	Pole	SAMPLED			0														
23	45.995891	-89.667673	28	Mann Lake	Vilas	7/23/2014	DAC & JLW	23	7	Muck	Pole	SAMPLED			0														
24	45.995889	-89.667040	35	Mann Lake	Vilas	7/23/2014	DAC & JLW	24	8	Muck	Pole	SAMPLED			0														
25	45.995887	-89.666408	37	Mann Lake	Vilas	7/23/2014	DAC & JLW	25	8	Muck	Pole	SAMPLED			1											1			
26	45.995885	-89.665775	58	Mann Lake	Vilas	7/23/2014	DAC & JLW	26	7	Rock	Pole	SAMPLED			1			1											
27	45.995883	-89.665142	60	Mann Lake	Vilas	7/23/2014	DAC & JLW	27	7	Muck	Pole	SAMPLED			0														
28	45.995881	-89.664509	79	Mann Lake	Vilas	7/23/2014	DAC & JLW	28	6	Muck	Pole	SAMPLED			1	1		1							1				
29	45.995880	-89.663877	80	Mann Lake	Vilas	7/23/2014	DAC & JLW	29	5	Rock	Pole	SAMPLED			2			1				1				1		1	
30	45.995878	-89.663244	103	Mann Lake	Vilas	7/23/2014	DAC & JLW	30	3	Rock	Pole	SAMPLED		YES	3			3						1					
31	45.995457	-89.670207	12	Mann Lake	Vilas	7/23/2014	DAC & JLW	31	5	Muck	Pole	SAMPLED			1			1						1					
32	45.995455	-89.669574	13	Mann Lake	Vilas	7/23/2014	DAC & JLW	32	7	Muck	Pole	SAMPLED			1			1						1					
33	45.995453	-89.668941	20	Mann Lake	Vilas	7/23/2014	DAC & JLW	33	7	Muck	Pole	SAMPLED			1			1											
34	45.995451	-89.668309	24	Mann Lake	Vilas	7/23/2014	DAC & JLW	34	7	Muck	Pole	SAMPLED			1			1						1		1			
35	45.995450	-89.667676	29	Mann Lake	Vilas	7/23/2014	DAC & JLW	35	7	Muck	Pole	SAMPLED			0														
36	45.995448	-89.667043	34	Mann Lake	Vilas	7/23/2014	DAC & JLW	36	7	Muck	Pole	SAMPLED			0														
37	45.995446	-89.666410	38	Mann Lake	Vilas	7/23/2014	DAC & JLW	37	7	Muck	Pole	SAMPLED			0														
38	45.995444	-89.665778	57	Mann Lake	Vilas	7/23/2014	DAC & JLW	38	7	Muck	Pole	SAMPLED			0														
39	45.995442	-89.665145	61	Mann Lake	Vilas	7/23/2014	DAC & JLW	39	8	Muck	Pole	SAMPLED			1									1					
40	45.995440	-89.664512	78	Mann Lake	Vilas	7/23/2014	DAC & JLW	40	8	Muck	Pole	SAMPLED			0														
41	45.995438	-89.663879	81	Mann Lake	Vilas	7/23/2014	DAC & JLW	41	7	Muck	Pole	SAMPLED			0														
42	45.995437	-89.663247	102	Mann Lake	Vilas	7/23/2014	DAC & JLW	42	7	Muck	Pole	SAMPLED			0														
43	45.995435	-89.662614	104	Mann Lake	Vilas	7/23/2014	DAC & JLW	43	2	Sand	Pole	SAMPLED		YES	3			2						1				1	
44	45.995431	-89.661348	129	Mann Lake	Vilas	7/23/2014	DAC & JLW	44	3	Sand	Pole	SAMPLED		YES	3	1		3							1			1	
45	45.995012	-89.668944	21	Mann Lake	Vilas	7/23/2014	DAC & JLW	45	6	Muck	Pole	SAMPLED			2			2						2					
46	45.995010	-89.668311	23	Mann Lake	Vilas	7/23/2014	DAC & JLW	46	7	Muck	Pole	SAMPLED			1			1						1					
47	45.995009	-89.667678	30	Mann Lake	Vilas	7/23/2014	DAC & JLW	47	7	Muck	Pole	SAMPLED			0														
48	45.995007	-89.667046	33	Mann Lake	Vilas	7/23/2014	DAC & JLW	48	7	Muck	Pole	SAMPLED			1									1					
49	45.995005	-89.666413	39	Mann Lake	Vilas	7/23/2014	DAC & JLW	49	7	Muck	Pole	SAMPLED			2			1						2					
50	45.995003	-89.665780	56	Mann Lake	Vilas	7/23/2014	DAC & JLW	50	7	Muck	Pole	SAMPLED			1			1						1					
51	45.995001	-89.665147	62	Mann Lake	Vilas	7/23/2014	DAC & JLW	51	8	Muck	Pole	SAMPLED			0														
52	45.994999	-89.664515	77	Mann Lake	Vilas	7/23/2014	DAC & JLW	52	8	Muck	Pole	SAMPLED			0														
53	45.994997	-89.663882	82	Mann Lake	Vilas	7/23/2014	DAC & JLW	53	8	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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
54	45.994996	-89.663249	101	Mann Lake	Vilas	7/23/2014	DAC & JLW	54	8	Muck	Pole	SAMPLED			0														
55	45.994994	-89.662616	105	Mann Lake	Vilas	7/23/2014	DAC & JLW	55	9	Muck	Pole	SAMPLED			0														
56	45.994992	-89.661984	128	Mann Lake	Vilas	7/23/2014	DAC & JLW	56	6	Sand	Pole	SAMPLED			2			1				1				2			
57	45.994990	-89.661351	130	Mann Lake	Vilas	7/23/2014	DAC & JLW	57	7	Rock	Pole	SAMPLED			2			2				2							
58	45.994988	-89.660718	149	Mann Lake	Vilas	7/23/2014	DAC & JLW	58	6	Sand	Pole	SAMPLED			3			3							2	1			
59	45.994965	-89.653125	273	Mann Lake	Vilas	7/23/2014	DAC & JLW	59	4	Muck	Pole	SAMPLED			2			2							1				
60	45.994963	-89.652493	274	Mann Lake	Vilas	7/23/2014	DAC & JLW	60	4	Sand	Pole	SAMPLED			2			2				1				1			
61	45.994569	-89.668314	22	Mann Lake	Vilas	7/23/2014	DAC & JLW	61	5	Muck	Pole	SAMPLED		YES	3			2						3					
62	45.994568	-89.667681	31	Mann Lake	Vilas	7/23/2014	DAC & JLW	62	6	Muck	Pole	SAMPLED			2							1		2					
63	45.994566	-89.667048	32	Mann Lake	Vilas	7/23/2014	DAC & JLW	63	7	Muck	Pole	SAMPLED			2	1		1				1		1					
64	45.994564	-89.666416	40	Mann Lake	Vilas	7/23/2014	DAC & JLW	64	7	Muck	Pole	SAMPLED			2			2											
65	45.994562	-89.665783	55	Mann Lake	Vilas	7/23/2014	DAC & JLW	65	7	Muck	Pole	SAMPLED			3			2						2					
66	45.994560	-89.665150	63	Mann Lake	Vilas	7/23/2014	DAC & JLW	66	8	Muck	Pole	SAMPLED			3	2		2						2					
67	45.994558	-89.664517	76	Mann Lake	Vilas	7/23/2014	DAC & JLW	67	9	Muck	Pole	SAMPLED			1									1					
68	45.994556	-89.663885	83	Mann Lake	Vilas	7/23/2014	DAC & JLW	68	9	Muck	Pole	SAMPLED			1			1											
69	45.994555	-89.663252	100	Mann Lake	Vilas	7/23/2014	DAC & JLW	69	9	Muck	Pole	SAMPLED			0														
70	45.994553	-89.662619	106	Mann Lake	Vilas	7/23/2014	DAC & JLW	70	9	Muck	Pole	SAMPLED			0														
71	45.994551	-89.661986	127	Mann Lake	Vilas	7/23/2014	DAC & JLW	71	9	Sand	Pole	SAMPLED			1			1											
72	45.994549	-89.661354	131	Mann Lake	Vilas	7/23/2014	DAC & JLW	72	9	Sand	Pole	SAMPLED			1									1					
73	45.994547	-89.660721	148	Mann Lake	Vilas	7/23/2014	DAC & JLW	73	10	Muck	Pole	SAMPLED			0														
74	45.994545	-89.660088	150	Mann Lake	Vilas	7/23/2014	DAC & JLW	74	11	Muck	Pole	SAMPLED			0														
75	45.994543	-89.659455	168	Mann Lake	Vilas	7/23/2014	DAC & JLW	75	10	Muck	Pole	SAMPLED			0														
76	45.994541	-89.658823	169	Mann Lake	Vilas	7/23/2014	DAC & JLW	76	10	Muck	Pole	SAMPLED			0														
77	45.994540	-89.658190	189	Mann Lake	Vilas	7/23/2014	DAC & JLW	77	10	Muck	Pole	SAMPLED			0														
78	45.994538	-89.657557	190	Mann Lake	Vilas	7/23/2014	DAC & JLW	78	3	Sand	Pole	SAMPLED			2			2				1		1		1			
79	45.994526	-89.653761	249	Mann Lake	Vilas	7/23/2014	DAC & JLW	79	7	Muck	Pole	SAMPLED			1			1											
80	45.994524	-89.653128	272	Mann Lake	Vilas	7/23/2014	DAC & JLW	80	7	Muck	Pole	SAMPLED			0														
81	45.994522	-89.652495	275	Mann Lake	Vilas	7/23/2014	DAC & JLW	81	7	Muck	Pole	SAMPLED			1										1				
82	45.994520	-89.651863	298	Mann Lake	Vilas	7/23/2014	DAC & JLW	82	6	Muck	Pole	SAMPLED			3			1						3					
83	45.994519	-89.651230	299	Mann Lake	Vilas	7/23/2014	DAC & JLW	83	6	Sand	Pole	SAMPLED			1			1				1							
84	45.994517	-89.650597	322	Mann Lake	Vilas	7/23/2014	DAC & JLW	84	3	Sand	Pole	SAMPLED			2			1							1	1		1	
85	45.994515	-89.649964	323	Mann Lake	Vilas	7/23/2014	DAC & JLW	85	3	Rock	Pole	SAMPLED		YES	3	1		3				1							
86	45.994125	-89.667051	46	Mann Lake	Vilas	7/23/2014	DAC & JLW	86	2	Rock	Pole	SAMPLED			1			1	1							1			
87	45.994123	-89.666418	41	Mann Lake	Vilas	7/23/2014	DAC & JLW	87	7	Muck	Pole	SAMPLED			2			2											
88	45.994121	-89.665786	54	Mann Lake	Vilas	7/23/2014	DAC & JLW	88	8	Muck	Pole	SAMPLED			1			1											
89	45.994119	-89.665153	64	Mann Lake	Vilas	7/23/2014	DAC & JLW	89	9	Muck	Pole	SAMPLED			1			1						1					
90	45.994117	-89.664520	75	Mann Lake	Vilas	7/23/2014	DAC & JLW	90	8	Muck	Pole	SAMPLED			0														
91	45.994115	-89.663887	84	Mann Lake	Vilas	7/23/2014	DAC & JLW	91	9	Muck	Pole	SAMPLED			0														
92	45.994114	-89.663255	99	Mann Lake	Vilas	7/23/2014	DAC & JLW	92	9	Muck	Pole	SAMPLED			0														
93	45.994112	-89.662622	107	Mann Lake	Vilas	7/23/2014	DAC & JLW	93	9	Muck	Pole	SAMPLED			0														
94	45.994110	-89.661989	126	Mann Lake	Vilas	7/23/2014	DAC & JLW	94	8	Rock	Pole	SAMPLED			1			1											
95	45.994108	-89.661356	132	Mann Lake	Vilas	7/23/2014	DAC & JLW	95	9	Muck	Pole	SAMPLED			1			1											
96	45.994106	-89.660724	147	Mann Lake	Vilas	7/23/2014	DAC & JLW	96	10	Muck	Pole	SAMPLED			1			1											
97	45.994104	-89.660091	151	Mann Lake	Vilas	7/23/2014	DAC & JLW	97	10	Muck	Pole	SAMPLED			0														
98	45.994102	-89.659458	167	Mann Lake	Vilas	7/23/2014	DAC & JLW	98	10	Muck	Pole	SAMPLED			1			1											
99	45.994100	-89.658825	170	Mann Lake	Vilas	7/23/2014	DAC & JLW	99	10	Muck	Pole	SAMPLED			0														
100	45.994099	-89.658193	188	Mann Lake	Vilas	7/23/2014	DAC & JLW	100	10	Muck	Pole	SAMPLED			0														
101	45.994097	-89.657560	191	Mann Lake	Vilas	7/23/2014	DAC & JLW	101	10	Muck	Pole	SAMPLED			1			1											
102	45.994095	-89.656927	210	Mann Lake	Vilas	7/23/2014	DAC & JLW	102	5	Sand	Pole	SAMPLED			2			2						1		1			
103	45.994087	-89.654396	248	Mann Lake	Vilas	7/23/2014	DAC & JLW	103	9	Muck	Pole	SAMPLED			0														
104	45.994085	-89.653764	250	Mann Lake	Vilas	7/23/2014	DAC & JLW	104	9	Muck	Pole	SAMPLED			0														
105	45.994083	-89.653131	271	Mann Lake	Vilas	7/23/2014	DAC & JLW	105	9	Muck	Pole	SAMPLED			1			1											
106	45.994081	-89.652498	276	Mann Lake	Vilas	7/23/2014	DAC & JLW	106	8	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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
107	45.994079	-89.651865	297	Mann Lake	Vilas	7/23/2014	DAC & JLW	107	8	Muck	Pole	SAMPLED			0														
108	45.994078	-89.651233	300	Mann Lake	Vilas	7/23/2014	DAC & JLW	108	8	Muck	Pole	SAMPLED			1			1							1				
109	45.994076	-89.650600	321	Mann Lake	Vilas	7/23/2014	DAC & JLW	109	7	Rock	Pole	SAMPLED			1			1											
110	45.994074	-89.649967	324	Mann Lake	Vilas	7/23/2014	DAC & JLW	110	5	Rock	Pole	SAMPLED			2			1				2							
111	45.993687	-89.668319	48	Mann Lake	Vilas	7/23/2014	DAC & JLW	111	3	Muck	Pole	SAMPLED			1			1											
112	45.993686	-89.667686	47	Mann Lake	Vilas	7/23/2014	DAC & JLW	112	4	Muck	Pole	SAMPLED			2			1				2		1					
113	45.993684	-89.667054	45	Mann Lake	Vilas	7/23/2014	DAC & JLW	113	5	Muck	Pole	SAMPLED			1			1											
114	45.993682	-89.666421	42	Mann Lake	Vilas	7/23/2014	DAC & JLW	114	7	Muck	Pole	SAMPLED			3			3											
115	45.993680	-89.665788	53	Mann Lake	Vilas	7/23/2014	DAC & JLW	115	7	Muck	Pole	SAMPLED			1			1											
116	45.993678	-89.665155	65	Mann Lake	Vilas	7/23/2014	DAC & JLW	116	9	Muck	Pole	SAMPLED			0														
117	45.993676	-89.664523	74	Mann Lake	Vilas	7/23/2014	DAC & JLW	117	8	Muck	Pole	SAMPLED			1			1											
118	45.993674	-89.663890	85	Mann Lake	Vilas	7/23/2014	DAC & JLW	118	9	Muck	Pole	SAMPLED			1			1										1	
119	45.993673	-89.663257	98	Mann Lake	Vilas	7/23/2014	DAC & JLW	119	9	Muck	Pole	SAMPLED			0														
120	45.993671	-89.662625	108	Mann Lake	Vilas	7/23/2014	DAC & JLW	120	9	Muck	Pole	SAMPLED			0														
121	45.993669	-89.661992	125	Mann Lake	Vilas	7/23/2014	DAC & JLW	121	9	Muck	Pole	SAMPLED			0														
122	45.993667	-89.661359	133	Mann Lake	Vilas	7/23/2014	DAC & JLW	122	9	Muck	Pole	SAMPLED			0														
123	45.993665	-89.660726	146	Mann Lake	Vilas	7/23/2014	DAC & JLW	123	10	Muck	Pole	SAMPLED			1			1											
124	45.993663	-89.660094	152	Mann Lake	Vilas	7/23/2014	DAC & JLW	124	10	Muck	Pole	SAMPLED			0														
125	45.993661	-89.659461	166	Mann Lake	Vilas	7/23/2014	DAC & JLW	125	10	Muck	Pole	SAMPLED			1			1											
126	45.993659	-89.658828	171	Mann Lake	Vilas	7/23/2014	DAC & JLW	126	10	Muck	Pole	SAMPLED			1			1											
127	45.993658	-89.658195	187	Mann Lake	Vilas	7/23/2014	DAC & JLW	127	10	Muck	Pole	SAMPLED			0														
128	45.993656	-89.657563	192	Mann Lake	Vilas	7/23/2014	DAC & JLW	128	10	Muck	Pole	SAMPLED			0														
129	45.993654	-89.656930	209	Mann Lake	Vilas	7/23/2014	DAC & JLW	129	10	Muck	Pole	SAMPLED			1			1											
130	45.993652	-89.656297	211	Mann Lake	Vilas	7/23/2014	DAC & JLW	130	3	Sand	Pole	SAMPLED		YES	3			3								2			
131	45.993650	-89.655665	227	Mann Lake	Vilas	7/23/2014	DAC & JLW	131	5	Sand	Pole	SAMPLED			3			3							1	1			
132	45.993648	-89.655032	228	Mann Lake	Vilas	7/23/2014	DAC & JLW	132	10	Muck	Pole	SAMPLED			0														
133	45.993646	-89.654399	247	Mann Lake	Vilas	7/23/2014	DAC & JLW	133	10	Muck	Pole	SAMPLED			0														
134	45.993644	-89.653766	251	Mann Lake	Vilas	7/23/2014	DAC & JLW	134	9	Muck	Pole	SAMPLED			0														
135	45.993642	-89.653134	270	Mann Lake	Vilas	7/23/2014	DAC & JLW	135	10	Muck	Pole	SAMPLED			0														
136	45.993640	-89.652501	277	Mann Lake	Vilas	7/23/2014	DAC & JLW	136	9	Muck	Pole	SAMPLED			0														
137	45.993638	-89.651868	296	Mann Lake	Vilas	7/23/2014	DAC & JLW	137	9	Muck	Pole	SAMPLED			0														
138	45.993637	-89.651235	301	Mann Lake	Vilas	7/23/2014	DAC & JLW	138	9	Muck	Pole	SAMPLED			1			1											
139	45.993635	-89.650603	320	Mann Lake	Vilas	7/23/2014	DAC & JLW	139	8	Muck	Pole	SAMPLED			0														
140	45.993633	-89.649970	325	Mann Lake	Vilas	7/23/2014	DAC & JLW	140	8	Muck	Pole	SAMPLED			1			1											
141	45.993631	-89.649337	342	Mann Lake	Vilas	7/23/2014	DAC & JLW	141	4	Sand	Pole	SAMPLED			1			1				1						1	
142	45.993243	-89.667056	44	Mann Lake	Vilas	7/23/2014	DAC & JLW	142	3	Sand	Pole	SAMPLED			3			3		1			1		1		1		
143	45.993241	-89.666424	43	Mann Lake	Vilas	7/23/2014	DAC & JLW	143	6	Muck	Pole	SAMPLED			2			1				1		1					
144	45.993239	-89.665791	52	Mann Lake	Vilas	7/23/2014	DAC & JLW	144	8	Muck	Pole	SAMPLED			2			2											
145	45.993237	-89.665158	66	Mann Lake	Vilas	7/23/2014	DAC & JLW	145	7	Muck	Pole	SAMPLED			2			2											
146	45.993235	-89.664525	73	Mann Lake	Vilas	7/23/2014	DAC & JLW	146	8	Muck	Pole	SAMPLED			0														
147	45.993233	-89.663893	86	Mann Lake	Vilas	7/23/2014	DAC & JLW	147	9	Muck	Pole	SAMPLED			0														
148	45.993232	-89.663260	97	Mann Lake	Vilas	7/23/2014	DAC & JLW	148	9	Muck	Pole	SAMPLED			1											1			
149	45.993230	-89.662627	109	Mann Lake	Vilas	7/23/2014	DAC & JLW	149	9	Muck	Pole	SAMPLED			0														
150	45.993228	-89.661994	124	Mann Lake	Vilas	7/23/2014	DAC & JLW	150	9	Muck	Pole	SAMPLED			0														
151	45.993226	-89.661362	134	Mann Lake	Vilas	7/23/2014	DAC & JLW	151	9	Muck	Pole	SAMPLED			0														
152	45.993224	-89.660729	145	Mann Lake	Vilas	7/23/2014	DAC & JLW	152	10	Muck	Pole	SAMPLED			0														
153	45.993222	-89.660096	153	Mann Lake	Vilas	7/23/2014	DAC & JLW	153	10	Muck	Pole	SAMPLED			0														
154	45.993220	-89.659464	165	Mann Lake	Vilas	7/23/2014	DAC & JLW	154	10	Muck	Pole	SAMPLED			0														
155	45.993218	-89.658831	172	Mann Lake	Vilas	7/23/2014	DAC & JLW	155	10	Muck	Pole	SAMPLED			0														
156	45.993217	-89.658198	186	Mann Lake	Vilas	7/23/2014	DAC & JLW	156	10	Muck	Pole	SAMPLED			0														
157	45.993215	-89.657565	193	Mann Lake	Vilas	7/23/2014	DAC & JLW	157	10	Muck	Pole	SAMPLED			0														
158	45.993213	-89.656933	208	Mann Lake	Vilas	7/23/2014	DAC & JLW	158	11	Muck	Pole	SAMPLED			0														
159	45.993211	-89.656300	212	Mann Lake	Vilas	7/23/2014	DAC & JLW	159	11	Muck	Pole	SAMPLED			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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
160	45.993209	-89.655667	226	Mann Lake	Vilas	7/23/2014	DAC & JLW	160	11	Muck	Pole	SAMPLED			0														
161	45.993207	-89.655035	229	Mann Lake	Vilas	7/23/2014	DAC & JLW	161	10	Muck	Pole	SAMPLED			0														
162	45.993205	-89.654402	246	Mann Lake	Vilas	7/23/2014	DAC & JLW	162	10	Muck	Pole	SAMPLED			0														
163	45.993203	-89.653769	252	Mann Lake	Vilas	7/23/2014	DAC & JLW	163	10	Muck	Pole	SAMPLED			1			1											
164	45.993201	-89.653136	269	Mann Lake	Vilas	7/23/2014	DAC & JLW	164	10	Muck	Pole	SAMPLED			0														
165	45.993199	-89.652504	278	Mann Lake	Vilas	7/23/2014	DAC & JLW	165	9	Muck	Pole	SAMPLED			0														
166	45.993197	-89.651871	295	Mann Lake	Vilas	7/23/2014	DAC & JLW	166	10	Muck	Pole	SAMPLED			0														
167	45.993196	-89.651238	302	Mann Lake	Vilas	7/23/2014	DAC & JLW	167	9	Muck	Pole	SAMPLED			0														
168	45.993194	-89.650605	319	Mann Lake	Vilas	7/23/2014	DAC & JLW	168	9	Muck	Pole	SAMPLED			1			1											
169	45.993192	-89.649973	326	Mann Lake	Vilas	7/23/2014	DAC & JLW	169	8	Muck	Pole	SAMPLED			0														
170	45.993190	-89.649340	341	Mann Lake	Vilas	7/23/2014	DAC & JLW	170	8	Muck	Pole	SAMPLED			1			1											
171	45.993188	-89.648707	343	Mann Lake	Vilas	7/23/2014	DAC & JLW	171	4	Rock	Pole	SAMPLED			2			1				1			1			1	
172	45.993184	-89.647442	358	Mann Lake	Vilas	7/23/2014	DAC & JLW	172	5	Muck	Pole	SAMPLED										1			1				
173	45.992798	-89.665793	51	Mann Lake	Vilas	7/23/2014	DAC & JLW	173	6	Muck	Pole	SAMPLED			2			2											
174	45.992796	-89.665161	67	Mann Lake	Vilas	7/23/2014	DAC & JLW	174	8	Muck	Pole	SAMPLED			0														
175	45.992794	-89.664528	72	Mann Lake	Vilas	7/23/2014	DAC & JLW	175	8	Muck	Pole	SAMPLED			1	1													
176	45.992792	-89.663895	87	Mann Lake	Vilas	7/23/2014	DAC & JLW	176	8	Muck	Pole	SAMPLED			0														
177	45.992791	-89.663263	96	Mann Lake	Vilas	7/23/2014	DAC & JLW	177	8	Muck	Pole	SAMPLED			1									1					
178	45.992789	-89.662630	110	Mann Lake	Vilas	7/23/2014	DAC & JLW	178	9	Muck	Pole	SAMPLED			0														
179	45.992787	-89.661997	123	Mann Lake	Vilas	7/23/2014	DAC & JLW	179	9	Muck	Pole	SAMPLED			1			1											
180	45.992785	-89.661364	135	Mann Lake	Vilas	7/23/2014	DAC & JLW	180	9	Muck	Pole	SAMPLED			0														
181	45.992783	-89.660732	144	Mann Lake	Vilas	7/23/2014	DAC & JLW	181	10	Muck	Pole	SAMPLED			0														
182	45.992781	-89.660099	154	Mann Lake	Vilas	7/23/2014	DAC & JLW	182	10	Muck	Pole	SAMPLED			0														
183	45.992779	-89.659466	164	Mann Lake	Vilas	7/23/2014	DAC & JLW	183	10	Muck	Pole	SAMPLED			0														
184	45.992777	-89.658834	173	Mann Lake	Vilas	7/23/2014	DAC & JLW	184	10	Muck	Pole	SAMPLED			0														
185	45.992776	-89.658201	185	Mann Lake	Vilas	7/23/2014	DAC & JLW	185	10	Muck	Pole	SAMPLED			0														
186	45.992774	-89.657568	194	Mann Lake	Vilas	7/23/2014	DAC & JLW	186	10	Muck	Pole	SAMPLED			0														
187	45.992772	-89.656935	207	Mann Lake	Vilas	7/23/2014	DAC & JLW	187	11	Muck	Pole	SAMPLED			0														
188	45.992770	-89.656303	213	Mann Lake	Vilas	7/23/2014	DAC & JLW	188	11	Muck	Pole	SAMPLED			0														
189	45.992768	-89.655670	225	Mann Lake	Vilas	7/23/2014	DAC & JLW	189	11	Muck	Pole	SAMPLED			0														
190	45.992766	-89.655037	230	Mann Lake	Vilas	7/23/2014	DAC & JLW	190	11	Muck	Pole	SAMPLED			0														
191	45.992764	-89.654405	245	Mann Lake	Vilas	7/23/2014	DAC & JLW	191	10	Muck	Pole	SAMPLED			1			1											
192	45.992762	-89.653772	253	Mann Lake	Vilas	7/23/2014	DAC & JLW	192	10	Muck	Pole	SAMPLED			0														
193	45.992760	-89.653139	268	Mann Lake	Vilas	7/23/2014	DAC & JLW	193	10	Muck	Pole	SAMPLED			0														
194	45.992758	-89.652506	279	Mann Lake	Vilas	7/23/2014	DAC & JLW	194	10	Muck	Pole	SAMPLED			0														
195	45.992756	-89.651874	294	Mann Lake	Vilas	7/23/2014	DAC & JLW	195	10	Muck	Pole	SAMPLED			0														
196	45.992755	-89.651241	303	Mann Lake	Vilas	7/23/2014	DAC & JLW	196	10	Muck	Pole	SAMPLED			0														
197	45.992753	-89.650608	318	Mann Lake	Vilas	7/23/2014	DAC & JLW	197	9	Muck	Pole	SAMPLED			1			1											
198	45.992751	-89.649976	327	Mann Lake	Vilas	7/23/2014	DAC & JLW	198	5	Rock	Pole	SAMPLED			1											1			
199	45.992749	-89.649343	340	Mann Lake	Vilas	7/23/2014	DAC & JLW	199	4	Rock	Pole	SAMPLED			2			2			1								
200	45.992747	-89.648710	344	Mann Lake	Vilas	7/23/2014	DAC & JLW	200	3	Rock	Pole	SAMPLED			1											1			
201	45.992745	-89.648077	357	Mann Lake	Vilas	7/23/2014	DAC & JLW	201	4	Rock	Pole	SAMPLED			1			1							1				
202	45.992743	-89.647445	359	Mann Lake	Vilas	7/23/2014	DAC & JLW	202	5	Muck	Pole	SAMPLED			1			1											
203	45.992741	-89.646812	360	Mann Lake	Vilas	#########	DAC & JLW	203	5	Muck	Pole	SAMPLED			3			1						3					
204	45.992739	-89.646179	361	Mann Lake	Vilas	7/23/2014	DAC & JLW	204	5	Muck	Pole	SAMPLED			2			2				1		1					
205	45.992357	-89.665796	50	Mann Lake	Vilas	7/23/2014	DAC & JLW	205	6	Muck	Pole	SAMPLED			2			1						1					
206	45.992355	-89.665163	68	Mann Lake	Vilas	7/23/2014	DAC & JLW	206	7	Muck	Pole	SAMPLED			3	2		3											
207	45.992353	-89.664531	71	Mann Lake	Vilas	7/23/2014	DAC & JLW	207	8	Muck	Pole	SAMPLED			1			1											
208	45.992351	-89.663898	88	Mann Lake	Vilas	7/23/2014	DAC & JLW	208	8	Muck	Pole	SAMPLED			0														
209	45.992350	-89.663265	95	Mann Lake	Vilas	7/23/2014	DAC & JLW	209	8	Muck	Pole	SAMPLED			1			1											
210	45.992348	-89.662633	111	Mann Lake	Vilas	7/23/2014	DAC & JLW	210	9	Muck	Pole	SAMPLED			1			1											
211	45.992346	-89.662000	122	Mann Lake	Vilas	7/23/2014	DAC & JLW	211	9	Muck	Pole	SAMPLED			0														
212	45.992344	-89.661367	136	Mann Lake	Vilas	7/23/2014	DAC & JLW	212	10	Muck	Pole	SAMPLED			0														

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213	45.9923421	-89.6607344	143	Mann Lake	Vilas	7/23/2014	DAC & JLW	213	10	Muck	Pole	SAMPLED			0														
214	45.9923402	-89.6601017	155	Mann Lake	Vilas	7/23/2014	DAC & JLW	214	10	Muck	Pole	SAMPLED			1			1											
215	45.9923383	-89.659469	163	Mann Lake	Vilas	7/23/2014	DAC & JLW	215	10	Muck	Pole	SAMPLED			0														
216	45.9923364	-89.6588363	174	Mann Lake	Vilas	7/23/2014	DAC & JLW	216	10	Muck	Pole	SAMPLED			0														
217	45.9923345	-89.6582036	184	Mann Lake	Vilas	7/23/2014	DAC & JLW	217	10	Muck	Pole	SAMPLED			0														
218	45.9923326	-89.6575709	195	Mann Lake	Vilas	7/23/2014	DAC & JLW	218	10	Muck	Pole	SAMPLED			0														
219	45.9923307	-89.6569381	206	Mann Lake	Vilas	7/23/2014	DAC & JLW	219	11	Muck	Pole	SAMPLED			0														
220	45.9923288	-89.6563054	214	Mann Lake	Vilas	7/23/2014	DAC & JLW	220	11	Muck	Pole	SAMPLED			1			1											
221	45.9923269	-89.6556727	224	Mann Lake	Vilas	7/23/2014	DAC & JLW	221	11	Muck	Pole	SAMPLED			1			1											
222	45.992325	-89.65504	231	Mann Lake	Vilas	7/23/2014	DAC & JLW	222	11	Muck	Pole	SAMPLED			0														
223	45.9923231	-89.6544073	244	Mann Lake	Vilas	7/23/2014	DAC & JLW	223	10	Muck	Pole	SAMPLED			0														
224	45.9923212	-89.6537746	254	Mann Lake	Vilas	7/23/2014	DAC & JLW	224	11	Muck	Pole	SAMPLED			0														
225	45.9923193	-89.6531419	267	Mann Lake	Vilas	7/23/2014	DAC & JLW	225	11	Muck	Pole	SAMPLED			0														
226	45.9923174	-89.6525092	280	Mann Lake	Vilas	7/23/2014	DAC & JLW	226	10	Muck	Pole	SAMPLED			0														
227	45.9923154	-89.6518765	293	Mann Lake	Vilas	7/23/2014	DAC & JLW	227	10	Muck	Pole	SAMPLED			0														
228	45.9923135	-89.6512437	304	Mann Lake	Vilas	7/23/2014	DAC & JLW	228	10	Muck	Pole	SAMPLED			0														
229	45.9923116	-89.650611	317	Mann Lake	Vilas	7/23/2014	DAC & JLW	229	10	Muck	Pole	SAMPLED			0														
230	45.9923096	-89.6499783	328	Mann Lake	Vilas	7/23/2014	DAC & JLW	230	8	Rock	Pole	SAMPLED			0														
231	45.9923077	-89.6493456	339	Mann Lake	Vilas	7/23/2014	DAC & JLW	231	2	Rock	Pole	SAMPLED			1			1								1		1	
232	45.9923058	-89.6487129	345	Mann Lake	Vilas	7/23/2014	DAC & JLW	232	7	Muck	Pole	SAMPLED			1			1											
233	45.9923038	-89.6480802	356	Mann Lake	Vilas	7/23/2014	DAC & JLW	233	6	Muck	Pole	SAMPLED			1			1											
234	45.9923019	-89.6474475	364	Mann Lake	Vilas	7/23/2014	DAC & JLW	234	6	Muck	Pole	SAMPLED			1			1											
235	45.9922999	-89.6468148	363	Mann Lake	Vilas	7/23/2014	DAC & JLW	235	6	Rock	Pole	SAMPLED			1			1				1							
236	45.992298	-89.6461821	362	Mann Lake	Vilas	7/23/2014	DAC & JLW	236	2	Sand	Pole	SAMPLED			1			1							1	1			
237	45.9922842	-89.6417531	399	Mann Lake	Vilas	7/23/2014	DAC & JLW	237	2	Sand	Pole	SAMPLED			1			1											
238	45.9922822	-89.6411204	400	Mann Lake	Vilas	7/23/2014	DAC & JLW	238	5	Muck	Pole	SAMPLED			0														
239	45.991916	-89.6657988	49	Mann Lake	Vilas	7/23/2014	DAC & JLW	239	3	Sand	Pole	SAMPLED			1			1											
240	45.9919141	-89.6651661	69	Mann Lake	Vilas	7/23/2014	DAC & JLW	240	0			TERRESTRIAL																	
241	45.9919123	-89.6645334	70	Mann Lake	Vilas	7/23/2014	DAC & JLW	241	4	Sand	Pole	SAMPLED			2			2	1										
242	45.9919104	-89.6639007	89	Mann Lake	Vilas	7/23/2014	DAC & JLW	242	8	Muck	Pole	SAMPLED			1			1											
243	45.9919086	-89.6632679	94	Mann Lake	Vilas	7/23/2014	DAC & JLW	243	8	Muck	Pole	SAMPLED			0														
244	45.9919067	-89.6626352	112	Mann Lake	Vilas	7/23/2014	DAC & JLW	244	8	Muck	Pole	SAMPLED			1			1											
245	45.9919048	-89.6620025	121	Mann Lake	Vilas	7/23/2014	DAC & JLW	245	8	Muck	Pole	SAMPLED			0													1	
246	45.9919029	-89.6613698	137	Mann Lake	Vilas	7/23/2014	DAC & JLW	246	9	Muck	Pole	SAMPLED			1			1											
247	45.9919011	-89.6607371	142	Mann Lake	Vilas	7/23/2014	DAC & JLW	247	12	Muck	Pole	SAMPLED			0														
248	45.9918992	-89.6601044	156	Mann Lake	Vilas	7/23/2014	DAC & JLW	248	11	Muck	Pole	SAMPLED			0														
249	45.9918973	-89.6594717	162	Mann Lake	Vilas	7/23/2014	DAC & JLW	249	10	Muck	Pole	SAMPLED			0														
250	45.9918954	-89.658839	175	Mann Lake	Vilas	7/23/2014	DAC & JLW	250	10	Muck	Pole	SAMPLED			0														
251	45.9918935	-89.6582063	183	Mann Lake	Vilas	7/23/2014	DAC & JLW	251	10	Muck	Pole	SAMPLED			0														
252	45.9918916	-89.6575736	196	Mann Lake	Vilas	7/23/2014	DAC & JLW	252	10	Muck	Pole	SAMPLED			0														
253	45.9918897	-89.6569409	205	Mann Lake	Vilas	7/23/2014	DAC & JLW	253	10	Muck	Pole	SAMPLED			0														
254	45.9918878	-89.6563082	215	Mann Lake	Vilas	7/23/2014	DAC & JLW	254	11	Muck	Pole	SAMPLED			0														
255	45.9918859	-89.6556755	223	Mann Lake	Vilas	7/23/2014	DAC & JLW	255	11	Muck	Pole	SAMPLED			1			1											
256	45.991884	-89.6550427	232	Mann Lake	Vilas	7/23/2014	DAC & JLW	256	11	Muck	Pole	SAMPLED			0														
257	45.9918821	-89.65441	243	Mann Lake	Vilas	7/23/2014	DAC & JLW	257	11	Muck	Pole	SAMPLED			0														
258	45.9918802	-89.6537773	255	Mann Lake	Vilas	7/23/2014	DAC & JLW	258	11	Muck	Pole	SAMPLED			0														
259	45.9918783	-89.6531446	266	Mann Lake	Vilas	7/23/2014	DAC & JLW	259	11	Muck	Pole	SAMPLED			0														
260	45.9918764	-89.6525119	281	Mann Lake	Vilas	7/23/2014	DAC & JLW	260	10	Muck	Pole	SAMPLED			0														
261	45.9918744	-89.6518792	292	Mann Lake	Vilas	7/23/2014	DAC & JLW	261	10	Muck	Pole	SAMPLED			0														
262	45.9918725	-89.6512465	305	Mann Lake	Vilas	7/23/2014	DAC & JLW	262	9	Muck	Pole	SAMPLED			0														
263	45.9918706	-89.6506138	316	Mann Lake	Vilas	7/23/2014	DAC & JLW	263	9	Muck	Pole	SAMPLED			0														
264	45.9918686	-89.6499811	329	Mann Lake	Vilas	7/23/2014	DAC & JLW	264	9	Muck	Pole	SAMPLED			0														
265	45.9918667	-89.6493484	338	Mann Lake	Vilas	7/23/2014	DAC & JLW	265	9	Muck	Pole	SAMPLED			1			1											

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266	45.9918647	-89.6487157	346	Mann Lake	Vilas	7/23/2014	DAC & JLW	266	8	Muck	Pole	SAMPLED			0														
267	45.9918628	-89.648083	355	Mann Lake	Vilas	7/23/2014	DAC & JLW	267	6	Muck	Pole	SAMPLED			1			1											
268	45.9918609	-89.6474503	365	Mann Lake	Vilas	7/23/2014	DAC & JLW	268	6	Rock	Pole	SAMPLED			1			1						1					
269	45.9918491	-89.643654	396	Mann Lake	Vilas	7/23/2014	DAC & JLW	269	5	Muck	Pole	SAMPLED			0														
270	45.9918471	-89.6430213	397	Mann Lake	Vilas	7/23/2014	DAC & JLW	270	4	Muck	Pole	SAMPLED			0														
271	45.9918431	-89.6417559	398	Mann Lake	Vilas	7/23/2014	DAC & JLW	271	6	Muck	Pole	SAMPLED			0														
272	45.9918412	-89.6411232	401	Mann Lake	Vilas	7/23/2014	DAC & JLW	272	6	Muck	Pole	SAMPLED			1			1											
273	45.9918392	-89.6404905	402	Mann Lake	Vilas	7/23/2014	DAC & JLW	273	6	Muck	Pole	SAMPLED			0														
274	45.9918372	-89.6398578	403	Mann Lake	Vilas	7/23/2014	DAC & JLW	274	4	Sand	Pole	SAMPLED			1									1					
275	45.9914694	-89.6639033	90	Mann Lake	Vilas	7/23/2014	DAC & JLW	275	4	Sand	Pole	SAMPLED			3	3								1					
276	45.9914675	-89.6632706	93	Mann Lake	Vilas	7/23/2014	DAC & JLW	276	7	Muck	Pole	SAMPLED			2			2											
277	45.9914657	-89.6626379	113	Mann Lake	Vilas	7/23/2014	DAC & JLW	277	8	Muck	Pole	SAMPLED			0														
278	45.9914638	-89.6620052	120	Mann Lake	Vilas	7/23/2014	DAC & JLW	278	8	Muck	Pole	SAMPLED			0														
279	45.9914619	-89.6613725	138	Mann Lake	Vilas	7/23/2014	DAC & JLW	279	8	Muck	Pole	SAMPLED			1									1					
280	45.9914601	-89.6607398	141	Mann Lake	Vilas	7/23/2014	DAC & JLW	280	8	Rock	Pole	SAMPLED			2	1		2											
281	45.9914582	-89.6601071	157	Mann Lake	Vilas	7/23/2014	DAC & JLW	281	16			DEEP																	
282	45.9914563	-89.6594744	161	Mann Lake	Vilas	7/23/2014	DAC & JLW	282	11	Muck	Pole	SAMPLED			0														
283	45.9914544	-89.6588417	176	Mann Lake	Vilas	7/23/2014	DAC & JLW	283	10	Muck	Pole	SAMPLED			0														
284	45.9914525	-89.658209	182	Mann Lake	Vilas	7/23/2014	DAC & JLW	284	10	Muck	Pole	SAMPLED			0														
285	45.9914506	-89.6575763	197	Mann Lake	Vilas	7/23/2014	DAC & JLW	285	10	Muck	Pole	SAMPLED			1			1											
286	45.9914487	-89.6569436	204	Mann Lake	Vilas	7/23/2014	DAC & JLW	286	10	Muck	Pole	SAMPLED			0														
287	45.9914468	-89.6563109	216	Mann Lake	Vilas	7/23/2014	DAC & JLW	287	11	Muck	Pole	SAMPLED			0														
288	45.9914449	-89.6556782	222	Mann Lake	Vilas	7/23/2014	DAC & JLW	288	11	Muck	Pole	SAMPLED			0														
289	45.991443	-89.6550455	233	Mann Lake	Vilas	7/23/2014	DAC & JLW	289	11	Muck	Pole	SAMPLED			0														
290	45.9914411	-89.6544128	242	Mann Lake	Vilas	7/23/2014	DAC & JLW	290	10	Muck	Pole	SAMPLED			0														
291	45.9914392	-89.6537801	256	Mann Lake	Vilas	7/23/2014	DAC & JLW	291	11	Muck	Pole	SAMPLED			0														
292	45.9914373	-89.6531474	265	Mann Lake	Vilas	7/23/2014	DAC & JLW	292	10	Muck	Pole	SAMPLED			0														
293	45.9914353	-89.6525147	282	Mann Lake	Vilas	7/23/2014	DAC & JLW	293	10	Muck	Pole	SAMPLED			0														
294	45.9914334	-89.651882	291	Mann Lake	Vilas	7/23/2014	DAC & JLW	294	10	Muck	Pole	SAMPLED			0														
295	45.9914315	-89.6512493	306	Mann Lake	Vilas	7/23/2014	DAC & JLW	295	9	Muck	Pole	SAMPLED			0														
296	45.9914296	-89.6506166	315	Mann Lake	Vilas	7/23/2014	DAC & JLW	296	9	Muck	Pole	SAMPLED			0														
297	45.9914276	-89.6499839	330	Mann Lake	Vilas	7/23/2014	DAC & JLW	297	9	Muck	Pole	SAMPLED			0														
298	45.9914257	-89.6493512	337	Mann Lake	Vilas	7/23/2014	DAC & JLW	298	9	Muck	Pole	SAMPLED			0														
299	45.9914237	-89.6487185	347	Mann Lake	Vilas	7/23/2014	DAC & JLW	299	6	Rock	Pole	SAMPLED			0														
300	45.9914218	-89.6480858	354	Mann Lake	Vilas	7/23/2014	DAC & JLW	300	6	Rock	Pole	SAMPLED			0														
301	45.9914198	-89.6474531	366	Mann Lake	Vilas	7/23/2014	DAC & JLW	301	0			TERRESTRIAL																	
302	45.99141	-89.6442896	395	Mann Lake	Vilas	7/23/2014	DAC & JLW	302	1	Muck	Pole	SAMPLED			1			1											
303	45.9914081	-89.6436569	412	Mann Lake	Vilas	7/23/2014	DAC & JLW	303	6	Muck	Pole	SAMPLED			0														
304	45.9914061	-89.6430242	411	Mann Lake	Vilas	7/23/2014	DAC & JLW	304	7	Muck	Pole	SAMPLED			0														
305	45.9914041	-89.6423915	410	Mann Lake	Vilas	7/23/2014	DAC & JLW	305	7	Muck	Pole	SAMPLED			0														
306	45.9914021	-89.6417588	409	Mann Lake	Vilas	7/23/2014	DAC & JLW	306	7	Muck	Pole	SAMPLED			0														
307	45.9914002	-89.6411261	408	Mann Lake	Vilas	7/23/2014	DAC & JLW	307	6	Muck	Pole	SAMPLED			0														
308	45.9913982	-89.6404934	407	Mann Lake	Vilas	7/23/2014	DAC & JLW	308	6	Muck	Pole	SAMPLED			0														
309	45.9913962	-89.6398607	406	Mann Lake	Vilas	7/23/2014	DAC & JLW	309	6	Muck	Pole	SAMPLED			0														
310	45.9913942	-89.639228	405	Mann Lake	Vilas	7/23/2014	DAC & JLW	310	5	Muck	Pole	SAMPLED			0														
311	45.9913922	-89.6385953	404	Mann Lake	Vilas	7/23/2014	DAC & JLW	311	1	Muck	Pole	SAMPLED			1			1		1							1		
312	45.9910265	-89.6632733	92	Mann Lake	Vilas	7/23/2014	DAC & JLW	312	7	Muck	Pole	SAMPLED			1			1											
313	45.9910247	-89.6626406	114	Mann Lake	Vilas	7/23/2014	DAC & JLW	313	7	Muck	Pole	SAMPLED			1		1												
314	45.9910228	-89.6620079	119	Mann Lake	Vilas	7/23/2014	DAC & JLW	314	7	Muck	Pole	SAMPLED			3			2						3					
315	45.9910209	-89.6613752	139	Mann Lake	Vilas	7/23/2014	DAC & JLW	315	6	Muck	Pole	SAMPLED			1			1						1					
316	45.9910153	-89.6594771	160	Mann Lake	Vilas	7/23/2014	DAC & JLW	316	14	Muck	Pole	SAMPLED			0														
317	45.9910134	-89.6588444	177	Mann Lake	Vilas	7/23/2014	DAC & JLW	317	11	Muck	Pole	SAMPLED			0														
318	45.9910115	-89.6582117	181	Mann Lake	Vilas	7/23/2014	DAC & JLW	318	11	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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
319	45.9910096	-89.657579	198	Mann Lake	Vilas	7/23/2014	DAC & JLW	319	12	Muck	Pole	SAMPLED			0														
320	45.9910077	-89.6569463	203	Mann Lake	Vilas	7/23/2014	DAC & JLW	320	12			DEEP																	
321	45.9910058	-89.6563136	217	Mann Lake	Vilas	7/23/2014	DAC & JLW	321	12	Muck	Pole	SAMPLED			0														
322	45.9910039	-89.6556809	221	Mann Lake	Vilas	7/23/2014	DAC & JLW	322	11	Muck	Pole	SAMPLED			1			1											
323	45.991002	-89.6550482	234	Mann Lake	Vilas	7/23/2014	DAC & JLW	323	11	Muck	Pole	SAMPLED			0														
324	45.9910001	-89.6544155	241	Mann Lake	Vilas	7/23/2014	DAC & JLW	324	10	Muck	Pole	SAMPLED			0														
325	45.9909982	-89.6537828	257	Mann Lake	Vilas	7/23/2014	DAC & JLW	325	10	Muck	Pole	SAMPLED			0														
326	45.9909963	-89.6531501	264	Mann Lake	Vilas	7/23/2014	DAC & JLW	326	10	Muck	Pole	SAMPLED			0														
327	45.9909943	-89.6525174	283	Mann Lake	Vilas	7/23/2014	DAC & JLW	327	10	Muck	Pole	SAMPLED			0														
328	45.9909924	-89.6518847	290	Mann Lake	Vilas	7/23/2014	DAC & JLW	328	10	Muck	Pole	SAMPLED			0														
329	45.9909905	-89.651252	307	Mann Lake	Vilas	7/23/2014	DAC & JLW	329	9	Muck	Pole	SAMPLED			0														
330	45.9909885	-89.6506194	314	Mann Lake	Vilas	7/23/2014	DAC & JLW	330	9	Muck	Pole	SAMPLED			0														
331	45.9909866	-89.6499867	331	Mann Lake	Vilas	7/23/2014	DAC & JLW	331	9	Muck	Pole	SAMPLED			0														
332	45.9909847	-89.649354	336	Mann Lake	Vilas	7/23/2014	DAC & JLW	332	9	Muck	Pole	SAMPLED			0														
333	45.9909827	-89.6487213	348	Mann Lake	Vilas	7/23/2014	DAC & JLW	333	9	Muck	Pole	SAMPLED			0														
334	45.9909808	-89.6480886	353	Mann Lake	Vilas	7/23/2014	DAC & JLW	334	8	Muck	Pole	SAMPLED			1			1											
335	45.9909788	-89.6474559	367	Mann Lake	Vilas	7/23/2014	DAC & JLW	335	9	Muck	Pole	SAMPLED			1			1											
336	45.9909769	-89.6468232	373	Mann Lake	Vilas	7/23/2014	DAC & JLW	336	6	Rock	Pole	SAMPLED			0														
337	45.9909749	-89.6461905	374	Mann Lake	Vilas	7/23/2014	DAC & JLW	337	3	Sand	Pole	SAMPLED			2			2			1								
338	45.990973	-89.6455578	384	Mann Lake	Vilas	7/23/2014	DAC & JLW	338	5	Rock	Pole	SAMPLED			2			2											
339	45.990971	-89.6449251	385	Mann Lake	Vilas	7/23/2014	DAC & JLW	339	7	Muck	Pole	SAMPLED			1									1					
340	45.990969	-89.6442924	394	Mann Lake	Vilas	7/23/2014	DAC & JLW	340	6	Rock	Pole	SAMPLED			1										1				
341	45.9909671	-89.6436597	413	Mann Lake	Vilas	7/23/2014	DAC & JLW	341	8	Muck	Pole	SAMPLED			0														
342	45.9909651	-89.643027	414	Mann Lake	Vilas	7/23/2014	DAC & JLW	342	7	Muck	Pole	SAMPLED			0														
343	45.9909631	-89.6423943	415	Mann Lake	Vilas	7/23/2014	DAC & JLW	343	7	Muck	Pole	SAMPLED			1			1											
344	45.9909611	-89.6417616	416	Mann Lake	Vilas	7/23/2014	DAC & JLW	344	7	Muck	Pole	SAMPLED			0														
345	45.9909591	-89.6411289	417	Mann Lake	Vilas	7/23/2014	DAC & JLW	345	7	Muck	Pole	SAMPLED			0														
346	45.9909572	-89.6404962	418	Mann Lake	Vilas	7/23/2014	DAC & JLW	346	6	Muck	Pole	SAMPLED			0														
347	45.9909552	-89.6398635	419	Mann Lake	Vilas	7/23/2014	DAC & JLW	347	6	Muck	Pole	SAMPLED			1									1					
348	45.9909532	-89.6392308	420	Mann Lake	Vilas	7/23/2014	DAC & JLW	348	5	Muck	Pole	SAMPLED			0														
349	45.9909512	-89.6385981	421	Mann Lake	Vilas	7/23/2014	DAC & JLW	349	2	Muck	Pole	SAMPLED			1			1											
350	45.9905855	-89.663276	91	Mann Lake	Vilas	7/23/2014	DAC & JLW	350	6	Muck	Pole	SAMPLED			3			3				1		1				1	
351	45.9905837	-89.6626433	115	Mann Lake	Vilas	7/23/2014	DAC & JLW	351	6	Muck	Pole	SAMPLED			3			2						3					
352	45.9905818	-89.6620106	118	Mann Lake	Vilas	7/23/2014	DAC & JLW	352	6	Muck	Pole	SAMPLED		YES	3			3						3					
353	45.9905799	-89.6613779	140	Mann Lake	Vilas	7/23/2014	DAC & JLW	353	5	Sand	Pole	SAMPLED			2			2						1		1			
354	45.9905762	-89.6601125	158	Mann Lake	Vilas	7/23/2014	DAC & JLW	354	3	Sand	Pole	SAMPLED			3		3						1			1		1	
355	45.9905743	-89.6594798	159	Mann Lake	Vilas	7/23/2014	DAC & JLW	355	9	Sand	Pole	SAMPLED			1			1				1		1					
356	45.9905724	-89.6588471	178	Mann Lake	Vilas	7/23/2014	DAC & JLW	356	12	Muck	Pole	SAMPLED			0														
357	45.9905705	-89.6582144	180	Mann Lake	Vilas	7/23/2014	DAC & JLW	357	12	Muck	Pole	SAMPLED			0														
358	45.9905686	-89.6575817	199	Mann Lake	Vilas	7/23/2014	DAC & JLW	358	13			DEEP																	
359	45.9905667	-89.656949	202	Mann Lake	Vilas	7/23/2014	DAC & JLW	359	16			DEEP																	
360	45.9905648	-89.6563164	218	Mann Lake	Vilas	7/23/2014	DAC & JLW	360	18			DEEP																	
361	45.9905629	-89.6556837	220	Mann Lake	Vilas	7/23/2014	DAC & JLW	361	15			DEEP																	
362	45.990561	-89.655051	235	Mann Lake	Vilas	7/23/2014	DAC & JLW	362	12	Muck	Pole	SAMPLED			0														
363	45.9905591	-89.6544183	240	Mann Lake	Vilas	7/23/2014	DAC & JLW	363	10	Muck	Pole	SAMPLED			0														
364	45.9905572	-89.6537856	258	Mann Lake	Vilas	7/23/2014	DAC & JLW	364	10	Muck	Pole	SAMPLED			0														
365	45.9905552	-89.6531529	263	Mann Lake	Vilas	7/23/2014	DAC & JLW	365	10	Muck	Pole	SAMPLED			0														
366	45.9905533	-89.6525202	284	Mann Lake	Vilas	7/23/2014	DAC & JLW	366	10	Muck	Pole	SAMPLED			0														
367	45.9905514	-89.6518875	289	Mann Lake	Vilas	7/23/2014	DAC & JLW	367	10	Muck	Pole	SAMPLED			0														
368	45.9905495	-89.6512548	308	Mann Lake	Vilas	7/23/2014	DAC & JLW	368	9	Muck	Pole	SAMPLED			0														
369	45.9905475	-89.6506221	313	Mann Lake	Vilas	7/23/2014	DAC & JLW	369	9	Muck	Pole	SAMPLED			0														
370	45.9905456	-89.6499894	332	Mann Lake	Vilas	7/23/2014	DAC & JLW	370	9	Muck	Pole	SAMPLED			0														
371	45.9905437	-89.6493567	335	Mann Lake	Vilas	7/23/2014	DAC & JLW	371	9	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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
372	45.9905417	-89.6487241	349	Mann Lake	Vilas	7/23/2014	DAC & JLW	372	10	Muck	Pole	SAMPLED			0														
373	45.9905398	-89.6480914	352	Mann Lake	Vilas	7/23/2014	DAC & JLW	373	9	Muck	Pole	SAMPLED			1			1											
374	45.9905378	-89.6474587	368	Mann Lake	Vilas	7/23/2014	DAC & JLW	374	8	Muck	Pole	SAMPLED			0														
375	45.9905359	-89.646826	372	Mann Lake	Vilas	7/23/2014	DAC & JLW	375	8	Muck	Pole	SAMPLED			1									1					
376	45.9905339	-89.6461933	375	Mann Lake	Vilas	7/23/2014	DAC & JLW	376	9	Muck	Pole	SAMPLED			0														
377	45.990532	-89.6455606	383	Mann Lake	Vilas	7/23/2014	DAC & JLW	377	8	Muck	Pole	SAMPLED			0														
378	45.99053	-89.6449279	386	Mann Lake	Vilas	7/23/2014	DAC & JLW	378	8	Muck	Pole	SAMPLED			0														
379	45.990528	-89.6442952	393	Mann Lake	Vilas	7/23/2014	DAC & JLW	379	7	Muck	Pole	SAMPLED			0														
380	45.9905261	-89.6436625	428	Mann Lake	Vilas	7/23/2014	DAC & JLW	380	8	Muck	Pole	SAMPLED			0														
381	45.9905241	-89.6430298	427	Mann Lake	Vilas	7/23/2014	DAC & JLW	381	7	Muck	Pole	SAMPLED			1			1											
382	45.9905221	-89.6423971	426	Mann Lake	Vilas	7/23/2014	DAC & JLW	382	7	Muck	Pole	SAMPLED			0														
383	45.9905201	-89.6417645	425	Mann Lake	Vilas	7/23/2014	DAC & JLW	383	6	Muck	Pole	SAMPLED			1			1											
384	45.9905181	-89.6411318	424	Mann Lake	Vilas	7/23/2014	DAC & JLW	384	6	Muck	Pole	SAMPLED			2									2					
385	45.9905161	-89.6404991	423	Mann Lake	Vilas	7/23/2014	DAC & JLW	385	6	Muck	Pole	SAMPLED			1									1					
386	45.9905142	-89.6398664	422	Mann Lake	Vilas	7/23/2014	DAC & JLW	386	4	Muck	Pole	SAMPLED			1									1					
387	45.9901426	-89.662646	116	Mann Lake	Vilas	7/23/2014	DAC & JLW	387	5	Sand	Pole	SAMPLED			2			2				1		1					
388	45.9901408	-89.6620133	117	Mann Lake	Vilas	7/23/2014	DAC & JLW	388	5	Sand	Pole	SAMPLED			3			3						2					
389	45.9901295	-89.6582171	179	Mann Lake	Vilas	7/23/2014	DAC & JLW	389	11	Muck	Pole	SAMPLED			0														
390	45.9901276	-89.6575845	200	Mann Lake	Vilas	7/23/2014	DAC & JLW	390	10	Muck	Pole	SAMPLED			1			1											
391	45.9901257	-89.6569518	201	Mann Lake	Vilas	7/23/2014	DAC & JLW	391	10	Rock	Pole	SAMPLED			0														
392	45.9901219	-89.6556864	219	Mann Lake	Vilas	7/23/2014	DAC & JLW	392	9	Rock	Pole	SAMPLED			1			1											
393	45.99012	-89.6550537	236	Mann Lake	Vilas	7/23/2014	DAC & JLW	393	11	Muck	Pole	SAMPLED			0														
394	45.9901181	-89.654421	239	Mann Lake	Vilas	7/23/2014	DAC & JLW	394	10	Muck	Pole	SAMPLED			0														
395	45.9901162	-89.6537883	259	Mann Lake	Vilas	7/23/2014	DAC & JLW	395	10	Muck	Pole	SAMPLED			1			1											
396	45.9901142	-89.6531556	262	Mann Lake	Vilas	7/23/2014	DAC & JLW	396	10	Muck	Pole	SAMPLED			1			1											
397	45.9901123	-89.652523	285	Mann Lake	Vilas	7/23/2014	DAC & JLW	397	10	Muck	Pole	SAMPLED			0														
398	45.9901104	-89.6518903	288	Mann Lake	Vilas	7/23/2014	DAC & JLW	398	10	Muck	Pole	SAMPLED			0														
399	45.9901085	-89.6512576	309	Mann Lake	Vilas	7/23/2014	DAC & JLW	399	9	Muck	Pole	SAMPLED			0														
400	45.9901065	-89.6506249	312	Mann Lake	Vilas	7/23/2014	DAC & JLW	400	10	Muck	Pole	SAMPLED			0														
401	45.9901046	-89.6499922	333	Mann Lake	Vilas	7/23/2014	DAC & JLW	401	10	Muck	Pole	SAMPLED			0														
402	45.9901027	-89.6493595	334	Mann Lake	Vilas	7/23/2014	DAC & JLW	402	10	Muck	Pole	SAMPLED			0														
403	45.9901007	-89.6487268	350	Mann Lake	Vilas	7/23/2014	DAC & JLW	403	9	Muck	Pole	SAMPLED			0														
404	45.9900988	-89.6480942	351	Mann Lake	Vilas	7/23/2014	DAC & JLW	404	9	Muck	Pole	SAMPLED			0														
405	45.9900968	-89.6474615	369	Mann Lake	Vilas	7/23/2014	DAC & JLW	405	9	Muck	Pole	SAMPLED			0														
406	45.9900949	-89.6468288	371	Mann Lake	Vilas	7/23/2014	DAC & JLW	406	9	Muck	Pole	SAMPLED			0														
407	45.9900929	-89.6461961	376	Mann Lake	Vilas	7/23/2014	DAC & JLW	407	8	Muck	Pole	SAMPLED			0														
408	45.9900909	-89.6455634	382	Mann Lake	Vilas	7/23/2014	DAC & JLW	408	8	Muck	Pole	SAMPLED			0														
409	45.990089	-89.6449307	387	Mann Lake	Vilas	7/23/2014	DAC & JLW	409	7	Muck	Pole	SAMPLED			0														
410	45.990087	-89.644298	392	Mann Lake	Vilas	7/23/2014	DAC & JLW	410	7	Muck	Pole	SAMPLED			0														
411	45.990085	-89.6436654	429	Mann Lake	Vilas	7/23/2014	DAC & JLW	411	6	Muck	Pole	SAMPLED			2									2					
412	45.9900831	-89.6430327	430	Mann Lake	Vilas	7/23/2014	DAC & JLW	412	6	Muck	Pole	SAMPLED			1									1					
413	45.9900811	-89.6424	431	Mann Lake	Vilas	7/23/2014	DAC & JLW	413	5	Muck	Pole	SAMPLED			2			1								2			
414	45.989679	-89.6550564	237	Mann Lake	Vilas	7/23/2014	DAC & JLW	414	8	Sand	Pole	SAMPLED			1			1											
415	45.9896771	-89.6544238	238	Mann Lake	Vilas	7/23/2014	DAC & JLW	415	11	Muck	Pole	SAMPLED			0														
416	45.9896751	-89.6537911	260	Mann Lake	Vilas	7/23/2014	DAC & JLW	416	11	Muck	Pole	SAMPLED			0														
417	45.9896732	-89.6531584	261	Mann Lake	Vilas	7/23/2014	DAC & JLW	417	12	Muck	Pole	SAMPLED			0														
418	45.9896713	-89.6525257	286	Mann Lake	Vilas	7/23/2014	DAC & JLW	418	11	Muck	Pole	SAMPLED			0														
419	45.9896694	-89.651893	287	Mann Lake	Vilas	7/23/2014	DAC & JLW	419	11	Muck	Pole	SAMPLED			0														
420	45.9896675	-89.6512604	310	Mann Lake	Vilas	7/23/2014	DAC & JLW	420	10	Muck	Pole	SAMPLED			0														
421	45.9896655	-89.6506277	311	Mann Lake	Vilas	7/23/2014	DAC & JLW	421	10	Sand	Pole	SAMPLED			1			1											
422	45.9896539	-89.6468316	370	Mann Lake	Vilas	7/23/2014	DAC & JLW	422	5	Sand	Pole	SAMPLED			1			1						1					
423	45.9896519	-89.6461989	377	Mann Lake	Vilas	7/23/2014	DAC & JLW	423	8	Muck	Pole	SAMPLED			1			1											
424	45.9896499	-89.6455662	381	Mann Lake	Vilas	7/23/2014	DAC & JLW	424	8	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	TRF	Ceratophyllum demersum	Eleocharis acicularis	Elodea canadensis	Heteranthera dubia	Lemna minor	Myriophyllum sibiricum	Najas flexilis	Nymphaea odorata	Potamogeton foliosus	Potamogeton friesii	Potamogeton richardsonii	Spirodela polyrhiza	Vallisneria americana	Freshwater sponge
425	45.989648	-89.6449335	388	Mann Lake	Vilas	7/23/2014	DAC & JLW	425	6	Rock	Pole	SAMPLED			0														
426	45.989646	-89.6443009	391	Mann Lake	Vilas	7/23/2014	DAC & JLW	426	6	Sand	Pole	SAMPLED			0														
427	45.9892109	-89.6462017	378	Mann Lake	Vilas	7/23/2014	DAC & JLW	427	4	Sand	Pole	SAMPLED			1			1											
428	45.9892089	-89.645569	380	Mann Lake	Vilas	7/23/2014	DAC & JLW	428	7	Muck	Pole	SAMPLED			0														
429	45.989207	-89.6449364	389	Mann Lake	Vilas	7/23/2014	DAC & JLW	429	6	Muck	Pole	SAMPLED			0														
430	45.9887679	-89.6455719	379	Mann Lake	Vilas	7/23/2014	DAC & JLW	430	6	Rock	Pole	SAMPLED			0														
431	45.988766	-89.6449392	390	Mann Lake	Vilas	7/23/2014	DAC & JLW	431	5	Rock	Pole	SAMPLED			1			1											

F

APPENDIX F

WDNR Fisheries Reports:

1950 Memorandum, Stocking Records and Winterkill Photos

WDNR Aeration Projects, 2006

Rick Cornelius

Wisconsin Conservation Department

INTRA-OFFICE
MEMORANDUM

Vilas County
Mann Lake

Date September 15, 1950

File

TO: Arthur Oehmcke

FROM: L. E. Morehouse

SUBJECT: Management of Mann lake

In accordance with your memorandum on the management of Mann lake, Vilas county, and taking into consideration that the population is as your letter states, I believe that this body of water could be used to an advantage in 1951 for walleye rearing. In talking with the employees it is their belief that seining it would be rather simple as it has good seining areas.

In using it for walleye rearing, we would not only have a large reservoir from which we may be able to obtain much needed walleye fingerlings but will have it stocked with fingerling walleye as you suggested but which will be one year later.

Therefore, it is my recommendation that we stock it in 1951 with walleye fry at a rate to be determined at a later date when returns from Borth and Mayflower are in.

L. E. Morehouse

LEM:ec
NOTED:

Arthur G. Oehmcke SEP 16 1950
Date

Wisconsin Conservation Department

Wisconsin Conservation Department

INTRA-OFFICE
INTRA-OFFICE
MEMORANDUM
MEMORANDUM

Date September 11, 1950

TO: Arthur Oehmcke
L. E. Morehouse
FROM: L. C. W. Threinen
Arthur Oehmcke

SUBJECT: **Management of Mann Lake**

As you know, the subject of Mann lake has long been a problem to this division. The management of Mann lake waters appears to be quite a challenge since it winterkills quite frequently and the fish population has varied from excellent to fair and poor.

My present information indicates that there is a tremendous population of suckers in Mann lake, which are of no use to fishermen and which would be better off removed.

I am therefore recommending that some action be taken to remove suckers from these waters for use as fish food at the trout hatcheries and partly for live transfer to maintain muskellunge and hybrids at the Woodruff station. In addition, as in the case of other freeze-out lakes, I am recommending the introduction of walleye fingerling in the event that surpluses are available this year. It would be interesting to determine what walleyes will do with remaining feed in the lake. Years ago, walleyes were quite dominant in Mann lake but subsequent die-offs and catches have reduced the population to practically nothing.

I would appreciate your comments on this approach on the management of Mann lake. It would be advisable to begin a project of this nature immediately if walleye fingerling are available.

Arthur Oehmcke

AO:maj

NOTED:

Date

PLANTING RECORD Mann LK , Fi-238

Date	Species	Number Planted	Size	Remarks
1950	Walleye	4,800,000	Fry	5/19
1950	"	2,200 000	"	5/27
1949	Muskellunge	10	Adult	
1949	"	185	Yearling	
1952	"	1240	Fngl	
1953	Walleye	4900	"	
1954	Muskellunge	106	"	7/26
1955	Wall eye	4800	"	
1956	"	750,000	Fry	6/26
1956	Muskellunge	30	Fngl.	7/30
1957	"	823	"	
1958	"	106		
1959	"	87802	Fry	
1962	"	500	Fngl.	
1962	LMB	3000	"	
1964	Walleye	5,000	Fngl.	
1964	Panfish	10,371	—	
1966	Perch	2,900	~~Fngl~~	
1966	LMB	2,118	Fngl.	
1968	Wall eye	3000		
1968	Northern	390		
1976	"	120,566	FRY	5-7-76
1977	"	116,200	Fry	4-29
1989				
1989	B.G.	330	3" Avg	10/11
"	N.P.	104	7"-15"	7/6
6-8-90	LMB	200	10" Adult	
6-20-90	B.G.	2950	5" Adult	
5-11-01	Walleye	4,000,000	fry .3cm	
5-23-01	Musky	190,350	fry .5cm	
5-18-04	Walleye	3,174,400	Fry .5cm	
2005	Walleye	1,024,000	fry .5"	

PLANTING RECORD

Year	Species	Size	Number
1935	WALLEYED PIKE	FRY	580,050
1935	MUSKELLUNGE	FRY	44,580
1936	WALLEYED PIKE	FRY	323,000
1937	WALLEYED PIKE	FRY	751,850
1941	MUSKELLUNGE	ADULT	10
1941	MUSKELLUNGE	FRY	20,000
1942	"	"	25,000
1945	LMB	Fgl.	600

Landing PETE ANDERSON

Cooperator SAME

Address SAYNER Tel.

Boats YES Motor NO

Other resorts (name) NO

Housekeeping cabin groups (name) NO

Remarks:

N

W E

S

(This space for mapping by field personnel)

Wisconsin Conservation Department

Form F1-S6


3-2012
MANN LAKE


2- 2012 MANN LAKE

Description and Summary of Lake Aeration Projects to Prevent Fish Winterkill in Barron and Polk Counties, Wisconsin

Rick Cornelius

Senior Fisheries Biologist, Retired

Wisconsin Department of Natural Resources

Northern Region – Barron

April, 2006

Executive Summary

Barron and Polk Counties in northwestern Wisconsin contain many small lakes which have winterkill conditions. Desirable sport fish populations can be established in these lakes only if the occurrence of winterkill is greatly reduced or eliminated. In 1977 the first successful attempt to eliminate winterkill in an area lake using aeration occurred on Largon Lake, Polk County. By 2005-2006 seventeen lakes totaling over 3,000 acres (range 54-1,534 acres) had managed aeration projects. The aeration projects have resulted in improved sport fish populations in these lakes.

Two types of aeration systems have proven effective and relatively economical in reducing or eliminating winterkill in a variety of lakes; the compressed air aeration system and the surface aspirating aeration system. The installation, operation, maintenance, and cost of each system are discussed along with a summary of the individual lakes where aeration projects occur in the two counties. Projects are funded and operated in various ways, but often involve a variety of partnerships between the DNR, local units of government, lake districts and lake associations, and individual lakeshore property owners.

Introduction

Barron County and Polk County in northwestern Wisconsin contain numerous small lakes which have fish winterkill conditions. Dissolved oxygen levels in these lakes decline throughout the winter to the point that by mid too late winter fish start to die due to lack of oxygen. Fish winterkill severity ranges from annual total winterkills in some lakes to infrequent partial winterkills in other lakes.

An important factor which influences the frequency and severity of winterkill is a lake's morphology, including average and maximum depth, the presence or absence of shallow bays where fish can be trapped, and the presence or absence of inlets, outlets, and spring areas. Fertile lakes probably have a greater tendency to winterkill than infertile lakes due to greater oxygen demand from decaying organic matter.

Factors which can influence whether or not a lake will winterkill in any specific year include the duration and depth of ice and snow cover, the status of lake levels, and for some lakes whether or not fall turnover is complete. Because of the year to year variability of these factors, predicting whether an occasional winterkill lake will have winterkill conditions in any particular year is not possible.

Annual severe winterkill can result in total absence of fish in a lake, while occasional partial winterkills can result in an unbalanced fish population which can fluctuate greatly in numbers and composition. As winterkill lakes have become increasingly developed with seasonal and permanent dwellings, there has been increased interest in creating desirable sport fish populations in these lakes. To create desirable fish populations, winterkill conditions have to be eliminated or at least greatly reduced. In addition, management techniques to control winterkill conditions have to be simple and economical, so that lakeshore property owners, sportsmen's

clubs, and local units of government that have limited manpower and finances can feasibly undertake such projects.

The earliest attempts to prevent winterkill by the use of aeration in this area utilized spray type aerators which sprayed water into the air. This method proved ineffective in preventing winterkills in lakes. The first successful attempt at aeration in the Barron and Polk County area occurred at Largon Lake in Polk County in 1977, when a compressed air aeration system was developed and installed. From 1977 through 2005, a total of 18 aeration systems were installed in lakes in Barron and Polk Counties (Figure 1; Table 1). Two types of aeration systems have proven effective and relatively economical in reducing or eliminating winterkill in a variety of lakes; the compressed air aeration system and the surface aspirating aeration system. Both have advantages and disadvantages, as discussed below. All cost figures presented are 2005 US dollars.

Lake Selection, Site Selection, Aerator Type. Lakes as shallow as five feet maximum depth and as large as 1,534 acres have been aerated with some success in this area. However, there is no guarantee that a lake can be successfully and economically aerated, and certainly a lake with a maximum depth of five feet is on the edge of being too shallow. Strong local support for an aeration project should be important criteria in selecting a lake as a candidate for aeration. Willingness of local citizens to become actively involved in the project is also important. Before a project is initiated, it should be agreed upon as to who will do what, from purchasing the aeration system to installing it and operating it on a yearly basis.

Having electricity at the site, or at least near the site, is critical, as the aerators are driven by electric motors. Water of at least five feet maximum depth should be within several hundred feet of the shore.

The presence of public land or a willing landowner on which to site the project is important. Liability can be an issue when installing aeration systems. The landowner where the system is to be located must obtain the water regulations permit, and becomes liable for the aeration system. Therefore, it is best if the landowner is not an individual, but is a unit of government or a lake district. The liability aspect must be made clear to the landowner. Maintaining an open water barricade in accordance with Wisconsin Statute 167.26 is important in regard to liability.

Compressed air aeration systems are less labor intensive than aspirating aeration systems, and so are often the most practical if a lake group is to operate the system. However, because aspirating aeration systems are generally more powerful than compressed air systems, they may be better suited to aerate lakes greater than 250 acres and shallow lakes less than 10 feet maximum depth. A compressed air system was only marginally successful on six ft deep Camelia Lake, but a 2 hp aspirating aerator was much more successful at preventing winterkill. Four 3 hp aspirating aerators have prevented winterkill conditions from occurring in the northern one-half of 1,534 acre Prairie Lake for 15 years.

Installation of the Open Water Barricades. A very important part of any aeration project is the placement and maintenance of a barricade around the open water created by the aeration system. Wisconsin Statute 167.26 states that "(2) Any person creating ice holes by aeration of water, may, in lieu of the requirements of sub (1), erect and maintain a barricade around such holes consisting of uprights spaced every 25 feet or less, connected by a continuous rope, cord or

similar material placed 3 ½ feet off the surface of the ice. The connecting rope, and/or similar material shall have reflectorized ribbon or tape attached to it, so as to be highly visible, and shall be of sufficient strength to permit retrieval of the barricade following melting of ice. Any person erecting such a barricade shall remove the barricade and all parts thereof from the ice or water immediately after the ice has melted. (3) Persons barricading ice holes in the manner specified in this section shall not be liable for damages suffered by persons who enter within the barricaded area."

It has been the practice of some operators of compressed air systems to turn on the aerators and let the open water area develop, and then place the barricade around the open water. This method does not meet the standards of Statute 167.26, as for a time there is unbarricaded open water present, creating a potential liability.

A better way to operate is to: 1) turn on the aerators before freeze-up to blow the water out of the air lines and to identify the locations of air bubbles rising to the surface. Mark these locations using GPS or another method; 2) turn off the aerators until the ice is thick enough to walk on, and erect the barricade around the area that will become open water, making sure the barricade is large enough; 3) drill some holes through the ice where the air bubbles will come to the surface, then turn on the aerators and let the open water develop.

Any materials can be used for the barricade as long as they meet the standards of Statute 167.26. A convenient method is to use 5/8 in diameter, 5 ft long fiberglass fence posts with a 3 in by 3 in PVC sponge net float pushed up about one ft onto each fence post. Holes are drilled into the ice every 25 ft or less, forming a perimeter of the barricade, and a fence post is placed in each hole so the net float rests on the ice. The float gives the post upright stability, and the post will float for easy retrieval in the spring.

Fence post clips and zip ties can be used to attach ½ in black polypropylene rope to the fence posts. Reflective tape and markers can be purchased to place on the fence posts and rope. Black markers attached to the posts and rope provides definition against the white snow making the barricade easier to see during the day (See Appendix Table 1 for barricade material list and vendors). Signs should be placed at public access sites warning of open water due to aerator operation.

Design, Installation and Operation of a Compressed Air Aeration System. The compressed air aeration system is permanently installed at the site. The system consists of one or more air compressors housed in a shelter on the shoreline, which push air through two or more air lines which extend along the lake bottom to the deepest part of the lake that can be reached in 400 feet or less (Figure 2). Air is released from the end of the air lines into the water where it bubbles up through the water column to the surface. This action creates a current which causes warmer water near the lake bottom to rise to the surface, creating an ice-free area which allows water to be reoxygenated. The air lines should be run inside a length of 4 inch PVC pipe from the aerator shed out into several feet of water depth to protect the lines from damage. A barricade needs to be constructed around the open water.

The aeration system must be operated throughout the winter months, from December into March. Most compressed air aeration systems are not powerful enough to increase dissolved oxygen levels, or even hold them steady, but they slow the rate of decline so that adequate dissolved oxygen (greater than 2.0 ppm in the upper five to ten feet of water) is still available in late winter.

Because funding is often a concern when working with small groups of partners, the procedure has been to install the smallest aeration system which has a reasonable chance of preventing winterkill from occurring. If the system proves inadequate, it can be enlarged.

Lakes with a maximum depth of at least 10 feet and a mean depth of at least six feet can often be aerated successfully with a compressed air system. In general, one ¾ hp aeration unit may aerate a 30 to 50 acre lake, with an additional ¾ hp unit added for each 30 to 50 acres. Because fish are attracted to areas of adequate oxygen, it is not necessary to maintain desirable oxygen levels throughout the entire lake.

A single aeration unit consists of a ¾ hp or 1 hp oilless vane compressor, a two valve outlet, a muffler system, and two air lines each consisting of ¾ inch weighted heavy duty polyethylene tubing. Pre-weighted polyethylene tubing is available, but regular heavy duty polyethylene tubing weighted with ½ inch by 20 foot reinforcing rod placed end to end works well and is more cost-effective. The cost of one ¾ hp aeration unit is approximately $1,150.00, and the cost of operation of one ¾ hp unit is about $30.00 to $50.00 per month in electricity.

Ceramic diffusers are available which can be placed at the ends of the air lines to create smaller bubbles and thereby increase the aerators efficiency. However, the diffusers are a maintenance problem in that the micropores become clogged, and satisfactory results have been obtained simply by capping the ends of the air lines and drilling several 1/8 inch holes into the last several feet of tubing.

One advantage to a compressed air system is that once the system has been installed, relatively little maintenance is required beyond the erection of an open water barricade in early winter and its removal each spring. The system needs to be turned on before freeze-up to check

for problems and to blow water out of the air lines. The air line valves must be shut immediately after the compressors are turned off to keep water out of the air lines during the freeze-up period.

It is recommended that the carbon vanes in the air compressor be replaced about every nine months of operation. A vane set costs about $85.00. Other possible maintenance concerns are muskrats *Ondatra zibethica* chewing holes in the air lines that then need repair and boat anchors catching and moving air lines that then need to be reset. If reinforcing rods are used to weigh down the air lines, they should be placed end to end to keep the air lines flat on the bottom.

Design, Installation and Operation of a Surface Aspirating Aeration System. Surface aspirating aeration systems are currently (2005) in use on four area lakes (Table 1). Each aerator unit consists of an aerator floating on a molded polyethylene pontoon. The aerator consists of an electric motor (2 or 3 hp) attached to an adjustable hollow shaft that angles into the water (Figure 3). The shaft drives a propeller/diffuser that draws air through intake holes above the water surface and shoots a stream of air through the shaft into the water. Underwater power cable and mooring cable are necessary, and the open water must be surrounded by a barricade. The cost of one 2 hp unit with 200 feet of under water power cable is about $1,350.00. Operating cost is estimated at $120.00 to $180.00 per month in electricity for one 3 hp unit.

A significant difference between the surface aspirating aeration system and the compressed air system is that the compressed air system is permanently installed at the site, while the aspirating system must be installed each winter and removed each spring. Therefore, the aspirating systems are considerably more labor intensive, and may require Department of Natural Resources (DNR) assistance for installation and removal. On the plus side, the aspirating systems are portable and ideal for emergency aeration situations.

Aspirating aeration systems are not installed until the ice is thick enough for ATV travel. Chain saws are used to cut holes in the ice large enough to place each aerator/pontoon assembly. Anchoring cables are attached to the pontoons in a triangular fashion, and large cement blocks are attached at the ends of each of the cables so they will fall to the bottom as the ice is eroded away by the action of the aerators. Underwater power cables are run from the aerators to an electrical source on shore, and polyethylene floats are attached to the cables so that they do not sink to the bottom.

The individual aerators can be placed in a lake in a variety of configurations. In this area, the aerators have been placed so that the shafts of the aerators are pointing out into the main portion of the lake, and if four aerators are used, they are placed as at the four corners of a square or rectangle, 50 to 100 feet apart.

Aspirating aeration systems are generally more powerful than compressed air systems, and can sustain or even elevate dissolved oxygen levels in some instances. In general, one 2 hp aspirating aerator may aerate a 75 acre lake, with an additional aerator necessary for each additional 75 acres. Dissolved oxygen levels can be monitored, and individual aerators turned on or off as the situation dictates. However, thin ice conditions can be created when aerators are turned on and off, so it is especially important to maintain a good barricade, and at least one aerator should be operating at all times to maintain some open water. The aerators must be operated until ice-out is complete to protect the aerators from being dislodged and damaged by ice push. This type of aerator damage occurred on Staples Lake one year.

Aeration Projects

The following is a summary of the eighteen aeration projects which have taken place in Barron and Polk Counties. This summary indicates the general success of aeration in reducing or eliminating winterkill, and also shows the variety of situations where this management practice can work.

Antler Lake – Polk County

Antler Lake is a 101 acre seepage lake located in central Polk County. The lake is landlocked and has a maximum depth of twenty two ft and a mean depth of nine ft. The sport fishery consists of largemouth bass *Micropterous salmoides*, northern pike *Esox lucius* and panfish. Walleye *Sander vitreus* have been periodically stocked since 1989 when aeration was started.

Antler Lake had occasional partial winterkills, and was particularly susceptible when the lake level was below normal. A serious winterkill occurred in February of 1989, prompting the Antler Lake District to become interested in an aerator system. A cooperative project between the DNR and the Lake District was undertaken and an aeration system was installed in the fall of 1989. Three, ½ hp air compressors and associated equipment were purchased by the DNR, and the system is operated and maintained by the Lake District. There has been no winterkill since the initiation of aeration. A 1995 fisheries survey indicated that the largemouth bass population had increased significantly since the 1989 winterkill, and that some walleyes were present (Cornelius 1995a).

Bass Lake – Polk County

Bass Lake is a 138 acre seepage lake located in northern Polk County. The lake has a maximum depth of nineteen ft and a mean depth of six ft, and the south one-third of the lake is a

shallow bay with a maximum depth of six ft. The lake has had a history of periodic partial winterkills which adversely affected the fishery of largemouth bass, northern pike and panfish.

In 1997 the Polk County Sportsman's Club expressed an interest in installing and operating an aeration system in Bass Lake. Installation of a compressed air system began in the fall of 1997, but the lake froze before the air lines could be installed on the lake bottom. A DNR owned 3 hp aspirating aerator was run periodically during the winter of 1997-98 to insure that winterkill did not occur. The compressed air system was installed in the summer of 1998. The aeration system was purchased by the Sportsman's Club, and consists of three ¾ hp compressors and six air lines. The Sportsman's Club pays the operating costs, but most years DNR personnel put up the barricade. There has been no recorded winterkill since the initiation of aeration. A 1998 fisheries survey found that largemouth bass, northern pike, bluegills and pumpkinseeds were all present in sufficient numbers that good populations should develop in the absence of winterkill conditions (Cornelius 1998).

Camelia Lake – Polk County

Camelia Lake is a 60 acre lake located in the Village of Clayton in southeast Polk County. The lake has a maximum depth of six ft and a mean depth of four ft. The lake is eutrophic, with heavy summer algae blooms. Due to frequent severe winterkills, the fish population was poor, consisting of small black crappies *Pomoxis nigromaculatus*, black bullheads *Ictalusus melas,* and fathead minnows *Pimephales promelas*.

In the mid 1980s, the Village expressed interest in developing a project with the DNR to create a desirable fish population in Camelia Lake. In January of 1986, the lake was treated with rotenone to remove the undesirable fish population. Two ½ hp air compressors were installed

and started operating in the late fall of 1986. An additional ½ hp air compressor was installed in 1992.

Success of aeration was variable. Adequate dissolved oxygen levels were maintained during "normal" winters, but in severe winters, winterkill occurred. In 2000, the Village added a 2 hp aspirating aerator, and no winterkill has occurred since then. In 2005-2006, the Village may attempt running only the aspirating aerator to prevent winterkill. A likely improving fish population of northern pike, largemouth bass and panfish is present, based on anecdotal evidence of improved angling success and increased fishing pressure.

Chain Lake – Barron County

Chain Lake is a 107 acre lake located in the northeastern Barron County. The lake has three basins, two north of County highway V, and one south of County highway V. The lake has a maximum depth of nineteen ft and a mean depth of seven ft. The lake contains largemouth bass, northern pike and panfish, but has a history of periodic severe winterkills.

In 1992, the DNR and Barron County cooperated on a project to install a compressed air system in the south two basins of Chain Lake. Three ½ hp air compressors were installed, with four air lines going north of County highway V and two south of County highway V through the road culvert. There was no winterkill following aeration until the winter of 2003-04, when a serious winterkill occurred in the basin north of County highway V. Following the winterkill, the three ½ hp air compressors were replaced with three 1 hp air compressors, which will hopefully prevent future winterkills. Maintenance and electricity costs are the responsibility of lakeshore property owners, with contributions from the Brill Sportsmen's Club. A 2000 fisheries

survey found good largemouth bass and northern pike populations in terms of density and size distribution (Cornelius 2000a). However, the 2003-04 winterkill almost certainly had a significant adverse impact on the fish population.

Coon Lake – Polk County

Coon Lake is a 54 acre lake located in the Village of Frederic in northwest Polk County. The lake has a maximum depth of sixteen ft and a mean depth of ten ft. The lake is subject to widely fluctuating water levels. Coon Lake has a history of periodic serious winterkills, particularly during low water levels. In 1968 the Village installed two "Fresh-Flo" aerators, but winterkills continued. A 1979 electrofishing survey found one northern pike, several bluegills and crappies, and abundant bullheads. Coon Lake was treated with rotenone in the fall of 1980 to eliminate the bullhead population. In the summer of 1981 a compressed air system was installed consisting of two ½ hp air compressors and four air lines. Since the installation of this system, there have been two partial winterkills, in 1988-89 and in 1996-97. These winterkills occurred during low water levels. In spite of the two winterkills, a 2000 fisheries survey showed that largemouth bass and bluegill populations were re-established, and the overall fish population was improved compared to before aeration (Cornelius 2000b). The Village maintains and operates the aeration system.

Desair Lake – Barron County

Desair Lake is an 81 acre lake located in north central Barron County. The lake has a maximum depth of thirty three ft and a mean depth of seventeen ft. The lake has fluctuating water levels and is subject to heavy summer and fall algae blooms. The lake had a fairly desirable fish population of largemouth bass, northern pike and panfish until two consecutive

years of severe winterkill in 1995-96 and 1996-97. In a cooperative effort between the Lake Association, Barron County and the DNR, a compressed air system was installed and started operating in December, 1999. The system consists of three ¾ hp air compressors and six air lines. There has been no winterkill since the aeration system started operating. The Lake Association pays maintenance and electricity costs, while the DNR personnel have been putting up the barricade. A 1999-2000 fisheries survey indicated that the largemouth bass and bluegill populations which were severely impacted by the two winterkills were well on their way to recovery (Cornelius 2000c).

Diamond Lake – Polk County

Diamond Lake is a 126 acre seepage lake located north of the Village of Frederic in Polk County. The lake has a maximum depth of fifteen ft, and much of the lake is less than ten ft deep. A 1995 fisheries survey found fair populations of largemouth bass and northern pike, and good populations of bluegills and pumpkinseeds (Cornelius 1995b). Diamond Lake has a history of occasional partial winterkills. A lakeshore resident operated a surface aerator for years, but the benefits were likely insignificant. In the fall of 1995 a compressed air system was installed consisting of one ½ hp air compressor with two air lines. The system was considered underpowered for a 126 acre lake, but financial constraints precluded a larger system (one landowner was paying all electrical and maintenance costs). A partial winterkill occurred in the winter of 1995-96, and low dissolved oxygen was found during the winter of 1996-97, but no dead fish were reported. Since 1996, no winterkill has been documented.

East (Lotus) Lake – Polk County

East (Lotus) Lake is a 246 acre lake located in western Polk County near the Village of Dresser. The lake is shallow, with a maximum depth of fifteen ft and a mean depth of seven ft. The water is somewhat turbid due to carp *Cyprinus carpio* and bullhead activity, and heavy summer algae blooms can occur. East Lake has a long history of fish winterkill. A 2000 fisheries survey found a poor fish population dominated by carp and bullheads, with low numbers of northern pike and small panfish (Cornelius 2000d). The Polk County Sportsmen's Club was interested in an aeration project for East Lake, and donated funds for an aeration system. A compressed air system consisting of two ¾ hp air compressors with four air lines was installed in 2004. The system is now in its second winter of operation, and to date dissolved oxygen levels have remained well above 2.0 ppm. The Osceola Rod and Gun Club have been paying the electrical costs, while DNR personnel have been putting up the barricade.

Ice House Lake - Polk County

Ice House Lake is a six acre seepage lake located in the Village Park at Clear Lake in southeast Polk County. The lake has a maximum depth of thirty five ft and a mean depth of fourteen ft. Ice House Lake has been managed as a trout lake for many years. In 1986 the lake was chemically treated with rotenone to remove non-trout species. The lake had periodic low winter dissolved oxygen levels, which some years prevented trout from surviving over the winter. In 1987 a compressed air system was installed which consisted of one ½ hp air compressor and two air lines. This system prevented trout winterkill, but Ice House Lake still produced very few larger trout. It was surmised that a very large percentage of the stocked trout population was harvested each summer, so that winter aeration was not significantly improving the fishery. Aeration was discontinued after about four years of operation.

Kirby Lake – Barron County

Kirby Lake is a 92 acre seepage lake located in northwest Barron County. The lake has a maximum depth of 19 ft and a mean depth of eight ft. Water levels can fluctuate several ft over time. Occasional partial winterkills adversely affected the sport fish population of largemouth bass, northern pike and panfish. In 1988, a compressed air system was installed by Barron County with technical assistance and partial funding from the DNR. Two ½ hp air compressors and four air lines installed. The Lake District is responsible for operation and maintenance of the aeration system. Since the initiation of aeration, winterkill has been minimal. A partial winterkill of panfish occurred in 1992, the only documented case of winterkill. A 1995 fisheries survey found good populations of largemouth bass and northern pike (Cornelius 1995c). Bluegill and crappie populations had excellent size distributions.

Largon Lake – Polk County

Largon Lake is a 129 acre seepage lake located in northern Polk County. The lake has a maximum depth of ten ft and a mean depth of six ft. Heavy summer algae blooms are common. Prior to 1977, Largon Lake had frequent partial winterkills, and the fish population was composed mainly of a small northern pike population and a large bullhead population. The Largon Lake District was interested in improving the sport fish population, and funded and helped design the first compressed air aeration system to be installed in the area. Largon Lake was treated with rotenone during the winter of 1976-77 to remove the large bullhead population. The aeration system was installed in 1977 and consisted of four ½ hp air compressors with eight air lines. Ceramic diffusers with micropores were placed at the ends of the air lines to increase the efficiency of the aeration system. The ceramic filters proved to be a maintenance problem, as

the micropores would clog up every few years and require cleaning. Because of this, diffusers were not installed on subsequent systems, replaced by several 1/8 in holes drilled in the last several feet of capped air line. The Lake District is responsible for operation and maintenance of the aeration system. There has been no recorded winterkill in Largon Lake since the aeration system was installed 28 years ago. A 2003 fisheries survey indicated a quality northern pike population existed in Largon Lake (Benike 2004).

Little Butternut Lake – Polk County

Little Butternut Lake is a 189 acre lake located one mile west of the Village of Luck in northwest Polk County. The lake has a maximum depth of twenty three ft and a mean depth of eight ft. Butternut Creek runs through the lake. The sport fish population consists of northern pike, largemouth bass, walleye, and panfish. Little Butternut Lake has a history of occasional partial winterkills. In 1998 the Polk County Sportsmen's Club funded a compressed air system consisting of four ¾ hp air compressors with eight air lines. The aeration system, which is operated by the Sportsmen's Club and lakeshore property owners, has operated most but not all winters since its installation. No winterkill has been recorded since the aeration system was installed.

McKeith Lake – Polk County

McKeith Lake is a 72 acre landlocked seepage lake located near the Village of Cushing in western Polk County. The lake has two basins which are similar in size, one with a maximum depth of fifteen ft and the other with a maximum depth of five ft. The lake has a history of frequent severe winterkill, with fathead minnows being the main fish species present. A development company purchased considerable shoreline on McKeith Lake, which was then

plotted into building sites. The company wished to develop a desirable sport fish population in the lake, and in 1998 installed two ¾ hp air compressors with four air lines in the deeper of the two basins. No winterkill has been documented since the initiation of aeration, although dissolved oxygen levels dropped as low as 1.0 ppm throughout the water column during the winter of 2000-2001. Lakeshore property owners have been operating the aeration system.

Moon Lake – Barron County

Moon Lake is an 84 acre landlocked seepage lake located in a residential area on the south edge of the City of Rice Lake. The lake has a maximum depth of about five ft. Moon Lake has a history of frequent partial winterkills and a 1988 fisheries survey found a moderate number of northern pike, one largemouth bass, small bluegills and abundant bullheads (Cornelius 1993a). In 2001 several lakeshore property owners installed one 2 hp aspirating aerator in the lake. No winterkill has occurred since the installation of the aerator. Lakeshore property owners report that the fish population is improving.

Prairie Lake – Barron County

Prairie Lake is an elongate 1,534 acre impoundment which is part of the 3,764 acre Chetek Lakes Chain. The lake has a maximum depth of sixteen ft and a mean depth of nine ft. There is one small inlet that enters the north end of the lake. The lake is eutrophic, and heavy summer algae blooms are common. The lake has a high quality sport fish population of largemouth bass, northern pike, walleye, and panfish. Occasional partial winterkills consisting primarily of panfish but with some gamefish were a problem in the northern one-half of the lake. These winterkills were a considerable concern to the public, as Prairie Lake is a very popular fishing lake. In 1991 an aspirating aeration system was installed at Veterans Memorial Park, a county-

owned park near the north end of the lake. The aeration system consisted of six 3 hp aspirating aerators, with their shafts directed southward down the length of the lake. It soon became apparent that the continuous winter operation of all six aerators was unnecessary to maintain adequate dissolved oxygen levels. Now only four aerators are installed each winter. Dissolved oxygen levels are monitored several times per month, and from one to four aerators are operated as necessary. There has been no recorded winterkill since the aerators have been operating.

One problem that was encountered was that the aerators were top-heavy, and several have capsized during windy weather. Additional floatation helped solve this problem.

The DNR funded the initial cost of the aeration system. A maintenance agreement was signed with six units of government; Barron County, City of Chetek, and four townships. Therefore, electricity costs, which usually run from $1,000 to $1,500 per year are split six ways. DNR personnel install and remove the aerators and install the open water barricade, and the Lake Association removes the barricades. Prairie Lake continues to have a very desirable, well balanced fish population. A 2001 fisheries survey found moderate populations of walleyes, largemouth bass, and northern pike with good size distribution (Cornelius 2001). Bluegills and crappie populations also had very good size distributions.

South Twin Lake – Polk County

South Twin Lake is a 74 acre lake located in the City of Amery in southern Polk County. The lake has a maximum depth of nine ft and an average depth of five ft. The lake contains largemouth bass, northern pike and panfish. Severe winterkills were documented in 1956, 1975 and 1979, and likely occurred other years. In the fall of 1989 a compressed air system was installed by the Amery Lake District. The system consists of two 1/3 hp air compressors with

two air lines. Although the system is probably underpowered for a 74 acre lake, no winterkill occurred until January of 2001, when dissolved oxygen levels were low and some dead fish were observed. This was the only documented winterkill since the aeration system was installed. The Lake District operates and maintains the system. A 1993 fisheries survey found that moderate largemouth bass and northern pike populations were developing, and that an abundant, slow-growing bluegill population was also developing (Cornelius 1993b).

Staples Lake – Barron County

Staples Lake is located on the Barron-Polk County border. The lake is 304 acres, has a maximum depth of seventeen ft, and a mean depth of ten ft. The lake is highly euthropic and experiences heavy algae blooms during the summer and fall. Historically, Staples Lake has had a very high quality sport fish population consisting of walleye, largemouth bass, northern pike and panfish. The only recorded winterkills were in the 1930s until February of 1977, when a combination of low water levels and severe winter weather caused dissolved oxygen levels to drop below 2.0 ppm. Emergency aeration was attempted using a crisafoli pump powered by a power take-off tractor. Water was pumped from the lake through a large hose and then run down a baffle to oxygenate the water returning to the lake. Dissolved oxygen levels remained constant for about a week, and then the tractor quit and could not be restarted in twenty degree below zero temperatures. Fish started dying the next day, and a severe winterkill occurred. An unbalanced fish population developed, dominated by black bullhead and black crappie, and gamefish stocking was ineffective. Therefore, during the springs of 1984 and 1985, fyke nets were used to remove nearly three-fourths of the bullhead population, and crappies were removed to the point that catch per effort was reduced about 30% (Cornelius 1989). With additional stocking, a good

quality fish population was restored, and a 1993 fisheries survey concluded that recovery from the 1977 winterkill was complete (Cornelius 1993c).

From 1978 to 1999 no winterkill occurred, but dissolved oxygen levels dropped dangerously low during two winters. In 1999 the DNR and the Staples Lake District cooperated on an aeration project. Four 2 hp aspirating aerators were purchased by the DNR, with the Lake District paying the electrical costs of operation. Annual installation and removal of the aerators and barricade has been done mainly by DNR personnel. Dissolved oxygen levels have been very good since the aeration system has been operating.

Vincent Lake – Polk County

Vincent Lake is a 70 acre landlocked lake with a maximum depth of fifteen ft and a mean depth of nine ft. The lake is separated into two basins by a narrow channel, with the south basin being the largest. The lake is subject to considerable water level fluctuations. Vincent Lake contains largemouth bass, northern pike and panfish, and frequent severe winterkills have prevented the establishment of a desirable sport fish population. In the fall of 1993 several landowners, with technical advice from DNR, installed two ½ hp air compressors and four air lines in the south basin. Partial winterkills occurred during the winters of 1995-96 and 1996-97 even with the aerators operating. In the fall of 1997 an additional air compressor with two air lines was installed in the south basin. There has been no recorded winterkill in the south basin since the addition of the third air compressor. Lakeshore property owners operate and maintain the system. A 1999 fisheries survey found increasing populations of largemouth bass, northern pike, and bluegills, and the presence of some stocked walleyes (Cornelius 1999).

Summary

Aeration of winterkill lakes has been a useful management tool in Barron and Polk Counties. It is an affordable method of improving fish habitat in small to mid-sized lakes, and can have significant positive results. Aeration is highly visible management that anglers and lakeshore property owners can see taking place. Aeration projects are ideal for partnerships between the public and the DNR.

During 2005-2006 seventeen lakes totaling over 3,000 acres (range 54 – 1,534 acres) had managed aeration projects. In Barron and Polk Counties, aeration protects valuable high quality fisheries in Prairie Lake and Staples Lake, and has helped to maintain good quality fisheries in Kirby Lake, Antler Lake, Diamond Lake, and Little Butternut Lake. Aeration has allowed good quality fisheries to develop from poor quality fisheries in Largon Lake and Coon Lake. Fish populations are improving on Desair Lake, Moon Lake, Bass Lake, Camelia Lake, South Twin Lake, Chain Lake, and Vincent Lake due to aeration. The status of the fish population in McKeith Lake is unknown, and East Lake is only in its second year of operation. Of the eighteen aerated lakes, aeration has clearly been of little or no benefit in only Ice House Lake, and that was because occasional winterkill was not the primary limiting factor to the fish population.

The seventeen active aeration projects in Barron and Polk Counties are a significant workload for fisheries management personnel. In the previous four winters (2002-2003 through 2005-2006) WDNR staff has invested from 200 to 600 man-hours into aeration projects each year. Much of the workload takes place during the late fall and winter, a slower time of the year for field work. However, the removal of aspirating aerators and barricades occurs during ice-out in late winter and spring, and can conflict with fyke netting and other fish survey activities. No

additional aeration projects are foreseen in the near future, but as smaller, shallow lakes become developed, public interest in more aeration projects is possible. Fish management personnel will have to look at each new potential project and evaluate how it fits into the overall fisheries program, and to what extent fish management would be involved.

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Retired fisheries technician Jerry Perkins was involved with the installation and operation of many of the aeration systems, and in particular helped develop installation techniques for the earliest systems. Retired fisheries technician Gary Lund and fisheries technician Todd Brecka also were involved with the installation of many of the aeration systems. Fisheries supervisor Tom Beard gave strong support to the aeration program. It should be noted that without partners from the public, none of the aeration projects would have occurred. Thanks to fisheries supervisor Terry Margenau for reviewing this report and to Kim Dahlberg for typing it.

Literature Cited

Benike, H. M. 2004. Evaluation of a 32 inch minimum length limit for northern pike, Largon Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1989. Mechanical removal of bullhead and black crappie along with gamefish stocking, Staples Lake, Barron County, 1977-1986. Wisconsin Department of Natural Resources Fish Management Report 1414. 11pp.

Cornelius, R.R. 1993a. Fish survey, Moon Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1993b. Fish survey, South Twin Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1993c. Fish survey, Staples Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995a. Fish survey, Antler Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995b. Fish survey, Diamond Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1995c. Fish survey, Kirby Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1998. Fish survey, Bass Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 1999. Fish survey, Vincent Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000a. Fish survey, Chain Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000b. Fish survey, Coon Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2000c. Fish survey, Desair Lake, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R. R. 2000d. Fish survey, East (Lotus) Lake, Polk County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Cornelius, R.R. 2001. Fish survey, Pokegama Lake and Prairie Lake as representative samples of the Chetek Chain, Barron County, WI. Wisconsin Department of Natural Resources unpublished survey report. Barron field office.

Table 1. Barron and Polk County lakes with aeration systems. Year indicates the year aeration system was installed. All systems were active in 2005-2006, except Ice House Lake.

County Lake	Acres	Maximum Depth (ft)	Mean Depth (ft)	Year	Type
Barron					
Chain	107	19	7	1992	3 - ½ hp Air Compressors
Desair	81	33	17	1999	3 - ¾ hp Air Compressors
Kirby	92	19	8	1988	2 - ½ hp Air Compressors
Moon	84	5		2001	1 - 2 hp Aspirating Aerator
Prairie	1,534	16	9	1991	6 - 3 hp Aspirating Aerator
Staples	304	17	10	1999	4 - 2 hp Aspirating Aerator
Polk					
Antler	101	22	9	1988	3 - ½ hp Air Compressors
Bass	138	19	6	1998	3 - ¾ hp Air Compressors
Camelia	60	6	4	1986	3 - ½ hp Air Compressors 1 - 2 hp Aspirating Aerator
Coon	54	16	10	1981	2 - ½ hp Air Compressors
Diamond	126	15		1995	1 - ½ hp Air Compressor
East (Lotus)	246	15	7	2004	2 - ¾ hp Air Compressors
Ice House	6	35	14	1987	1 - ½ hp Air Compressor
Largon	129	10	6	1977	4 - ½ hp Air Compressors
Little Butternut	189	23	8	1998	4 - ¾ hp Air Compressors
McKeith	72	15		1998	2 - ¾ hp Air Compressors
South Twin	74	9	5	1989	2 - ⅓ hp Air Compressors
Vincent	70	15	9	1993	3 - ½ hp Air Compressors

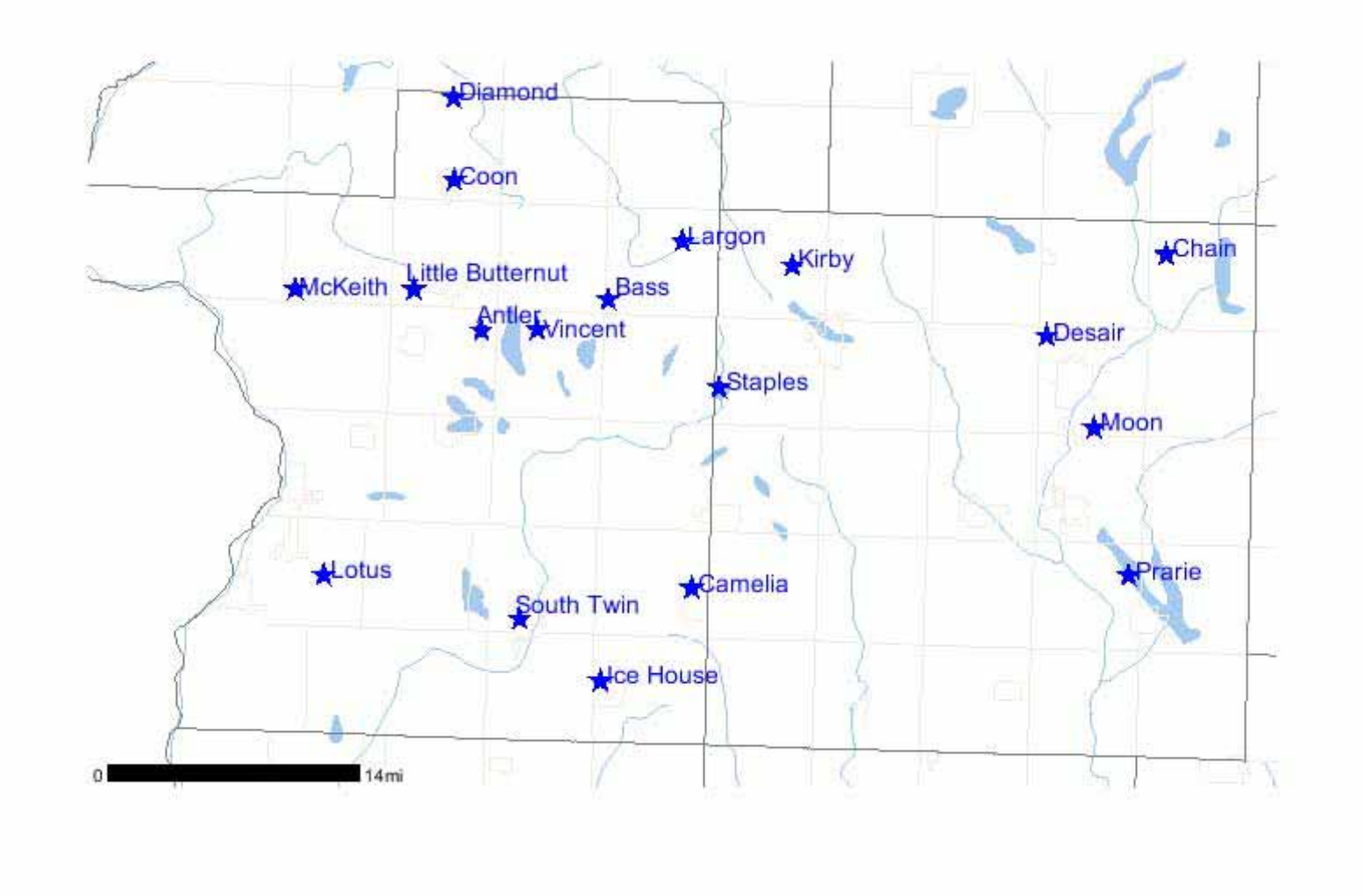

Figure 1. Barron and Polk County lake aeration projects, 1977 – 2005.

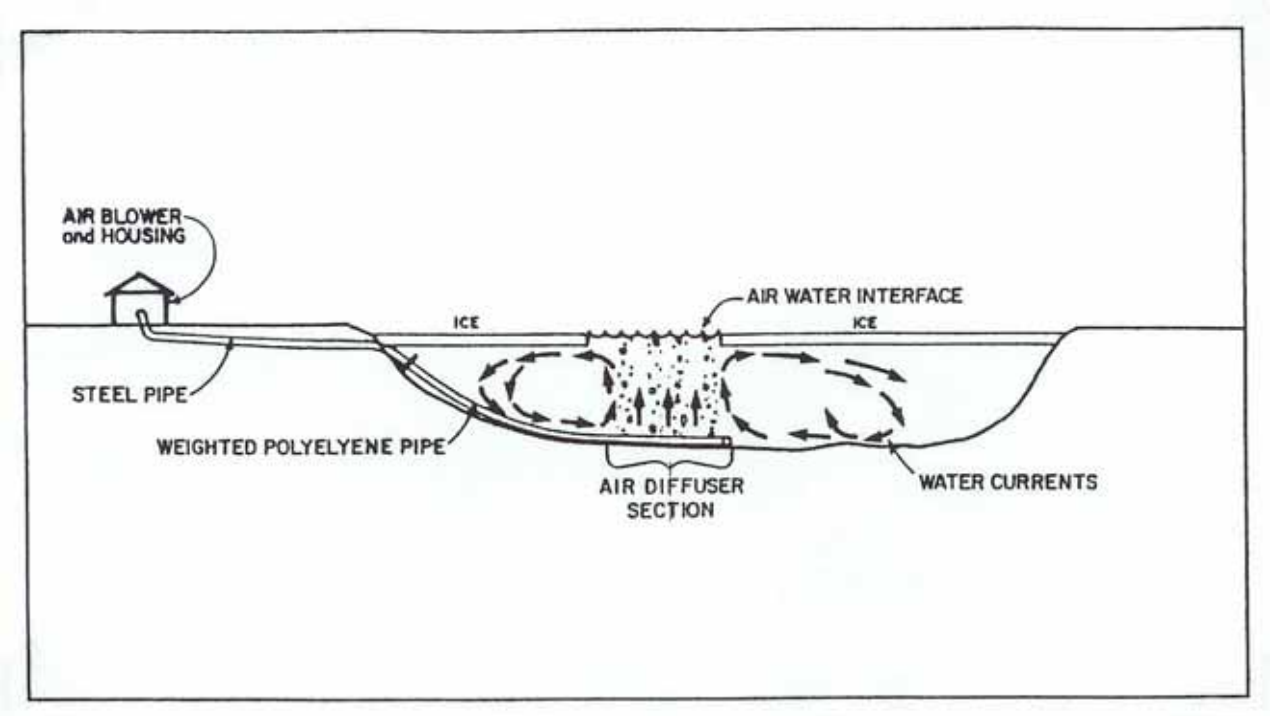

Figure 2. Compressed air aeration system.

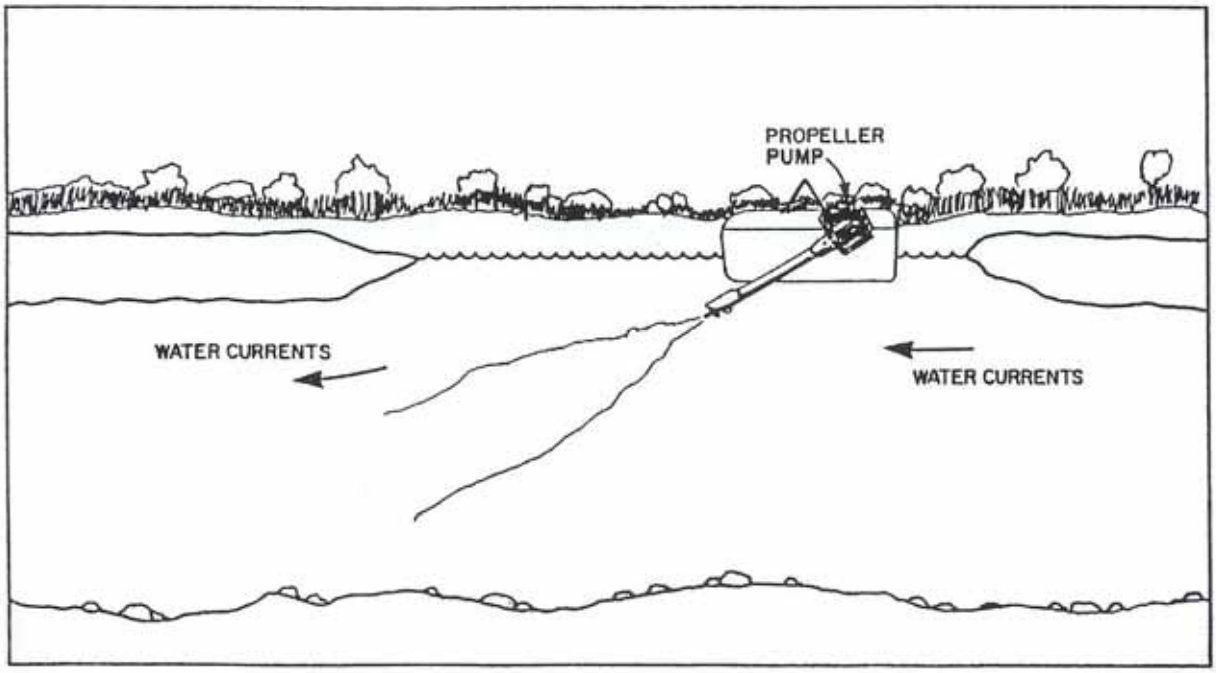

Figure 3. Surface aspirating aeration system.

Appendix Table 1. Aeration barrier fence vendors and materials.

Fiberglass Fence Posts/clips

Supplier: K- Fence
RR1 Box 195
Zumbro Falls, MN 55991
507/753-2943

Materials: 5/8 in diameter posts, 5 ft length
Cost - posts – approx. $3.40 each
Clips – approx. $7.25/25 clips

Floats

Supplier: Carlon Products Co.
800/243-6682

Materials: Model #SB-6 float approx. 3 in X 3 in with ½ in hole. One float/post. Double float every 5th post for extra buoyancy.
Cost – approx. $0.66/float

Rope

Supplier: Nylon Net Company
845 N. Main, P. O. Box 592
Memphis, TN
901/526-6500

Materials: Black polypropylene ½ in rope (600 ft role). Stock # 42167
Cost – approx. $44.96/role

Reflective tape and reflective markers

Supplier: Rent-A-Flash
13605 Stettin Drive
Marathon, WI 54448
715/472-7446 WI order dept. 800/472-7446

Materials: Tape – 6 in X 50 yd 1484 Orange
Cost – approx. $125.00

Reflective Trail Blazes, Model # CX TB-6 (Cut trail blazes in half, punch hole in one end for zip typing to the rope between post.)

Appendix Table 1 (continued).

Marker Signs

Supplier: Local lumber yards, Menards, etc.

Materials: 12 in X 8 in sheet of ¼ in peg board or other suitable lightweight material. Black spray paint. Paint signs black and zip tie to the top of every 5th post to provide contrast and daytime visibility. Need enough zip ties to connect the rope to each post, marker signs to the top and reflective markers between each post.