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

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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?

- To create a better understanding of lake's positive and negative attributes.
- To discover ways to minimize the negative attributes and maximize the positive attributes.
- To foster realistic expectations and dispel myths.
- To create a snapshot of the lake for future reference and planning.

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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
  - Stakeholder Survey
  - Shoreline Assessment

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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
  - Curly-leaf pondweed survey
  - Point-intercept survey
  - Plant community mapping
  - Volunteer survey findings

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Non-native Aquatic Plants

Curly-leaf Pondweed

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Non-native Aquatic Plants

Eurasian Water Milfoil

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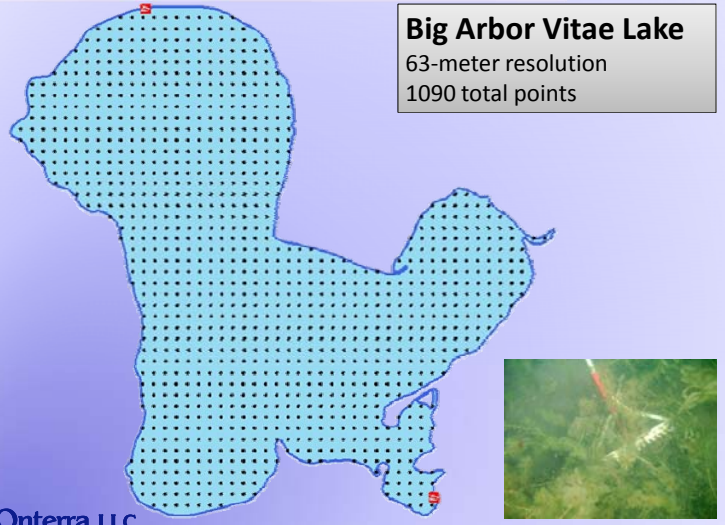

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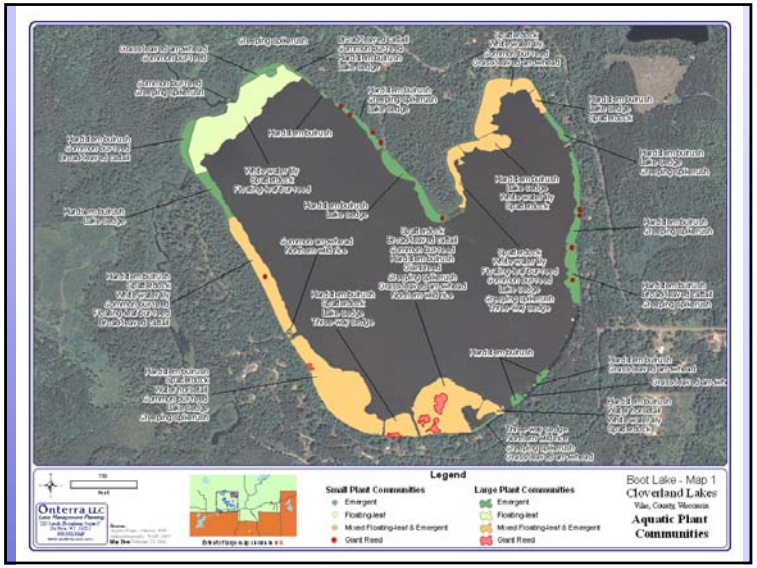

Fisheries Data Integration

- 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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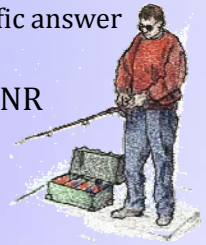
Stakeholder Survey

- 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.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

Urbanized **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

UWEX Extension

Wisconsin Dept. of Natural Resources

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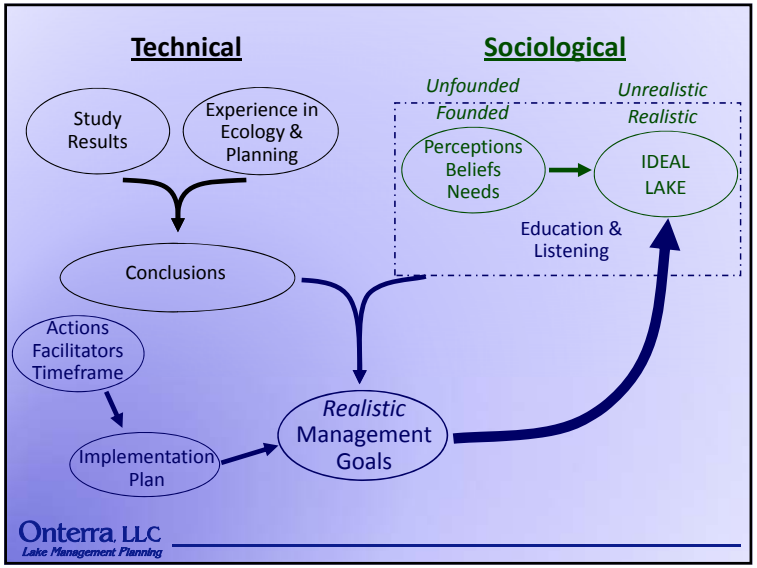
The Planning Process

…it's not as easy as you may think.



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Presentation Outline

- Lake Management Planning Project Overview
- Study Results
  - Water Quality
  - Watershed
  - Aquatic Plants
  - Fishery
- "Big Picture"
- Stakeholder Survey

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Study and Plan Goals

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

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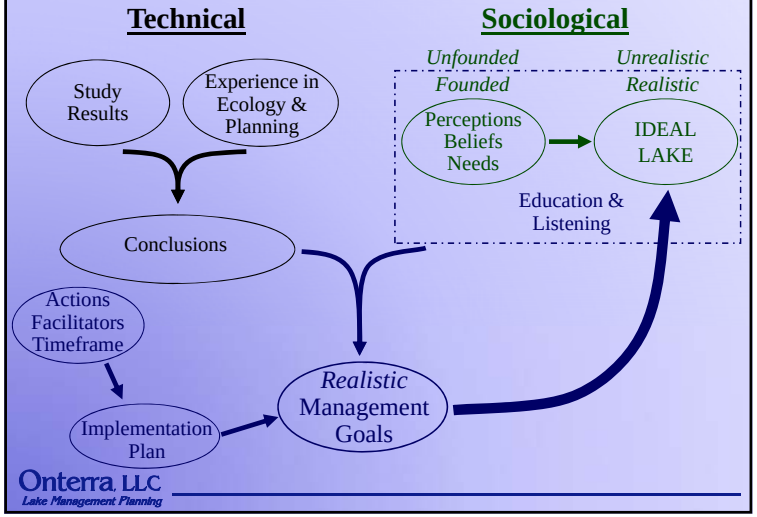
Planning Process



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Water Quality

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Wisconsin Ecoregions

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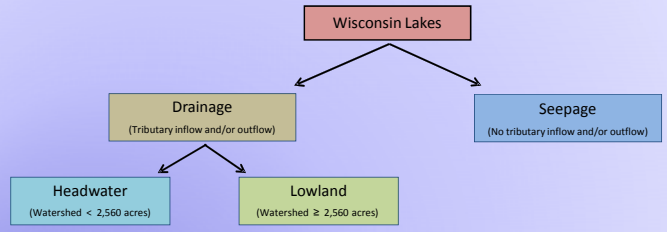
Wisconsin Lakes Classification



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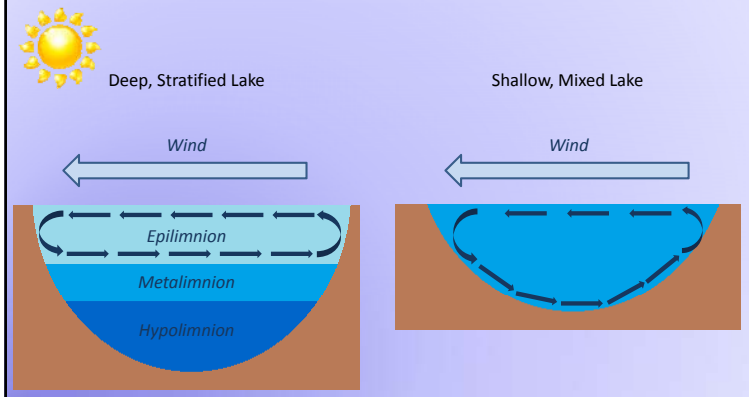
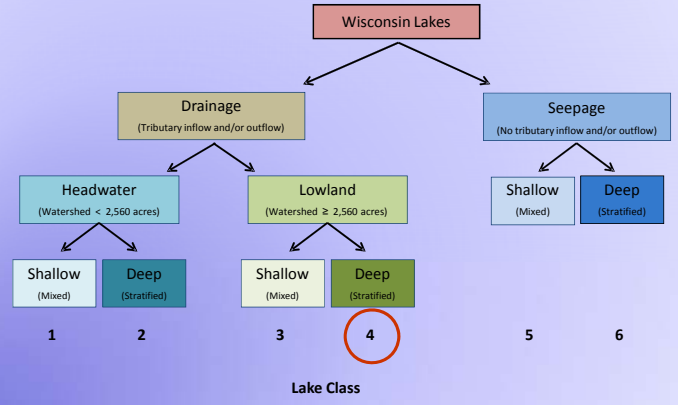
Lake Management Planning

Wisconsin Lakes Classification



Onterra, LLC
Lake Management Planning

Wisconsin Lakes Classification



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Water Quality

Phosphorus (Limiting Plant Nutrient)

Nitrogen:Phosphorus = 20:1

Chlorophyll-*a* (Algal Abundance)

Low to moderate abundance
- Seasonal variation

Water Clarity (Secchi Disk)

High Water Clarity
- Seasonal variation

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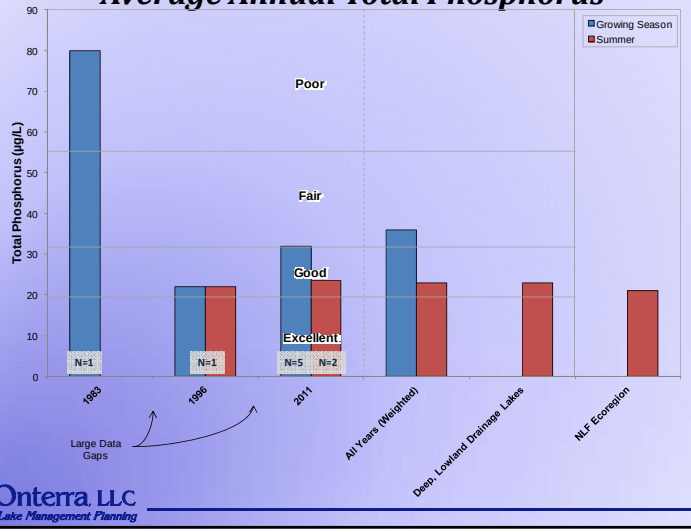
Average Annual Total Phosphorus



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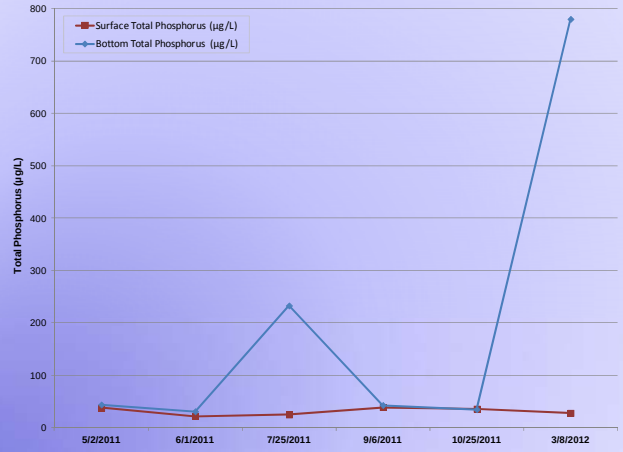
2011 Total Phosphorus



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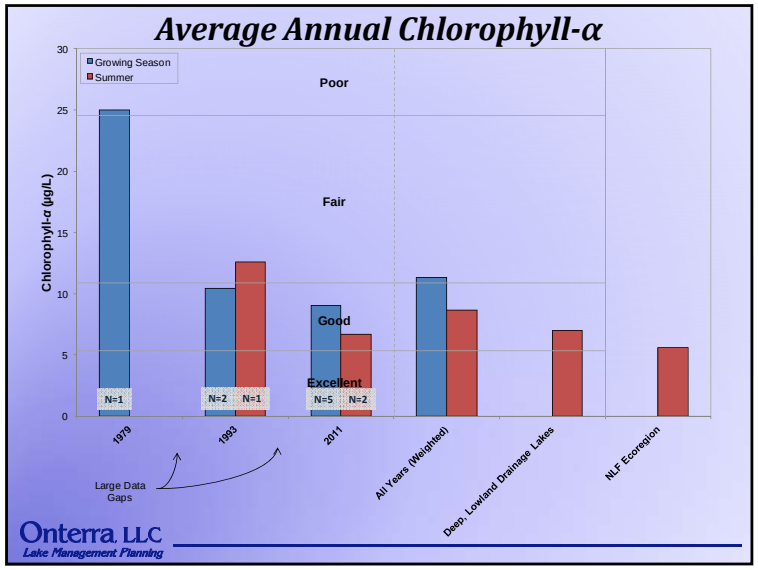
Lake Management Planning


Average Annual Chlorophyll-α
Growing Season
Summer
Poor
Fair
Good
Excellent
Chlorophyll-α (µg/L)
N=1
N=2
N=1
N=5
N=2
1979
1993
2011
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion
Large Data Gaps
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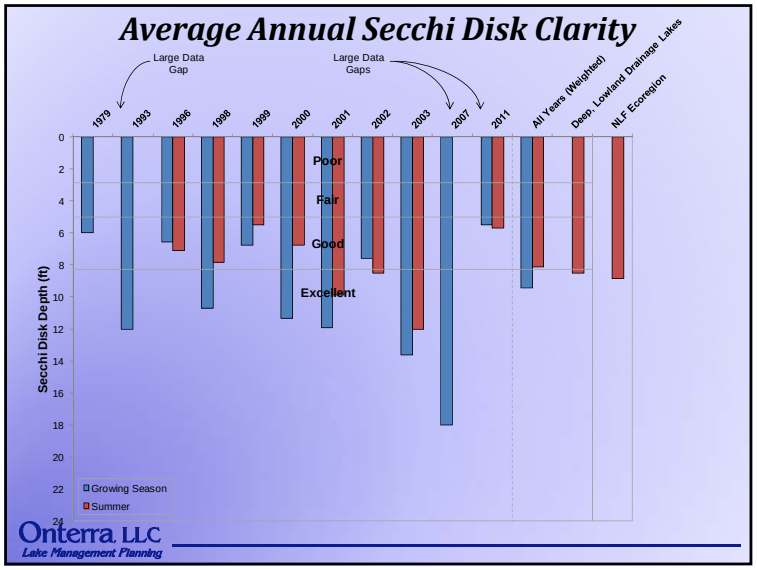
Lake Management Planning


Average Annual Secchi Disk Clarity
Large Data Gap
Large Data Gaps
1979
1983
1996
1998
1999
2000
2001
2002
2003
2007
2011
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion
Poor
Fair
Good
Excellent
Secchi Disk Depth (ft)
Growing Season
Summer
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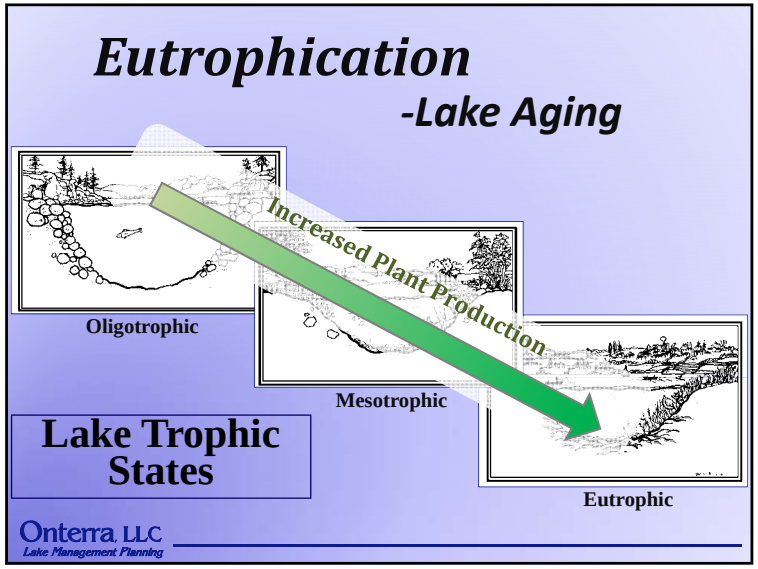
Eutrophication
-Lake Aging
Increased Plant Production
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
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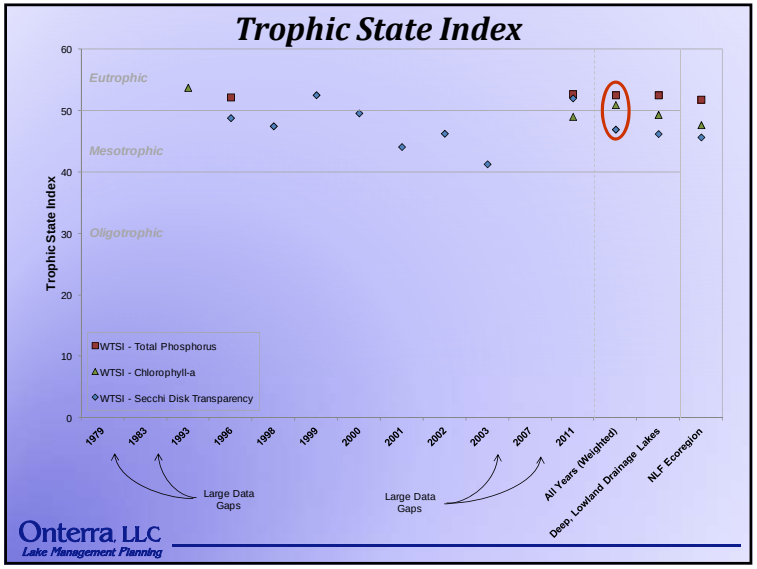
Trophic State Index
Eutrophic
Mesotrophic
Oligotrophic
Trophic State Index
WTSI - Total Phosphorus
WTSI - Chlorophyll-a
WTSI - Secchi Disk Transparency
1979
1983
1993
1996
1998
1999
2000
2001
2002
2003
2007
2011
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion
Large Data Gaps
Large Data Gaps
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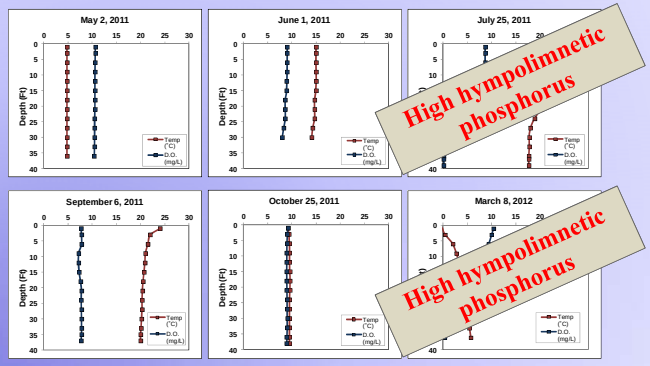
Dissolved Oxygen / Temperature



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Other Water Quality Results

- pH: 8.5
- Alkalinity = 53.6 mg/L as $CaCO_3$ – indicates [illegible] sensitivity to acid rain
- Moderate calcium concentrations (14.8 mg/L)
  - Borderline susceptibility to zebra mussel establishment

No veligers observed in 2011 samples

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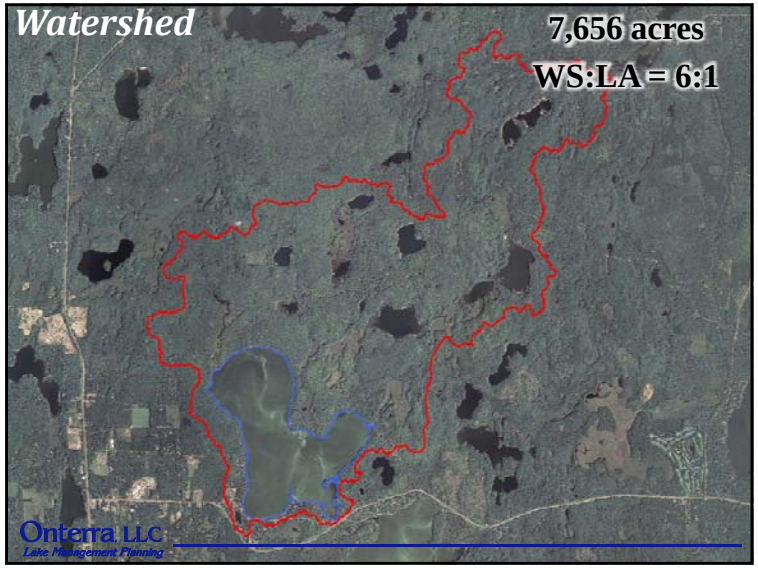
Watershed



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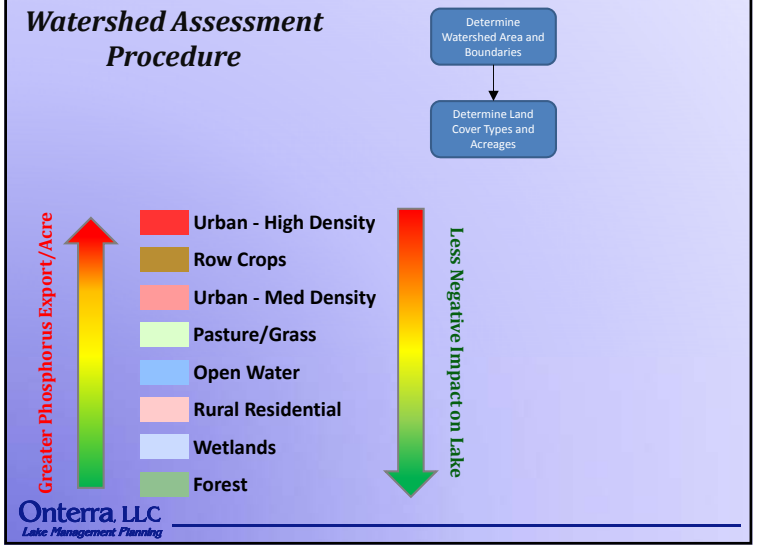
Watershed Assessment Procedure



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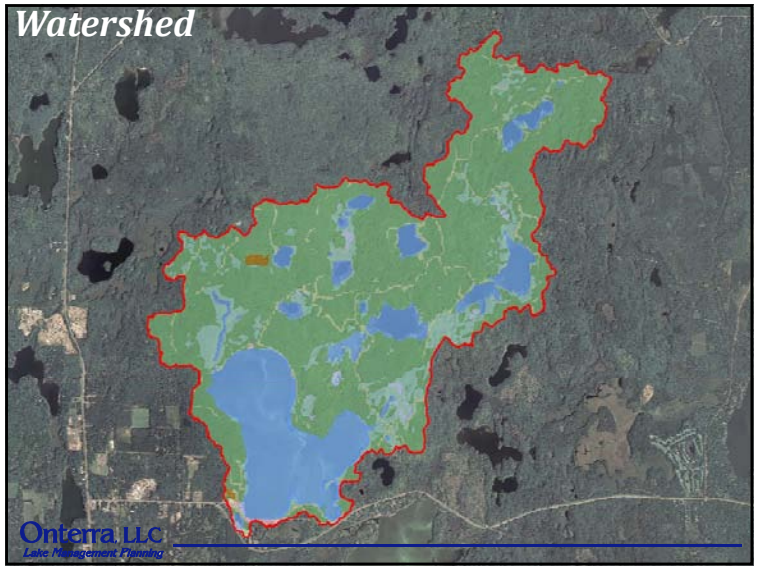

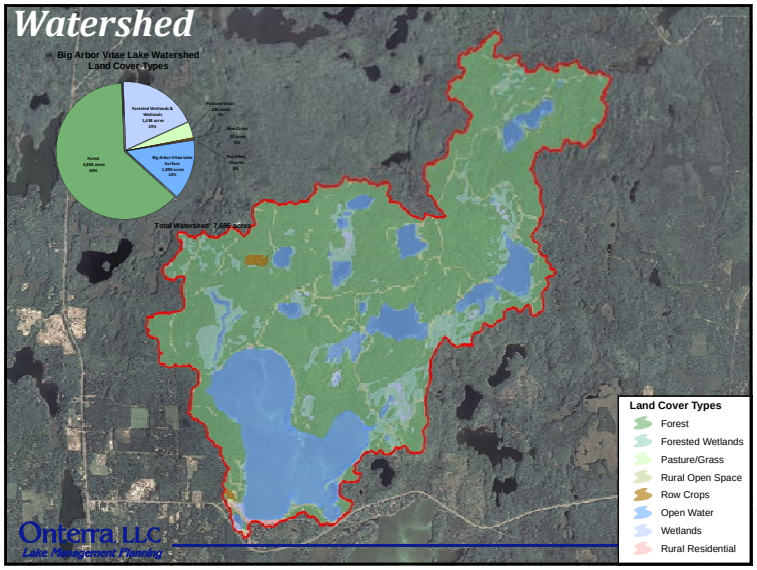

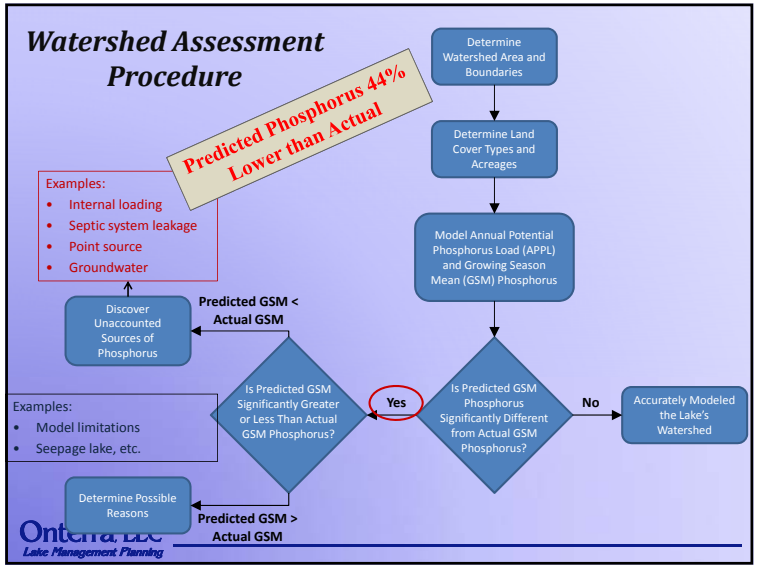

Discrepancy between WiLMS watershed modeling predicted phosphorus and 2011 field measurements

- **Unaccounted source(s) of phosphorus**
  - ~~Curly-leaf pondweed die-off?~~
  - ~~Point source input?~~
  - Septic system inputs? Possible, but not probable…
  - Ground water inputs? Not likely…
  - Internal loading from bottom sediments? ✔
    - Development of anoxic hypolimnion in July and March
    - Hypolimnetic phosphorus greater than 200 µg/L
    - Osgood Index value of 2.6; polymictic lake

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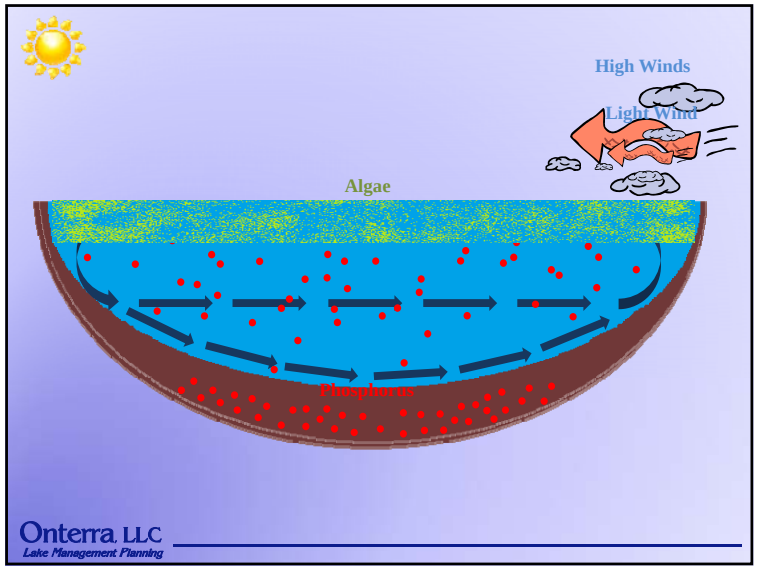
High Winds
Light Wind
Algae
Phosphorus
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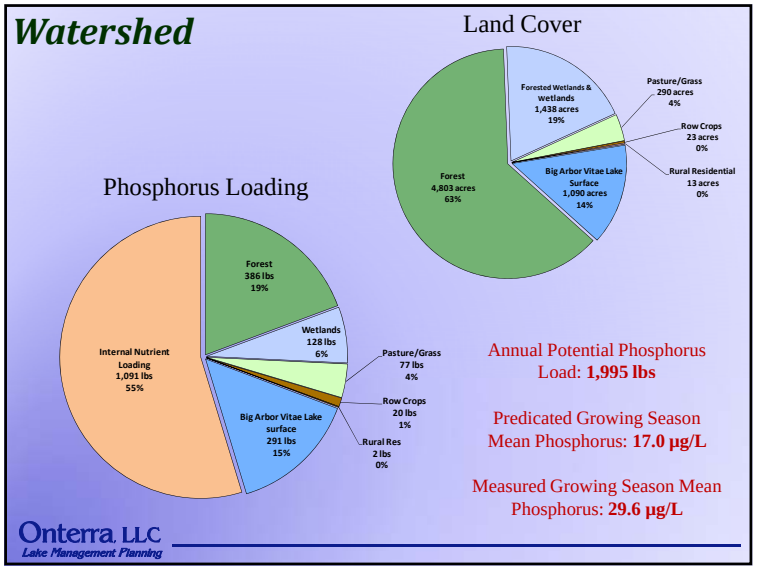
Watershed
Land Cover
Forested Wetlands & wetlands 1,438 acres 19%
Pasture/Grass 290 acres 4%
Row Crops 23 acres 0%
Rural Residential 13 acres 0%
Forest 4,803 acres 63%
Big Arbor Vitae Lake Surface 1,090 acres 14%
Phosphorus Loading
Forest 386 lbs 19%
Wetlands 128 lbs 6%
Pasture/Grass 77 lbs 4%
Row Crops 20 lbs 1%
Rural Res 2 lbs 0%
Big Arbor Vitae Lake surface 291 lbs 15%
Internal Nutrient Loading 1,091 lbs 55%
Annual Potential Phosphorus Load: 1,995 lbs
Predicated Growing Season Mean Phosphorus: 17.0 µg/L
Measured Growing Season Mean Phosphorus: 29.6 µg/L
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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
Range
Natural
Onterra LLC
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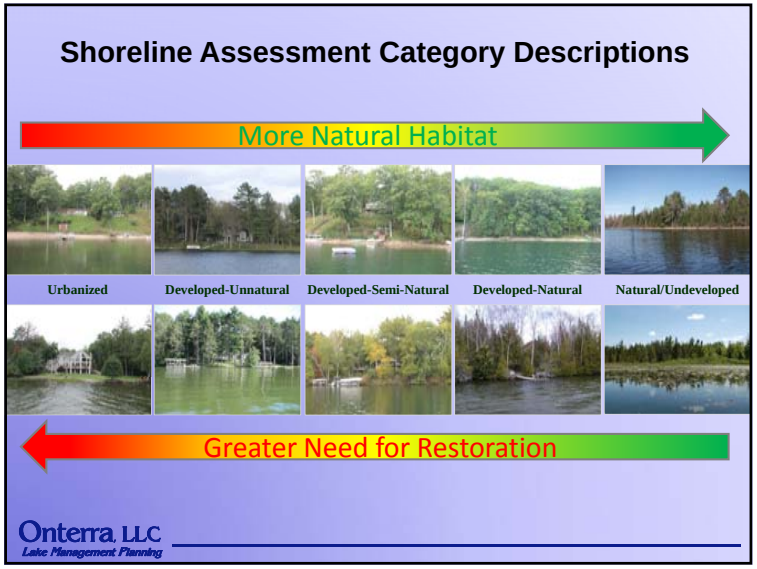
Shoreline Assessment Category Descriptions
More Natural Habitat
Urbanized
Developed-Unnatural
Developed-Semi-Natural
Developed-Natural
Natural/Undeveloped
Greater Need for Restoration
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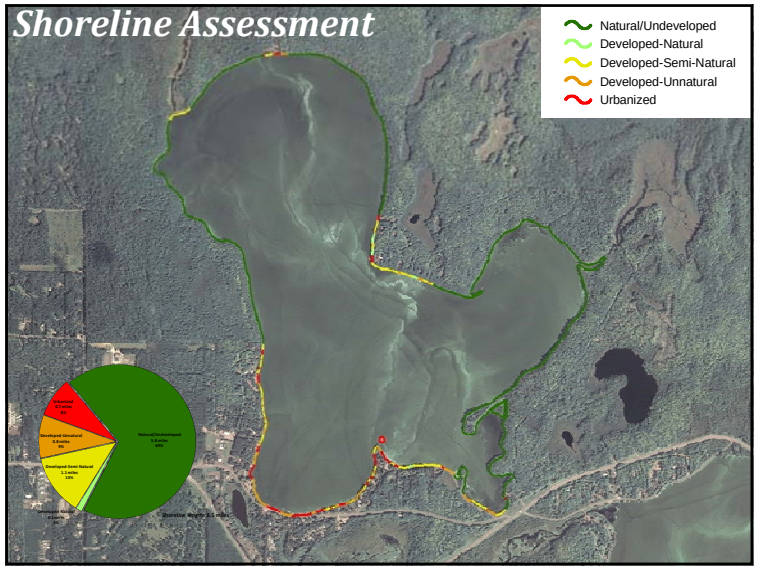
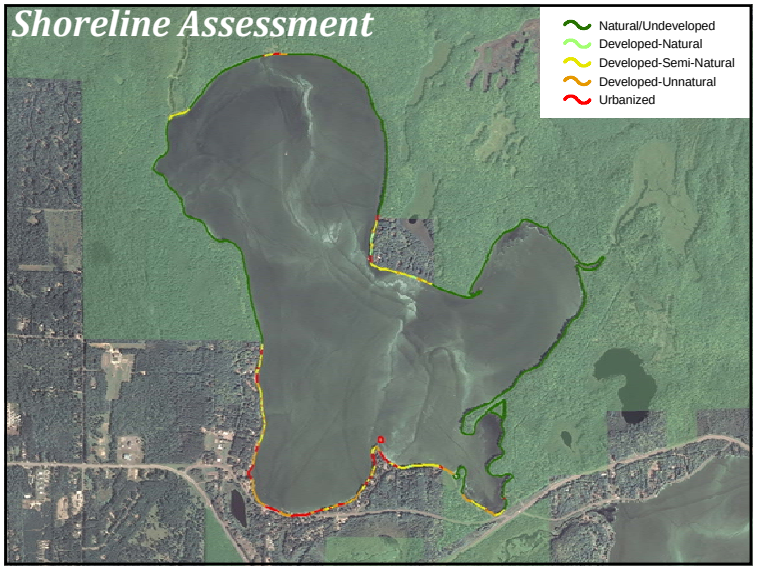
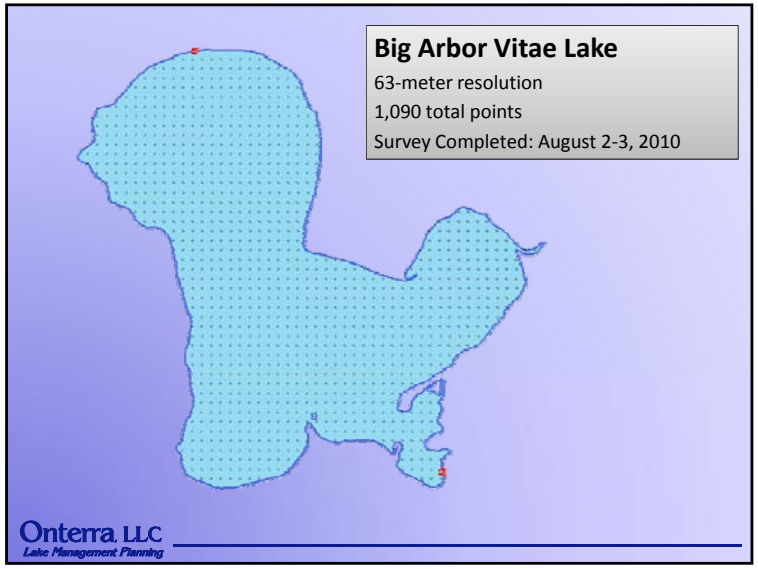

Shoreline Assessment
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized


Shoreline Assessment
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized


Big Arbor Vitae Lake
63-meter resolution
1,090 total points
Survey Completed: August 2-3, 2010
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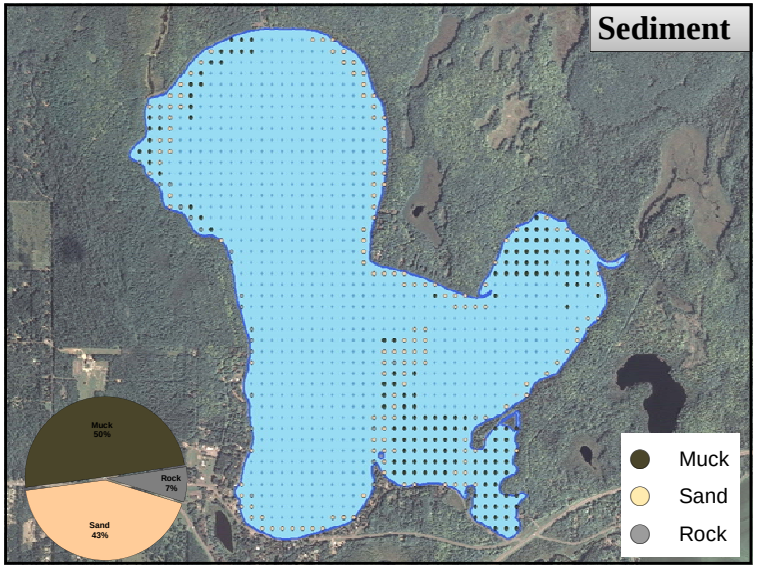
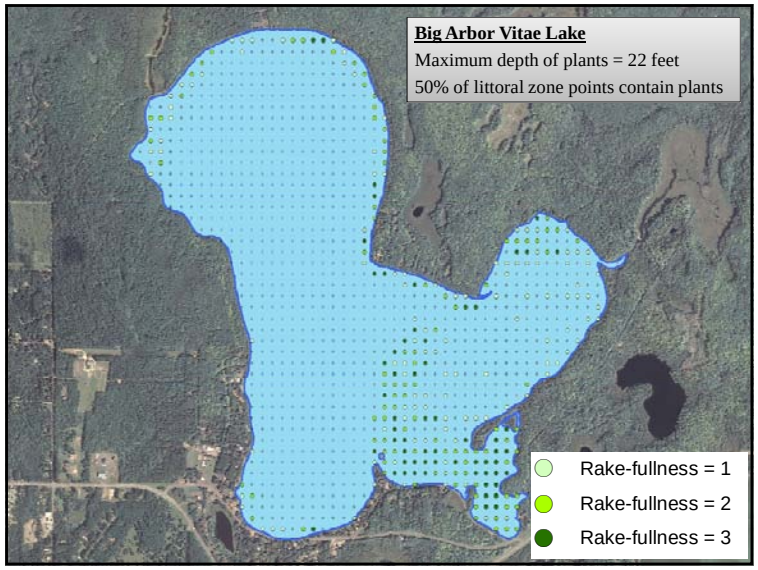

Sediment
Muck
50%
Rock
7%
Sand
43%
Muck
Sand
Rock



Species List

- **31 Native Species**
- **2 Non-native Species**
  - Curly-leaf pondweed
  - Reed canary grass
- **Avg. Conservatism: 6.2**

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)	2011 (Onterra)
E/E	*Calla palustris*	Water arum	9	I
	Carex comosa	Bristly sedge	5	I
	Carex crinita	Fringed sedge	6	I
	Iris versicolor	Northern blue flag	5	I
	Phalaris arundinacea	Reed canary grass	Exotic	I
FL	*Nuphar variegata*	Spatterdock	6	I
	Nymphaea odorata	White water lily	6	X
FL/E	*Sparganium angustifolium*	Narrow-leaf bur-reed	9	I
Submergent	*Chara spp.*	Muskgrasses	7	X
	Ceratophyllum demersum	Coontail	3	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum sibiricum	Northern water milfoil	7	X
	Najas flexilis	Slender naiad	6	X
	Nitella sp.	Stoneworts	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	X
	Potamogeton illinoensis	Illinois pondweed	8	X
	Potamogeton praelongus	White-stem pondweed	8	X
	Potamogeton pusillus	Small pondweed	7	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton robbinsii	Fern pondweed	8	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	Potamogeton strictifolius	Stiff pondweed	8	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Ranunculus aquatilis	White water-crowfoot	8	X
	Sagitaria sp. (rosette)	Arrowhead rosette	N/A	X
	Stuckenia pectinata	Sago pondweed	3	I
	Vallisneria americana	Wild celery	6	X
S/E	*Sagittaria cuneata*	Arum-leaved arrowhead	7	I
FF	*Lemna turionifera*	Turion duckweed	2	X
	Lemna trisulca	Forked duckweed	6	X
	Spirodela polyrhiza	Greater duckweed	5	X

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

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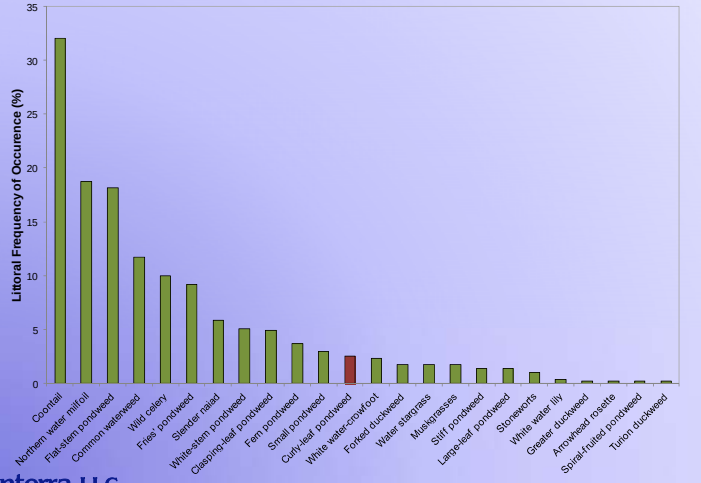
Littoral Frequency of Occurrence



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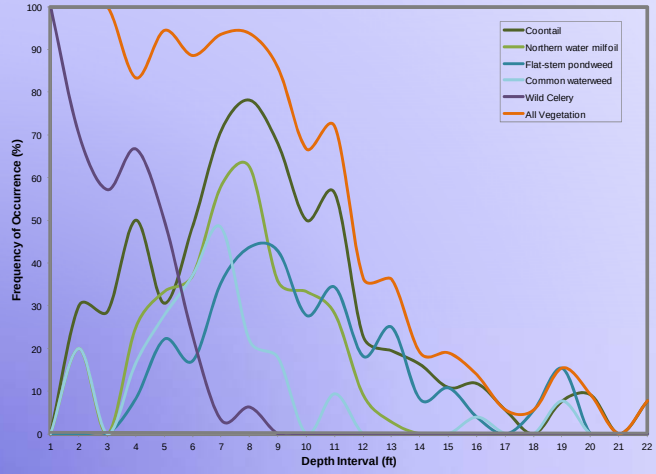
Maximum Depth of Plant Colonization



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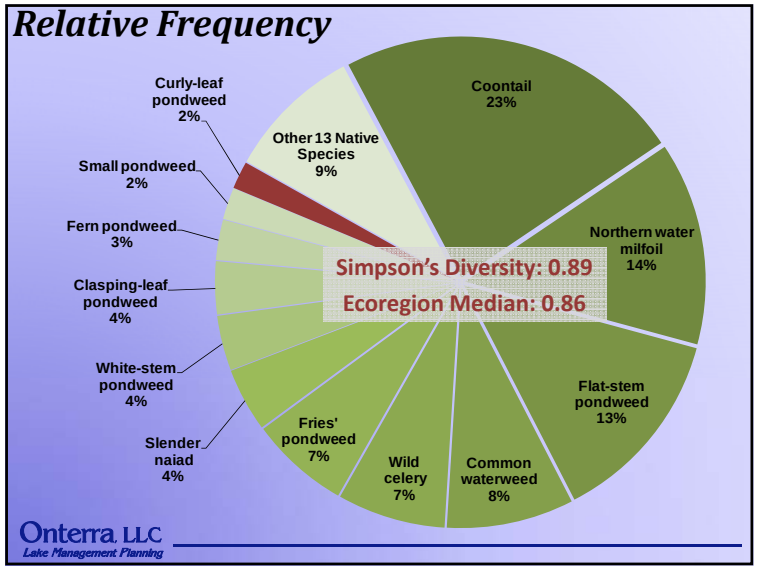
Lake Management Planning


Relative Frequency
Coontail 23%
Northern water milfoil 14%
Flat-stem pondweed 13%
Common waterweed 8%
Wild celery 7%
Fries' pondweed 7%
Slender naiad 4%
White-stem pondweed 4%
Clasping-leaf pondweed 4%
Fern pondweed 3%
Small pondweed 2%
Curly-leaf pondweed 2%
Other 13 Native Species 9%
Simpson's Diversity: 0.89
Ecoregion Median: 0.86
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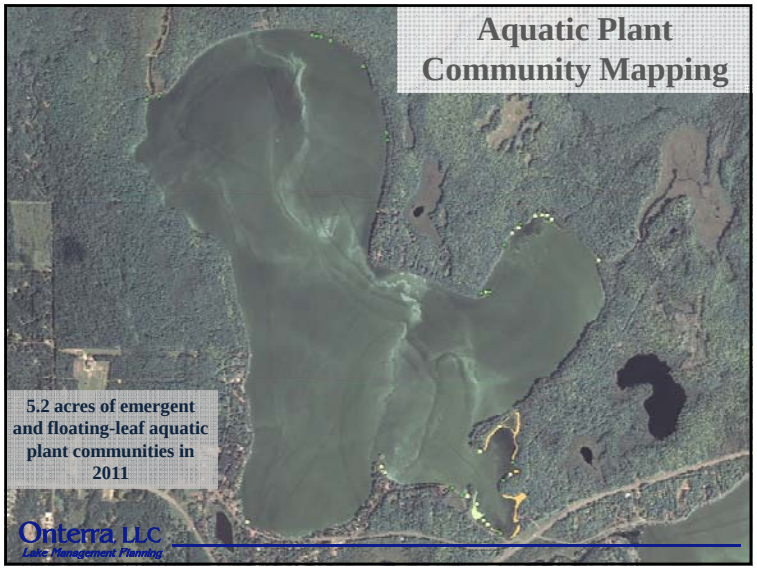
Lake Management Planning


Aquatic Plant Community Mapping
5.2 acres of emergent and floating-leaf aquatic plant communities in 2011
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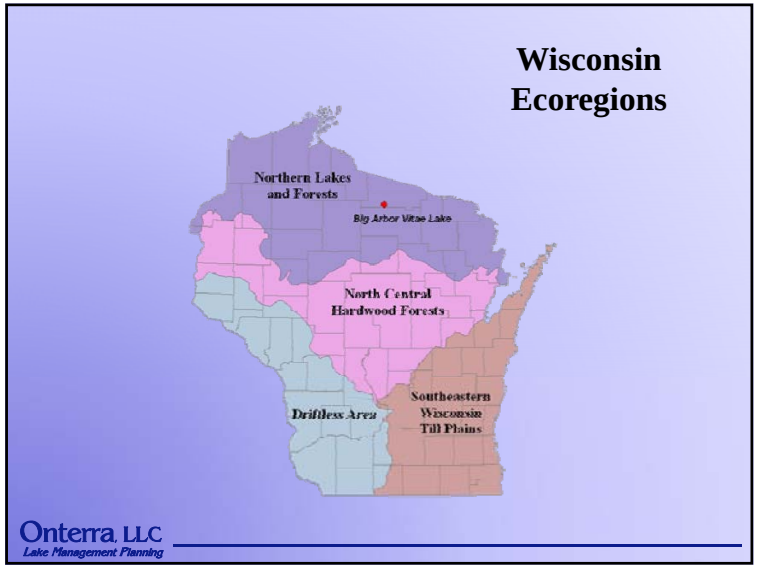
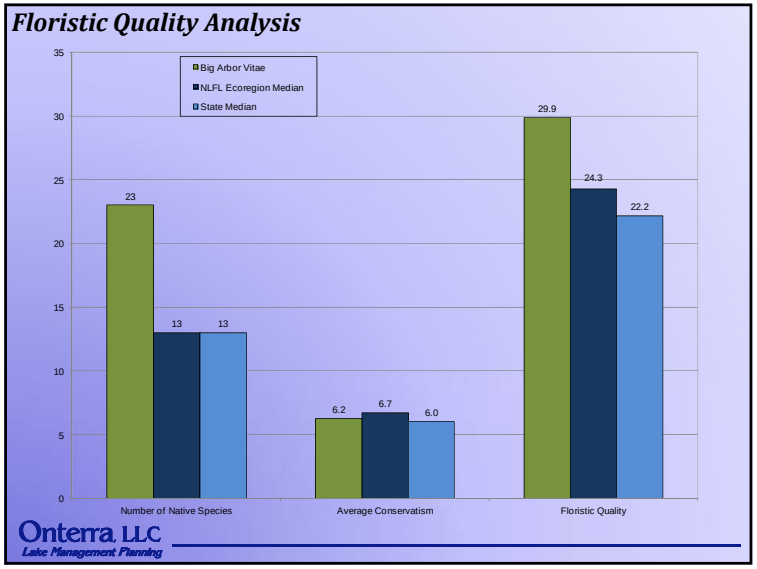
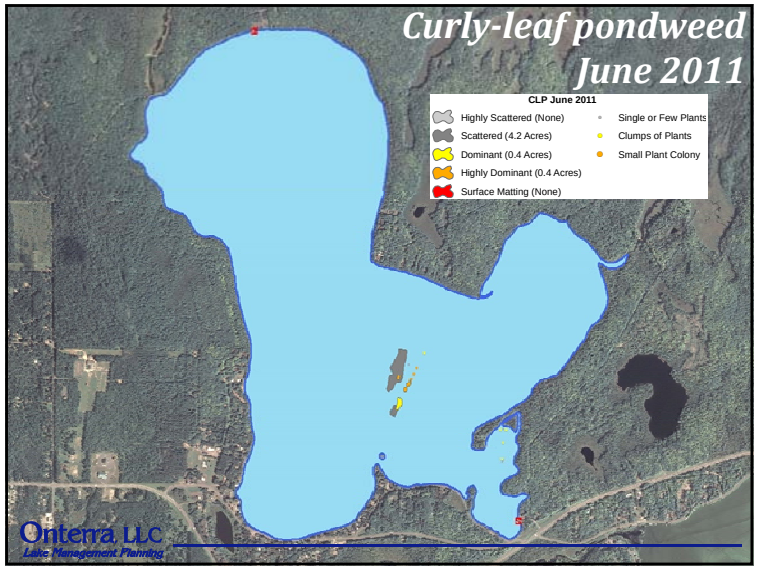

Wisconsin Ecoregions
Northern Lakes and Forests
Big Arbor Vitae Lake
North Central Hardwood Forests
Driftless Area
Southeastern Wisconsin Till Plains
Onterra LLC
Lake Management Planning

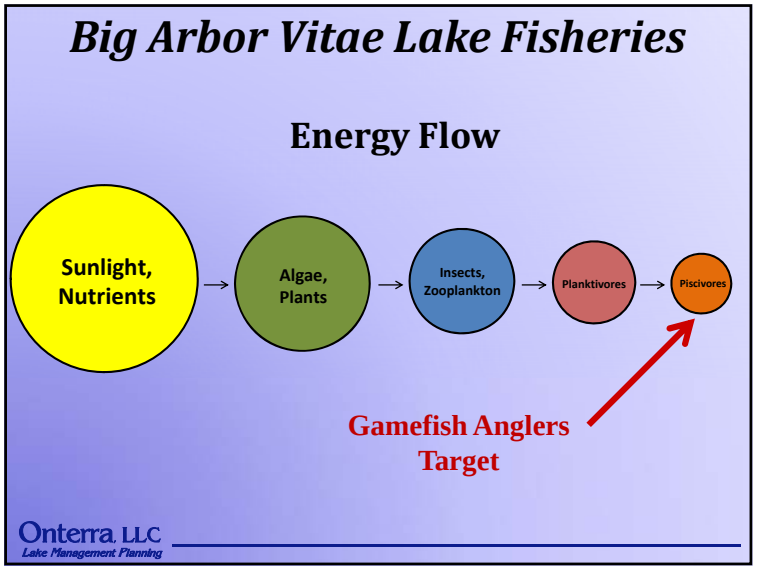

Floristic Quality Analysis
Big Arbor Vitae
NLFL Ecoregion Median
State Median
35
30
25
20
15
10
5
0
23
13
13
6.2
6.7
6.0
29.9
24.3
22.2
Number of Native Species
Average Conservatism
Floristic Quality
Onterra LLC
Lake Management Planning

Aquatic Plant Surveys

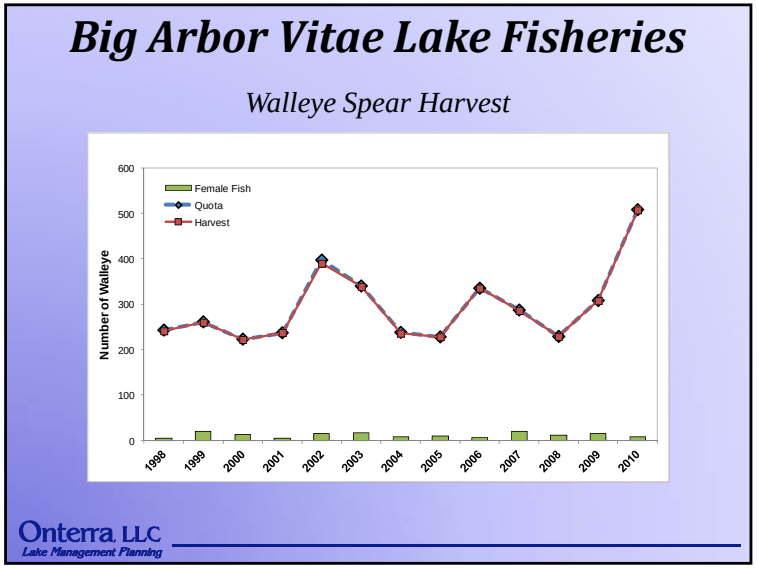
- Additional survey conducted August 29, 2012
- Assessed areas indicated by BAVLA to hold excessive plant growth
  - Excessive growth conditions observed
    - Northern water milfoil
    - Coontail

Onterra LLC
Lake Management Planning


Curly-leaf pondweed
June 2011
CLP June 2011
Highly Scattered (None)
Scattered (4.2 Acres)
Dominant (0.4 Acres)
Highly Dominant (0.4 Acres)
Surface Matting (None)
Single or Few Plants
Clumps of Plants
Small Plant Colony
Onterra LLC
Lake Management Planning

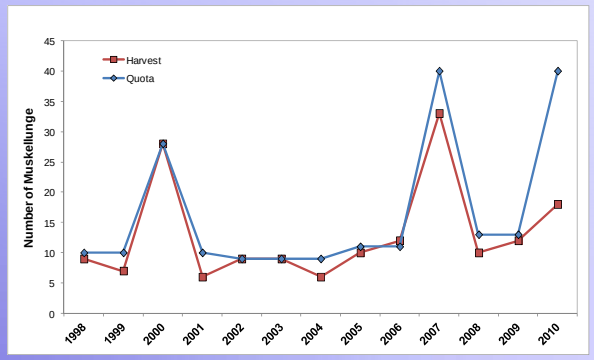

Big Arbor Vitae Lake Fisheries
Energy Flow
Sunlight, Nutrients
Algae, Plants
Insects, Zooplankton
Planktivores
Piscivores
Gamefish Anglers Target
Onterra LLC
Lake Management Planning


Big Arbor Vitae Fisheries
Treaty of 1842
Treaty of 1837
Big Arbor Vitae
Onterra LLC
Lake Management Planning


Big Arbor Vitae Lake Fisheries
Walleye Spear Harvest
Female Fish
Quota
Harvest
Number of Walleye
600
500
400
300
200
100
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Onterra LLC
Lake Management Planning

Big Arbor Vitae Lake Fisheries

Muskellunge Spear Harvest



Onterra LLC
Lake Management Planning

Big Arbor Vitae Lake Fisheries

Total Harvest – Anglers and Tribal Spearing

Muskellunge	2005	2008
Population Estimate	647	642
Angler Harvest	10	11
Angler Harvest %	2%	2%
Tribal Harvest	10	10
Tribal Harvest %	2%	2%

Walleye	2005	2008
Population Estimate	6,860	6,290
Angler Harvest	5,342	2,002
Angler Harvest %	78%	32%
Tribal Harvest	228	229
Tribal Harvest %	3%	4%

Onterra LLC
Lake Management Planning

Conclusions

- Water quality is fair
  - Limited historic data
  - Lake is naturally productive, but internal loading likely a significant source of phosphorus leading to algae blooms
- Overall watershed is in great condition
  - Land cover exports minimal phosphorus
  - Shoreland habitat mostly natural
- Aquatic plant community
  - Based upon standard analysis, native community is of high quality
  - Lake has relatively low diverse plant community, but is expected in this type of system
  - Curly-leaf pondweed may present future threat to ecosystem

Conclusions continued

- Fisheries
  - Lake's high productivity helps with producing high fish biomass
  - High plant abundance within bays is beneficial to fishery as they provide valuable structural habitat
  - Considerable pressure?

B

APPENDIX B

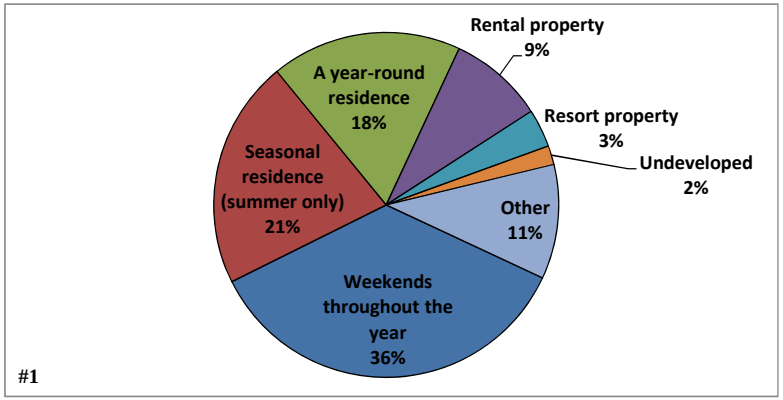
Stakeholder Survey Response Charts and Comments

Returned Surveys	52
Sent Surveys	110
Response Rate (%)	47.3

BIG ARBOR VITAE LAKE PROPERTY

#1 What type of property do you own on Big Arbor Vitae Lake?

	Total	%
Weekends throughout the year	20	*35.1*
Seasonal residence (summer only)	12	*21.1*
A year-round residence	10	*17.5*
Rental property	5	*8.8*
Resort property	2	*3.5*
Undeveloped	1	*1.8*
Other	6	*10.5*
I do not live on the lake	1	*1.8*
	57	*100.0*

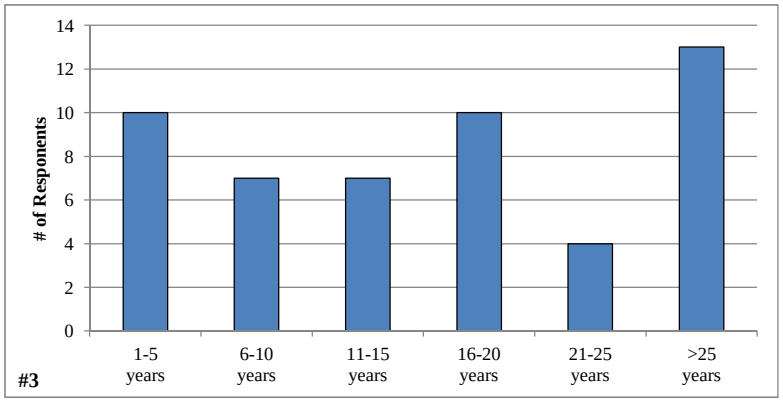


#2 How many days each year is your property used by you or others?

Answered Question	51
Average	105.3
Standard deviation	99.7

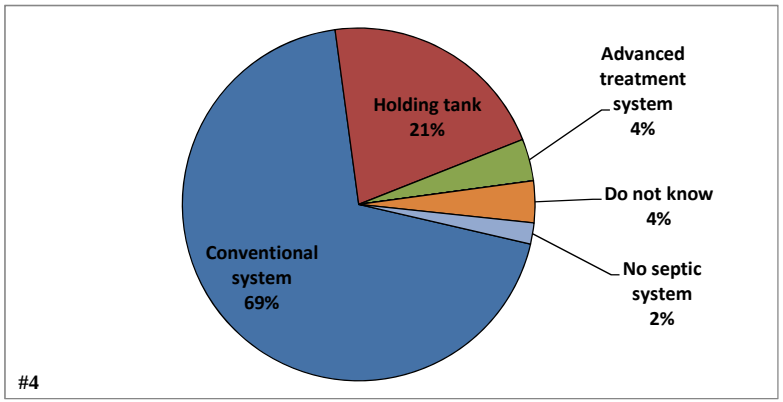
#3 How long have you owned your property on Big Arbor Vitae Lake?

	Total	%
1-5 years	10	*19.6*
6-10 years	7	*13.7*
11-15 years	7	*13.7*
16-20 years	10	*19.6*
21-25 years	4	*7.8*
>25 years	13	*25.5*
	51	*100.0*



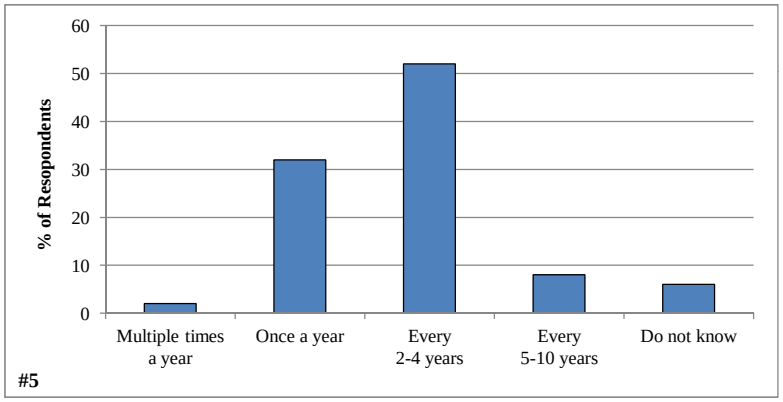
#4 What type of septic system does your property utilize?

	Total	%
Conventional system	36	*69.2*
Holding tank	11	*21.2*
Advanced treatment system	2	*3.8*
Mound	0	*0.0*
Municipal sewer	0	*0.0*
Do not know	2	*3.8*
No septic system	1	*1.9*
	52	*100.0*



#5 How often is the septic tank on your property pumped?

	Total	%
Multiple times a year	1	*2.0*
Once a year	16	*32.0*
Every 2-4 years	26	*52.0*
Every 5-10 years	4	*8.0*
Do not know	3	*6.0*
	50	*100.0*



RECREATIONAL USE ON BIG ARBOR VITAE LAKE

#6 How many years ago did you first visit Big Arbor Vitae Lake?

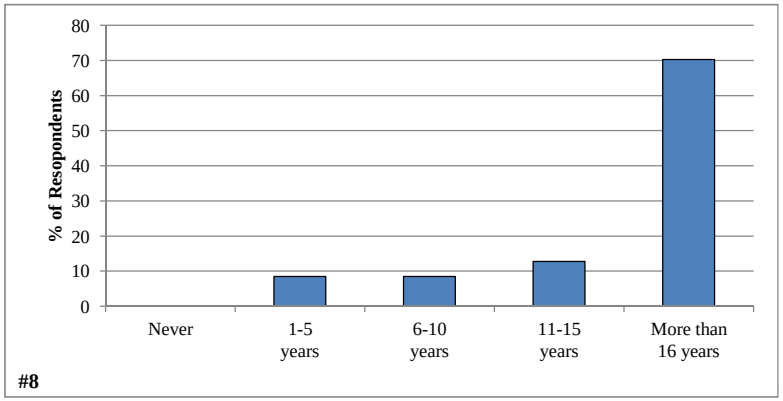
Answered Question	52
Average	26.1
Standard deviation	16.6

#7 Have you personally fished on Big Arbor Vitae Lake?

	Total	%
Yes	47	*92.2*
No	4	*7.8*
	51	*100.0*

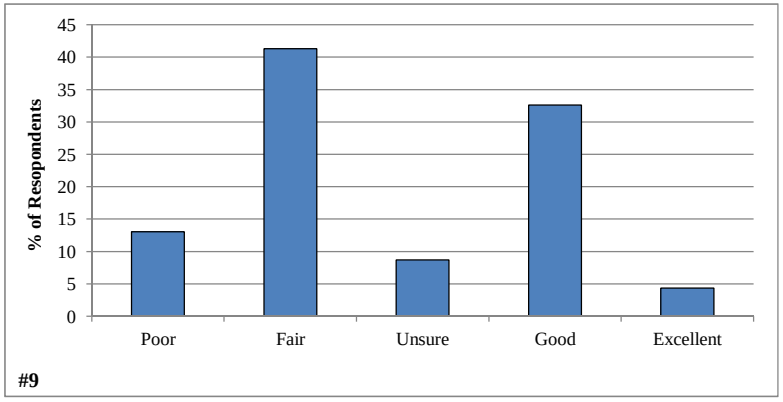
#8 For how many years have you fished Big Arbor Vitae Lake?

	Total	%
Never	0	*0.0*
1-5 years	4	*8.5*
6-10 years	4	*8.5*
11-15 years	6	*12.8*
More than 16 years	33	*70.2*
	47	*100.0*



#9 How would you describe the current quality of fishing on Big Arbor Vitae Lake?

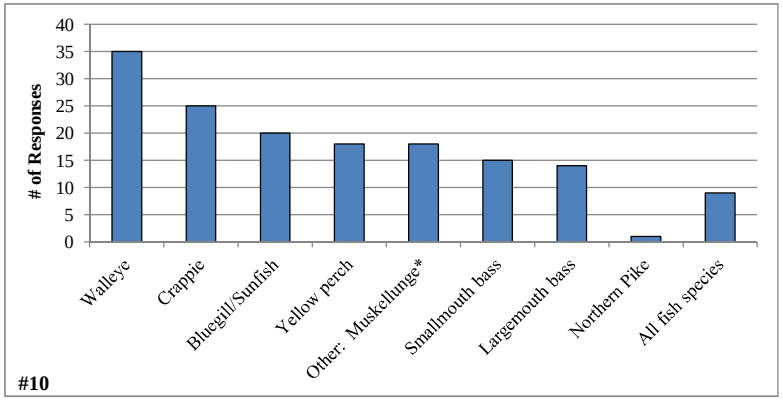
	Total	%
Poor	6	*13.0*
Fair	19	*41.3*
Unsure	4	*8.7*
Good	15	*32.6*
Excellent	2	*4.3*
	46	*100.0*



#10 What species of fish do you like to catch on Big Arbor Vitae Lake?

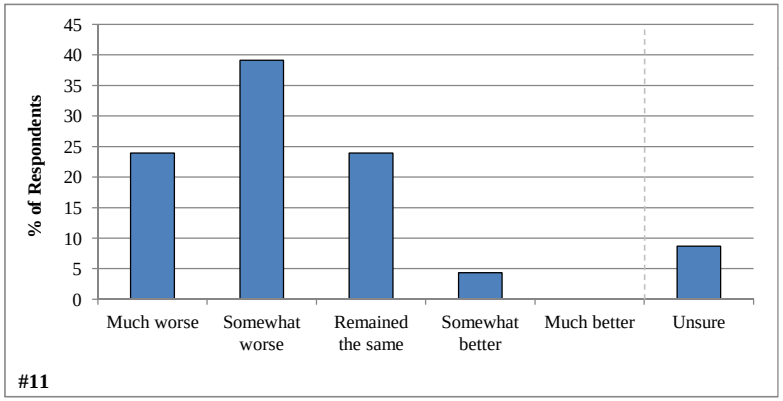
	Total
Walleye	35
Crappie	25
Bluegill/Sunfish	20
Yellow perch	18
Other: Muskellunge*	18
Smallmouth bass	15
Largemouth bass	14
Northern Pike	1
All fish species	9

**18 occurrences of Muskellunge noted in comments section*



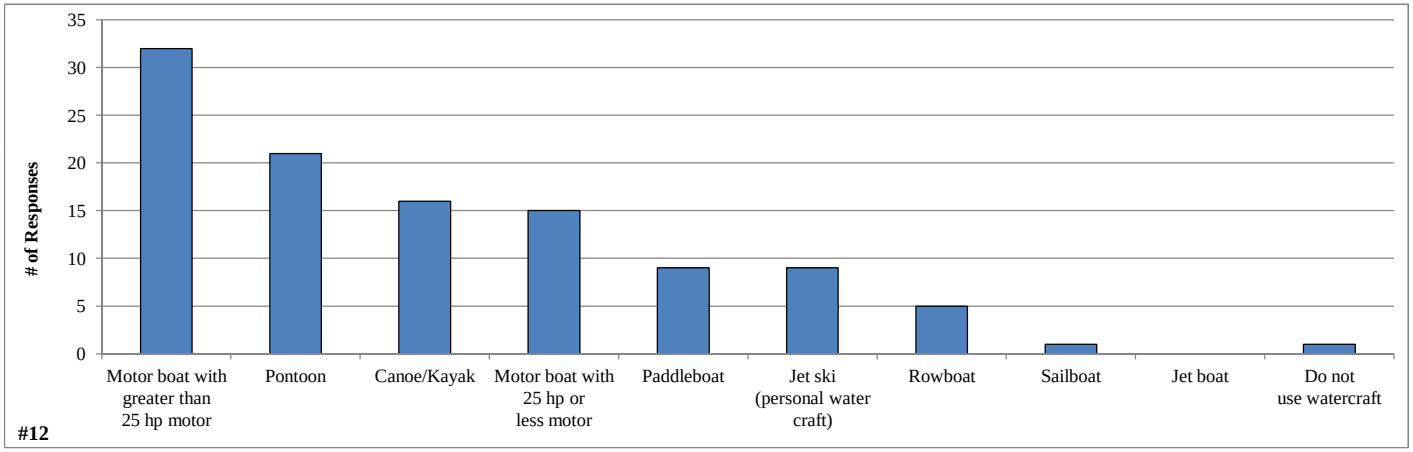
#11 How has the quality of fishing changed since you started fishing on the lake?

	Total	%
Much worse	11	*23.9*
Somewhat worse	18	*39.1*
Remained the Same	11	*23.9*
Somewhat better	2	*4.3*
Much better	0	*0.0*
Unsure	4	*8.7*
	46	*100.0*



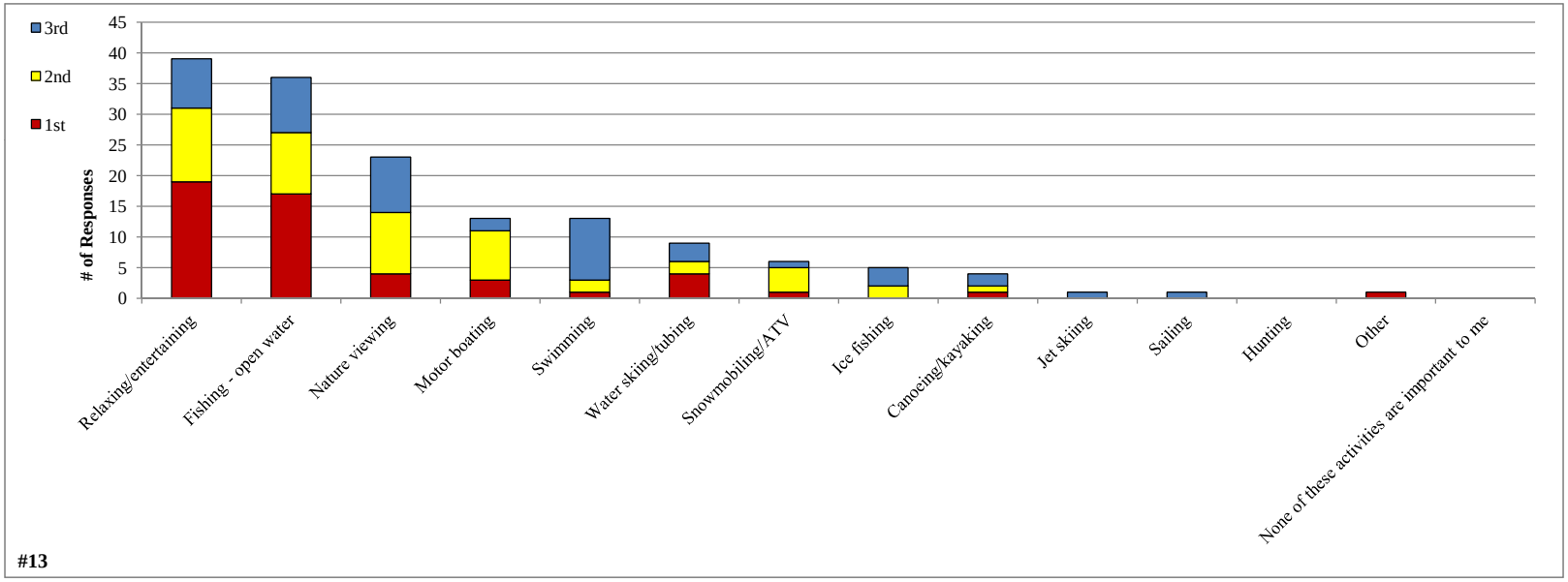
#12 What types of watercraft do you currently use on the lake?

	Total
Motor boat with greater than 25 hp motor	32
Pontoon	21
Canoe/Kayak	16
Motor boat with 25 hp or less motor	15
Paddleboat	9
Jet ski (personal water craft)	9
Rowboat	5
Sailboat	1
Jet boat	0
Do not use watercraft	1



#13 Please rank up to three activities that are important reasons for owning your property on or near the lake.

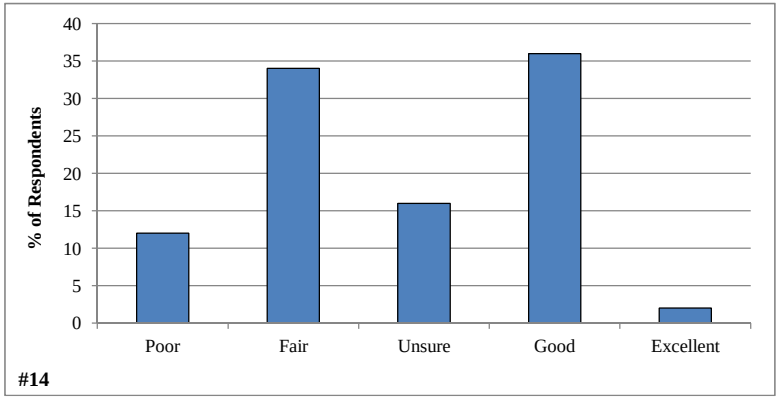
	1st	2nd	3rd	*% ranked*
Relaxing/entertaining	19	12	8	*25.8*
Fishing - open water	17	10	9	*23.8*
Nature viewing	4	10	9	*15.2*
Motor boating	3	8	2	*8.6*
Swimming	1	2	10	*8.6*
Water skiing/tubing	4	2	3	*6.0*
Snowmobiling/ATV	1	4	1	*4.0*
Ice fishing	0	2	3	*3.3*
Canoeing/kayaking	1	1	2	*2.6*
Jet skiing	0	0	1	*0.7*
Sailing	0	0	1	*0.7*
Hunting	0	0	0	*0.0*
Other	1	0	0	*0.7*
None of these activities are important to me	0	0	0	*0.0*
	51	51	49	*100.0*



BIG ARBOR VITAE LAKE CURRENT AND HISTORIC CONDITION, HEALTH AND MANAGEMENT

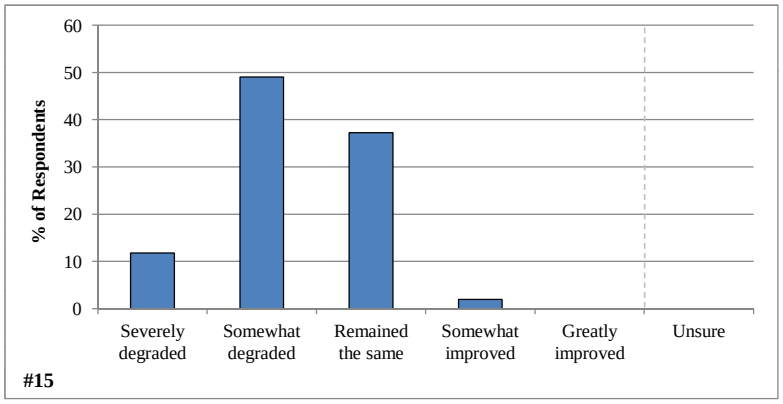
#14 How would you describe the current water quality of Big Arbor Vitae Lake?

	Total	%
Poor	6	*12.0*
Fair	17	*34.0*
Unsure	8	*16.0*
Good	18	*36.0*
Excellent	1	*2.0*
	50	*100.0*



#15 How has the water quality changed in Big Arbor Vitae Lake since you visited the lake?

	Total	%
Severely degraded	6	*11.8*
Somewhat degraded	25	*49.0*
Remained the same	19	*37.3*
Somewhat improved	1	*2.0*
Greatly improved	0	*0.0*
Unsure	0	*0.0*
	51	*100.0*



#16 Have you ever heard of aquatic invasive species?

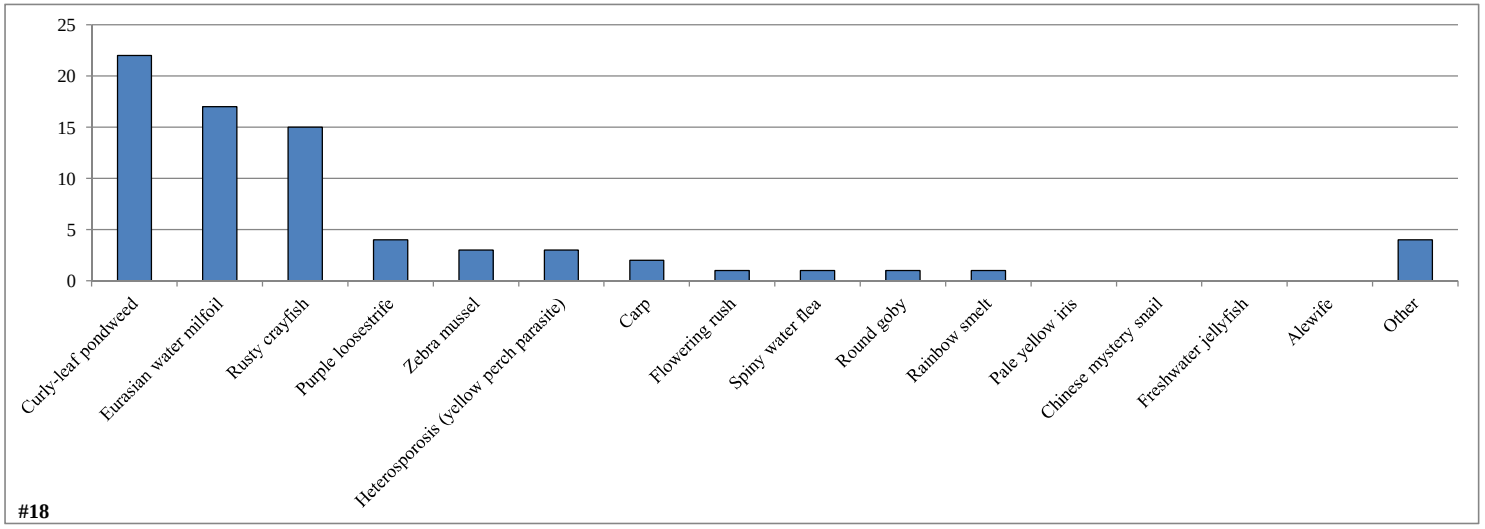
	Total	%
Yes	50	*98.0*
No	1	*2.0*
	51	*100.0*

#17 Are you aware of aquatic invasive species in the lake?

	Total	%
Yes	39	*79.6*
No	10	*20.4*
	49	*100.0*

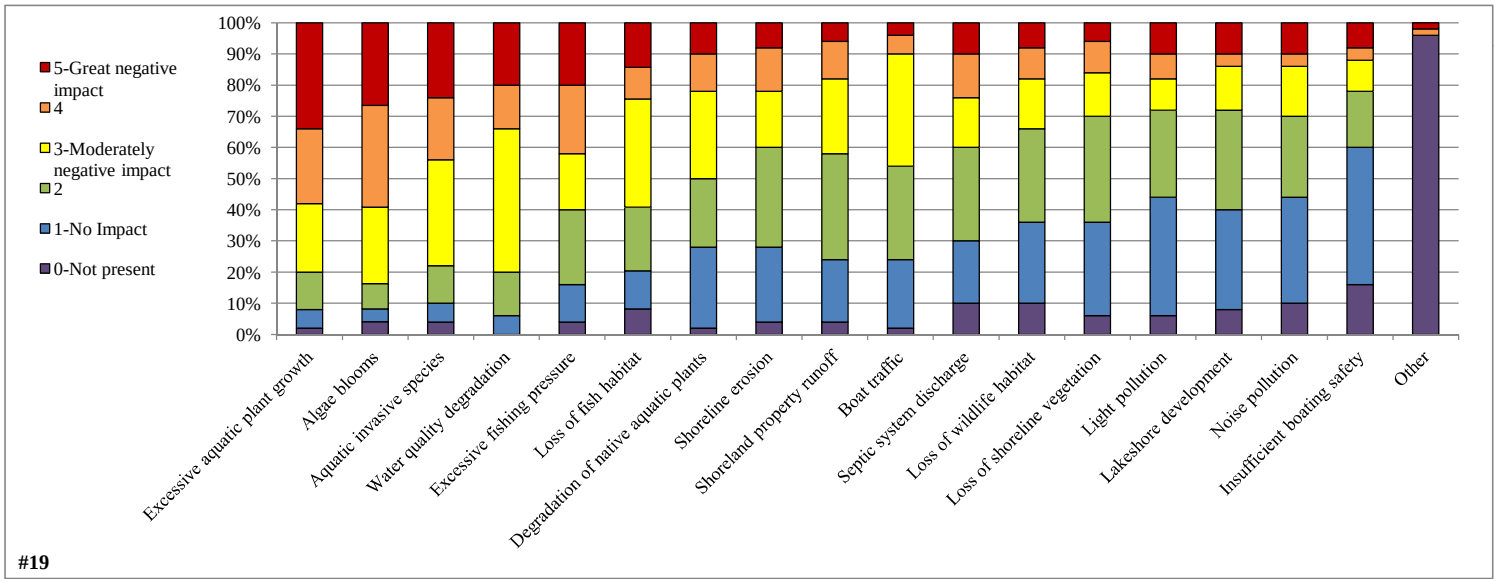
#18 Which aquatic invasive species are you aware of in the lake?

	Total
Curly-leaf pondweed	22
Eurasian water milfoil	17
Rusty crayfish	15
Purple loosestrife	4
Zebra mussel	3
Heterosporosis (yellow perch parasite)	3
Carp	2
Flowering rush	1
Spiny water flea	1
Round goby	1
Rainbow smelt	1
Pale yellow iris	0
Chinese mystery snail	0
Freshwater jellyfish	0
Alewife	0
Other	4



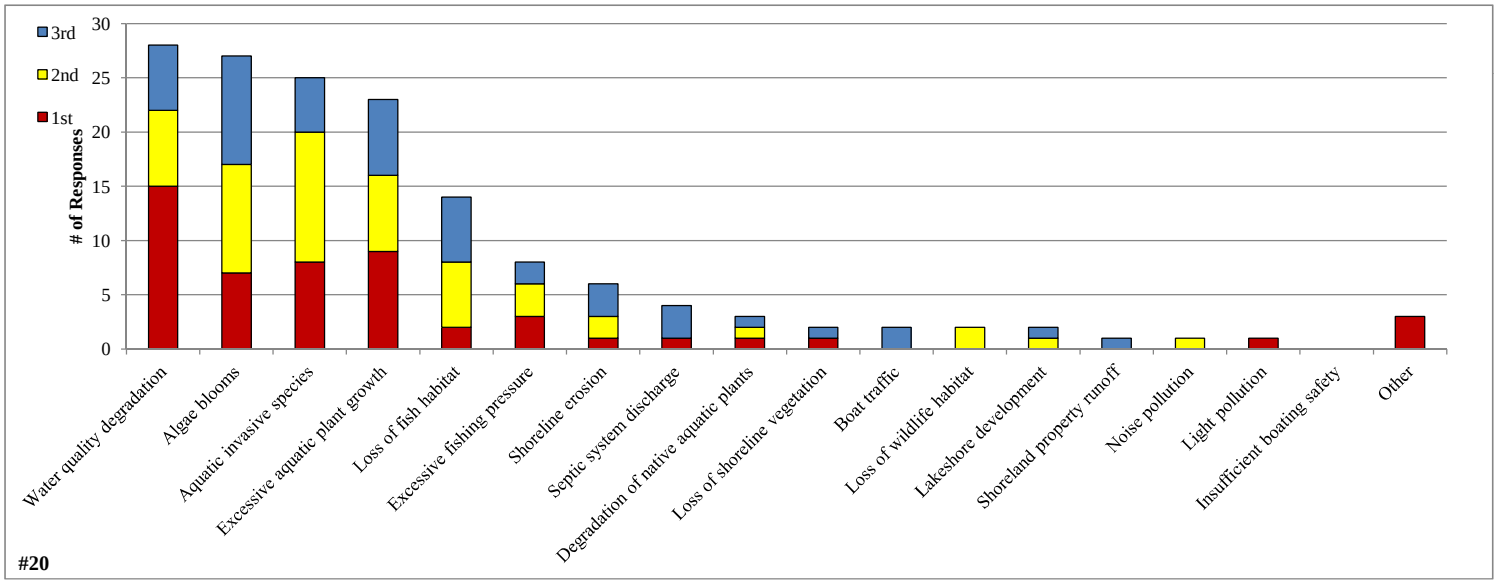
#19 To what level do you believe each of the following factors may be negatively impacting Big Arbor Vitae Lake?

	0-Not present	1-No Impact	2	3-Moderately negative impact	4	5-Great negative impact	*Total*	*Average*
Excessive aquatic plant growth	1	3	6	11	12	17	*49*	*3.6*
Algae blooms	2	2	4	12	16	13	*47*	*3.6*
Aquatic invasive species	2	3	6	17	10	12	*48*	*3.3*
Water quality degradation	0	3	7	23	7	10	*50*	*3.3*
Excessive fishing pressure	2	6	12	9	11	10	*48*	*3.0*
Loss of fish habitat	4	6	10	17	5	7	*45*	*2.7*
Degradation of native aquatic plants	1	13	11	14	6	5	*49*	*2.5*
Shoreline erosion	2	12	16	9	7	4	*48*	*2.4*
Shoreland property runoff	2	10	17	12	6	3	*48*	*2.4*
Boat traffic	1	11	15	18	3	2	*49*	*2.3*
Septic system discharge	5	10	15	8	7	5	*45*	*2.3*
Loss of wildlife habitat	5	13	15	8	5	4	*45*	*2.1*
Loss of shoreline vegetation	3	15	17	7	5	3	*47*	*2.1*
Light pollution	3	19	14	5	4	5	*47*	*2.1*
Lakeshore development	4	16	16	7	2	5	*46*	*2.0*
Noise pollution	5	17	13	8	2	5	*45*	*2.0*
Insufficient boating safety	8	22	9	5	2	4	*42*	*1.7*
Other	48	0	0	0	1	1	*2*	*0.2*



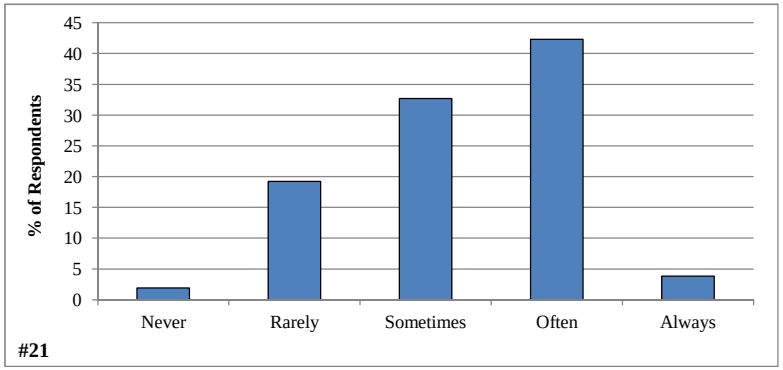
#20 From the list below, please rank your top three concerns regarding the lake.

	1st	2nd	3rd	*% Ranked*
Water quality degradation	15	7	6	*18.4*
Algae blooms	7	10	10	*17.8*
Aquatic invasive species	8	12	5	*16.4*
Excessive aquatic plant growth	9	7	7	*15.1*
Loss of fish habitat	2	6	6	*9.2*
Excessive fishing pressure	3	3	2	*5.3*
Shoreline erosion	1	2	3	*3.9*
Septic system discharge	1	0	3	*2.6*
Degradation of native aquatic plants	1	1	1	*2.0*
Loss of shoreline vegetation	1	0	1	*1.3*
Boat traffic	0	0	2	*1.3*
Loss of wildlife habitat	0	2	0	*1.3*
Lakeshore development	0	1	1	*1.3*
Shoreland property runoff	0	0	1	*0.7*
Noise pollution	0	1	0	*0.7*
Light pollution	1	0	0	*0.7*
Insufficient boating safety	0	0	0	*0.0*
Other	3	0	0	*2.0*
	52	52	48	*100.0*



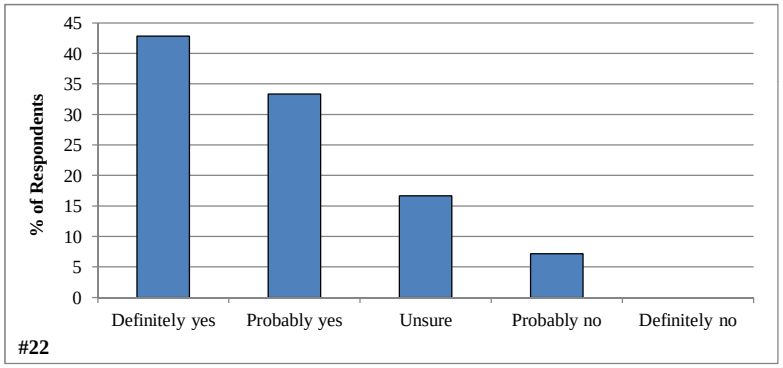
#21 During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of the lake?

	Total	%
Never	1	*1.9*
Rarely	10	*19.2*
Sometimes	17	*32.7*
Often	22	*42.3*
Always	2	*3.8*
	52	*100.0*



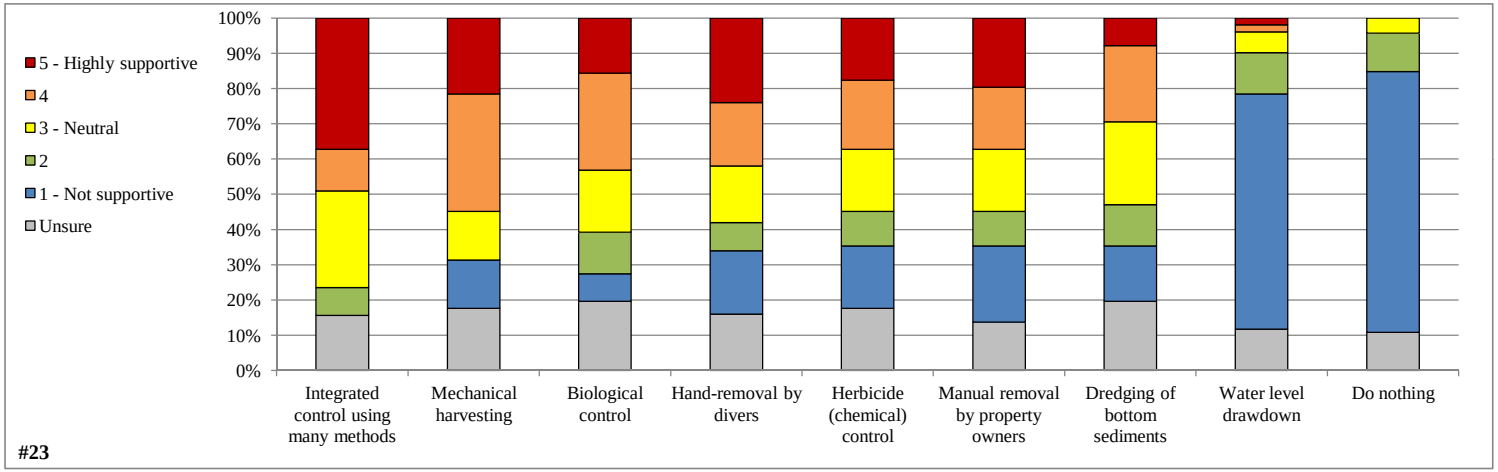
#22 Considering your answer to the question above, do you believe aquatic plant control is needed on the lake?

	Total	%
Definitely yes	18	*42.9*
Probably yes	14	*33.3*
Unsure	7	*16.7*
Probably no	3	*7.1*
Definitely no	0	*0.0*
	42	*100.0*



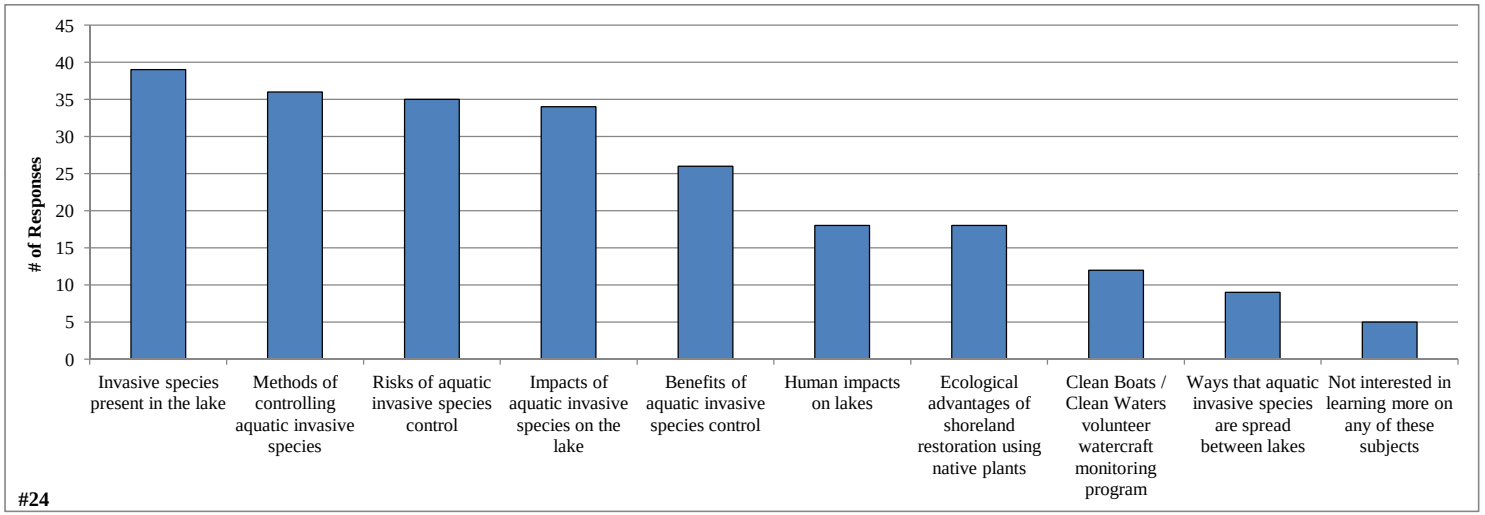
#23 What is your level of support for the responsible use of the following techniques on the lake?

	1 - Not supportive	2	3 - Neutral	4	5 - Highly supportive	Unsure	Total	Average
Integrated control using many methods	0	4	14	6	19	8	*43*	*3.8*
Mechanical harvesting	7	0	7	17	11	9	*42*	*3.5*
Biological control	4	6	9	14	8	10	*41*	*3.3*
Hand-removal by divers	9	4	8	9	12	8	*42*	*3.2*
Herbicide (chemical) control	9	5	9	10	9	9	*42*	*3.0*
Manual removal by property owners	11	5	9	9	10	7	*44*	*3.0*
Dredging of bottom sediments	8	6	12	11	4	10	*41*	*2.9*
Water level drawdown	34	6	3	1	1	6	*45*	*1.4*
Do nothing	34	5	2	0	0	5	*41*	*1.1*



#24 Which of these subjects would you like to learn more about?

	Total
Invasive species present in the lake	39
Methods of controlling aquatic invasive species	36
Risks of aquatic invasive species control	35
Impacts of aquatic invasive species on the lake	34
Benefits of aquatic invasive species control	26
Human impacts on lakes	18
Ecological advantages of shoreland restoration using native plants	18
Clean Boats / Clean Waters volunteer watercraft monitoring program	12
Ways that aquatic invasive species are spread between lakes	9
Not interested in learning more on any of these subjects	5



BIG ARBOR VITAE LAKE ASSOCIATION

#25 Before receiving this mailing, have you ever heard of the Big Arbor Vitae Lake Association?

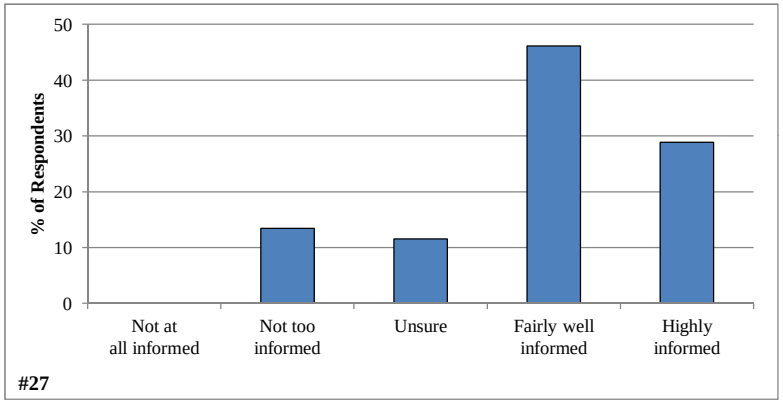
	Total	%
Yes	51	*98.1*
No	1	*1.9*
	52	*100.0*

#26 What is your membership status with the Big Arbor Vitae Lake Association?

	Total	%
Current member	43	*84.3*
Former member	0	*0.0*
Never been a member	8	*15.7*
	51	*100.0*

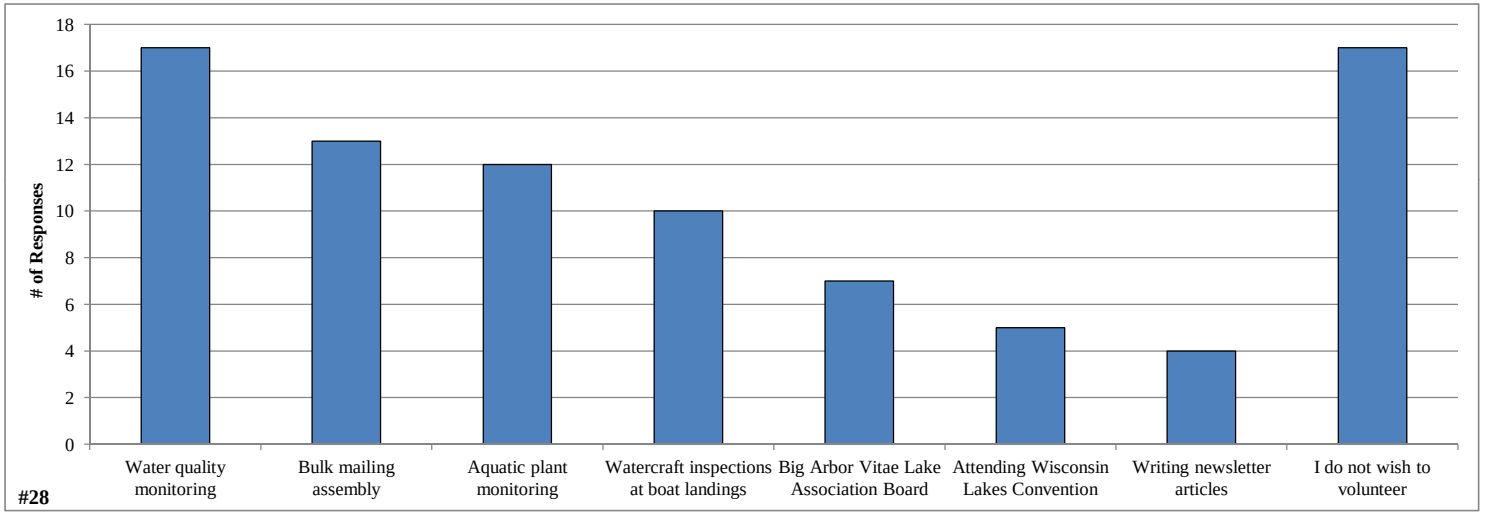
#27 How informed has the Big Arbor Vitae Lake Association kept you regarding issues with the lake and its management?

	Total	%
Not at all informed	0	*0.0*
Not too informed	7	*13.5*
Unsure	6	*11.5*
Fairly well informed	24	*46.2*
Highly informed	15	*28.8*
	52	*100.0*



#28 Please circle the activities you would be willing to participate in if the Big Arbor Vitae Lake Association requires additional assistance.

	Total
Water quality monitoring	17
Bulk mailing assembly	13
Aquatic plant monitoring	12
Watercraft inspections at boat landings	10
Big Arbor Vitae Lake Association Board	7
Attending Wisconsin Lakes Convention	5
Writing newsletter articles	4
I do not wish to volunteer	17



Survey Number	1g Comment	10h Comment	13m Comment	18p Comment	19r Comment	20r Comment	Other Comments (and Question 29)
1							
2					excessive pier length		
3	come & go throughout the year						
4		muskie			spearing		
5							
6		muskie					have noticed extreme weed & algae bloom the past 5 yrs. Seems to be getting worse. Thanks for all you do in making our lake better.
7		muskie					
8							
9		muskie		weeds			
10							
11	occasional winter weekends	muskie					
12							
13							
14		muskie					loss of fish habitat due to excess fish lost from Indian spearfishing. Lake has gone downsince this has been allowed to take excessive fish from our lake with no control.
15							
16		muskie					efforst must be taken soon to 1. reduce/eliminate invasive aquatic plants. 2. & reduce native plants. 3. and reduce algae bloom/improve water quality & clarity to allow snorkeling & diving in the lake.
17					bass population		worried about what seems to be a recent explosion in large mouth bass population and its cause/effect on the ecosystem especially when related to other fish species like walleye.
18							
19							
20	year round vacation home	muskie					
21							
22							It is very important that we contineu to increase the knowledge of the threats that may impact our lake. The BAVLA has done a great job getting this effort started. We are a small group of landowners & we will all need to play a role in the BAVLA to keep it moving forward. Getting accurate information out to as many people who use our lake as possible will be important. Education helps all stakeholders take action. Thank you Don & Nancy Wallace, Mary Lou Shepski, Darcy Nicklas & everyone who has put time in thus far. Your efforts are most appreceiated.
23							During our time at the lake summer 2011 we noted improvements in water quality and far fewer algae blooms. Since it was relatively cool, wet summer, we are curious as to whether these factors have significant effects. We would find it useful to have a list of lawn care & septic system care practices that are best for the lake. DNR offers lots of info for direct shoreline restoration & care, but what about lawns & gardens near the lake but not on shore!
24		muskie					
25	part time year around						
26	6 months off and on	catch & release					Thanks for asking.
27		muskie					
28							
29	year round condo cottage			some kind of weed			
30							
31							
32			campground				
33		muskie					
34	vacations	muskie					Water seems to get worse every year. The weekend of 9/10 & 11 the water on the bayside by Four Seasons smelled so foul I didn't want to go boating. I couldn't let my dog swim because of the green film on top of the water. I think it is something we need to address. I would like to see fees for people putting boats in at the landings, ti should not just be home owners on the lake that pay. I would hate to see shemiclas that may endanger eagles, wildlife or fish population.
35							
36	several times during summer				spearing		
37		muskie				spearing	
38							
39							meetings are hard for me to attend because I am usually gone on holiday weekends.
40	6 mo residence						
41	supper club						
42							Thanks for all the work put into this by all the volunteers.
43							
44		muskie		bull head			
45						spearing	main concern is spearing with number of fish being removed. Too many weeds at times.
46				not sure by name	not qualified to respond		
47							
48		muskie					
49							Thank you to the current leaders within the BAVLA. BAVLA needs help & without the association, none of this would be happening. Thank you. To help control lake access, is there any way to close 2 of the 3 boat landings? Perhaps expand the North landing & close the others? Excessiv fishing pressure certainly has on impact on the lake, reduced access may help this problem.
50		muskie					
51		muskie					
52		muskie					

C

APPENDIX C

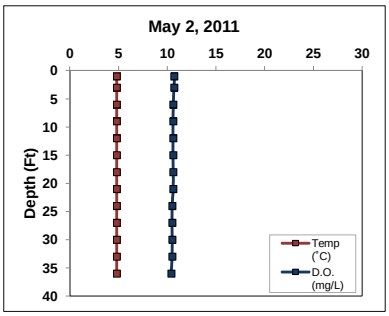
Water Quality Data

Big Arbor Vitae Lake

Date: 5/2/2011
Time: 10:15
Weather: 100% clouds, breezy, 32°F
Entry: TWH

Max Depth: 37.6
BAVLS Depth (ft): 3.0
BAVLB Depth (ft): 34.0
Secchi Depth (ft): 6.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	4.8	10.7	7.8	109.0
3	4.8	10.7	7.8	109.0
6	4.8	10.6	7.8	109.0
9	4.8	10.6	7.9	109.0
12	4.8	10.6	7.9	109.0
15	4.8	10.6	7.9	109.0
18	4.8	10.6	7.9	109.0
21	4.8	10.6	7.9	109.0
24	4.8	10.5	7.9	109.0
27	4.8	10.5	7.9	109.0
30	4.8	10.5	7.9	109.0
33	4.8	10.5	7.9	109.0
36	4.8	10.4	7.9	109.0



Parameter	BAVLS	BAVLB
Total P (µg/L)	38.00	44.00
Dissolved P (µg/L)	ND	ND
Chl-*a* (µg/L)	11.60	NA
TKN (µg/L)	39.00	36.00
$NO_3 + NO_2$-N (µg/L)	ND	ND
NH_3-N (µg/L)	ND	ND
Total N (µg/L)	39.00	36.00
Lab Cond. (µS/cm)	114.00	114.00
Lab pH	7.69	7.73
Alkalinity (mg/L $CaCO_3$)	53.60	53.70
Total Susp. Solids (mg/L)	4.00	5.00
Calcium (mg/L)	14.80	NA

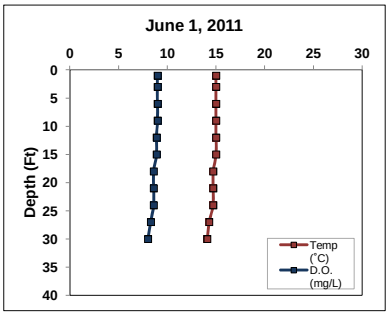
Data collected by TAH (Onterra)

Big Arbor Vitae Lake

Date: 6/1/2011
Time: 12:15
Weather: 90% sun, very windy, 68°F
Entry: TWH

Max Depth: 31.2
BAVLS Depth (ft): 3.0
BAVLB Depth (ft): 26.0
Secchi Depth (ft): 5.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	15.0	9.0	8.4	110.0
3	15.0	9.0	8.5	110.0
6	15.0	9.0	8.5	110.0
9	15.0	9.0	8.5	110.0
12	15.0	8.9	8.5	111.0
15	15.0	8.9	8.5	111.0
18	14.7	8.6	8.3	110.0
21	14.7	8.6	8.3	110.0
24	14.7	8.6	8.3	111.0
27	14.3	8.3	8.2	111.0
30	14.1	8.0	8.1	111.0



Parameter	BAVLS	BAVLB
Total P (µg/L)	22.00	31.00
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	4.51	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)	4.00	6.00
Calcium (mg/L)	NA	NA

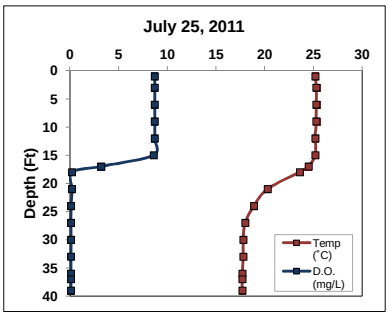
Data collected by TWH and MMF (Onterra)

Big Arbor Vitae Lake

Date: 7/25/2011
Time: 13:05
Weather: 80°F sunny 25% clouds and windy
Entry: MMF

Max Depth: 40.0
BAVLS Depth (ft): 3.0
BAVLB Depth (ft): 37.0
Secchi Depth (ft): 6.4

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	25.2	8.7	9.4	113.0
3	25.3	8.7	9.4	113.0
6	25.3	8.7	9.4	113.0
9	25.3	8.7	9.4	113.0
12	25.2	8.7	9.4	113.0
15	25.2	8.6	9.4	113.0
17	24.5	3.2	8.1	113.0
18	23.6	0.2	7.5	117.0
21	20.3	0.2	7.4	119.0
24	18.9	0.1	7.5	139.0
27	18.0	0.1	7.5	150.0
30	17.8	0.1	7.6	152.0
33	17.8	0.1	7.6	152.0
36	17.7	0.1	7.6	153.0
37	17.7	0.1	7.6	153.0
39	17.7	0.1	7.6	154.0



Parameter	BAVLS	BAVLB
Total P (µg/L)	25.00	233.00
Dissolved P (µg/L)	ND	20.00
Chl-*a* (µg/L)	8.90	NA
TKN (µg/L)	490.00	1380.00
$NO_3 + NO_2$-N (µg/L)	ND	24.00
NH_3-N (µg/L)	ND	703.00
Total N (µg/L)	490.00	1404.00
Lab Cond. (µS/cm)	113.00	140.00
Lab pH	8.69	7.20
Alkalinity (mg/L $CaCO_3$)	54.10	67.80
Total Susp. Solids (mg/L)	3.00	13.00
Calcium (mg/L)	NA	NA

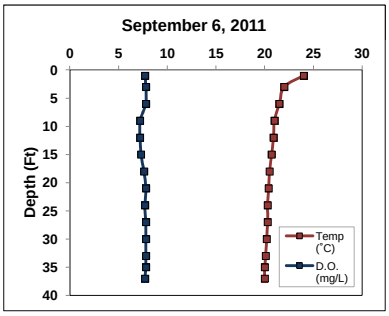
Data collected by TWH and MMF (Onterra)

Big Arbor Vitae Lake

Date: 9/6/2011
Time: 13:00
Weather: clear, little wind, 62°
Entry: TWH

Max Depth: 38
BAVLS Depth (ft): 3
BAVLB Depth (ft): 35
Secchi Depth (ft): 4

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	24	7.7		
3	22	7.8		
6	21.5	7.8		
9	21	7.2		
12	20.9	7.2		
15	20.7	7.3		
18	20.5	7.6		
21	20.4	7.8		
24	20.3	7.7		
27	20.3	7.8		
30	20.2	7.8		
33	20.1	7.8		
35	20	7.8		
37	20	7.7		



Parameter	BAVLS	BAVLB
Total P (µg/L)	39.00	43.00
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	2.22	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)	5.00	6.00
Calcium (mg/L)	NA	NA

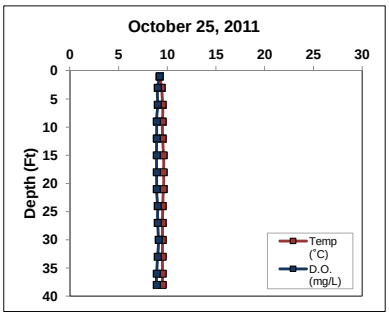
Data collected by TAH and TWH (Onterra) Much algae visible.

Big Arbor Vitae Lake

Date: 10/25/2011
Time: 11:00
Weather: 100% clouds, light breeze, 45°F
Entry: TWH

Max Depth: 38.9
BAVLS Depth (ft): 3
BAVLB Depth (ft): 36
Secchi Depth (ft): 6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	9.2	9.2		
3	9.4	9		
6	9.5	9		
9	9.5	8.9		
12	9.5	8.9		
15	9.6	8.9		
18	9.6	8.9		
21	9.6	8.9		
24	9.5	9		
27	9.5	9		
30	9.5	9.1		
33	9.5	9		
36	9.5	8.9		
38	9.5	8.9		



Parameter	BAVLS	BAVLB
Total P (µg/L)	36.00	35.00
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	17.80	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)	5.00	5.00
Calcium (mg/L)	NA	NA

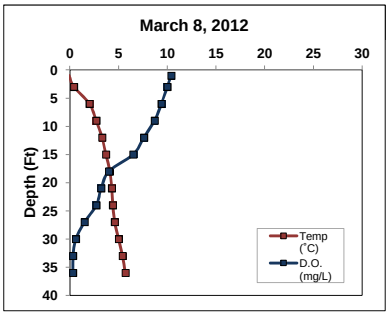
Data collected by TWH (Onterra)

Big Arbor Vitae Lake

Date: 3/8/2012
Time: 11:00
Weather: sunny, 40's
Entry: TWH

Max Depth: 37.7
BAVLS Depth (ft): 3
BAVLB Depth (ft): 34
Secchi Depth (ft): 17.2

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	-0.1	10.4	7.9	115
3	0.4	10	7.9	115
6	2	9.4	7.9	113
9	2.7	8.7	7.9	113
12	3.3	7.6	7.8	113
15	3.7	6.5	7.8	115
18	4.1	4	7.7	117
21	4.3	3.2	7.7	122
24	4.4	2.7	7.7	125
27	4.6	1.5	7.6	131
30	5	0.6	7.6	153
33	5.4	0.3	7.7	183
36	5.7	0.3	7.9	213



Parameter	BAVLS	BAVLB
Total P (µg/L)	28.00	780.00
Dissolved P (µg/L)	7.00	63.00
Chl-*a* (µg/L)	NA	NA
TKN (µg/L)	290.00	1780.00
$NO_3 + NO_2$-N (µg/L)	66.00	ND
NH_3-N (µg/L)	37.00	1320.00
Total N (µg/L)	356.00	1780.00
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	ND	13.00
Calcium (mg/L)	NA	NA

Data collected by TAH and TWH (Onterra) Ice depth: 1.7ft

Water Quality Data

2010	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	6	7.4	NA	NA
Total P (µg/L)	6	31.3	6	194.3
Dissolved P (µg/L)	3	7.0	3	41.5
Chl a (µg/L)	5	9.0	0	NA
TKN (µg/L	3	273.0	3	1065.3
NO3+NO2-N (µg/L)	3	66.0	3	24.0
NH3-N (µg/L)	3	37.0	3	1011.5
Total N (µg/L)	3	295.0	3	1073.3
Lab Cond. (µS/cm)	2	113.5	2	127.0
Lab pH	2	8.2	2	7.5
Alkal (mg/l CaCO3)	2	53.9	2	60.8
Total Susp Sol (mg/l)	6	4.2	6	8.0
Calcium (µg/L)	1	14.8	0	NA

Wisconsin Trophic State Index (WTSI)

Year	TP	Chl-a	Secchi
1979			
1983			
1993		53.8	
1996	52.2		48.8
1998			47.5
1999			52.6
2000			49.6
2001			44.1
2002			46.3
2003			41.3
2007			
2011	52.7	49.0	52.0
All Years (Weighted)	52.5	51.0	46.9
ep, Lowland Drainage Lak	52.5	49.4	46.2
NLF Ecoregion	51.8	47.7	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
1979	1	6.0	0		1	25.0	0					
1983									1	80.0	0.0	
1993	1	12.0	0		2	10.4	1	12.6	1	25.0	0.0	
1996	4	6.6	2	7.1					1	22.0	1.0	22.0
1998	6	10.7	4	7.8								
1999	7	6.8	2	5.5								
2000	7	11.3	2	6.8								
2001	6	11.9	4	9.9								
2002	5	7.6	3	8.5								
2003	4	13.6	2	12.0								
2007	1	18.0	0									
2011	5	5.5	2	5.7	5	9.0	2	6.7	5	32.0	2.0	23.5
All Years (Weighted)		9.5		8.1		11.4		8.7		35.9		23.0
Deep, Lowland Drainage Lakes				8.5				7.0				23.0
NLF Ecoregion				8.9				5.6				21.0

D

APPENDIX D

2012 WDNR Sediment Core Report

RESULTS OF SEDIMENT CORES TAKEN FROM BIG AND LITTLE ARBOR VITAE LAKES, VILAS COUNTY, WISCONSIN

Paul Garrison Wisconsin Department of Natural Resources
October 2012

Aquatic organisms are good indicators of a lake's water quality because they are in direct contact with the water and are strongly affected by the chemical composition of their surroundings. Most indicator groups grow rapidly and are short lived so the community composition responds rapidly to changing environmental conditions. One of the most useful organisms for paleolimnological analysis are diatoms. These are a type of algae which possess siliceous cell walls, which enables them to be highly resistant to degradation and are usually abundant, diverse, and well-preserved in sediments. They are especially useful, as they are ecologically diverse. Diatom species have unique features as shown in Figure 1, which enable

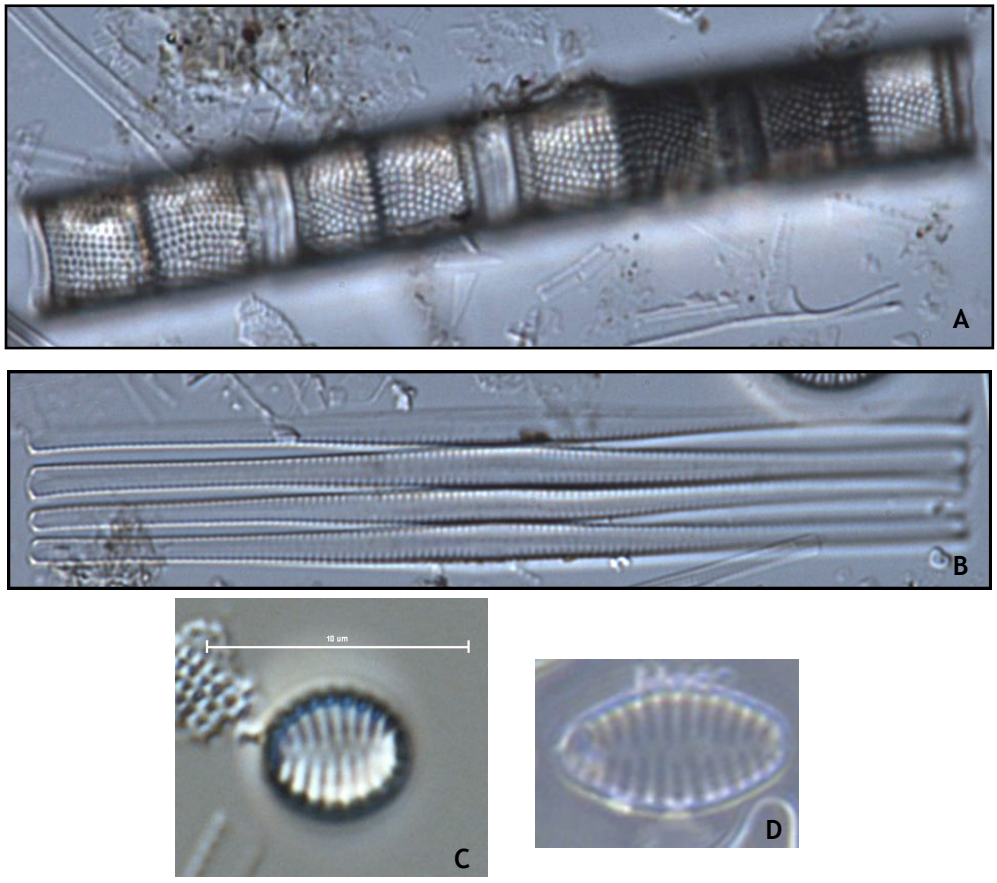


Figure 1. Photomicrographs of the diatoms commonly found in the study lakes. The top two diatoms, *Aulacoseira am*bigua (A), and *Fragilaria crotonensis* (B) are found in the open water environments while the bottom two diatoms are part of the benthic *Fragilaria* (C and D). The latter two diatoms are commonly found attached to substrates such as macrophytes. The top diatom, *A. ambigua*, was a common part of the diatom community in top sample of the lakes while the benthic *Fragilaria* were more common in the bottom core samples.

them to be readily identified. Certain taxa are usually found under nutrient poor conditions while others are more common under elevated nutrient levels. Some species float in the open water areas while others grow attached to objects such as aquatic plants or the lake bottom.

By determining changes in the diatom community it is possible to determine water quality changes that have occurred in the lake. The diatom community provides information about changes in nutrient concentrations, water clarity, and pH conditions as well as alterations in the aquatic plant (macrophyte) community.

On 19 September 2012 sediment cores were collected near the deep areas of Big Arbor Vitae (N45.93201° W89.65263°) and Little Arbor Vitae (N45.91312° W89.61984°) lakes using a gravity corer. The water depth in Big Arbor Vitae was 28 feet and 21 feet in Little Arbor Vitae. The length of the Big Arbor Vitae core was 46.5 cm and the length of the Little Arbor Vitae core was 45 cm. It is assumed that the upper sample represents present conditions while the deeper sample is indicative of water quality conditions at least 100 years ago. In the Big Arbor Vitae core the upper 20 cm was brown in color with scattered black particles while the bottom half of the core was a uniform brown color. In the Little Arbor Vitae core, the upper 19 cm was dark brown in color while the bottom portion of the core was medium brown in color.

Results

In both Big and Little Arbor Vitae lakes the diatom community in the bottom samples (bottom portion of the sediment cores) was dominated by benthic diatoms (Figures 2 and 3). The dominant taxa were of the genus *Fragilaria*, which have recently been split into various other genera. The dominant species were *Staurosira construens* and *Staurosirella pinnata*. Both of these taxa are common in many lakes. These are diatoms which grow either on substrates such as macrophytes or on the sediment.

The diatom communities were much different in the top samples. The community was dominated by planktonic diatoms (Figures 2 and 3) which are taxa that float in the open water. The most common species were *Aulacoseira granulata* and *Fragilaria crotonensis*. The latter species is common in lakes with moderate phosphorus levels while A. granulata is common in wind swept lakes with elevated phosphorus levels. The shift from benthic to planktonic species is also an indication of increased phosphorus levels. With higher phosphorus concentrations the decreasing water clarity reduces the light available for diatoms that grow on substrates and favors those diatoms that float near the surface.

In many lakes in northern and north central WI there has been an increase in submerged aquatic vegetation (SAV) and only a small increase in phosphorus in recent years. This does not appear to be the case in the Arbor Vitae lakes. The diatom community indicates that in both of these lakes the current phosphorus levels are higher than they were historically.

Diatom assemblages historically have been used as indicators of nutrient changes in a qualitative way. In recent years, ecologically relevant statistical methods have been developed to infer environmental conditions from diatom assemblages. These methods are based on multivariate ordination and weighted averaging regression and calibration. Ecological preferences of diatom species are determined by relating modern limnological variables to sur-

BIG ARBOR VITAE LAKE

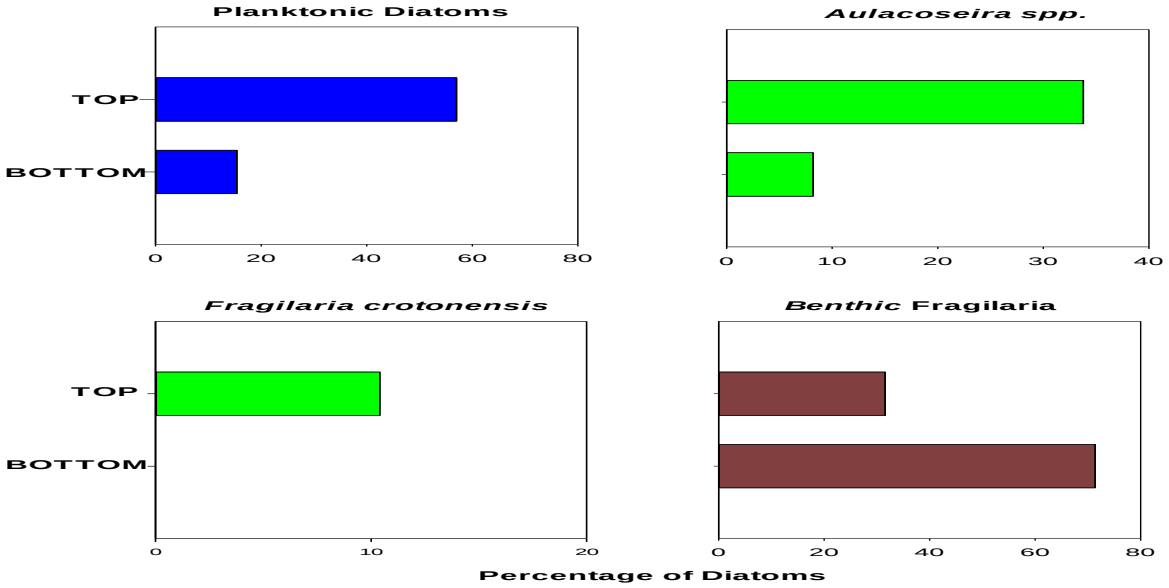


Figure 2. Changes in the abundance of some important diatoms found in the Big Arbor Vitae Lake sediment core. The dominant diatoms at the present time are those that float in the open water. The increase in planktonic diatoms in the top sample compared with the bottom sample, indicates higher phosphorus levels in the top sample.

LITTLE ARBOR VITAE LAKE

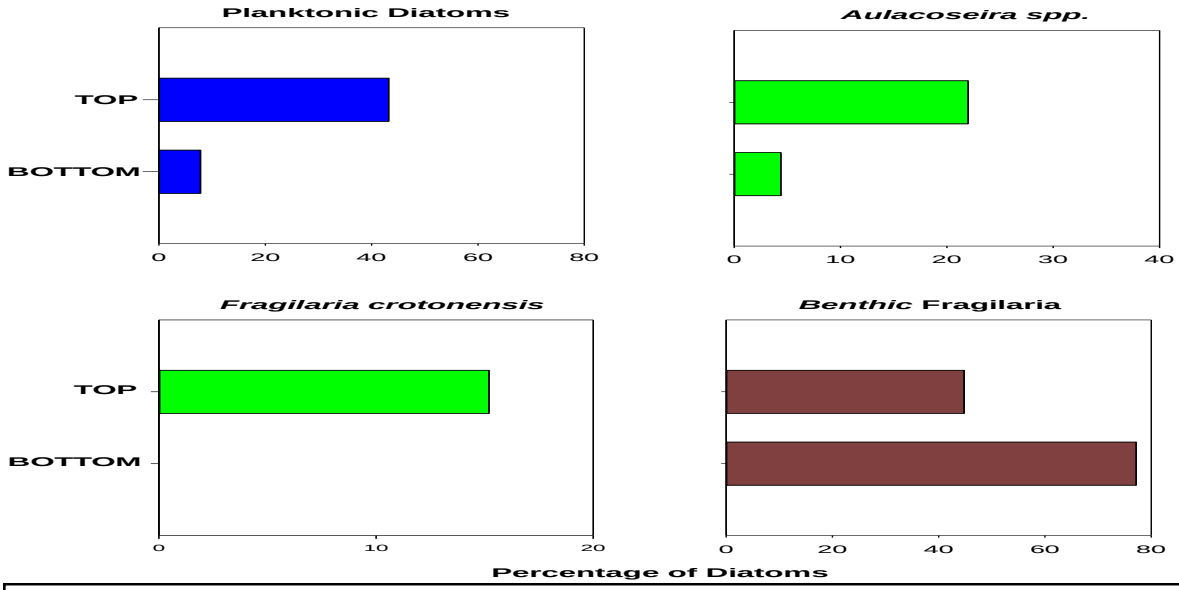


Figure 3. Changes in the abundance of some important diatoms found in the Little Arbor Vitae Lake sediment core. The dominant diatoms at the present time are those that float in the open water. The increase in planktonic diatoms in the top sample compared with the bottom sample, indicates higher phosphorus levels in the top sample.

face sediment diatom assemblages. The species-environment relationships are then used to infer environmental conditions from fossil diatom assemblages found in the sediment core.

Such a model was applied to the diatom communities in the Arbor Vitae lakes. In both lakes the present day phosphorus concentration is significantly higher than it was historically (Table 1). The predicted value for Little Arbor Vitae is similar to the mean summer phosphorus level measured in 2010. Phosphorus concentrations was 30 µg L^{-1} until mid-summer and then increased to 50-60 µg L^{-1} later in the summer. The model may be slightly over estimating the historical phosphorus concentration, especially in Little Arbor Vitae Lake because the dominate taxa were benthic *Fragilaria*. These diatoms have a wide tolerance of phosphorus concentrations. Since the model was developed using recently deposited diatom communities there were few lakes that likely had the lower phosphorus concentrations that were more common prior to European settlement.

Table. 1. Mean summer phosphorus concentrations in the Arbor Vitae lakes (µg L^{-1}). The observed value represents the last 5 years in White Ash Lake and 2010 in North White Ash Lake. The concentration for the top and bottom samples were estimated from the diatom community.

	Top	Bottom
Big Arbor Vitae	57	29
Little Arbor Vitae	44	34

In summary, the diatom community indicates that the present day phosphorus concentrations experienced in the Arbor Vitae lakes is significantly higher than it was prior to the arrival of European settlers. Historically the phosphorus concentration was around 30 µg L^{-1} in both lakes. Most lakes in this region where the diatom community has been examined in sediment cores do not show this amount of phosphorus increase. This amount of phosphorus increase is more common in southern and central Wisconsin lakes with highly altered landuse in the watershed.

BIG ARBOR VITAE LAKE					
Vilas County				Aulacoseira spp.	0.338
				Small Fragilaria	0.200
Top (0-2 cm)				Benthic Fragilaria	0.316
				Cyclotella spp.	0.010
	COUNT TOTAL			Stephanodiscus spp.	0.066
	Number	Prop.			
TAXA					
Achnanthes oblongella Østrup	5	0.010		Species Richness	46
Achnanthidium exiguum (Grunow) Czarnecki	1	0.002		Diversity	2.72
Amphora copulata (kützing) Schoeman et Archibald	2	0.004			
Amphora pediculus (Kützing) Grunow	1	0.002			
Asterionella formosa Hassal	15	0.030			
Aulacoseira ambigua (Grunow) Simonsen	74	0.148			
Aulacoseira granulata (Ehrenberg) Simonsen	88	0.176			
Aulacoseira italica (Ehrenberg) Simonsen	3	0.006			
Aulacoseira sp. 1?	4	0.008			
Caloneis silicula (Ehrenberg) Cleve	4	0.008			
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	2	0.004			
Cocconeis placentula var. placentula Ehrenberg	3	0.006			
Cocconeis pseudothumensis Reichardt	1	0.002			
Discotella stelligera (Hustedt) Houk et Klee	5	0.010			
Encyonema spp.	1	0.002			
Fragilaria capucina var. mesolepta Rabenhorst	1	0.002			
Fragilaria crotonensis Kitton	22	0.044			
Fragilaria crotonensis var. oregona Sovereign	30	0.060			
Fragilaria vaucheriae (Kützing) Petersen	3	0.006			
Geissleria paludosa (Hustedt) Lange-Bertalot et Metzeltin	1	0.002			
Gomphonema insigne Gregory	1	0.002			
Gomphonema spp.	2	0.004			
Navicula cincta (Ehrenberg) Ralfs	2	0.004			
Navicula harderii Hustedt	2	0.004			
Navicula obdurata Hohn et Hellermann	2	0.004			
Navicula pseudoventralis Hustedt	4	0.008			
Nitzschia amphibia Grunow	1	0.002			
Nitzschia dissipata var. media (Hantzsch) Grunow	1	0.002			
Nitzschia spp.	2	0.004			
Pinnularia subgibba Krammer	1	0.002			
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot	3	0.006			
Planothidium joursacense (Héribaud) Lange-Bertalot	1	0.002			
Pseudostaurosira brevistriata (Grunow) Williams et Round	20	0.040			
Sellaphora laevissima (Kützing) Mann	2	0.004			
Sellaphora pupula (Kützing) Mereschkowsky	2	0.004			
Staurosira construens Ehrenberg	32	0.064			
Staurosira construens var. venter (Ehrenberg) Hamilton	7	0.014			
Staurosirella leptostauron var. dubia (Grunow) Edlund	3	0.006			
Staurosirella martyi (Héribaud) Morales et Manoylov	2	0.004			
Staurosirella pinnata (Ehrenberg) Williams et Round	93	0.186			
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	1	0.002			
Stephanodiscus minutulus (Kützing) Cleve et Möller	3	0.006			
Stephanodiscus niagarae Ehrenberg	30	0.060			
Synedra acus Kützing	1	0.002			
Synedra acus var. angustissima (Grunow) Van Heurck	6	0.012			
Tabellaria flocculosa (strain IIIp) sensu Koppen	5	0.010			
unknown pennate	5	0.010			
TOTAL	500	1.000			
Planktonic diatoms		0.570			
Nonplanktonic diatoms		0.430			

BIG ARBOR VITAE LAKE					
Vilas County				Aulacoseira spp.	0.082
				Small Fragilaria	0.428
Bottom (42-44 cm)				Benthic Fragilaria	0.714
				Cyclotella spp.	0.000
	COUNT TOTAL			Stephanodiscus spp.	0.072
	Number	Prop.			
TAXA					
Achnanthes curtissima Carter	2	0.004		Species Richness	30
Achnanthes oblongella Østrup	1	0.002		Diversity	1.94
Achnanthidium spp	1	0.002			
Amphora copulata (kützing) Schoeman et Archibald	3	0.006			
Aulacoseira ambigua (Grunow) Simonsen	1	0.002			
Aulacoseira granulata (Ehrenberg) Simonsen	38	0.076			
Aulacoseira sp. 1?	2	0.004			
Cavinula scutelloides (Smith) Lange-Bertalot et Metzeltin	3	0.006			
Cocconeis placentula var. placentula Ehrenberg	1	0.002			
Encyonema spp.	3	0.006			
Fragilaria vaucheriae (Kützing) Petersen	3	0.006			
Gomphonema spp.	4	0.008			
Karayevia clevei (Grunow) Bukhtiyarova	2	0.004			
Navicula pseudoventralis Hustedt	6	0.012			
Navicula spp.	1	0.002			
Navicula vulpina Kützing	3	0.006			
Opephora olsenii Möller	12	0.024			
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot	1	0.002			
Planothidium joursacense (Héribaud) Lange-Bertalot	10	0.020			
Pseudostaurosira brevistriata (Grunow) Williams et Round	7	0.014			
Reimeria sinuata (Gregory) Kociolek et Stoermer	1	0.002			
Sellaphora sp. 1?	1	0.002			
Staurosira construens Ehrenberg	114	0.228			
Staurosira construens var. venter (Ehrenberg) Hamilton	2	0.004			
Staurosirella leptostauron var. dubia (Grunow) Edlund	11	0.022			
Staurosirella martyi (Héribaud) Morales et Manoylov	1	0.002			
Staurosirella pinnata (Ehrenberg) Williams et Round	212	0.424			
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	10	0.020			
Stephanodiscus minutulus (Kützing) Cleve et Möller	3	0.006			
Stephanodiscus niagarae Ehrenberg	33	0.066			
unknown pennate	8	0.016			
TOTAL	500	1.000			
Planktonic diatoms		0.154			
Nonplanktonic diatoms		0.846			

LITTLE ARBOR VITAE LAKE

Vilas County

Top (0-2 cm)

COUNT TOTAL

TAXA	Number	Prop.
Achnanthidium jackii Rabhenhorst	2	0.004
Amphora pediculus (Kützing) Grunow	2	0.004
Asterionella formosa Hassal	1	0.002
Aulacoseira granulata (Ehrenberg) Simonsen	64	0.128
Aulacoseira italica (Ehrenberg) Simonsen	46	0.092
Cavinula scutelloides (Smith) Lange-Bertalot et Metzeltin	1	0.002
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	1	0.002
Cymbella cymbiformis Agardh	2	0.004
Encyonema minutum (Hilse) Mann	3	0.006
Encyonema spp.	1	0.002
Epithemia turgida (Ehrenberg) Kützing	1	0.002
Fragilaria capucina var. mesolepta Rabenhorst	19	0.038
Fragilaria crotonensis Kitton	33	0.066
Fragilaria crotonensis var. oregona Sovereign	43	0.086
Fragilaria tenera (Smith) Lange-Bertalot	1	0.002
Gomphonema acuminatum Ehrenberg	1	0.002
Gomphonema minutum (Agardh) Agardh	1	0.002
Navicula spp.	1	0.002
Neidium spp.	1	0.002
Nitzschia inconspicua Grunow	1	0.002
Nitzschia spp.	3	0.006
Opephora olsenii Möller	1	0.002
Pinnularia spp.	1	0.002
Placoneis gastrum (Ehrenberg) Mereschkowsky	1	0.002
Planothidium haynaldii (Schaarschmidt) Lange-Bertalot	2	0.004
Planothidium joursacense (Héribaud) Lange-Bertalot	2	0.004
Planothidium lanceolatum (Brébisson ex Kützing) Lange-E	4	0.008
Pseudostaurosira brevistriata (Grunow) Williams et Round	31	0.062
Pseudostaurosira parasitica (Smith) Morales	2	0.004
Sellaphora pupula (Kützing) Meresckowsky	1	0.002
Staurosira construens Ehrenberg	51	0.102
Staurosira construens var. binodis (Ehrenberg) Hamilton	77	0.154
Staurosirella leptostauron var. dubia (Grunow) Edlund	2	0.004
Staurosirella pinnata (Ehrenberg) Williams et Round	57	0.114
Staurosirella pinnata var. lancettula (Schumann) Siver et	6	0.012
Stephanodiscus niagarae Ehrenberg	29	0.058
unknown pennate	5	0.010
TOTAL	500	1.000
Planktonic diatoms		0.432
Nonplanktonic diatoms		0.568

Aulacoseira spp.	0.220
Small Fragilaria	0.114
Benthic Fragilaria	0.448
Cyclotella spp.	0.000
Stephanodiscus spp.	0.058

Species Richness	36
Diversity	2.60

LITTLE ARBOR VITAE LAKE

Vilas County

Bottom (42-44 cm)

COUNT TOTAL

TAXA	Number	Prop.
Achnanthidium exiguum (Grunow) Czarnecki	1	0.002
Amphora copulata (kützing) Schoeman et Archibald	1	0.002
Amphora pediculus (Kützing) Grunow	2	0.004
Asterionella formosa Hassal	4	0.008
Aulacoseira ambigua (Grunow) Simonsen	11	0.022
Aulacoseira granulata (Ehrenberg) Simonsen	5	0.010
Aulacoseira italica (Ehrenberg) Simonsen	4	0.008
Aulacoseira sp. 1?	2	0.004
Encyonema mesianum (Cholnoky) Mann in Round, Crawford and Man	2	0.004
Encyonema spp.	7	0.014
Fragilaria crotonensis Kitton	1	0.002
Fragilaria sp. 1	4	0.008
Gomphonema minutum (Agardh) Agardh	1	0.002
Karayevia clevei (Grunow) Bukhtiyarova	1	0.002
Navicula cryptotenella Lange-Bertalot ex Krammer et Lange-Bertalot	1	0.002
Navicula minima Grunow in Van Heurck	2	0.004
Navicula modica Hustedt	2	0.004
Navicula peregrina (Ehrenberg) Kützing	1	0.002
Navicula pseudoanglica Lange-Bertalot	2	0.004
Navicula pseudoventralis Hustedt	18	0.036
Navicula spp.	2	0.004
Neidium spp.	1	0.002
Nitzschia amphibia fo. frauenfeldii (Grunow) Lange-Bertalot	1	0.002
Nitzschia amphibia Grunow	1	0.002
Nitzschia spp.	1	0.002
Placoneis clementis (Grunow) Cox	1	0.002
Planothidium joursacense (Héribaud) Lange-Bertalot	3	0.006
Platessa conspicua (Mayer) Lange-Bertalot	2	0.004
Pseudostaurosira brevistriata (Grunow) Williams et Round	25	0.050
Punctastriata mimetica Morales	9	0.018
Sellaphora laevissima (Kützing) Mann	2	0.004
Sellaphora sp. 1?	1	0.002
Staurosira construens Ehrenberg	141	0.282
Staurosira construens var. binodis (Ehrenberg) Hamilton	6	0.012
Staurosirella leptostauron var. dubia (Grunow) Edlund	3	0.006
Staurosirella pinnata (Ehrenberg) Williams et Round	184	0.368
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	18	0.036
Stephanodiscus niagarae Ehrenberg	12	0.024
unknown pennate	15	0.030
TOTAL	500	1.000
Planktonic diatoms		0.078
Nonplanktonic diatoms		0.922

Aulacoseira spp.	0.044
Small Fragilaria	0.368
Benthic Fragilaria	0.772
Cyclotella spp.	0.000
Stephanodiscus spp.	0.024
Species Richness	38
Diversity	2.06

E

APPENDIX E

Watershed Analysis WiLMS Results

Date: 10/11/2012 Scenario: BAV New watershed

Lake Id: Big Abor Vitae
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 6567.0 acre
Total Unit Runoff: 14.00 in.
Annual Runoff Volume: 7661.5 acre-ft
Lake Surface Area <As>: 1090.0 acre
Lake Volume <V>: 19827.0 acre-ft
Lake Mean Depth <z>: 18.2 ft
Precipitation - Evaporation: 5.5 in.
Hydraulic Loading: 8161.1 acre-ft/year
Areal Water Load <qs>: 7.5 ft/year
Lake Flushing Rate <p>: 0.41 1/year
Water Residence Time: 2.43 year
Observed spring overturn total phosphorus (SPO): 38.0 mg/m^3
Observed growing season mean phosphorus (GSM): 29.6 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	23.0	0.50	1.00	3.00	2.3	5	9	28
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	290.0	0.10	0.30	0.50	8.6	12	35	59
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)	13.0	0.05	0.10	0.25	0.1	0	1	1
Wetlands	1438.0	0.10	0.10	0.10	14.2	58	58	58
Forest	4803.0	0.05	0.09	0.18	42.6	97	175	350
Lake Surface	1090.0	0.10	0.30	1.00	32.2	44	132	441

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)		0.30	0.50	0.80	
# capita-years	0.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	476.5	905.0	2066.0	100.0
Total Loading (kg)	216.2	410.5	937.1	100.0
Areal Loading (lb/ac-year)	0.44	0.83	1.90	
Areal Loading (mg/m^2-year)	49.00	93.06	212.45	
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)	379.3	613.3	1093.5	100.0
Total NPS Loading (kg)	172.0	278.2	496.0	100.0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 10/11/2012 Scenario: 57
Observed spring overturn total phosphorus (SPO): 38.0 mg/m^3
Observed growing season mean phosphorus (GSM): 29.6 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	10	19	43	-11	-37
Canfield-Bachmann, 1981 Natural Lake	10	17	30	-13	-44
Canfield-Bachmann, 1981 Artificial Lake	11	17	28	-13	-44
Rechow, 1979 General	3	6	15	-24	-81
Rechow, 1977 Anoxic	14	26	60	-4	-14
Rechow, 1977 water load<50m/year	6	10	24	-20	-68
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	10	18	42	-20	-53
Vollenweider, 1982 Combined OECD	9	15	30	-19	-56
Dillon-Rigler-Kirchner	5	10	24	-28	-74
Vollenweider, 1982 Shallow Lake/Res.	7	12	24	-22	-65

Larsen-Mercier, 1976	8	16	36	-22	-58
Nurnberg, 1984 Oxic	6	11	24	-19	-64

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	11	35	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	5	49	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	5	49	FIT	1	GSM
Rechow, 1979 General	3	12	FIT	0	GSM
Rechow, 1977 Anoxic	16	48	FIT	0	GSM
Rechow, 1977 water load<50m/year	6	19	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	9	36	FIT	0	SPO
Vollenweider, 1982 Combined OECD	8	29	FIT	0	ANN
Dillon-Rigler-Kirchner	6	19	L	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	6	23	FIT	0	ANN
Larsen-Mercier, 1976	10	29	P Pin	0	SPO
Nurnberg, 1984 Oxic	6	21	FIT	0	ANN

Water and Nutrient Outflow Module

Date: 10/11/2012 Scenario: 42
Average Annual Surface Total Phosphorus: 33.8mg/m^3
Annual Discharge: 8.16E+003 AF => 1.01E+007 m^3
Annual Outflow Loading: 719.6 LB => 326.4 kg

F

APPENDIX F

Aquatic Plant Survey Data

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
1	45.93744313	-89.66675288	9	Muck	Pole																											1
2	45.93687611	-89.66675627	4	Rock	Pole																											
3	45.93970883	-89.66592657	5	Sand	Pole									1						1						1						1
4	45.93914181	-89.66592998	6	Muck	Pole			1												1		1										
5	45.93857480	-89.66593338	8	Muck	Pole			1		1																						
6	45.93800778	-89.66593679	9	Muck	Pole			2																		1						
7	45.93744076	-89.66594019	9	Muck	Pole			1																		1						
8	45.93687374	-89.66594360	10	Muck	Pole																											
9	45.93630672	-89.66594700	9	Sand	Pole									1																		
10	45.93970645	-89.66511385	4	Rock	Pole																											1
11	45.93913944	-89.66511727	6	Rock	Pole			2						1												1						
12	45.93857242	-89.66512068	8	Muck	Pole									1								1										
13	45.93800540	-89.66512409	8	Sand	Pole			1																								
14	45.93743838	-89.66512751	8	Sand	Pole			1						1												1						
15	45.93687136	-89.66513092	8	Sand	Pole			2																		1						
16	45.93630435	-89.66513433	10	Muck	Pole																											
17	45.93573733	-89.66513775	6	Rock	Pole																											
18	45.94027109	-89.66429771	5	Sand	Pole											1											1					1
19	45.93970407	-89.66430114	6	Sand	Pole			1		1				1																	1	
20	45.93913705	-89.66430456	8	Sand	Pole			1																								
21	45.93857003	-89.66430798	10	Sand	Pole																											
22	45.93800302	-89.66431140	12	Sand	Pole																											
23	45.93743600	-89.66431482	12	Sand	Pole																											
24	45.93686898	-89.66431824	14		Rope																											
25	45.93630196	-89.66432167	16		Rope																											
26	45.93573494	-89.66432509	11	Rock	Pole																											
27	45.93516792	-89.66432851	13	Sand	Pole																											
28	45.93460091	-89.66433193	5	Sand	Pole																											
29	45.94083572	-89.66348156	6	Sand	Pole			1																							1	
30	45.94026870	-89.66348499	8	Sand	Pole			2						1																		
31	45.93970168	-89.66348842	13	Sand	Pole																											
32	45.93913466	-89.66349185	18		Rope																											
33	45.93856764	-89.66349528	18		Rope																											
34	45.93800063	-89.66349871	18		Rope																											
35	45.93743361	-89.66350214	21			DEEP																										
36	45.93686659	-89.66350557	0			DEEP																										
37	45.93629957	-89.66350900	0			DEEP																										
38	45.93573255	-89.66351243	0			DEEP																										
39	45.93516553	-89.66351586	18		Rope																											
40	45.93459852	-89.66351929	11	Rock	Pole																											
41	45.94140034	-89.66266539	8	Sand	Pole									2					1													
42	45.94083332	-89.66266882	12	Muck	Rope																					1						
43	45.94026630	-89.66267226	19	Muck	Rope																											
44	45.93969928	-89.66267570	19	Muck	Rope																											
45	45.93913227	-89.66267914	20	Muck	Rope																											
46	45.93856525	-89.66268258	0			DEEP																										
47	45.93799823	-89.66268602	0			DEEP																										
48	45.93743121	-89.66268945	0			DEEP																										
49	45.93686419	-89.66269289	0			DEEP																										
50	45.93629718	-89.66269633	20		Rope																											
51	45.93573016	-89.66269977	19		Rope																											
52	45.93516314	-89.66270321	19		Rope																											
53	45.93459612	-89.66270664	20	Muck	Rope																											
54	45.93402910	-89.66271008	12	Rock	Pole																											
55	45.94196495	-89.66184920	8	Sand	Pole			1						2												1						
56	45.94139793	-89.66185264	16	Muck	Rope			1		1																						
57	45.94083092	-89.66185609	19	Muck	Rope																											
58	45.94026390	-89.66185954	0			DEEP																										
59	45.93969688	-89.66186298	0			DEEP																										
60	45.93912986	-89.66186643	0			DEEP																										
61	45.93856285	-89.66186988	0			DEEP																										
62	45.93799583	-89.66187332	0			DEEP																										
63	45.93742881	-89.66187677	0			DEEP																										
64	45.93686179	-89.66188022	0			DEEP																										
65	45.93629477	-89.66188366	0			DEEP																										
66	45.93572776	-89.66188711	0			DEEP																										
67	45.93516074	-89.66189055	0			DEEP																										
68	45.93459372	-89.66189400	0			DEEP																										
69	45.93402670	-89.66189745	21	Muck	Rope																											
70	45.93345968	-89.66190089	13	Rock	Pole																											
71	45.94252956	-89.66103299	7	Sand	Pole			2						1																		
72	45.94196254	-89.66103645	18	Muck	Rope																											
73	45.94139553	-89.66103990	0			DEEP																										
74	45.94082851	-89.66104336	0			DEEP																										
75	45.94026149	-89.66104681	0			DEEP																										
76	45.93969447	-89.66105027	0			DEEP																										
77	45.93912746	-89.66105372	0			DEEP																										
78	45.93856044	-89.66105718	0			DEEP																										
79	45.93799342	-89.66106063	0			DEEP																										
80	45.93742640	-89.66106409	0			DEEP																										
81	45.93685938	-89.66106754	0			DEEP																										
82	45.93629237	-89.66107100	0			DEEP																										
83	45.93572535	-89.66107445	0			DEEP																										
84	45.93515833	-89.66107790	0			DEEP																										
85	45.93459131	-89.66108136	0			DEEP																										
86	45.93402429	-89.66108481	0			DEEP																										
87	45.93345727	-89.66108827	21	Muck	Rope																											
88	45.94252715	-89.66022023	18	Muck	Rope																											
89	45.94196013	-89.66022370	21	Muck	Rope																											
90	45.94139311	-89.66022716	0			DEEP																										
91	45.94082610	-89.66023062	0			DEEP																										
92	45.94025908	-89.66023409	0			DEEP																										
93	45.93969206	-89.66023755	0			DEEP																										
94	45.93912504	-89.66024101	0			DEEP																										
95	45.93855803	-89.66024448	0			DEEP																										
96	45.93799101	-89.66024794	0			DEEP																										
97	45.93742399	-89.66025140	0			DEEP																										
98	45.93685697	-89.66025487	0			DEEP																										
99	45.93628995	-89.66025833	0			DEEP																										
100	45.93572294	-89.66026179	0			DEEP																										
101	45.93515592	-89.66026525	0			DEEP																										
102	45.93458890	-89.66026872	0			DEEP																										
103	45.93402188	-89.66027218	0			DEEP																										
104	45.93345486	-89.66027564	0			DEEP																										
105	45.93288784	-89.66027910	5	Sand	Pole																											
106	45.94309175	-89.65940400	7	Muck	Pole														1													1
107	45.94252473	-89.65940747	22	Muck	Rope																											
108	45.94195771	-89.65941095	0			DEEP																										
109	45.94139069	-89.65941442	0			DEEP																										
110	45.94082368	-89.65941789	0			DEEP																										
111	45.94025666	-89.65942136	0			DEEP																										
112	45.93968964	-89.65942483	0			DEEP																										
113	45.93912262	-89.65942830	0			DEEP																										

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
114	45.93855561	-89.65943178	0			DEEP																										
115	45.93798859	-89.65943525	0			DEEP																										
116	45.93742157	-89.65943872	0			DEEP																										
117	45.93685455	-89.65944219	0			DEEP																										
118	45.93628753	-89.65944566	0			DEEP																										
119	45.93572052	-89.65944913	0			DEEP																										
120	45.93515350	-89.65945260	0			DEEP																										
121	45.93458648	-89.65945607	0			DEEP																										
122	45.93401946	-89.65945954	0			DEEP																										
123	45.93345244	-89.65946301	0			DEEP																										
124	45.93288543	-89.65946648	18		Rope																											
125	45.93231841	-89.65946996	8	Rock	Pole																											
126	45.93175139	-89.65947343	6	Rock	Pole																											
127	45.94308932	-89.65859124	18	Muck	Rope																					1						
128	45.94252230	-89.65859472	22	Muck	Rope			1																								
129	45.94195529	-89.65859820	0			DEEP																										
130	45.94138827	-89.65860168	0			DEEP																										
131	45.94082125	-89.65860516	0			DEEP																										
132	45.94025423	-89.65860864	0			DEEP																										
133	45.93968722	-89.65861212	0			DEEP																										
134	45.93912020	-89.65861560	0			DEEP																										
135	45.93855318	-89.65861908	0			DEEP																										
136	45.93798616	-89.65862256	0			DEEP																										
137	45.93741915	-89.65862604	0			DEEP																										
138	45.93685213	-89.65862951	0			DEEP																										
139	45.93628511	-89.65863299	0			DEEP																										
140	45.93571809	-89.65863647	0			DEEP																										
141	45.93515107	-89.65863995	0			DEEP																										
142	45.93458406	-89.65864343	0			DEEP																										
143	45.93401704	-89.65864691	0			DEEP																										
144	45.93345002	-89.65865039	0			DEEP																										
145	45.93288300	-89.65865387	0			DEEP																										
146	45.93231598	-89.65865735	0			DEEP																										
147	45.93174896	-89.65866082	19		Rope																											
148	45.93118195	-89.65866430	21		Rope																											
149	45.93061493	-89.65866778	15		Rope																											
150	45.93004791	-89.65867126	9	Rock	Pole																											
151	45.92948089	-89.65867474	6	Rock	Pole																											
152	45.92040858	-89.65873037	6	Sand	Pole			2		1				1																		
153	45.91984156	-89.65873385	5	Sand	Pole									1	1				1													1
154	45.91927454	-89.65873732	5	Sand	Pole					1				1					1							1				1		
155	45.94308689	-89.65777847	19	Muck	Rope																					1						
156	45.94251987	-89.65778196	23	Muck	Rope																											
157	45.94195286	-89.65778545	0			DEEP																										
158	45.94138584	-89.65778893	0			DEEP																										
159	45.94081882	-89.65779242	0			DEEP																										
160	45.94025180	-89.65779591	0			DEEP																										
161	45.93968479	-89.65779940	0			DEEP																										
162	45.93911777	-89.65780289	0			DEEP																										
163	45.93855075	-89.65780638	0			DEEP																										
164	45.93798373	-89.65780986	0			DEEP																										
165	45.93741671	-89.65781335	0			DEEP																										
166	45.93684970	-89.65781684	0			DEEP																										
167	45.93628268	-89.65782033	0			DEEP																										
168	45.93571566	-89.65782381	0			DEEP																										
169	45.93514864	-89.65782730	0			DEEP																										
170	45.93458163	-89.65783079	0			DEEP																										
171	45.93401461	-89.65783428	0			DEEP																										
172	45.93344759	-89.65783776	0			DEEP																										
173	45.93288057	-89.65784125	0			DEEP																										
174	45.93231355	-89.65784474	0			DEEP																										
175	45.93174653	-89.65784822	0			DEEP																										
176	45.93117952	-89.65785171	0			DEEP																										
177	45.93061250	-89.65785520	0			DEEP																										
178	45.93004548	-89.65785868	22			DEEP																										
179	45.92947846	-89.65786217	19		Rope																											
180	45.92891144	-89.65786566	15		Rope																											
181	45.92834442	-89.65786914	11	Rock	Pole																											
182	45.92777740	-89.65787263	7	Rock	Pole					1																						
183	45.92721039	-89.65787611	7	Rock	Pole																											
184	45.92664337	-89.65787960	11	Sand	Pole																											
185	45.92607635	-89.65788309	14		Rope																											
186	45.92550933	-89.65788657	16		Rope																											
187	45.92494231	-89.65789006	12	Rock	Pole																											
188	45.92437529	-89.65789354	14		Rope																											
189	45.92380827	-89.65789703	14		Rope																											
190	45.92324125	-89.65790051	7	Rock	Pole																											
191	45.92210721	-89.65790748	8	Sand	Pole					1				1												1						
192	45.92154019	-89.65791097	15		Rope																											
193	45.92097317	-89.65791445	20		Rope																											
194	45.92040616	-89.65791794	19		Rope																											
195	45.91983914	-89.65792142	8	Rock	Pole									2																		
196	45.91927212	-89.65792491	10	Sand	Pole																											
197	45.91870510	-89.65792839	7	Sand	Pole					1				1					1							2						
198	45.94308445	-89.65696570	20		Rope																											
199	45.94251744	-89.65696920	22		Rope																											
200	45.94195042	-89.65697270	0			DEEP																										
201	45.94138340	-89.65697619	0			DEEP																										
202	45.94081638	-89.65697969	0			DEEP																										
203	45.94024937	-89.65698319	0			DEEP																										
204	45.93968235	-89.65698668	0			DEEP																										
205	45.93911533	-89.65699018	0			DEEP																										
206	45.93854831	-89.65699368	0			DEEP																										
207	45.93798130	-89.65699717	0			DEEP																										
208	45.93741428	-89.65700067	0			DEEP																										
209	45.93684726	-89.65700416	0			DEEP																										
210	45.93628024	-89.65700766	0			DEEP																										
211	45.93571323	-89.65701116	0			DEEP																										
212	45.93514621	-89.65701465	0			DEEP																										
213	45.93457919	-89.65701815	0			DEEP																										
214	45.93401217	-89.65702164	0			DEEP																										
215	45.93344515	-89.65702514	0			DEEP																										
216	45.93287813	-89.65702863	0			DEEP																										
217	45.93231112	-89.65703213	0			DEEP																										
218	45.93174410	-89.65703562	0			DEEP																										
219	45.93117708	-89.65703912	0			DEEP																										
220	45.93061006	-89.65704261	0			DEEP																										
221	45.93004304	-89.65704611	0			DEEP																										
222	45.92947602	-89.65704960	0			DEEP																										
223	45.92890901	-89.65705310	0			DEEP																										
224	45.92834199	-89.65705659	0			DEEP																										
225	45.92777497	-89.65706009	0			DEEP																										
226	45.92720795	-89.65706358	0			DEEP																										

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
227	45.92664093	-89.65706707	0			DEEP																										
228	45.92607391	-89.65707057	0			DEEP																										
229	45.92550689	-89.65707406	0			DEEP																										
230	45.92493987	-89.65707755	0			DEEP																										
231	45.92437286	-89.65708105	0			DEEP																										
232	45.92380584	-89.65708454	0			DEEP																										
233	45.92323882	-89.65708804	22		Rope																											
234	45.92267180	-89.65709153	23		Rope																											
235	45.92210478	-89.65709502	23		Rope																											
236	45.92153776	-89.65709852	0			DEEP																										
237	45.92097074	-89.65710201	0			DEEP																										
238	45.92040372	-89.65710550	0			DEEP																										
239	45.91983670	-89.65710899	19		Rope																											
240	45.91926968	-89.65711249	17		Rope																											
241	45.91870266	-89.65711598	11	Sand	Pole																											
242	45.91813564	-89.65711947	3	Sand	Pole													1														1
243	45.94308201	-89.65615294	17		Rope																											
244	45.94251499	-89.65615644	21		Rope																											
245	45.94194798	-89.65615995	0			DEEP																										
246	45.94138096	-89.65616345	0			DEEP																										
247	45.94081394	-89.65616696	0			DEEP																										
248	45.94024692	-89.65617046	0			DEEP																										
249	45.93967991	-89.65617397	0			DEEP																										
250	45.93911289	-89.65617747	0			DEEP																										
251	45.93854587	-89.65618098	0			DEEP																										
252	45.93797885	-89.65618448	0			DEEP																										
253	45.93741184	-89.65618798	0			DEEP																										
254	45.93684482	-89.65619149	0			DEEP																										
255	45.93627780	-89.65619499	0			DEEP																										
256	45.93571078	-89.65619850	0			DEEP																										
257	45.93514377	-89.65620200	0			DEEP																										
258	45.93457675	-89.65620550	0			DEEP																										
259	45.93400973	-89.65620901	0			DEEP																										
260	45.93344271	-89.65621251	0			DEEP																										
261	45.93287569	-89.65621602	0			DEEP																										
262	45.93230867	-89.65621952	0			DEEP																										
263	45.93174166	-89.65622302	0			DEEP																										
264	45.93117464	-89.65622653	0			DEEP																										
265	45.93060762	-89.65623003	0			DEEP																										
266	45.93004060	-89.65623353	0			DEEP																										
267	45.92947358	-89.65623703	0			DEEP																										
268	45.92890656	-89.65624054	0			DEEP																										
269	45.92833955	-89.65624404	0			DEEP																										
270	45.92777253	-89.65624754	0			DEEP																										
271	45.92720551	-89.65625104	0			DEEP																										
272	45.92663849	-89.65625455	0			DEEP																										
273	45.92607147	-89.65625805	0			DEEP																										
274	45.92550445	-89.65626155	0			DEEP																										
275	45.92493743	-89.65626505	0			DEEP																										
276	45.92437041	-89.65626856	0			DEEP																										
277	45.92380339	-89.65627206	0			DEEP																										
278	45.92323638	-89.65627556	0			DEEP																										
279	45.92266936	-89.65627906	0			DEEP																										
280	45.92210234	-89.65628256	0			DEEP																										
281	45.92153532	-89.65628606	0			DEEP																										
282	45.92096830	-89.65628957	0			DEEP																										
283	45.92040128	-89.65629307	0			DEEP																										
284	45.91983426	-89.65629657	0			DEEP																										
285	45.91926724	-89.65630007	0			DEEP																										
286	45.91870022	-89.65630357	14		Rope																											
287	45.91813320	-89.65630707	5	Sand	Pole																										1	1
288	45.94307956	-89.65534017	16		Rope			1																		1						
289	45.94251255	-89.65534368	20		Rope																											
290	45.94194553	-89.65534720	0			DEEP																										
291	45.94137851	-89.65535071	0			DEEP																										
292	45.94081149	-89.65535422	0			DEEP																										
293	45.94024448	-89.65535774	0			DEEP																										
294	45.93967746	-89.65536125	0			DEEP																										
295	45.93911044	-89.65536476	0			DEEP																										
296	45.93854342	-89.65536828	0			DEEP																										
297	45.93797641	-89.65537179	0			DEEP																										
298	45.93740939	-89.65537530	0			DEEP																										
299	45.93684237	-89.65537881	0			DEEP																										
300	45.93627535	-89.65538233	0			DEEP																										
301	45.93570834	-89.65538584	0			DEEP																										
302	45.93514132	-89.65538935	0			DEEP																										
303	45.93457430	-89.65539286	0			DEEP																										
304	45.93400728	-89.65539637	0			DEEP																										
305	45.93344026	-89.65539989	0			DEEP																										
306	45.93287325	-89.65540340	0			DEEP																										
307	45.93230623	-89.65540691	0			DEEP																										
308	45.93173921	-89.65541042	0			DEEP																										
309	45.93117219	-89.65541393	0			DEEP																										
310	45.93060517	-89.65541744	0			DEEP																										
311	45.93003815	-89.65542096	0			DEEP																										
312	45.92947114	-89.65542447	0			DEEP																										
313	45.92890412	-89.65542798	0			DEEP																										
314	45.92833710	-89.65543149	0			DEEP																										
315	45.92777008	-89.65543500	0			DEEP																										
316	45.92720306	-89.65543851	0			DEEP																										
317	45.92663604	-89.65544202	0			DEEP																										
318	45.92606902	-89.65544553	0			DEEP																										
319	45.92550201	-89.65544904	0			DEEP																										
320	45.92493499	-89.65545255	0			DEEP																										
321	45.92436797	-89.65545606	0			DEEP																										
322	45.92380095	-89.65545957	0			DEEP																										
323	45.92323393	-89.65546308	0			DEEP																										
324	45.92266691	-89.65546659	0			DEEP																										
325	45.92209989	-89.65547010	0			DEEP																										
326	45.92153287	-89.65547361	0			DEEP																										
327	45.92096585	-89.65547712	0			DEEP																										
328	45.92039883	-89.65548063	0			DEEP																										
329	45.91983181	-89.65548414	0			DEEP																										
330	45.91926479	-89.65548765	0			DEEP																										
331	45.91869777	-89.65549116	19		Rope																											
332	45.91813076	-89.65549467	9	Sand	Pole									1											1							
333	45.94307711	-89.65452740	15		Rope			2																		1						
334	45.94251009	-89.65453093	21		Rope																											
335	45.94194307	-89.65453445	0			DEEP																										
336	45.94137606	-89.65453797	0			DEEP																										
337	45.94080904	-89.65454149	0			DEEP																										
338	45.94024202	-89.65454501	0			DEEP																										
339	45.93967501	-89.65454853	0			DEEP																										

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
340	45.93910799	-89.65455206	0			DEEP																										
341	45.93854097	-89.65455558	0			DEEP																										
342	45.93797395	-89.65455910	0			DEEP																										
343	45.93740694	-89.65456262	0			DEEP																										
344	45.93683992	-89.65456614	0			DEEP																										
345	45.93627290	-89.65456966	0			DEEP																										
346	45.93570588	-89.65457318	0			DEEP																										
347	45.93513886	-89.65457670	0			DEEP																										
348	45.93457185	-89.65458022	0			DEEP																										
349	45.93400483	-89.65458374	0			DEEP																										
350	45.93343781	-89.65458726	0			DEEP																										
351	45.93287079	-89.65459078	0			DEEP																										
352	45.93230377	-89.65459430	0			DEEP																										
353	45.93173676	-89.65459782	0			DEEP																										
354	45.93116974	-89.65460134	0			DEEP																										
355	45.93060272	-89.65460486	0			DEEP																										
356	45.93003570	-89.65460838	0			DEEP																										
357	45.92946868	-89.65461190	0			DEEP																										
358	45.92890166	-89.65461542	0			DEEP																										
359	45.92833465	-89.65461894	0			DEEP																										
360	45.92776763	-89.65462246	0			DEEP																										
361	45.92720061	-89.65462598	0			DEEP																										
362	45.92663359	-89.65462950	0			DEEP																										
363	45.92606657	-89.65463301	0			DEEP																										
364	45.92549955	-89.65463653	0			DEEP																										
365	45.92493253	-89.65464005	0			DEEP																										
366	45.92436551	-89.65464357	0			DEEP																										
367	45.92379850	-89.65464709	0			DEEP																										
368	45.92323148	-89.65465061	0			DEEP																										
369	45.92266446	-89.65465412	0			DEEP																										
370	45.92209744	-89.65465764	0			DEEP																										
371	45.92153042	-89.65466116	0			DEEP																										
372	45.92096340	-89.65466468	0			DEEP																										
373	45.92039638	-89.65466820	0			DEEP																										
374	45.91982936	-89.65467171	0			DEEP																										
375	45.91926234	-89.65467523	0			DEEP																										
376	45.91869532	-89.65467875	0			DEEP																										
377	45.91812830	-89.65468227	9	Sand	Pole																											
378	45.94307465	-89.65371464	8		Rope			2																								
379	45.94250763	-89.65371817	22		Rope																											
380	45.94194061	-89.65372170	22		Rope																											
381	45.94137360	-89.65372523	0			DEEP																										
382	45.94080658	-89.65372876	0			DEEP																										
383	45.94023956	-89.65373229	0			DEEP																										
384	45.93967255	-89.65373582	0			DEEP																										
385	45.93910553	-89.65373935	0			DEEP																										
386	45.93853851	-89.65374288	0			DEEP																										
387	45.93797149	-89.65374641	0			DEEP																										
388	45.93740448	-89.65374994	0			DEEP																										
389	45.93683746	-89.65375346	0			DEEP																										
390	45.93627044	-89.65375699	0			DEEP																										
391	45.93570342	-89.65376052	0			DEEP																										
392	45.93513640	-89.65376405	0			DEEP																										
393	45.93456939	-89.65376758	0			DEEP																										
394	45.93400237	-89.65377111	0			DEEP																										
395	45.93343535	-89.65377464	0			DEEP																										
396	45.93286833	-89.65377816	0			DEEP																										
397	45.93230132	-89.65378169	0			DEEP																										
398	45.93173430	-89.65378522	0			DEEP																										
399	45.93116728	-89.65378875	0			DEEP																										
400	45.93060026	-89.65379228	0			DEEP																										
401	45.93003324	-89.65379581	0			DEEP																										
402	45.92946622	-89.65379933	0			DEEP																										
403	45.92889921	-89.65380286	0			DEEP																										
404	45.92833219	-89.65380639	0			DEEP																										
405	45.92776517	-89.65380992	0			DEEP																										
406	45.92719815	-89.65381344	0			DEEP																										
407	45.92663113	-89.65381697	0			DEEP																										
408	45.92606411	-89.65382050	0			DEEP																										
409	45.92549709	-89.65382402	0			DEEP																										
410	45.92493008	-89.65382755	0			DEEP																										
411	45.92436306	-89.65383108	0			DEEP																										
412	45.92379604	-89.65383460	0			DEEP																										
413	45.92322902	-89.65383813	0			DEEP																										
414	45.92266200	-89.65384166	0			DEEP																										
415	45.92209498	-89.65384518	0			DEEP																										
416	45.92152796	-89.65384871	0			DEEP																										
417	45.92096094	-89.65385224	0			DEEP																										
418	45.92039392	-89.65385576	0			DEEP																										
419	45.91982690	-89.65385929	0			DEEP																										
420	45.91925988	-89.65386281	0			DEEP																										
421	45.91869286	-89.65386634	20		Rope																											
422	45.91812585	-89.65386986	9	Sand	Pole									2											1	1						
423	45.94307218	-89.65290187	8	Sand	Pole			1						2					1							1						
424	45.94250517	-89.65290541	21		Rope																											
425	45.94193815	-89.65290895	22		Rope																											
426	45.94137113	-89.65291249	0			DEEP																										
427	45.94080411	-89.65291603	0			DEEP																										
428	45.94023710	-89.65291956	0			DEEP																										
429	45.93967008	-89.65292310	0			DEEP																										
430	45.93910306	-89.65292664	0			DEEP																										
431	45.93853605	-89.65293018	0			DEEP																										
432	45.93796903	-89.65293371	0			DEEP																										
433	45.93740201	-89.65293725	0			DEEP																										
434	45.93683499	-89.65294079	0			DEEP																										
435	45.93626798	-89.65294433	0			DEEP																										
436	45.93570096	-89.65294786	0			DEEP																										
437	45.93513394	-89.65295140	0			DEEP																										
438	45.93456692	-89.65295494	0			DEEP																										
439	45.93399990	-89.65295847	0			DEEP																										
440	45.93343289	-89.65296201	0			DEEP																										
441	45.93286587	-89.65296555	0			DEEP																										
442	45.93229885	-89.65296908	0			DEEP																										
443	45.93173183	-89.65297262	0			DEEP																										
444	45.93116481	-89.65297616	0			DEEP																										
445	45.93059780	-89.65297969	0			DEEP																										
446	45.93003078	-89.65298323	0			DEEP																										
447	45.92946376	-89.65298677	0			DEEP																										
448	45.92889674	-89.65299030	0			DEEP																										
449	45.92832972	-89.65299384	0			DEEP																										
450	45.92776270	-89.65299737	0			DEEP																										
451	45.92719569	-89.65300091	0			DEEP																										
452	45.92662867	-89.65300444	0			DEEP																										

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
453	45.92606165	-89.65300798	0			DEEP																										
454	45.92549463	-89.65301151	0			DEEP																										
455	45.92492761	-89.65301505	0			DEEP																										
456	45.92436059	-89.65301858	0			DEEP																										
457	45.92379357	-89.65302212	0			DEEP																										
458	45.92322655	-89.65302565	0			DEEP																										
459	45.92265954	-89.65302919	0			DEEP																										
460	45.92209252	-89.65303272	0			DEEP																										
461	45.92152550	-89.65303626	0			DEEP																										
462	45.92095848	-89.65303979	0			DEEP																										
463	45.92039146	-89.65304333	0			DEEP																										
464	45.91982444	-89.65304686	0			DEEP																										
465	45.91925742	-89.65305040	0			DEEP																										
466	45.91869040	-89.65305393	18		Rope																											
467	45.91812338	-89.65305746	7	Sand	Pole			1						2					1						1	1						
468	45.94306971	-89.65208911	5	Sand	Pole						1			1					2							1	1					1
469	45.94250269	-89.65209265	21		Rope																											
470	45.94193568	-89.65209620	22		Rope																											
471	45.94136866	-89.65209975	0			DEEP																										
472	45.94080164	-89.65210329	0			DEEP																										
473	45.94023463	-89.65210684	0			DEEP																										
474	45.93966761	-89.65211039	0			DEEP																										
475	45.93910059	-89.65211393	0			DEEP																										
476	45.93853357	-89.65211748	0			DEEP																										
477	45.93796656	-89.65212102	0			DEEP																										
478	45.93739954	-89.65212457	0			DEEP																										
479	45.93683252	-89.65212812	0			DEEP																										
480	45.93626550	-89.65213166	0			DEEP																										
481	45.93569849	-89.65213521	0			DEEP																										
482	45.93513147	-89.65213875	0			DEEP																										
483	45.93456445	-89.65214230	0			DEEP																										
484	45.93399743	-89.65214584	0			DEEP																										
485	45.93343042	-89.65214939	0			DEEP																										
486	45.93286340	-89.65215293	0			DEEP																										
487	45.93229638	-89.65215648	0			DEEP																										
488	45.93172936	-89.65216002	0			DEEP																										
489	45.93116234	-89.65216357	0			DEEP																										
490	45.93059533	-89.65216711	0			DEEP																										
491	45.93002831	-89.65217065	0			DEEP																										
492	45.92946129	-89.65217420	0			DEEP																										
493	45.92889427	-89.65217774	0			DEEP																										
494	45.92832725	-89.65218129	0			DEEP																										
495	45.92776023	-89.65218483	0			DEEP																										
496	45.92719322	-89.65218837	0			DEEP																										
497	45.92662620	-89.65219192	0			DEEP																										
498	45.92605918	-89.65219546	0			DEEP																										
499	45.92549216	-89.65219901	0			DEEP																										
500	45.92492514	-89.65220255	0			DEEP																										
501	45.92435812	-89.65220609	0			DEEP																										
502	45.92379110	-89.65220964	0			DEEP																										
503	45.92322408	-89.65221318	0			DEEP																										
504	45.92265707	-89.65221672	0			DEEP																										
505	45.92209005	-89.65222026	0			DEEP																										
506	45.92152303	-89.65222381	0			DEEP																										
507	45.92095601	-89.65222735	0			DEEP																										
508	45.92038899	-89.65223089	0			DEEP																										
509	45.91982197	-89.65223444	0			DEEP																										
510	45.91925495	-89.65223798	0			DEEP																										
511	45.91868793	-89.65224152	18		Rope																											
512	45.91812091	-89.65224506	5	Sand	Pole					1				1	1							1									1	1
513	45.94306723	-89.65127634	1	Sand	Pole																										1	
514	45.94250022	-89.65127990	9	Sand	Pole														1		1											
515	45.94193320	-89.65128345	21		Rope																											
516	45.94136618	-89.65128701	0			DEEP																										
517	45.94079917	-89.65129056	0			DEEP																										
518	45.94023215	-89.65129412	0			DEEP																										
519	45.93966513	-89.65129767	0			DEEP																										
520	45.93909811	-89.65130122	0			DEEP																										
521	45.93853110	-89.65130478	0			DEEP																										
522	45.93796408	-89.65130833	0			DEEP																										
523	45.93739706	-89.65131189	0			DEEP																										
524	45.93683005	-89.65131544	0			DEEP																										
525	45.93626303	-89.65131899	0			DEEP																										
526	45.93569601	-89.65132255	0			DEEP																										
527	45.93512899	-89.65132610	0			DEEP																										
528	45.93456197	-89.65132966	0			DEEP																										
529	45.93399496	-89.65133321	0			DEEP																										
530	45.93342794	-89.65133676	0			DEEP																										
531	45.93286092	-89.65134032	0			DEEP																										
532	45.93229390	-89.65134387	0			DEEP																										
533	45.93172689	-89.65134742	0			DEEP																										
534	45.93115987	-89.65135097	0			DEEP																										
535	45.93059285	-89.65135453	0			DEEP																										
536	45.93002583	-89.65135808	0			DEEP																										
537	45.92945881	-89.65136163	0			DEEP																										
538	45.92889179	-89.65136518	0			DEEP																										
539	45.92832478	-89.65136874	0			DEEP																										
540	45.92775776	-89.65137229	0			DEEP																										
541	45.92719074	-89.65137584	0			DEEP																										
542	45.92662372	-89.65137939	0			DEEP																										
543	45.92605670	-89.65138295	0			DEEP																										
544	45.92548968	-89.65138650	0			DEEP																										
545	45.92492267	-89.65139005	0			DEEP																										
546	45.92435565	-89.65139360	0			DEEP																										
547	45.92378863	-89.65139715	0			DEEP																										
548	45.92322161	-89.65140070	0			DEEP																										
549	45.92265459	-89.65140425	0			DEEP																										
550	45.92208757	-89.65140781	0			DEEP																										
551	45.92152055	-89.65141136	0			DEEP																										
552	45.92095353	-89.65141491	0			DEEP																										
553	45.92038651	-89.65141846	0			DEEP																										
554	45.91981950	-89.65142201	0			DEEP																										
555	45.91925248	-89.65142556	0			DEEP																										
556	45.91868546	-89.65142911	11	Sand	Pole																											
557	45.94249773	-89.65046714	4	Sand	Pole										1										1						1	1
558	45.94193072	-89.65047070	11	Sand	Pole														1		1											
559	45.94136370	-89.65047427	22		Rope																											
560	45.94079668	-89.65047783	22		Rope																											
561	45.94022967	-89.65048139	0			DEEP																										
562	45.93966265	-89.65048495	0			DEEP																										
563	45.93909563	-89.65048852	0			DEEP																										
564	45.93852861	-89.65049208	0			DEEP																										
565	45.93796160	-89.65049564	0			DEEP																										

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
566	45.93739458	-89.65049920	0			DEEP																										
567	45.93682756	-89.65050277	0			DEEP																										
568	45.93626055	-89.65050633	0			DEEP																										
569	45.93569353	-89.65050989	0			DEEP																										
570	45.93512651	-89.65051345	0			DEEP																										
571	45.93455949	-89.65051701	0			DEEP																										
572	45.93399247	-89.65052058	0			DEEP																										
573	45.93342546	-89.65052414	0			DEEP																										
574	45.93285844	-89.65052770	0			DEEP																										
575	45.93229142	-89.65053126	0			DEEP																										
576	45.93172440	-89.65053482	0			DEEP																										
577	45.93115739	-89.65053838	0			DEEP																										
578	45.93059037	-89.65054194	0			DEEP																										
579	45.93002335	-89.65054550	0			DEEP																										
580	45.92945633	-89.65054907	0			DEEP																										
581	45.92888931	-89.65055263	0			DEEP																										
582	45.92832229	-89.65055619	0			DEEP																										
583	45.92775528	-89.65055975	0			DEEP																										
584	45.92718826	-89.65056331	0			DEEP																										
585	45.92662124	-89.65056687	0			DEEP																										
586	45.92605422	-89.65057043	0			DEEP																										
587	45.92548720	-89.65057399	0			DEEP																										
588	45.92492018	-89.65057755	0			DEEP																										
589	45.92435317	-89.65058111	0			DEEP																										
590	45.92378615	-89.65058467	0			DEEP																										
591	45.92321913	-89.65058823	0			DEEP																										
592	45.92265211	-89.65059179	0			DEEP																										
593	45.92208509	-89.65059535	0			DEEP																										
594	45.92151807	-89.65059891	0			DEEP																										
595	45.92095105	-89.65060247	0			DEEP																										
596	45.92038403	-89.65060602	0			DEEP																										
597	45.91981701	-89.65060958	0			DEEP																										
598	45.91924999	-89.65061314	22			DEEP																										
599	45.91868298	-89.65061670	9	Sand	Pole																											
600	45.94192823	-89.64965795	6	Sand	Pole									1	1				1												1	1
601	45.94136121	-89.64966152	11	Sand	Pole			1											1													
602	45.94079419	-89.64966510	16		Rope																											
603	45.94022718	-89.64966867	0			DEEP																										
604	45.93966016	-89.64967224	0			DEEP																										
605	45.93909314	-89.64967581	0			DEEP																										
606	45.93852613	-89.64967938	0			DEEP																										
607	45.93795911	-89.64968295	0			DEEP																										
608	45.93739209	-89.64968652	0			DEEP																										
609	45.93682507	-89.64969009	0			DEEP																										
610	45.93625806	-89.64969366	0			DEEP																										
611	45.93569104	-89.64969723	0			DEEP																										
612	45.93512402	-89.64970080	0			DEEP																										
613	45.93455700	-89.64970437	0			DEEP																										
614	45.93398999	-89.64970794	0			DEEP																										
615	45.93342297	-89.64971151	0			DEEP																										
616	45.93285595	-89.64971508	0			DEEP																										
617	45.93228893	-89.64971865	0			DEEP																										
618	45.93172192	-89.64972222	0			DEEP																										
619	45.93115490	-89.64972579	0			DEEP																										
620	45.93058788	-89.64972936	0			DEEP																										
621	45.93002086	-89.64973293	0			DEEP																										
622	45.92945384	-89.64973650	0			DEEP																										
623	45.92888683	-89.64974007	0			DEEP																										
624	45.92831981	-89.64974364	0			DEEP																										
625	45.92775279	-89.64974721	0			DEEP																										
626	45.92718577	-89.64975077	0			DEEP																										
627	45.92661875	-89.64975434	0			DEEP																										
628	45.92605173	-89.64975791	0			DEEP																										
629	45.92548472	-89.64976148	0			DEEP																										
630	45.92491770	-89.64976505	0			DEEP																										
631	45.92435068	-89.64976862	0			DEEP																										
632	45.92378366	-89.64977218	0			DEEP																										
633	45.92321664	-89.64977575	0			DEEP																										
634	45.92264962	-89.64977932	0			DEEP																										
635	45.92208260	-89.64978289	0			DEEP																										
636	45.92151558	-89.64978646	0			DEEP																										
637	45.92094857	-89.64979002	0			DEEP																										
638	45.92038155	-89.64979359	0			DEEP																										
639	45.91981453	-89.64979716	0			DEEP																										
640	45.91924751	-89.64980072	13		Rope																											
641	45.91868049	-89.64980429	6	Sand	Pole			1	1						1							1					1					
642	45.94135872	-89.64884878	5	Sand	Pole										2	1			1													2
643	45.94079170	-89.64885236	7	Sand	Pole									1					1		1											
644	45.94022468	-89.64885594	12	Sand	Pole																											
645	45.93965767	-89.64885952	0			DEEP																										
646	45.93909065	-89.64886310	0			DEEP																										
647	45.93852363	-89.64886668	0			DEEP																										
648	45.93795661	-89.64887026	0			DEEP																										
649	45.93738960	-89.64887384	0			DEEP																										
650	45.93682258	-89.64887742	0			DEEP																										
651	45.93625556	-89.64888100	0			DEEP																										
652	45.93568855	-89.64888458	0			DEEP																										
653	45.93512153	-89.64888815	0			DEEP																										
654	45.93455451	-89.64889173	0			DEEP																										
655	45.93398749	-89.64889531	18		Rope																											
656	45.93342048	-89.64889889	10	Sand	Pole																1											
657	45.93285346	-89.64890247	8	Sand	Pole			3						1					1													
658	45.93228644	-89.64890604	6	Sand	Pole										2				2		1											
659	45.93171942	-89.64890962	4	Sand	Pole														1								1					
660	45.93115240	-89.64891320	17		Rope																											
661	45.93058539	-89.64891678	0			DEEP																										
662	45.93001837	-89.64892035	0			DEEP																										
663	45.92945135	-89.64892393	0			DEEP																										
664	45.92888433	-89.64892751	0			DEEP																										
665	45.92831731	-89.64893109	0			DEEP																										
666	45.92775030	-89.64893466	0			DEEP																										
667	45.92718328	-89.64893824	0			DEEP																										
668	45.92661626	-89.64894182	0			DEEP																										
669	45.92604924	-89.64894539	0			DEEP																										
670	45.92548222	-89.64894897	0			DEEP																										
671	45.92491520	-89.64895255	0			DEEP																										
672	45.92434819	-89.64895612	0			DEEP																										
673	45.92378117	-89.64895970	0			DEEP																										
674	45.92321415	-89.64896328	0			DEEP																										
675	45.92264713	-89.64896685	0			DEEP																										
676	45.92208011	-89.64897043	0			DEEP																										
677	45.92151309	-89.64897400	20		Rope																											
678	45.92094607	-89.64897758	21		Rope																											

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
679	45.92037905	-89.64898116	0			DEEP																										
680	45.91981203	-89.64898473	13	Sand	Pole																											
681	45.94022218	-89.64804322	4	Sand	Pole						1				2	1											1				1	2
682	45.93965517	-89.64804681	7	Sand	Pole			1							2																	1
683	45.93908815	-89.64805039	11	Sand	Pole										1				1		1											
684	45.93852113	-89.64805398	19		Rope			1		1																1						
685	45.93795411	-89.64805757	0			DEEP																										
686	45.93738710	-89.64806116	20		Rope			1																								
687	45.93682008	-89.64806474	13		Rope																											
688	45.93625306	-89.64806833	11	Sand	Pole																					1						
689	45.93568605	-89.64807192	8	Sand	Pole			2						2							1										1	
690	45.93511903	-89.64807550	7	Sand	Pole			1						3					1							1						
691	45.93455201	-89.64807909	6	Sand	Pole														2												1	
692	45.93398499	-89.64808268	5	Sand	Pole										1						1											
693	45.93114990	-89.64810061	6	Sand	Pole			1						1					2							1						1
694	45.93058289	-89.64810419	17		Rope																											
695	45.93001587	-89.64810778	0			DEEP																										
696	45.92944885	-89.64811137	0			DEEP																										
697	45.92888183	-89.64811495	0			DEEP																										
698	45.92831481	-89.64811854	0			DEEP																										
699	45.92774780	-89.64812212	0			DEEP																										
700	45.92718078	-89.64812571	20		Rope																											
701	45.92661376	-89.64812929	0			DEEP																										
702	45.92604674	-89.64813288	22		Rope																											
703	45.92547972	-89.64813646	21		Rope																											
704	45.92491270	-89.64814005	18		Rope																											
705	45.92434569	-89.64814363	14		Rope																											
706	45.92377867	-89.64814722	12	Sand	Pole									1					1													
707	45.92321165	-89.64815080	14	Rock	Pole																											
708	45.92264463	-89.64815439	10	Sand	Pole			2						1												1						
709	45.92207761	-89.64815797	8	Sand	Pole			3		1																1						
710	45.92151059	-89.64816155	2	Rock	Pole						1																					
711	45.92037656	-89.64816872	2	Rock	Pole			1																							1	
712	45.93908564	-89.64723769	2	Sand	Pole										1							1									1	1
713	45.93851863	-89.64724128	5	Sand	Pole										1	1			1												1	1
714	45.93795161	-89.64724488	5	Sand	Pole			1						1					1												1	1
715	45.93738459	-89.64724847	5	Sand	Pole						1			1	1				1			1									1	1
716	45.93681757	-89.64725207	5	Sand	Pole														2												1	1
717	45.93625056	-89.64725567	2	Sand	Pole						1					1						1									1	1
718	45.93568354	-89.64725926	1	Sand	Pole																										1	
719	45.93114740	-89.64728802	8	Sand	Pole			2						1	1																	
720	45.93058038	-89.64729161	0			DEEP																										
721	45.93001336	-89.64729521	0			DEEP																										
722	45.92944635	-89.64729880	0			DEEP																										
723	45.92887933	-89.64730239	0			DEEP																										
724	45.92831231	-89.64730599	0			DEEP																										
725	45.92774529	-89.64730958	20	Muck	Rope																											
726	45.92717827	-89.64731317	12	Sand	Pole																											
727	45.92661126	-89.64731677	11	Sand	Pole			3						1								1				1						
728	45.92604424	-89.64732036	10	Sand	Pole			2						1							1											
729	45.92547722	-89.64732395	9	Muck	Pole		2	1																		1						
730	45.92491020	-89.64732755	7	Muck	Pole			2		1									1							1						
731	45.92434318	-89.64733114	6	Muck	Pole		1	2		1				1					1							1						
732	45.92377616	-89.64733473	5	Sand	Pole										2																	1
733	45.92320914	-89.64733833	5	Sand	Pole										1																	1
734	45.92264213	-89.64734192	5	Sand	Pole																	1									1	1
735	45.92207511	-89.64734551	5	Sand	Pole										2				1			1									1	1
736	45.92150809	-89.64734910	2	Sand	Pole				1										1			1					2				1	1
737	45.92094107	-89.64735270	4	Sand	Pole			1	1	1											1						1				1	1
738	45.93114489	-89.64647543	5	Sand	Pole				1										1							1					1	
739	45.93057787	-89.64647903	0			DEEP																										
740	45.93001085	-89.64648263	0			DEEP																										
741	45.92944384	-89.64648623	0			DEEP																										
742	45.92887682	-89.64648984	0			DEEP																										
743	45.92830980	-89.64649344	0			DEEP																										
744	45.92774278	-89.64649704	14	Muck	Rope																											
745	45.92717576	-89.64650064	9	Sand	Pole			3						1												1						
746	45.92660874	-89.64650424	7	Rock	Pole		1	1		1										1												1
747	45.92604173	-89.64650784	7	Muck	Pole		1	2		1				1					1		1					1						
748	45.92547471	-89.64651145	6	Muck	Pole		1	1		1				1					1		1					1						
749	45.92490769	-89.64651505	6	Sand	Pole										1				2												1	
750	45.92434067	-89.64651865	6	Sand	Pole		2							1	1										1		1					
751	45.92377365	-89.64652225	9	Sand	Pole		1	1											3							1						
752	45.92320663	-89.64652585	11	Muck	Pole			1		1				1												2						
753	45.92263962	-89.64652945	9	Muck	Pole			3																	1							
754	45.92207260	-89.64653305	10	Sand	Pole			2											1													
755	45.92150558	-89.64653665	11	Muck	Pole			1																								
756	45.92093856	-89.64654025	8	Muck	Pole			1		2				1												1						
757	45.93114237	-89.64566284	3	Sand	Pole										1																1	1
758	45.93057535	-89.64566645	13	Sand	Pole																					1						
759	45.93000834	-89.64567006	0			DEEP																										
760	45.92944132	-89.64567367	0			DEEP																										
761	45.92887430	-89.64567728	18		Rope																											
762	45.92830728	-89.64568089	14		Rope																											
763	45.92774026	-89.64568450	8	Sand	Pole			3		1				1						1						1						
764	45.92717325	-89.64568811	7	Sand	Pole		1							1					1							1						
765	45.92660623	-89.64569172	6	Sand	Pole															1												
766	45.92603921	-89.64569533	6	Sand	Pole		1								1				1						1							
767	45.92547219	-89.64569894	6	Sand	Pole										1				2												1	
768	45.92490517	-89.64570255	10	Muck	Pole		1	2						1					1							1						
769	45.92433816	-89.64570616	13	Muck	Pole			1																		1						
770	45.92377114	-89.64570977	13	Muck	Pole			1																								
771	45.92320412	-89.64571338	12	Muck	Pole			2																		1						
772	45.92263710	-89.64571699	12	Muck	Pole			3												1						1						
773	45.92207008	-89.64572059	11	Muck	Pole			3																								
774	45.92150306	-89.64572420	10	Muck	Pole			3																								
775	45.92093604	-89.64572781	9	Muck	Pole			3												1												
776	45.92036903	-89.64573142	3	Sand	Pole																										1	
777	45.93057283	-89.64485386	8	Sand	Pole			3						1												1						
778	45.93000581	-89.64485748	17		Rope																											
779	45.92943880	-89.64486110	16		Rope																											
780	45.92887178	-89.64486472	14		Rope			1																								
781	45.92830476	-89.64486834	9	Sand	Pole			2		1				1												3						
782	45.92773774	-89.64487196	6	Sand	Pole		1												1					1								
783	45.92717072	-89.64487558	6	Sand	Pole					1									1			1										1
784	45.92660371	-89.64487919	5	Sand	Pole			1		1				1												1					1	1
785	45.92603669	-89.64488281	8	Muck	Pole			2		1				1					1							1						
786	45.92546967	-89.64488643	9		Rope			2																		1						
787	45.92490265	-89.64489005	14	Muck	Pole			1												1												
788	45.92433563	-89.64489367	14	Muck	Pole			1																		1						
789	45.92376862	-89.64489728	13	Muck	Pole			2																		1						
790	45.92320160	-89.64490090	13	Muck	Pole																											
791	45.92263458	-89.64490452	13	Muck	Pole																					1						

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
792	45.92206756	-89.64490814	12	Muck	Pole			2																								
793	45.92150054	-89.64491175	11	Muck	Pole			3						1						1												
794	45.92093352	-89.64491537	8	Muck	Pole			3						1												1						
795	45.92036650	-89.64491899	5	Sand	Pole			2																		1					1	
796	45.93057030	-89.64404128	6	Sand	Pole			1						1								1										
797	45.93000329	-89.64404491	14		Rope																											
798	45.92943627	-89.64404854	17		Rope																											
799	45.92886925	-89.64405216	15		Rope																											
800	45.92830223	-89.64405579	12	Sand	Pole									1																		
801	45.92773521	-89.64405942	7	Sand	Pole			1						1						3						1						
802	45.92716820	-89.64406304	5	Sand	Pole										1																	1
803	45.92660118	-89.64406667	9	Sand	Pole			2						1						1						2						
804	45.92603416	-89.64407030	14		Rope																											
805	45.92546714	-89.64407392	13		Rope																											
806	45.92490012	-89.64407755	14		Rope			1																		1						
807	45.92433311	-89.64408117	15		Rope			1																								
808	45.92376609	-89.64408480	13	Muck	Pole			2																		1						
809	45.92319907	-89.64408843	13	Muck	Pole																											
810	45.92263205	-89.64409205	13	Muck	Pole		1												1													
811	45.92206503	-89.64409568	11	Muck	Pole			3															1									
812	45.92149801	-89.64409930	11	Muck	Pole			3						1																		
813	45.92093100	-89.64410293	11	Muck	Pole		1	3						1									1			1						
814	45.93056777	-89.64322870	2	Sand	Pole				1	1					1						1	1										1
815	45.93000075	-89.64323233	13	Muck	Pole																											
816	45.92943373	-89.64323597	18		Pole																											
817	45.92886672	-89.64323961	18		Rope																											
818	45.92829970	-89.64324324	16		Rope			2																								
819	45.92773268	-89.64324688	16	Muck	Rope																											
820	45.92716566	-89.64325051	13		Rope																					1						
821	45.92659865	-89.64325415	13		Rope																											
822	45.92603163	-89.64325778	16		Rope																											
823	45.92546461	-89.64326141	15		Rope																											
824	45.92489759	-89.64326505	15		Rope																											
825	45.92433057	-89.64326868	14		Rope																											
826	45.92376355	-89.64327232	13	Muck	Rope			1												1						1						
827	45.92319654	-89.64327595	13	Muck	Pole																											
828	45.92262952	-89.64327959	13	Muck	Pole																					2						
829	45.92206250	-89.64328322	11	Muck	Pole			3												1												
830	45.92149548	-89.64328685	11	Muck	Pole			3												1												
831	45.92092846	-89.64329049	11	Muck	Pole			1		1										1						1						
832	45.92999821	-89.64241976	7	Sand	Pole			1						2																		
833	45.92943119	-89.64242340	16		Rope																											
834	45.92886418	-89.64242705	17		Rope																											
835	45.92829716	-89.64243069	16		Rope																											
836	45.92773014	-89.64243433	17	Muck	Rope			1																								
837	45.92716312	-89.64243798	15		Rope																											
838	45.92659611	-89.64244162	14		Rope																											
839	45.92602909	-89.64244526	16		Rope			1																								
840	45.92546207	-89.64244891	16		Rope																											
841	45.92489505	-89.64245255	15		Rope																					1						
842	45.92432803	-89.64245619	15		Rope																											
843	45.92376102	-89.64245983	15	Muck	Rope																					1						
844	45.92319400	-89.64246348	14	Muck	Pole			1																								
845	45.92262698	-89.64246712	13	Muck	Pole																											
846	45.92205996	-89.64247076	12	Muck	Pole			2																								
847	45.92149294	-89.64247440	13	Muck	Pole			1																								
848	45.92092592	-89.64247805	10	Muck	Pole			1																								
849	45.92035890	-89.64248169	5	Sand	Pole			1		1	1																				1	
850	45.92999567	-89.64160719	5	Sand	Pole														1													
851	45.92942865	-89.64161084	10	Sand	Pole									2												1						
852	45.92886163	-89.64161449	18		Rope																											
853	45.92829461	-89.64161814	16		Rope																											
854	45.92772760	-89.64162179	16	Muck	Rope																											
855	45.92716058	-89.64162545	17		Rope																											
856	45.92659356	-89.64162910	19		Rope																											
857	45.92602654	-89.64163275	16		Rope			1		1																						
858	45.92545952	-89.64163640	16		Rope																											
859	45.92489251	-89.64164005	16		Rope																											
860	45.92432549	-89.64164370	16		Rope																											
861	45.92375847	-89.64164735	15	Muck	Rope																											
862	45.92319145	-89.64165100	13	Muck	Pole																											
863	45.92262443	-89.64165465	13	Muck	Pole									1								1										
864	45.92205742	-89.64165830	11	Muck	Pole			1		1				1												1						
865	45.92149040	-89.64166195	8	Muck	Pole			2						2									1			1						
866	45.92092338	-89.64166560	7	Sand	Pole			2		1		1		1																		
867	45.92035636	-89.64166925	6	Sand	Pole			2		1		1																				
868	45.92999312	-89.64079461	1	Sand	Pole																										1	
869	45.92942610	-89.64079827	7	Sand	Pole			2						1						1												
870	45.92885908	-89.64080193	16		Rope																											
871	45.92829206	-89.64080559	18		Rope																											
872	45.92772505	-89.64080925	16	Muck	Rope																											
873	45.92715803	-89.64081291	16		Rope																											
874	45.92659101	-89.64081657	16		Rope																											
875	45.92602399	-89.64082023	16		Rope																											
876	45.92545697	-89.64082389	16		Rope																											
877	45.92488996	-89.64082755	16		Rope																											
878	45.92432294	-89.64083121	16		Rope																											
879	45.92375592	-89.64083487	16	Muck	Rope																					1						
880	45.92318890	-89.64083853	14	Muck	Pole																											
881	45.92262188	-89.64084219	8	Sand	Pole			1						3																		
882	45.92205486	-89.64084585	5	Sand	Pole				1	1									1			1									1	
883	45.92148785	-89.64084950	5	Sand	Pole					1																	1				1	
884	45.92092083	-89.64085316	6	Sand	Pole			1		1								1													1	
885	45.92035381	-89.64085682	4	Sand	Pole			1																							1	1
886	45.91978679	-89.64086048	0			SHALLOW																										
887	45.92942354	-89.63998571	8	Sand	Pole			2						1												1						
888	45.92885652	-89.63998938	18		Rope																											
889	45.92828951	-89.63999304	16		Rope																											
890	45.92772249	-89.63999671	17	Muck	Rope																											
891	45.92715547	-89.64000038	17		Rope																											
892	45.92658845	-89.64000405	16		Rope																											
893	45.92602144	-89.64000772	16		Rope																											
894	45.92545442	-89.64001138	16		Rope																											
895	45.92488740	-89.64001505	17		Rope																											
896	45.92432038	-89.64001872	17		Rope																											
897	45.92375336	-89.64002239	9	Rock	Pole																					1						
898	45.92205231	-89.64003339	5	Sand	Pole			1		1				1								1									2	
899	45.92148529	-89.64003706	9	Muck	Pole			2		1		1						1					1			1						
900	45.92091827	-89.64004072	9	Muck	Pole			2		1										1			1									
901	45.92035125	-89.64004439	3	Sand	Pole										1																1	1
902	45.91978424	-89.64004806	5	Muck	Pole					2		1		1																		1
903	45.91921722	-89.64005172	5	Muck	Pole			1														1	1									1
904	45.91865020	-89.64005539	4	Muck	Pole									1						1		1									1	1

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
905	45.93055501	-89.63916579	5	Sand	Pole			1																							2	
906	45.92942098	-89.63917314	13	Sand	Pole																											
907	45.92885396	-89.63917682	17		Rope																											
908	45.92828694	-89.63918050	16		Rope																											
909	45.92771993	-89.63918417	15	Muck	Rope																											
910	45.92715291	-89.63918785	16		Rope																											
911	45.92658589	-89.63919153	15		Rope																											
912	45.92601887	-89.63919520	16		Rope			1																								
913	45.92545185	-89.63919888	16		Rope																											
914	45.92488484	-89.63920255	16		Rope																											
915	45.92431782	-89.63920623	15		Rope																											
916	45.92375080	-89.63920990	8	Sand	Pole																										1	
917	45.92261676	-89.63921726	0			TERRESTRIAL																										
918	45.92204975	-89.63922093	6	Muck	Pole			1		1	1	1		1									1				1				1	1
919	45.92148273	-89.63922461	8	Muck	Pole			3						1																		
920	45.92091571	-89.63922828	9	Muck	Pole			2		1				1									1			1						
921	45.92034869	-89.63923196	8	Muck	Pole			2		1													1			1						1
922	45.91978167	-89.63923563	7	Muck	Pole			1		2				1								1	1									1
923	45.91921465	-89.63923931	7	Muck	Pole			2		1				1								1	1								1	
924	45.91864764	-89.63924298	6	Muck	Pole					1												1	1									1
925	45.93168648	-89.63834584	2	Sand	Pole																										1	
926	45.93111946	-89.63834952	12	Muck	Pole																											
927	45.93055244	-89.63835321	14		Rope																											
928	45.92998543	-89.63835689	12	Muck	Pole			1							1											1						
929	45.92941841	-89.63836058	17		Rope																											
930	45.92885139	-89.63836426	17		Rope																											
931	45.92828438	-89.63836795	16		Rope																											
932	45.92771736	-89.63837163	16	Muck	Rope																											
933	45.92715034	-89.63837532	16		Rope																											
934	45.92658332	-89.63837900	15		Rope																											
935	45.92601630	-89.63838269	16		Rope																											
936	45.92544929	-89.63838637	16		Rope																											
937	45.92488227	-89.63839005	16		Rope																											
938	45.92431525	-89.63839374	13		Rope																											
939	45.92318121	-89.63840111	5	Muck	Pole			2		1																1						
940	45.92261420	-89.63840479	6	Muck	Pole					3				1												1						1
941	45.92204718	-89.63840847	7	Muck	Pole			1		2																1						1
942	45.92148016	-89.63841216	7	Muck	Pole			1		2				1																		
943	45.92091314	-89.63841584	7	Muck	Pole			2		1													1			1						
944	45.92034612	-89.63841952	9	Muck	Pole			1		1													3									1
945	45.91977911	-89.63842321	8	Muck	Pole			2										1					1									
946	45.91921209	-89.63842689	7	Muck	Pole			2		1													1			1						
947	45.91864507	-89.63843057	7	Muck	Pole			1		1								1		1												1
948	45.91807805	-89.63843426	4	Muck	Pole			1						1									1								2	1
949	45.93281794	-89.63752585	4	Sand	Pole			1										1													1	
950	45.93225092	-89.63752955	8	Muck	Pole																											
951	45.93168390	-89.63753324	10	Muck	Pole			1																								
952	45.93111689	-89.63753693	10	Muck	Pole									1						1						1						
953	45.93054987	-89.63754063	14		Rope																											
954	45.92998285	-89.63754432	16		Rope																											
955	45.92941584	-89.63754801	16		Rope																											
956	45.92884882	-89.63755171	15		Rope																											
957	45.92828180	-89.63755540	15		Rope																											
958	45.92771478	-89.63755909	16	Muck	Rope																											
959	45.92714777	-89.63756279	15		Rope																											
960	45.92658075	-89.63756648	15		Rope																											
961	45.92601373	-89.63757017	16		Rope																											
962	45.92544671	-89.63757386	16		Pole																											
963	45.92487969	-89.63757756	15		Rope																											
964	45.92431268	-89.63758125	7	Sand	Pole			1						1																		
965	45.92317864	-89.63758863	5	Muck	Pole			1		1																1						
966	45.92261162	-89.63759232	6	Muck	Pole					1												2										1
967	45.92204460	-89.63759602	7	Muck	Pole					1										1												1
968	45.92147759	-89.63759971	6	Muck	Pole			1		1								1				1										1
969	45.92091057	-89.63760340	7	Muck	Pole			1		2		1											1									1
970	45.91977653	-89.63761078	4	Muck	Pole			1						1			1														1	1
971	45.91920951	-89.63761447	6	Muck	Pole			1		1				1																		1
972	45.91864250	-89.63761816	6	Muck	Pole																											1
973	45.91807548	-89.63762186	6	Muck	Pole			2																								1
974	45.93338238	-89.63670953	3	Sand	Pole			1																			1					
975	45.93281536	-89.63671324	8	Muck	Pole			2				1																				
976	45.93224834	-89.63671694	9	Muck	Pole			3																								
977	45.93168132	-89.63672064	11	Muck	Pole			1																		1						
978	45.93111431	-89.63672434	12	Muck	Pole																											
979	45.93054729	-89.63672804	14		Rope																											
980	45.92998027	-89.63673175	15		Rope																											
981	45.92941326	-89.63673545	14		Rope																											
982	45.92884624	-89.63673915	15		Rope			1																								
983	45.92827922	-89.63674285	15		Rope																											
984	45.92771220	-89.63674655	15	Muck	Rope																											
985	45.92714519	-89.63675025	15		Rope																											
986	45.92657817	-89.63675395	15		Rope																											
987	45.92601115	-89.63675766	17		Rope																											
988	45.92544413	-89.63676136	15		Rope																											
989	45.92487712	-89.63676506	0			TEMPORARY OBSTACLE																										
990	45.92317606	-89.63677616	2	Muck	Pole				2						1																1	
991	45.92204203	-89.63678356	2	Sand	Pole			2		1				1			1															
992	45.91977395	-89.63679836	2	Muck	Pole			2				1	1	1			V										1			1	1	
993	45.91920693	-89.63680206	3	Muck	Pole			2																								1
994	45.91807290	-89.63680946	4	Muck	Pole			2		1																1						
995	45.93337979	-89.63589691	6	Muck	Pole			1						1																		
996	45.93281277	-89.63590062	9	Muck	Pole			2																								
997	45.93224576	-89.63590433	10	Muck	Pole			1						2							1					1						
998	45.93167874	-89.63590804	11	Muck	Pole			1						1												1						
999	45.93111172	-89.63591175	12	Muck	Pole																											
1000	45.93054470	-89.63591546	13		Rope																											
1001	45.92997769	-89.63591917	14		Rope																		1									
1002	45.92941067	-89.63592288	14		Rope																											
1003	45.92884365	-89.63592659	14		Rope																											
1004	45.92827664	-89.63593030	14		Rope																											
1005	45.92770962	-89.63593401	15	Muck	Rope																											
1006	45.92714260	-89.63593772	15		Rope																											
1007	45.92657558	-89.63594143	16		Rope																											
1008	45.92600857	-89.63594514	17		Rope																											
1009	45.92544155	-89.63594885	11	Sand	Pole			2						1												1						
1010	45.92487453	-89.63595256	3	Sand	Pole				1		1				1							1									1	
1011	45.93394421	-89.63508057	5	Muck	Pole			1						1								1									2	
1012	45.93337720	-89.63508429	7	Muck	Pole			1						1						1												
1013	45.93281018	-89.63508801	9	Muck	Pole			1						2																		
1014	45.93224316	-89.63509173	11	Muck	Pole																1											
1015	45.93167615	-89.63509545	11	Muck	Pole																					1						
1016	45.93110913	-89.63509916	12	Muck	Pole																											
1017	45.93054211	-89.63510288	13		Rope																											

Point Number	LATITUDE	LONGITUDE	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	Potamogeton crispus	Ceratophyllum demersum	Chara spp.	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Lemna turionifera	Myriophyllum sibiricum	Najas flexilis	Nitella sp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton friesii	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton spirillus	Potamogeton strictifolius	Potamogeton zosteriformis	Ranunculus aquatilis	Ranunculus flabellaris	Sagittaria sp. (rosette)	Spirodela polyrhiza	Vallisneria americana	Filamentous Algae
1018	45.92997510	-89.63510660	14		Rope																											
1019	45.92940808	-89.63511032	14		Rope																											
1020	45.92884106	-89.63511404	14		Pole																											
1021	45.92827404	-89.63511775	15		Rope																											
1022	45.92770703	-89.63512147	15	Muck	Rope																											
1023	45.92714001	-89.63512519	16		Rope																											
1024	45.92657299	-89.63512891	15		Rope																											
1025	45.92600597	-89.63513263	11		Rope																											
1026	45.93394162	-89.63426794	5	Sand	Pole			2				1																				
1027	45.93337460	-89.63427167	9	Muck	Pole			2						1																		
1028	45.93280758	-89.63427539	10	Muck	Pole																											
1029	45.93224057	-89.63427912	11	Muck	Pole			2						1												1						
1030	45.93167355	-89.63428285	13	Muck	Pole																											
1031	45.93110653	-89.63428657	11	Muck	Pole																											
1032	45.93053951	-89.63429030	13		Rope																											
1033	45.92997250	-89.63429403	13		Rope			1																		1						
1034	45.92940548	-89.63429775	14		Rope																											
1035	45.92883846	-89.63430148	14		Rope																											
1036	45.92827145	-89.63430521	14		Rope																											
1037	45.92770443	-89.63430893	15	Muck	Rope			1																								
1038	45.92713741	-89.63431266	16		Rope																											
1039	45.92657039	-89.63431638	15		Rope																					1						
1040	45.92600338	-89.63432011	6	Sand	Pole				1						1														1			
1041	45.93337200	-89.63345904	7	Sand	Pole			1						1						1												
1042	45.93280498	-89.63346278	10	Muck	Pole																											
1043	45.93223796	-89.63346652	9	Muck	Pole			1						2																		
1044	45.93167095	-89.63347025	12		Pole																											
1045	45.93110393	-89.63347399	13	Muck	Pole																											
1046	45.93053691	-89.63347772	12		Rope																											
1047	45.92996989	-89.63348146	13		Rope																											
1048	45.92940288	-89.63348519	13		Rope																											
1049	45.92883586	-89.63348892	14		Rope																											
1050	45.92826884	-89.63349266	15		Rope	0																										
1051	45.92770183	-89.63349639	14	Muck	Rope																											
1052	45.92713481	-89.63350013	14		Rope																											
1053	45.92656779	-89.63350386	7	Sand	Pole									1					1							1		1				
1054	45.93336939	-89.63264642	5	Sand	Pole						1			1																		
1055	45.93280237	-89.63265017	11	Muck	Pole																											
1056	45.93223535	-89.63265391	10	Muck	Pole			1																								
1057	45.93166834	-89.63265765	11	Muck	Pole			1												1												
1058	45.93110132	-89.63266140	12	Muck	Pole																											
1059	45.93053430	-89.63266514	12	Muck	Pole																											
1060	45.92996729	-89.63266888	14		Rope			1												1						1						
1061	45.92940027	-89.63267263	13	Muck	Pole																											
1062	45.92883325	-89.63267637	14		Rope																											
1063	45.92826623	-89.63268011	16		Rope														1													
1064	45.92769922	-89.63268385	15	Muck	Rope																											
1065	45.92713220	-89.63268760	6	Sand	Pole										1																	
1066	45.93279975	-89.63183755	7	Muck	Pole			1						2																		
1067	45.93223274	-89.63184130	11	Muck	Pole									1																		
1068	45.93166572	-89.63184506	12	Muck	Pole																											
1069	45.93109870	-89.63184881	12	Muck	Pole																											
1070	45.93053169	-89.63185256	12	Muck	Pole															1						1						
1071	45.92996467	-89.63185631	13		Rope																					1						
1072	45.92939765	-89.63186006	13		Rope																											
1073	45.92883064	-89.63186381	15		Rope																											
1074	45.92826362	-89.63186756	12	Sand	Pole																											
1075	45.92769660	-89.63187131	6	Sand	Pole										1								1								1	
1076	45.93223012	-89.63102870	4	Sand	Pole			1										1								1						1
1077	45.93166310	-89.63103246	11	Muck	Pole									1												1						
1078	45.93109608	-89.63103622	12	Muck	Pole																											
1079	45.93052907	-89.63103998	13	Muck	Pole																											
1080	45.92996205	-89.63104374	13		Rope																					1						
1081	45.92939503	-89.63104750	13		Rope																											
1082	45.92882802	-89.63105126	11	Sand	Pole									1												1						
1083	45.92826100	-89.63105502	2	Rock	Pole																											
1084	45.93109346	-89.63022363	6	Sand	Pole			1							1																	
1085	45.93052644	-89.63022740	13	Sand	Pole																											
1086	45.92995942	-89.63023117	13	Muck	Pole																											
1087	45.92939241	-89.63023493	15		Rope			1			1			1							1											
1088	45.92882539	-89.63023870	2	Sand	Pole						1											1										
1089	45.93165784	-89.62940726	0			SHALLOW																										
1090	45.93165520	-89.62859467	0			SHALLOW																										

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APPENDIX G

Big Arbor Vitae Fish Stocking Records - WDNR

Big Arbor Vitae Lake WDNR Muskellunge Stocking

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1972	Muskellunge	Unspecified	Fingerling	2,100	12
1973	Muskellunge	Unspecified	Fingerling	1,198	13
1974	Muskellunge	Unspecified	Fingerling	1,200	9
1977	Muskellunge	Unspecified	Fingerling	1,939	11.8
1979	Muskellunge	Unspecified	Fingerling	1,000	12
1980	Muskellunge	Unspecified	Fingerling	1,000	12
1981	Muskellunge	Unspecified	Fingerling	2,000	12
1982	Muskellunge	Unspecified	Fry	85,050	
1983	Muskellunge	Unspecified	Fingerling	2,084	10.33
1985	Muskellunge	Unspecified	Fry	82,400	1
1986	Muskellunge	Unspecified	Fingerling	1,100	11.33
1988	Muskellunge	Unspecified	Fingerling	1,211	10.4
1989	Muskellunge	Unspecified	Fingerling	2,720	2
1990	Muskellunge	Unspecified	Fingerling	1,000	10.67
1991	Muskellunge	Unspecified	Fingerling	550	11.5
1991	Muskellunge	Unspecified	Fry	180,703	1
1992	Muskellunge	Unspecified	Fingerling	91	11
1992	Muskellunge	Unspecified	Fry	95,500	1
1993	Muskellunge	Unspecified	Fry	148,400	0.4
1994	Muskellunge	Unspecified	Fry	60,000	0.4
1995	Muskellunge	Unspecified	Fry	163,900	0.4
1996	Muskellunge	Unspecified	Fingerling	944	10.2
1996	Muskellunge	Unspecified	Fry	201,900	0.5
1998	Muskellunge	Unspecified	Fry	100,000	0.5
1998	Muskellunge	Unspecified	Large Fingerling	1,167	12.1
1999	Muskellunge	Unspecified	Fry	220,300	0.5
2000	Muskellunge	Unspecified	Fry	136,350	0.5
2000	Muskellunge	Unspecified	Large Fingerling	1,100	10.7
2000	Muskellunge	Unspecified	Small Fingerling	11,688	1.1
2001	Muskellunge	Unspecified	Fry	345,200	0.5
2002	Muskellunge	Unspecified	Large Fingerling	1,090	10.6
2004	Muskellunge	Unspecified	Large Fingerling	1,090	10.25
2006	Muskellunge	Upper Wisconsin River	Large Fingerling	703	10.2
2008	Muskellunge	Upper Wisconsin River	Large Fingerling	1,090	10.4

Big Arbor Vitae Lake WDNR Walleye Stocking

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1973	Walleye	Unspecified	Fingerling	25,000	5
1975	Walleye	Unspecified	Fingerling	25,000	3
1979	Walleye	Unspecified	Fingerling	26,740	2
1993	Walleye	Unspecified	Fry	536,000	0.2
1995	Walleye	Unspecified	Fry	1,400,000	0.2

H

APPENDIX H

Great Lakes Fishery Commission: Heterosporis bulletin

***Heterosporis* sp.** *Yellow perch parasite*

Heterosporis sp. is a parasite of fish that infects muscle cells. Infected fillets have white, opaque areas in the muscle and appear “freezer-burned” or as if the tissue has already been cooked. This parasite was first identified in yellow perch from Catfish Lake in the Eagle River Chain of Lakes (Vilas County) Wisconsin in 2000. Since then, it has been detected in other lakes in Wisconsin, Michigan, Minnesota, and Canadian waters of eastern Lake Ontario. The percent of infected fish in these waters can range from less than 5% to about 30%. Prior to 2000, *Heterosporis* sp. infections were only reported in tank reared aquarium species such as angelfish and cichlids in Europe, bettas in Thailand, and Japanese eels in Taiwan. The source of *Heterosporis* infections in North America is unknown.

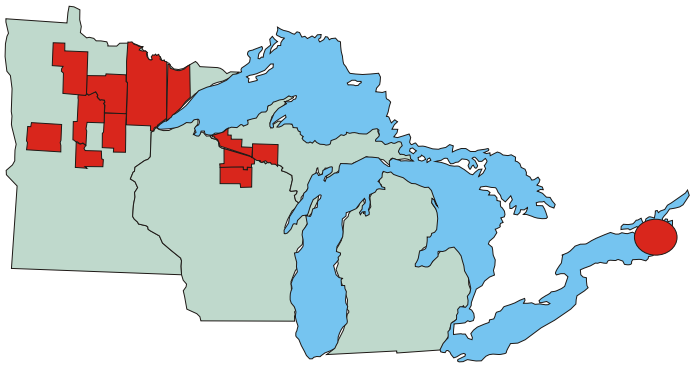
A yellow perch infected with *Heterosporis*. Notice the areas of infection where the muscle is white, opaque and appears freezer-burned or cooked. (Photograph by Dr. Dan Sutherland, University of Wisconsin-La Crosse)

Although the parasite was first observed in yellow perch, natural infections can occur in walleye, northern pike, trout-perch, burbot, pumpkinseed, sculpin and rockbass. Studies at the University of Wisconsin-La Crosse have shown other species can be infected under laboratory conditions: rainbow trout, Coho salmon, brook trout, brown trout, lake trout, white suckers, mosquito fish, channel catfish, fathead minnow, and largemouth bass. Bluegill, lake sturgeon, smallmouth bass, and golden shiners were exposed to spores, but did not become infected.

The *Heterosporis* Life Cycle. *Heterosporis* is a microsporidan parasite and part of its life cycle includes the formation of spores inside muscle cells. The spores are the infective stage of the parasite. Infection occurs when a fish eats an infected fish, or when a fish is exposed to spores in the water. Spores are released into the water when an infected fish dies and decomposes and can remain infective in water for at least two months at room temperature and up to one year in refrigerated water. Based on lab studies, opaque areas of infection in the muscle are visible to the eye about 5 weeks after a fish becomes infected. Over time, the entire muscle mass of a fish will be filled with spores and the entire fillet will become white and opaque.

Heterosporis spore bundles and spores

Heterosporis distribution (as of March 2005)



Lakes where *Heterosporis* infections have been confirmed. (The county is included in parentheses).

Wisconsin
Catfish (Vilas)
Eagle River Chain of Lakes (Vilas)
Big Arbor Vitae (Vilas)
Lac Vieux Desert (Vilas)
Robinson (Vilas)
Big St. Germain (Vilas)
Echo (Oneida)
Columbus (Oneida)

Michigan
Lac Vieux Desert (Gogebic)
Lake Emily (Iron)

Ontario
Eastern waters of Lake Ontario

Minnesota
Mille Lacs (Aitkin)
Vermillion (St. Louis)
Leech (Cass)
Gull (Cass)
Winnibigosh (Cass)
Steamboat (Cass)
Basswood (Lake)
Clitheral (Ottertail)
Horsehead (Ottertail)
Bass (Itasca)
Sand (Itasca)
Andrusia (Beltrami)
Alexander (Morrison)

Species naturally infected with *Heterosporis*:

In Wisconsin: yellow perch, walleye, pumpkinseed, sculpin, trout-perch, rock bass, and burbot; **In Minnesota:** yellow perch, walleye, and northern pike; **In Michigan**: yellow perch; **In Ontario:** yellow perch, rock bass, and pumpkinseed

Controlling the spread of *Heterosporis*

Fisheries biologists, anglers, commercial fishermen, bait harvesters and others who are involved with on-the-water activities can take the following precautions to prevent the spread of *Heterosporis* as well as the spread of other aquatic invasive species:

- Do not discard infected fish in a lake or river; place them in the garbage.

- Empty live wells and bilges away from water, in an area where the water will be absorbed into the ground.

Several methods have been found to effectively kill *Heterosporis* spores:

- Thoroughly dry boats, nets and other gear after using them, but before entering a new waterbody. Gear must be completely dry for a minimum of 24 hours for dessication to effectively kill the spores.

- Immerse gear in a chlorine bleach solution for five minutes (3 cups of household bleach in 5 gallons of water). Metal gear may be corroded when immersed in chlorine solutions. After gear has been disinfected, rinse it with clean water to remove residual chlorine. Keep chlorine solutions away from natural waterbodies. Fish and other aquatic life can be killed by trace amounts of chlorine in the water.

- Freezing at -4 °F for 24 hours (home freezer) will also kill the spores.

Until more is known about the susceptibility of other species of fish to infection by *Heterosporis*, fish should not be moved from lakes known to be infected with *Heterosporis* to other waters.

***Heterosporis* is not a human health concern** *Heterosporis* infections in the muscle will decrease the quality and change the texture of a fillet. People may choose not to consume infected fish for these reasons. Based on studies at the Centers for Disease Control in Atlanta, GA., there is no evidence that *Heterosporis* can infect people.

For more information, visit www.glfc.org/heterosporis.htm

Great Lakes Fishery Commission

SPORT FISH RESTORATION

APPENDIX I

Aquatic Plant Management Strategy – Northern Region WDNR.

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote "whole lake" management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the "up-north" appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these "invaders" benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). “

State Statute 23.24(3)(b) states:
“The department may require that an application for an aquatic plant management permit contain a plan for the department’s approval as to how the aquatic plants will be introduced, removed, or controlled.“

Wisconsin Administrative Code NR 109.04(3)(a) states:
“The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities.”

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

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* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the *nuisance* must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL AND MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose.
NR 109.02 Applicability.
NR 109.03 Definitions.
NR 109.04 Application requirements and fees.
NR 109.05 Permit issuance.
NR 109.06 Waivers.
NR 109.07 Invasive and nonnative aquatic plants.
NR 109.08 Prohibitions.
NR 109.09 Plan specifications and approval.
NR 109.10 Other permits.
NR 109.11 Enforcement.

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.07, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter. Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non−native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03; **correction made under s. 13.92 (4) (b) 7., Stats., Register March 2011 No. 663.**

NR 109.02 Applicability. A person sponsoring or conducting manual removal, burning or using mechanical means or aquatic plant inhibitors to control aquatic plants in navigable waters, or introducing non−native aquatic plants to waters of this state shall obtain an aquatic plant management permit from the department under this chapter.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.03 Definitions. In this chapter:

(1) "Aquatic community" means lake or river biological resources.

(2) "Beneficial water use activities" mean angling, boating, swimming or other navigational or recreational water use activity.

(3) "Body of water" means any lake, river or wetland that is a water of this state.

(4) "Complete application" means a completed and signed application form, the information specified in s. NR 109.04 and any other information which may reasonably be required from an applicant and which the department needs to make a decision under applicable provisions of law.

(5) "Department" means the Wisconsin department of natural resources.

(6) "Manual removal" means the control of aquatic plants by hand or hand−held devices without the use or aid of external or auxiliary power.

(7) "Navigable waters" means those waters defined as navigable under s. 30.10, Stats.

(8) "Permit" means aquatic plant management permit.

(9) "Plan" means aquatic plant management plan.

(10) "Wetlands" means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.04 Application requirements and fees. **(1)** Permit applications shall be made on forms provided by the department and shall be submitted to the regional director or designee for the region in which the project is located. Permit applications for licensed aquatic nursery growers may be submitted to the department of agriculture, trade and consumer protection.

Note: Applications may be obtained from the department's regional headquarters or service centers. DATCP has agreed to send application forms and instructions provided by the department to aquatic nursery growers along with license renewal forms. DATCP will forward all applications to the department for processing.

(2) The application shall be accompanied by all of the following unless the application is made by licensed aquatic nursery growers for selective harvesting of aquatic plants for nursery stock. Applications made by licensed aquatic nursery growers for harvest of nursery stock do not have to include the information required by par. (d), (e), (h), (i) or (j).

(a) A nonrefundable application fee. The application fee for an aquatic plant management permit is:

1. $30 for a proposed project to manage aquatic plants on less than one acre.

2. $30 per acre to a maximum of $300 for a proposed project to manage aquatic plants on one acre or larger. Partial acres shall be rounded up to the next full acre for fee determination. An annual renewal of this permit may be requested with an additional application fee of one−half the original application fee, but not less than $30.

(b) A legal description of the body of water including township, range and section number.

(c) One copy of a detailed map of the body of water with the proposed introduction or control area dimensions clearly shown. Private individuals doing plant introduction or control shall provide the name of the owner riparian to the management area, which includes the street address or block, lot and fire number where available and local telephone number or other pertinent information necessary to locate the property.

(d) One copy of any existing aquatic management plan for the body of water, or detailed reference to the plan, citing the plan references to the proposed introduction or control area, and a description of how the proposed introduction or control of aquatic plants is compatible with any existing plan.

(e) A description of the impairments to water use caused by the aquatic plants to be managed.

(f) A description of the aquatic plants to be controlled or removed.

(g) The type of equipment and methods to be used for introduction, control or removal.

(h) A description of other introduction or control methods considered and the justification for the method selected.

(i) A description of any other method being used or intended for use for plant management by the applicant or on the area abutting the proposed management area.

(j) The area used for removal, reuse or disposal of aquatic plants.

(k) The name of any person or commercial provider of control or removal services.

(3) (a) The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long−term sustainability of beneficial water use activities.

(b) Within 30 days of receipt of the plan, the department shall notify the applicant of any additional information or modifications to the plan that are required. If the applicant does not submit the additional information or modify the plan as requested by the department, the department may dismiss the aquatic plant management permit application.

(c) The department shall approve the aquatic plant management plan before an application may be considered complete.

(4) The permit sponsor may request an annual renewal in writing from the department under s. NR 109.05 if there is no change proposed in the conditions of the original permit issued.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.05 Permit issuance. (1) The department shall issue or deny issuance of the requested permit within 15 working days after receipt of a completed application and approved plan as required under s. NR 109.04 (3).

(2) The department may specify any of the following as conditions of the permit:

(a) The quantity of aquatic plants that may be introduced or controlled.

(b) The species of aquatic plants that may be introduced or controlled.

(c) The areas in which aquatic plants may be introduced or controlled.

(d) The methods that may be used to introduce or control aquatic plants.

(e) The times during which aquatic plants may be introduced or controlled.

(f) The allowable methods used for disposing of or using aquatic plants that are removed or controlled.

(g) Annual or other reporting requirements to the department that may include information related to pars. (a) to (f).

(3) The department may deny issuance of the requested permit if the department determines any of the following:

(a) Aquatic plants are not causing significant impairment of beneficial water use activities.

(b) The proposed introduction or control will not remedy the water use impairments caused by aquatic plants as identified as a part of the application in s. NR 109.04 (2) (e).

(c) The proposed introduction or control will result in a hazard to humans.

(d) The proposed introduction or control will cause significant adverse impacts to threatened or endangered resources.

(e) The proposed introduction or control will result in a significant adverse effect on water quality, aquatic habitat or the aquatic community including the native aquatic plant community.

(f) The proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

(g) The proposed management will result in significant adverse long−term or permanent changes to a plant community or a high value species in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Stuckenia pectinata (Potamogeton pectinatus), Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania spp., Zannichellia palustris and Brasenia schreberi.

(h) If wild rice is involved, the stipulations incorporated by *Lac Courte Oreilles v. Wisconsin*, 775 F. Supp. 321 (W.D. Wis. 1991) shall be complied with.

(i) The proposed introduction or control will interfere with the rights of riparian owners.

(j) The proposed management is inconsistent with a department approved aquatic plant management plan for the body of water.

(4) The department may approve the application in whole or in part consistent with the provisions of sub. (3). A denial shall be in writing stating the reasons for the denial.

(5) (a) The department may issue an aquatic plant management permit on less than one acre in a single riparian area for a 3−year term.

(b) The department may issue an aquatic plant management permit for a one−year term for more than one acre or more than one riparian area. The permit may be renewed annually for up to a total of 3 years in succession at the written request of the permit holder, provided no modifications or changes are made from the original permit.

(c) The department may issue an aquatic plant management permit containing a department−approved plan for a 3 to 5 year term.

(d) The department may issue an aquatic plant management permit to a licensed nursery grower for a 3−year term for the harvesting of aquatic plants from a publicly owned lake bed or for a 5−year term for harvesting of aquatic plants from privately owned beds with the permission of the property owner.

(6) The approval of an aquatic plant management permit does not represent an endorsement of the permitted activity, but represents that the applicant has complied with all criteria of this chapter.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03; reprinted to restore dropped language from rule order, Register October 2003 No. 574.

NR 109.06 Waivers. The department waives the permit requirements under this chapter for any of the following:

(1) Manual removal or use of mechanical devices to control or remove aquatic plants from a body of water 10 acres or less that is entirely confined on the property of one person with the permission of that property owner.

Note: A person who introduces native aquatic plants or removes aquatic plants by manual or mechanical means in the course of operating an aquatic nursery as authorized under s. 94.10, Stats., on privately owned non−navigable waters of the state is not required to obtain a permit for the activities.

(2) A riparian owner who manually removes aquatic plants from a body of water or uses mechanical devices designed for cutting or mowing vegetation to control plants on an exposed lake bed that abuts the owner's property provided that the removal meets all of the following:

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30−foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

2. Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 when performed in a manner that does not harm the native aquatic plant community; or

3. Removal of dislodged aquatic plants that drift on−shore and accumulate along the waterfront.

(b) Is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1., or in an area known to contain threatened or endangered resources or floating bogs.

(c) Does not interfere with the rights of other riparian owners.

(d) If wild rice is involved, the procedures of s. NR 19.09 (1) shall be followed.

(4) Control of purple loosestrife by manual removal or use of mechanical devices when performed in a manner that does not harm the native aquatic plant community or result in or encourage re−growth of purple loosestrife or other nonnative vegetation.

(5) Any aquatic plant management activity that is conducted by the department and is consistent with the purposes of this chapter.

(6) Manual removal and collection of native aquatic plants for lake study or scientific research when performed in a manner that does not harm the native aquatic plant community.

Note: Scientific collectors permit requirements are still applicable.

(7) Incidental cutting, removal or destroying of aquatic plants when engaged in beneficial water use activities.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.07 Invasive and nonnative aquatic plants. (1) The department may designate any aquatic plant as an invasive aquatic plant for a water body or a group of water bodies if it has the ability to cause significant adverse change to desirable aquatic habitat, to significantly displace desirable aquatic vegetation, or to reduce the yield of products produced by aquaculture.

(2) The following aquatic plants are designated as invasive aquatic plants statewide: Eurasian water milfoil, curly leaf pondweed and purple loosestrife.

(3) Native and nonnative aquatic plants of Wisconsin shall be determined by using scientifically valid publications and findings by the department.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.08 Prohibitions. (1) No person may distribute an invasive aquatic plant, under s. NR 109.07.

(2) No person may intentionally introduce Eurasian water milfoil, curly leaf pondweed or purple loosestrife into waters of this state without the permission of the department.

(3) No person may intentionally cut aquatic plants in public/navigable waters without removing cut vegetation from the body of water.

(4) (a) No person may place equipment used in aquatic plant management in a navigable water if the person has reason to believe that the equipment has any aquatic plants or zebra mussels attached.

(b) This subsection does not apply to equipment used in aquatic plant management when re−launched on the same body of water without having visited different waters, provided the re−launching will not introduce or encourage the spread of existing aquatic species within that body of water.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.09 Plan specifications and approval. (1) Applicants required to submit an aquatic plant management plan, under s. NR 109.04 (3), shall develop and submit the plan in a format specified by the department.

(2) The plan shall present and discuss each of the following items:

(a) The goals and objectives of the aquatic plant management and protection activities.

(b) A physical, chemical and biological description of the waterbody.

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

(e) An evaluation of chemical, mechanical, biological and physical aquatic plant control methods.

(f) Recommendations for an integrated aquatic plant management strategy utilizing some or all of the methods evaluated in par. (e).

(g) An education and information strategy.

(h) A strategy for evaluating the efficacy and environmental impacts of the aquatic plant management activities.

(i) The involvement of local units of government and any lake organizations in the development of the plan.

(3) The approval of an aquatic plant management plan does not represent an endorsement for plant management, but represents that adequate considerations in planning the actions have been made.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.10 Other permits. Permits issued under s. 30.12, 30.20, 31.02 or 281.36, Stats., or under ch. NR 107 may contain provisions which provide for aquatic plant management. If a permit issued under one of these authorities contains the appropriate conditions as required under this chapter for aquatic plant management, a separate permit is not required under this chapter. The permit shall explicitly state that it is intended to comply with the substantive requirements of this chapter.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

NR 109.11 Enforcement. (1) Violations of this chapter may be prosecuted by the department under chs. 23, 30 and 31, Stats.

(2) Failure to comply with the conditions of a permit issued under or in accordance with this chapter may result in cancellation of the permit and loss of permit privileges for the subsequent year. Notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder.

History: CR 02−061: cr. Register May 2003 No. 569, eff. 6−1−03.

J

APPENDIX J

Shoreland Habitat Best Management Practices Materials:

1. Wisconsin Biology Technical Note 1: Shoreland Habitat
2. Natural Resource Conservation Service Conservation Practice Standard: Shoreland Habitat

Wisconsin Biology Technical Note 1: Shoreland Habitat

Introduction

Definition of Shoreland Habitat:
An area adjacent to a water body in a non-agricultural setting that is vegetated with a diverse mixture of native species that include grasses, grass-like species, forbs, shrubs, and trees.

Purposes:

- Provide habitat for aquatic and terrestrial fauna
- Enhance adjacent shallow water habitat by providing shade and overhanging vegetation and promoting natural recovery of emergent species
- Promote shoreland corridors
- Increase the presence and diversity of native species
- Reduce the environmental and visual impact of nearby human activities
- Improve water quality
- Enhance bank stability

Interim Standard # 643A, Shoreland Habitat provides specific criteria for Shoreland Habitat establishment and for determining the dimensions of the practice (Section V). It identifies the necessary components of a Shoreland Habitat establishment plan (Section VII), and lists criteria for operation and maintenance of the practice (Section VIII). Local shoreland zoning ordinances and local shoreland restoration design standards may provide additional requirements and guidance. These may include greater buffer depths, more restrictive requirements for viewing/access corridors, and plant selection.

This technical note provides detailed guidance on the following:

Vegetation Establishment Technique ..... p. 2
Plan Components ..... p. 3
Plant Materials Selection and Density ..... p. 4
Additional Planning Considerations ..... p. 7
Steps for Accelerated Recovery ..... p. 9

- Site Preparation
- Planting Techniques

Site Care and Maintenance ..... p. 14
Resources ..... p. 17
Appendices ..... p. 19

Vegetation Establishment Techniques

Determining the appropriate vegetation establishment technique requires an assessment of the existing vegetative cover. In many cases a combination of the two general techniques described below will be appropriate due to varying existing vegetation conditions.

Initial site assessment should include:

- Identification of any native species present and their location, density, and vigor.
- Identification of any invasive species or noxious weeds present and their location, density, and vigor.
- Assessment of the density and vigor of any turf grasses present.

Natural Recovery

Natural recovery or "no-mow" zones are encouraged where feasible. Native vegetation will recover naturally when the site is protected from disturbance and where adequate seed and/or root sources and appropriate site conditions are present. Wet shoreline margins, where turf grasses are not well established, are particularly suited to natural recovery. Results may be slower than for planted buffers, but there is virtually no cost, and the end result may appear more natural.

An area where a dense growth of turf grasses has been maintained for several years is usually not well suited to natural recovery. Turf grasses frequently out-compete native vegetation, and the area may lack native seed sources. Areas with extensive stands of invasive weeds should also not be left to recover naturally.

Accelerated Recovery — Planted Buffers

Accelerated recovery techniques are most appropriate where insufficient native vegetation is present for natural recovery techniques, or where quick results are desired. Accelerated recovery techniques can include planting trees and shrubs, planting native grass and wildflower seedlings, or seeding native grasses and wildflowers. Steps for each of these accelerated recovery-planting techniques are described later in this Tech Note.

On many sites, natural and accelerated recovery techniques can be combined. For example, natural recovery might be used along the shoreline where there are native plants, and accelerated recovery used for the remainder of the restoration, where turf grasses dominate.

Plan Components

A plan shall be developed to guide the restoration process to ensure that restoration requirements and goals for the site are met. An example plan is included in Appendix 1.

The plan shall include:

- Site diagram or map
- Preparation schedule
- Planting dates and schedule
- Care and handling of plant materials
- Watering plan
- Maintenance plan including management of invasive species
- Plant and seed calculation worksheet

Site Diagram

Appendix 2 contains the "*Shoreland Habitat Plan – Site Diagram*" job sheet to assist with plan development.

The site diagram must be to scale and shall include:

- Location of existing primary structures
- Boundary of the practice
- Scale (1inch = 10 feet recommended)
- North arrow
- Location of ordinary high water mark
- Location of viewing/access corridor
- Existing shrubs and trees
- Locations where shrubs and trees are to be planted
- Areas where herbaceous cover will be planted and planting density
- A species list for the site
- Location of erosion control practices to be installed during practice establishment
- Location of practices to address channelized/concentrated flow

Plant Materials

Species Selection

Plants shall be selected from species lists of plant communities that are native to the county or region. Plants should further be chosen based on site soil, moisture, and light conditions. In some cases, such as lack of plant or seed availability, substitutions may be allowed. In addition, references such as those included at the end of this document may be used to make selections. For example, the herbarium website [http://wiscinfo.doit.wisc.edu/herbarium/Countysearch.html] can be queried based on counties, habitat types, or individual plant species.

Planting Densities

The table below describes planting standards for two major shoreland types: woodland, and barrens/dry prairie/wet prairie. The woodland has a nearly complete canopy of trees while the barrens/prairie and wetland are more open. Plant numbers are to be calculated based on the area in square feet to be reestablished and the appropriate density. The area to be reestablished shall be calculated for each layer. See Worksheet 1 for example area calculations.

Table 1. Shoreland Habitat Planting Densities

	Woodland		**Wetland or Barrens / Dry Prairie / Wet Prairie**	
Layer	**Minimum Number of Species[1]**	**Density**	**Minimum Number of Species[1]**	**Density**
Trees[2]	2	0.5 – 5 per 100 sq. ft.	0	0 - 0.2 per 100 sq. ft.
Shrubs	3	1 - 4 per 100 sq. ft. *If clumped, maintain min. 2 foot spacing*	2	0.2 - 0.5 per 100 sq. ft. *If clumped, maintain min. 2 foot spacing*
Herbaceous Cover[3]				
- Plant plugs	3	25 –75 plants per 100 sq. ft. *Soil must be mulched*	5	50 – 100 plants per 100 sq. ft. *Soil must be mulched*
- Seeding	3	Grass/Sedges: 4-8 oz. per 1000 sq. ft. Forbs: 2-4 oz per 1000 sq. ft.	5[4]	Grass/Sedges: 4-8 oz per 1000 sq. ft. Forbs: 2-4 oz. per 1000 sq. ft.

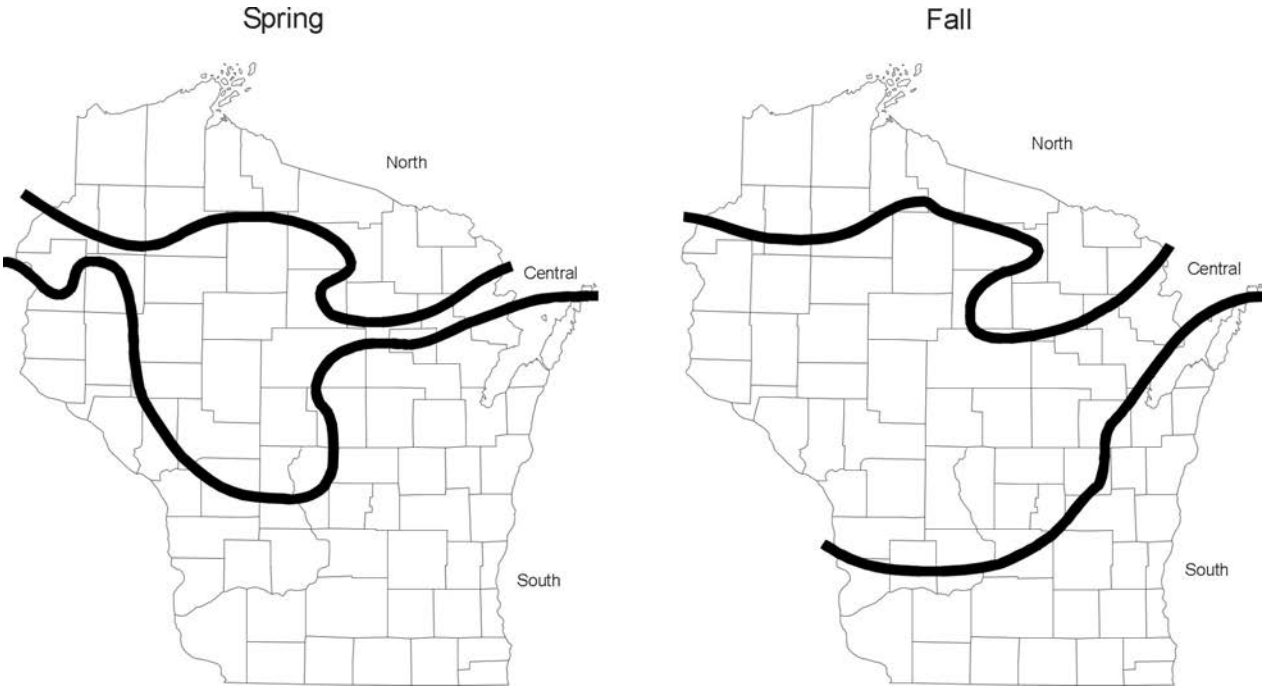
[1] Select species from established plant lists for shoreland habitat. Trees, shrubs, and groundcovers may be transplanted from adjacent woodland or open areas outside the restoration area.
[2] Trees must be at least 2 year old seedlings, 8 inches or taller.
[3] The herbaceous cover layer shall be comprised of a minimum of 30% grasses and/or sedges.
[4] Consider the use of plants rather than seeds in wet areas.

Planting Dates

The table below provides approximate dates for planting. Weather and soil conditions, which vary year-to-year, determine the most appropriate planting time. Please note that adequate moisture levels are assumed due to required watering practices.

Table 2. Recommended Planting Dates

	North	Central	South
Seeded Herbaceous Covers *Seeding early favors cool season plants. Seeding after soil temperature increases above 55 degrees favors warm season plants. Seed after July 1 to reduce weed seed germination.*	May 15 – August 10 *Best dates:* *June 1 – July 15*	May 1 – August 31 *Best dates:* *May 10 – July 20*	May 1- August 31 *Best dates:* *May 5 – July 31*
Plugs (Seedlings) and Potted Herbaceous Covers *Plant after danger of frost is past, and up to first frost. Later plantings may require more frequent watering because of increased temperatures.*	May 20 – September 15	May 1- October 31	May 1 – Nov. 15
Bare-root Trees and Shrubs	Any time soil is not frozen and before leaf-out, or after leaves fall.		
Potted Trees and Shrubs	Any time soil is not frozen.		



Worksheets for Calculating Plant and Seed Needs

Worksheet 1 can be used to calculate the square footage of area to be restored for each vegetative layer. Worksheet 2 can be used to calculate the amount of trees, shrubs, plants and seeds needed.

Worksheet 1: Area Calculations							
	Total Area of Shoreland Habitat (Square Feet)		**Total Area of Viewing/ Access Corridor**		**Total Area of Existing Layer to Preserve and/or Natural Recovery Zones**		**Total Area to be Planted**
Tree Layer		-		-		=	
Shrub Layers		-		-		=	
Herbaceous Layer - Plants		-		-		=	
Herbaceous Layer - Seeds		-		-		=	
SAMPLE[5] Herbaceous Layer-Plants	***6,000***	***-***	***1,500***	***-***	***1,000***	***=***	***3,500***

Worksheet 2: Seed or Plant Densities							
	Total Area to be Planted (Square Feet)		**Density Factor[6]**		**Seed or Plant Densities from Table 1.**		**Total Plants or Seeds to Install**
Tree Layer		÷	100	×		=	
Shrub Layer		÷	100	×		=	
Herbaceous Layer							
Plants		÷	100	×		=	
Grass Seeds		÷	1000	×		=	
Forbs Seeds		÷	1000	×		=	
SAMPLE[7] Herbaceous Layer-Plants	***3,500***	***÷***	***100***	***×***	***70***	=	***2450***

[5] This sample is 60x100 foot restoration (6,000 sq. ft.), with a 25x60 view corridor (1,500 sq. ft), and 1,000 sq. ft. of natural recovery.

[6] See Table 1, column 3, on page 4. Trees, shrubs and plant densities are given in number of plants/100 sq. ft., and seeding densities are given in number of ounces/1000 sq. ft.

[7] Sample site is 3,500 sq. ft., to be planted at 70 plant plugs per 100 sq. ft., for a total of 2450 plants needed.

Additional Planning Considerations

Exposed soil may be encountered because of erosion from runoff, bank instability, heavy use, or construction activities. Eliminate or minimize the cause of the bare soil and then stabilize the area following the guidelines below. Filter fabric fences may be necessary to capture sediment below exposed slopes. Specifications found in the Wisconsin Construction Site Best Management Practices Handbook must be followed.

Companion Seeding for Steep Slopes

When seeding on steep slopes, a companion seeding and/or other erosion control practices shall be used. See companion seeding rates table below.

Slopes >12%: Companion seeding of oats, side oats grama, or Canada wild rye.[8]
Slopes >20%: Companion seeding of oats, side oats grama, or Canada wild rye, and use either mulch and netting or an erosion control blanket.

Table 3. Seeding Rates for Companion Crops	
Oats	0.5 lbs./1000 ft.²
Canada Wild Rye	1 oz./1000 ft.²
Side Oats Grama	1 oz./1000 ft.²

Temporary Cover Crop for Exposed Soil

A temporary cover crop should be planted only if soils have been exposed, and the restoration planting is delayed. In most cases this would only occur in the late fall, generally after September 15th depending upon the location.

Table 4. Seeding Rates for Cover Crop	
Cereal Rye	0.5 – 1.0 lbs./ 1000 ft.²
Winter Wheat	0.5 – 1.0 lbs./ 1000 ft.²

[8] Oats are annuals that will temporarily stabilize an area and then be killed by a hard frost. Canada wild rye and side oats grama are short-lived native perennial grasses.

Runoff Control

Runoff from impervious surfaces and roof gutter downspouts should be directed to maximize infiltration. Runoff should be maintained in sheet flow (not channels) to the greatest extent possible. In soils where adequate infiltration cannot be achieved, outletting through a tile may be an option.

Fire Prevention

Areas with sandy soils are prone to forest fires. Conifer trees are especially susceptible to fire. To reduce fire danger, avoid planting conifers close to structures in those sandy areas of the state. Fire hazard is lower if conifers are planted on the waterward rather than the landward side of the house. Contact your local Department of Natural Resources Forest Ranger for information about fire-prone areas.

Cost of Buffer Preparation

Costs for completing a shoreland habitat project vary greatly. Planting shrubs or trees as bare-root stock greatly saves on the cost. Costs are kept to a minimum when landowners do the work themselves. If contractors are used, costs generally increase, but an experienced contractor may save money in the long run because the project may be more successful. Costs increase as the design shifts from "natural recovery" to "accelerated recovery." Seeding is generally cheaper than planting seedlings. However, seed takes longer to establish and there may be poor germination and seedling survival and excessive weed growth. Larger more established stock increases the price of the restoration. Balance budget constraints with concerns regarding timeliness and appearance.

Plant and Seed Sources

The DNR, counties, lake associations, and conservation groups sponsor shrub and tree sales annually in the spring. Statewide lists of native plant and seed sources are available from both the University of Wisconsin Extension (UWEX)[http://clean-water.uwex.edu/pubs/native/index.html] and the WDNR [http://www.DNR.state.wi.us/org/land/er/invasive/info/nurseries.htm]. Lists of sources of plants and seeds may also be available from your local government office.

Viewing and Access Corridor Design

Viewing corridors that are oriented somewhat obliquely to the shoreline, or are curved, are preferable to those that are perpendicular to the shoreline. This reduces the visual impact of human activities in the shoreland area. Corridor dimensions shall be determined by applicable county standards and ordinances; however, the maximum width of the viewing and access corridor shall be 30 feet.

Steps for Accelerated Recovery

Proper site preparation is one of the most important steps in establishing a native plant landscape. Reducing competition on the site by first removing the existing non-native vegetation is especially important. Turf grasses can quickly out-compete newly planted native plants if left in place.

Sometimes removing existing vegetation is not necessary, and it is possible to plant among existing scattered native plants or to leave zones of vegetation intact. The moist zone near the water's edge often consists mostly of native plants because turf grasses are flooded out. Seeds and underground stems may quickly revegetate the area if allowed to grow. Selected native flowers, grasses, and shrubs can usually be planted among existing native vegetation to fill in bare spots or to add color and variety. Plant flowers and grasses in a manner that will allow them to spread over the entire area. Stands of invasive plants like reed canary grass or purple loosestrife should be removed from wet areas.

Site Preparation

Removing Undesirable Vegetation

Techniques to remove existing vegetation by smothering and/or applying herbicide are described below.

Smothering – Use Black Plastic

Black plastic spread over vegetation eliminates light and creates heat that kills existing plants. This method is suitable for almost any site. In areas with high exposure to wind, extra care must be taken to anchor the plastic in place.

1. You will need
    a. 3.5 mil or thicker black plastic to adequately cover the area, plus extra to overlap sheets at least 6 inches.
    b. 4 inch or longer, 11 gauge or heavier U-shaped metal staples (enough to space 1 foot apart where plastic overlaps and at the edges).
    c. Heavy objects like logs, cement blocks, boards, or tires to hold the plastic in place.
2. Prepare the site by mowing, weed whacking, or trimming vegetation to be removed.
3. If soil is dry, water thoroughly. This will increase the weed killing effectiveness.
4. Lay down the plastic. Overlap the plastic at least 6 inches if using more than one piece. Staple in place at one-foot intervals as it is laid down.

5. Place heavy objects over plastic. All seams and edges must be firmly anchored to exclude light. Edges can also be buried in a shallow trench to help hold them in place.
6. Leave the plastic in place for 4-6 weeks during spring or summer. Make certain there is no sign of living vegetation before removing it.
7. Remove plastic, but leave dead vegetation in place. If using plant mulch over the dead vegetation, plant directly through the mulch.

Applying Herbicide

A glyphosate herbicide like *Roundup*® is recommended. Avoid drift of herbicide to water. If herbicide is to be applied in or over the water, an aquatic glyphosate formulation such as *Rodeo*® must be used, and a Department of Natural Resources permit is required. *Always follow label instructions carefully.*

Timing of herbicide applications is crucial. Do not apply when rain is forecast in the next 24 hours. Do not apply on windy days, since vegetation you wish to preserve may be damaged by herbicide drift. Vegetation must be actively growing for glyphosate herbicides to be effective. To encourage growth, mow grass and allow it to regrow several inches. Air temperature must be between 50 and 75 degrees Fahrenheit for cool season plants like quack grass and brome grass to be actively growing, and therefore effectively killed by the herbicide.

Be certain that vegetation is dead before planting. If turf is still green or yellow-green after 7 – 10 days, a repeated herbicide application is recommended.

Soil Amendments

In most cases soil amendments are **not** required to plant native plants. Adding black dirt or manure can be detrimental to lakeshore plantings. These soil amendments will favor weed growth, and the native plants may grow more quickly and be less sturdy.

Planting Techniques

Seedlings

Fertilizer use is recommended where mulches are used because they demand nitrogen as they decompose. Fertilizer should never be broadcast due to the potential for runoff into the lake. Instead, apply a very small amount of slow release *phosphorous free* fertilizer in each planting hole. Phosphorus levels are adequate in most soils, and phosphorus can increase algae growth in the lake. Phosphorus is the middle number of the three given on the fertilizer bag.

Application amounts will vary depending on nutrient concentration. For a 6-0-6 NPK ratio, use one teaspoon of organic fertilizer per grass or wildflower plant and ¼ cup per shrub or tree. Up to one cup can be added to larger shrub or tree planting holes.

Dead vegetation left in place after smothering or an herbicide application does not need to be removed. Leave the dead material to serve as a mulch to capture moisture, reduce weed growth,

and add organic material to the soil. Plant seedlings directly through the dead material. Roots must be buried in soil and not in the thatch of dead lawn, where the plant would quickly dry out and die.

Plants Installation

1. ***Lay mulch down prior to planting.*** Spread 2 to 3 inches of straw, wood chips, leaves, or pine needles to conserve moisture and reduce weed growth. Avoid using field hay because it generally contains weed seeds. Do not use marsh hay, which is reed canary grass, and is an invasive species.
2. ***Be ready to water.*** Watering plant plugs is critical to their success. Be ready with hoses and sprinklers before planting. Water seedlings immediately after they are planted.
3. ***Dig holes for plants***. A bulb planter or bulb auger drill bit attached to an electric drill will work well to speed up planting. Be sure the holes for the plants penetrate the dead grass.
4. ***Fertilize.*** A small amount of slow release, phosphorus-free fertilizer is recommended. The second number on the fertilizer label represents phosphorus. To fertilize, place a small amount in each plant hole. Excess fertilizer will encourage weed growth.
5. ***Place live plants in the ground soon after they are brought to the site.*** To store plants for a few days before planting, keep them in an area with partial sun such as on the east side of a building or under a deciduous tree. Do not leave them in a dark area for long periods; this will weaken plants. Water to keep packs moist once or twice a day.
6. ***Plant in the cool hours of the day.*** Plants will have a greater survival rate if planted on a cool day or during the morning or evening hours. To plant, separate the mulch, dig a hole, sprinkle organic fertilizer, place the plug in the hole, press the soil gently around the plug, and replace the mulch, being careful to keep mulch 1/2" from stem of plants.
7. ***Water.*** Water immediately after planting. Plan to water at least daily for the first few weeks or until plants are well established. If plants wilt or droop, a repeated watering may be necessary during the day. Once plants are established, water only if prolonged dry periods occur.

Seed Installation

1. ***Rake or till only enough to expose soil for planting seed***, no more than 1–2 inches deep.
2. ***Select seed.*** Refer to Table 1 for seeding densities. Greater amounts of seed will result in denser growth and better chances for success. Include 1 ounce of Canada wild rye per 1,000 square feet if desired. This seed will germinate readily to indicate areas where seeding is successful and help to hold the soil in place. Canada wild rye is a short-lived native perennial grass.
3. ***Mix seeds with slightly moist sand or sawdust.*** Fill an ice cream pail or similar one gallon bucket 2/3 full with moist, but not wet, sand or sawdust. Add up to 4 ounces of seed and mix well. The seeds will adhere to the sand or sawdust, so they can be spread more thinly and evenly.
4. ***Broadcast the seed/sand mixture.*** Use half of the seed/sand mixture to cover the entire area. Sow the remaining half while walking perpendicular to the line of the first pass to assure good

seed distribution. The sand or sawdust will make it easier to see places that have not been seeded.

5. ***Press seed in by tamping down the soil*** with a rake or lightly raking the seeds in. The site may be rolled with a water-filled roller to insure good soil/seed contact. Do not roll when soil is wet, this will compact the soil, decrease levels of oxygen in the soil, and reduce seed germination.
6. ***Mulch lightly*** with 1/2 inch of weed free straw. Soil must be visible between the straw stems, or the mulch is too thick to allow seedlings to grow. If mulch is used on steep slopes, hold it in place with jute or biodegradable net. A biodegradable erosion control blanket up to ½ inch thick may be used as an alternative to mulch.
7. ***Water.*** Water immediately following seeding. Watering seeds and small seedlings after sprouting is critical for sandy soils. Plan to water daily, preferably in the morning, for the first few weeks or until plants are well established. Check to see that soil is moist beneath the mulch. Very sandy sites may require watering more than once daily for the first few weeks. Once plants are established, water only if prolonged dry periods occur.

   Note: Watering *may* not be necessary for spring plantings in areas with loamy or clay soils as long as regular (weekly) rainfall of ½ inch or more occurs.

Shrubs and Trees

1. ***Keep bare-root stock moist and cool before planting.*** Dormant bare-root shrubs can be ordered in fall or winter for delivery in the spring. Plant bare-root stock as soon as it arrives if possible. If necessary, store bare-root stock close to 34 degrees Fahrenheit, to avoid breaking dormancy. Keep tree roots moist by periodically sprinkling with water. Do not soak roots in water because this will deprive them of oxygen.

2. ***Dig the hole deeply enough*** so that the roots won't curl or bunch up. The trees and shrubs should be planted about one-half inch deeper than they were in the nursery. Paler colored bark and a slight swelling on the stem show where the old soil line was. Bare rootstock may need to be root pruned. For more information about bare rootstock refer to WDNR website [http://www.DNR.state.wi.us/org/land/forestry/nursery/generalinfo/plantingprocs.htm#seedling] and contact your local forester.

3. ***Pack soil firmly around the roots.*** Air pockets left around the roots will dry them out. Press soil around the roots with your foot, but do not stomp on them.

4. ***Water regularly*** to keep soil moist but not saturated.

5. ***Mulch*** a two-foot diameter circle around each plant 2 to 3 inches deep with wood chips, straw, or leaves. This will reduce competition with other plants. Keep this area free of other growth by weed whacking or hand-pulling weeds for the first couple of years. Avoid mulching where there are steep slopes. In this case, reduce competition by weed whacking.

Transplanting Trees and Shrubs

It is best to transplant when trees and shrubs are dormant in the early spring or late fall. Identify and label trees and shrubs when leaves are on the plant. Obtain permission from the landowner before removing plant material. Dig up as much of the root as possible. Replace the duff layer of leaves and stems to reduce erosion at the site. Only dig up trees and shrubs if they are part of a large stand or if the seedlings are numerous. If the tree or shrub is uncommon or rare, do not move it. Only remove a small percentage of any one type of plant. Leave behind a large enough population to allow further reproduction of the native population.

Site Care and Maintenance

The most ideal maintenance is to simply leave the site alone. Do not fertilize, do not mow, do not rake, do not "clean up" fallen limbs or trees. Allow native vegetation to regrow.

In accelerated recovery areas, some initial maintenance may be required. Pulling invasive weeds around native shrubs, trees, and groundcovers the first year or two eliminates competition and will help to give them a good start. Maintenance over the long-term must be in accordance with the local shoreland ordinance requirements.

The duff layer, made up of fallen leaves and pine needles, should be left intact. This layer covers the soil, thereby conserving moisture, preventing erosion, and allowing water to infiltrate into the soil.

Year One

Watering

Regular watering in the first two months of a spring or summer planting is one of the most important factors for success. Without supplemental watering, roots may not reach the soil moisture they need. Watering at least 30 minutes each day allows vigorous root growth for plants to become quickly established. Timers to turn water on and off automatically are available from hardware and garden supply stores.

Where drainage is poor, water only in the morning, not at night when evaporation is reduced. Fungal diseases that start with excess moisture can kill young seedlings. Use lake water if feasible, since this water often is warmer and more nutrient-rich than well water. Pumping water from the lake is allowed in Wisconsin as long as no type of structure is left in the lake.

Protection Against Deer Browsing

Whitetail deer and other animals may damage plantings, especially trees and shrubs. Protect against damage by physical or chemical means. Surround newly planted trees and shrubs with 4 – 6 foot high, galvanized mesh fence supported with wooden stakes or fence posts, or cover plants with bird netting. Landscape products available to spray on plants deter browsing through strong tastes or odors. Red pepper spray is an example. Use of these products may need to be varied as deer become accustomed to their taste or smell. Protection against deer browsing is particularly important if deer are fed on the site or nearby. Deer feeding should be discouraged near restoration areas. For more information about deer damage refer to Craven et. al and the following Web site: [http://www1.uwex.edu/ces/pubs/pdf/G3083.PDF].

Weeding Planted Areas
Pull weeds out as early as possible being careful to not disturb the native plants. Be especially diligent in areas where non-native invasive species like purple loosestrife, mullein, lamb's quarter, quack grass, reed canary grass or bluegrass are known to be present.

Weeding Seeded Areas
It can be difficult to tell weeds from the native plants in a seeded area. Sprouting a small sample of the native seeds in a plant tray will assist with their identification. Cut off flowering heads of weeds before they go to seed. Perennial natives will eventually out-compete annual weeds that sprout from seed.

Another alternative is to repeatedly trim weedy vegetation to 6 to 8 inches with a weed-whacker. Remove clippings immediately if they cover the native seedlings. This will discourage weed growth, remove shade, and allow native seedlings to grow.

Fertilizing And Applying Insecticides
Fertilizers and insecticides should be avoided. Applying fertilizers may encourage weed growth. If native plants are selected appropriately, supplemental fertilization should not be required. Also avoid applying insecticides since so many are non-specific and can harm or even kill non-target species.

Vegetative Cover
At the end of the growing season, allow all dead vegetation to remain in place. It becomes a valuable seed source for next year's growth, provides food and cover for wildlife, and will help to cover the soil and slow spring runoff. The grass seed and dried flower heads add another level of appeal to the native landscape in the winter months.

Year Two

Watering
Water only during periods of severe drought.

Weeding
Thoroughly weed early in the summer. After this initial weeding, check for and remove weeds at least once a month.

Year Three and Beyond
No watering or weeding should be necessary except for extreme drought conditions or stubborn invasive weed problems. Leave vegetation in place in the fall and through the winter months. Approval from the zoning or land conservation office is required for extensive weed removal in the shoreland zone.

Prairie and savanna areas may be trimmed or burned only under an approved management plan. Additional permits or approval may be necessary before trimming or burning. Trim groundcover

in prairie areas no more than once every three to five years. Groundcover should be cut no less than 6-8 inches high. Cut vegetation in the late winter when the ground is still frozen, or in late spring, when the ground is dry enough to walk on without damaging new growth. Leave all dead plant clippings on-site. They will add to the shoreland soil structure. A controlled burn may be appropriate only in prairie and savanna areas. A burn should not be attempted until the prairie or savanna is well established – usually after five or more years. To determine if a controlled burn is appropriate evaluate the site for safety considerations; threats to structures, shrubs, and trees; and weed species present. In addition to any required permits, Department of Natural Resources broadcast burning permits are required in intensive fire zones.

Except in prairie areas that are identified in an approved management plan, any native trees, shrubs, and groundcover in the restoration area shall be left undisturbed. Trees and shrubs are intended to move in to create multiple layers of canopy cover. Tree thinning or removal of dead or diseased trees requires approval of the appropriate administering agency.

Vehicles shall be excluded from the buffer except for limited use in the viewing/access corridor. Docks and boatlifts shall be stored outside the buffer or in the viewing/access corridor.

Resources

References for Plant Selection

Please note that counties may have approved or recommended plant lists.

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SHORELAND HABITAT

(Acres)
CODE 643A (Interim)

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

Area adjacent to a waterbody or watercourse in a non-agricultural setting that is vegetated with a *diverse*[1] mixture of native species that can include grasses, grass-like species, forbs, shrubs, and trees.

II. Purposes

A. Provide habitat (food, shelter, nesting sites, over-winter cover) for aquatic and terrestrial fauna.

B. Enhance *littoral zone* (shallow water) habitat function for a broad range of vertebrate and invertebrate species by providing shade and cover with overhanging vegetation, and promoting natural recovery of emergent species.

C. Provide a source of detritus (decomposing organic matter) and large woody cover for aquatic organisms.

D. Provide shade to lower water temperatures and facilitate higher dissolved oxygen concentrations to improve habitat for aquatic organisms.

E. Promote shoreland corridors for aquatic and terrestrial flora and fauna.

F. Increase the presence and diversity of native plant and animal species in shoreland areas.

G. Reduce the environmental and visual impact of human activities in the near-shore area.

H. Improve water quality by reducing the amount of sediment and other pollutants, such as pesticides and nutrients in surface runoff.

I. Enhance bank stability by limiting intensive use, and reducing wave impact.

III. Conditions Where Practice Applies

This practice applies, but is not limited to, areas of shoreland development where it is desired to enhance or restore native mixed vegetation for the improvement of fish and wildlife habitat, water quality and bank stability.

Where the primary purpose is to control sediment to environmentally sensitive areas, refer to the Natural Resources Conservation Service (NRCS) Field Office Technical Guide Section IV (FOTG), Standard 393, Filter Strip.

Where the primary purpose is to control bank erosion, refer to NRCS FOTG Standard 580, Streambank and Shoreline Protection to be used in conjunction with this standard.

IV. Federal, State, and Local Laws

Installation and maintenance of shoreland habitat shall comply with all federal, state, and local laws, rules, or regulations. The landowner is responsible for securing required permits. This standard does not contain text of any federal, state, or local laws.

V. Criteria

The Wisconsin Biology Technical Note 1: Shoreland Habitat is an important guidance document to this standard. This can be found either in the NRCS Field Office Technical Guide (FOTG) or on the NRCS website: [http://www.wi.nrcs.usda.gov/fotg/index.html]

A. Establishment

1. Shoreland habitat shall be established by planting a diverse mix of native species that are adapted to site conditions and are representative of area plant communities. Where appropriate, natural recovery techniques may be utilized rather than planting. Refer to county species lists and/or the Wisconsin Biology Technical Note 1: Shoreland Habitat, where applicable.

2. In order to restore the functional values of a shoreland habitat, vegetation shall be vigorous, diverse and structurally complex

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

and shall include herbaceous cover, a shrub layer and a tree canopy. The only exception to this requirement shall be where natural conditions in the region lack these habitat components.

3. *Invasive plants* shall not be included in any installation.

4. Invasive plants and state listed *noxious weeds* shall be *controlled* during establishment, if present.

5. Exposure of bare soils during establishment shall be kept to a minimum. Measures shall be taken to prevent erosion.

6. Phosphorus application is only permitted where soil tests indicate a deficiency. Where fertilizer application is necessary, no drift or misapplication into the water shall occur.

7. Heavy equipment shall be excluded from the shoreland habitat area, to avoid compaction of soil.

8. Weeds shall be controlled until the shoreland habitat species are established.

9. A watering schedule shall be followed until species are established.

B. The starting point for measuring minimum shoreland habitat depths for the following landscape features shall be as follows.

1. Lakes. Practice depth shall be measured from the *ordinary high water mark* (OHWM) landward perpendicular to the shoreline.

2. Perennial and intermittent streams, and springs. Practice depth shall be measured from the OHWM. Each side of the stream shall be evaluated independently.

3. Wetlands. Practice depth shall be measured from the upland-wetland interface.

4. Existing tree and shrub corridors. Existing tree and shrub corridors shall be included as part of the measured practice depth.

C. Shoreland habitat dimensions

1. Practice depth: The minimum practice depth is 35 feet. Greater practice depths provide increased benefit and are encouraged.

   a. Where the principal structure is within 50 feet of the OHWM, land within 15 feet of the structure may be excluded from the practice.

2. Practice length: The practice shall extend the entire length of the lot, except that a viewing and access corridor is allowed.

3. A viewing and access corridor may extend from the lake inland. Corridor dimensions shall be determined by applicable county standards and ordinances. The maximum viewing corridor width is 30 feet.

D. Runoff from impervious surfaces, such as rooftops and driveways, in the contributing drainage area shall be evaluated and treated to promote infiltration and sheet flow.

E. When soil disturbance is necessary due to bank or gully repair, the appropriate action shall be taken to limit the disturbance and protect and replant all disturbed areas in accordance with this standard.

F. Areas of concentrated flow shall be evaluated and treated.

G. Areas below the OHWM shall not be disturbed. This does not preclude practices intended for bank stabilization.

VI. Considerations

A. Consider using this practice to enhance the conservation of declining species.

B. Consider marking practice boundaries in an identifiable manner until established.

VII. Plans and Specifications

Plans and specifications for the shoreland habitat describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall be prepared for each specific site where the practice will be installed. A plan includes information about the location, site preparation, vegetation establishment, and operation and maintenance requirements.

Plan specifications will include the following (see Wisconsin Biology Technical Note 1: Shoreland Habitat).

A. Dimensions of the practice to accomplish the planned purpose.

B. Site map or diagram.

C. Species selection, planting rates, location and spacing to accomplish the planned purpose.

D. Planting dates, care, and handling of the seeds or plants to ensure an acceptable rate of survival.

E. Site preparation sufficient to establish and grow selected species.

F. Identification and treatment of concentrated flow areas.

G. Operation and Maintenance Plan.

VIII. Operation and Maintenance

A. Dead or windblown trees provide cover and refuge for fish and wildlife, and should be left in place. Tree thinning or removal of dead or diseased trees requires approval by the appropriate administering agency.

B. Mowing or other removal of ground cover is prohibited in the practice area except as part of an approved maintenance plan.

C. The duff layer, made up of fallen leaves and/or pine needles, must be left intact. This layer covers the soil, thereby conserving moisture and preventing erosion.

D. State listed noxious weeds shall be controlled. Control of invasive plants is encouraged.

E. Herbicides are prohibited except as required for control of invasive plants and as approved by the appropriate administering agency. Avoid damage to shoreland habitat vegetation from herbicide application to nearby areas.

F. Fertilizers are prohibited after the establishment year, except as approved by appropriate administering agency.

G. Except for an access corridor, areas waterward of the practice shall be undisturbed.

H. Boats, docks and other equipment shall be excluded from the practice area to prevent soil compaction and damage to practice vegetation.

I. Vehicles shall be excluded except as necessary for establishment and maintenance activities.

J. Activities are prohibited in the practice area which damage or destroy the vegetation, such as piles of leaves, boards, etc.

IX. References

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UW Madison herbarium website (good source of county species lists):_[http://wiscinfo.doit.wisc.edu/herbarium/Countysearch.html].

Wisconsin Manual of Control Recommendations for Ecologically Invasive Plants: [http://www.dnr.state.wi.us/org/land/er/invasive/manual_toc.htm].

X. Definitions

Control (V.A.4.) – To destroy the above-ground portion of a weed in a manner and at the proper time to prevent the development and distribution of viable seeds or other propagules and their spread from one area to another. For species that reproduce vegetatively, control includes the use of methods which help contain or reduce the vegetative spread of the weed.

Diverse (V.A.1.) – For the purposes of this standard, a mix of plants is considered diverse when it meets the minimum number of species as specified in Wisconsin Biology Technical Note 1: Shoreland Habitat, Table 1.

Invasive plants (V. A. 3.) – Having the ability to significantly displace desirable vegetation in landscapes or to reduce yield of growing crops. The Department of Natural Resources Bureau of Endangered Resources maintains a list of invasive plants. For more guidance refer to the following Web site: [http://www.dnr.state.wi.us/org/land/er/invasive/index.htm].

Littoral zone (II.B.) – The near shore area of a lake or wetland where water is shallow enough to support the growth of rooted aquatic vegetation.

Noxious weed (V. A. 4.) – "Noxious weed" means Canada thistle, leafy spurge and field bindweed (creeping jenny) and any other weed the governing body of any municipality or the county board of any county by ordinance or resolution declares to be noxious within its respective boundaries (ref. WI Statute, Chapter 66, part 66.0404). For more information refer to the following Web site: [http://www.legis.state.wi.us./rsb/stats.html].

Ordinary high water mark (V. B. 1.) – The ordinary high water mark (OHWM) is the point on the bank or shore where the water is present often enough so that the lake or streambed begins to look different from the upland. Specifically, the OHWM is the point on the bank or shore up to which the water, by its presence, wave action, or flow, leaves a distinct mark on the shore or bank. The mark may be indicated by erosion, destruction of or change in vegetation, or other easily recognizable characteristics.

The OHWM can be located through on-site studies of physical and biological conditions at the shoreline. The principal indicator is the change from water plants to land plants. In the area where the plants change, the investigator may also use indicators such as change in soil type, ridges, or other erosion marks or water stains on rocks, soils, trees, or structures. If none of these indicators are available in the immediate location, the elevation of the OHWM may be found at another spot and transferred to that site in question.