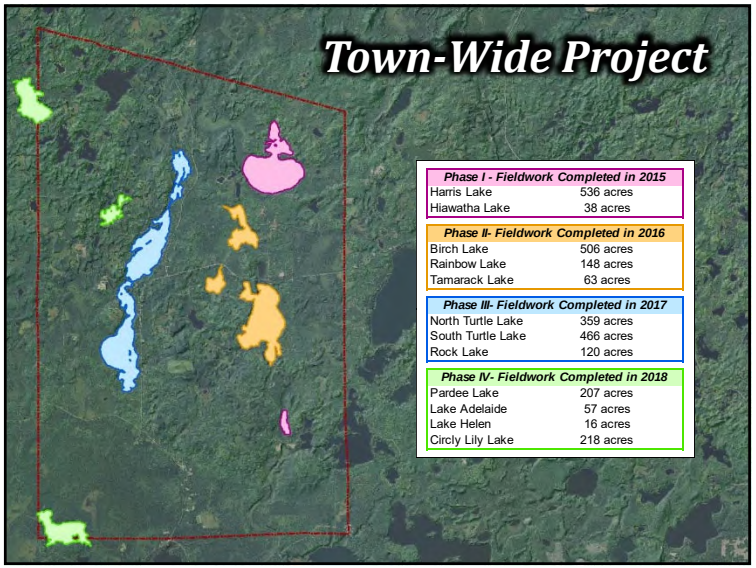
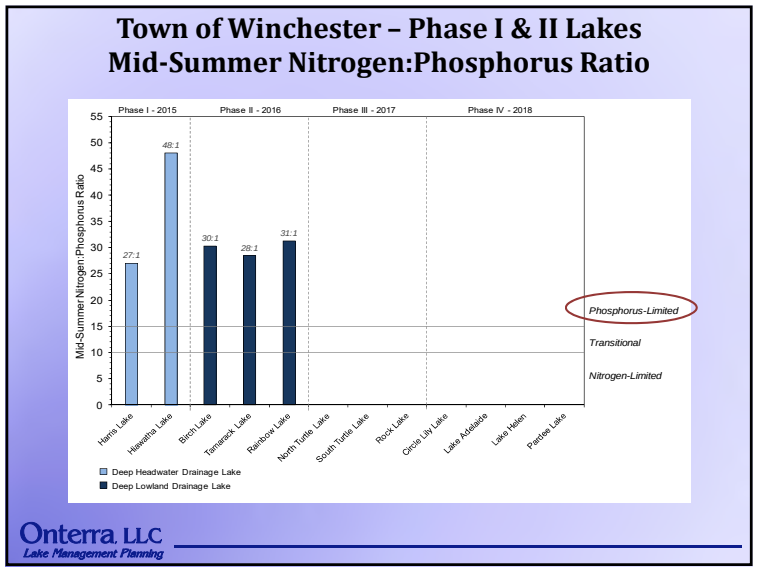

North Lakeland Discovery Center
Town of Winchester
Phase II
Birch, Tamarack, & Rainbow Lakes
Management Planning Project
Planning Meeting II
June 23, 2017
Brenton Butterfield
Onterra LLC
Lake Management Planning


Town-Wide Project
Phase I - Fieldwork Completed in 2015
Harris Lake 536 acres
Hiawatha Lake 38 acres
Phase II- Fieldwork Completed in 2016
Birch Lake 506 acres
Rainbow Lake 148 acres
Tamarack Lake 63 acres
Phase III- Fieldwork Completed in 2017
North Turtle Lake 359 acres
South Turtle Lake 466 acres
Rock Lake 120 acres
Phase IV- Fieldwork Completed in 2018
Pardee Lake 207 acres
Lake Adelaide 57 acres
Lake Helen 16 acres
Circly Lily Lake 218 acres


Town of Winchester – Phase I & II Lakes
Mid-Summer Nitrogen:Phosphorus Ratio
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Mid-Summer Nitrogen:Phosphorus Ratio
27:1
48:1
30:1
28:1
31:1
Phosphorus-Limited
Transitional
Nitrogen-Limited
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
Deep Headwater Drainage Lake
Deep Lowland Drainage Lake
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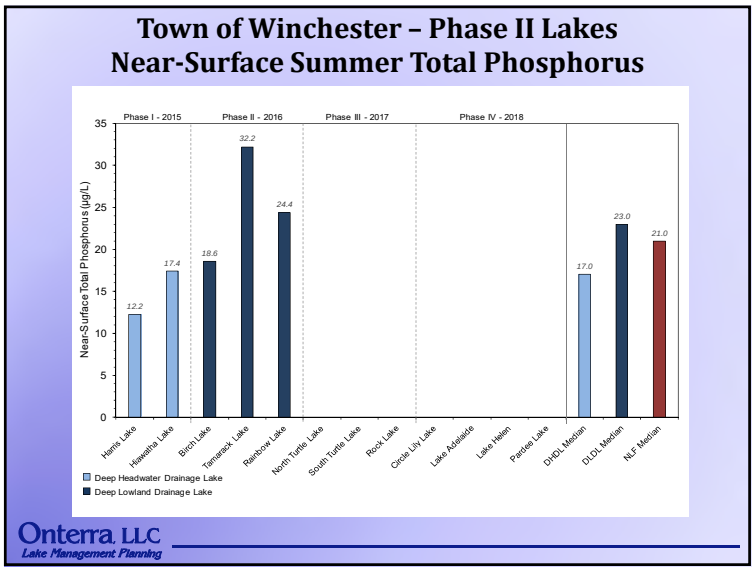
Town of Winchester – Phase II Lakes
Near-Surface Summer Total Phosphorus
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Near-Surface Total Phosphorus (µg/L)
12.2
17.4
18.6
32.2
24.4
17.0
23.0
21.0
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
DHDL Median
DLDL Median
NLF Median
Deep Headwater Drainage Lake
Deep Lowland Drainage Lake
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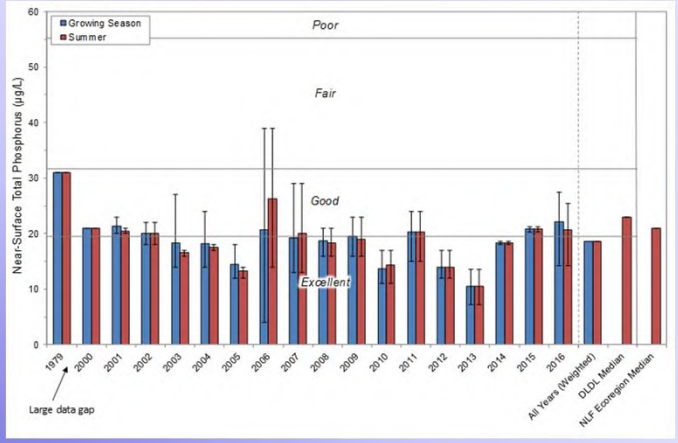
Birch Lake Total Phosphorus



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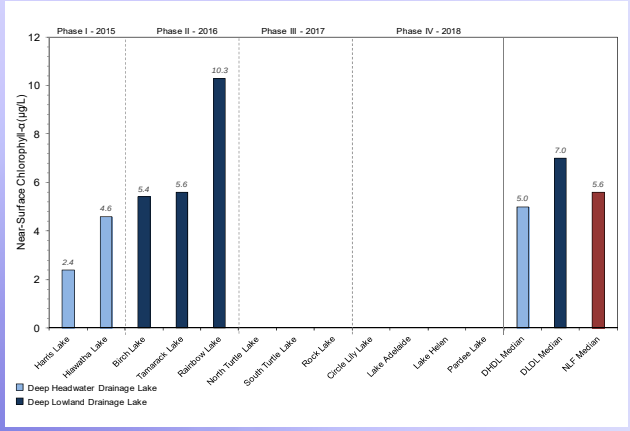
Town of Winchester – Phase I Lakes Chlorophyll-*a*



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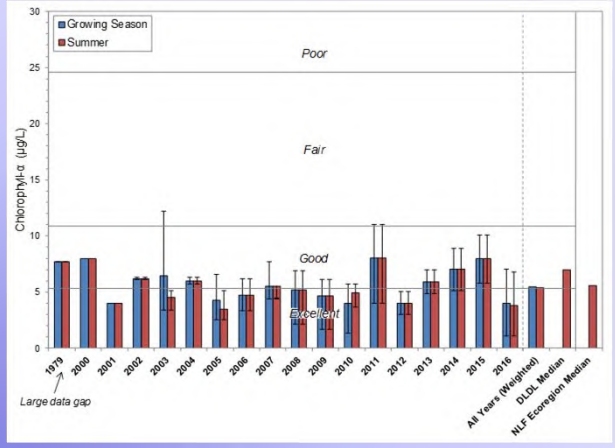
Birch Lake Chlorophyll-α



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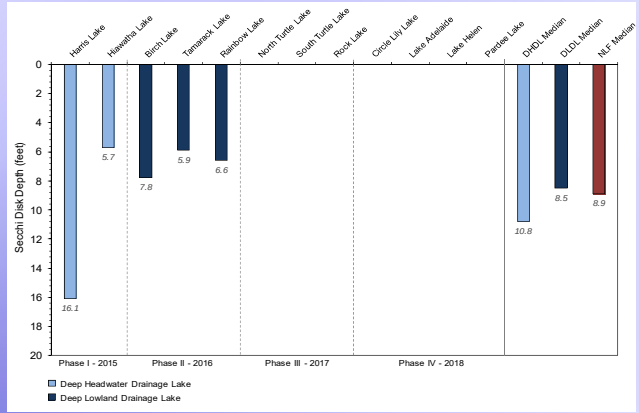
Town of Winchester – Phase I Lakes Secchi Disk Transparency



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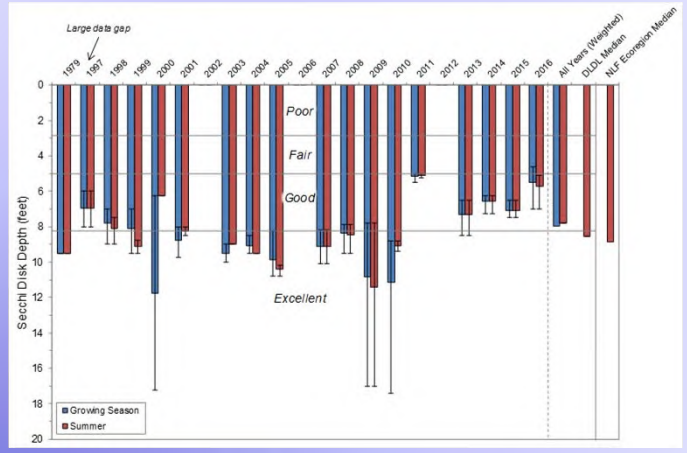
Birch Lake Secchi Disk Depth



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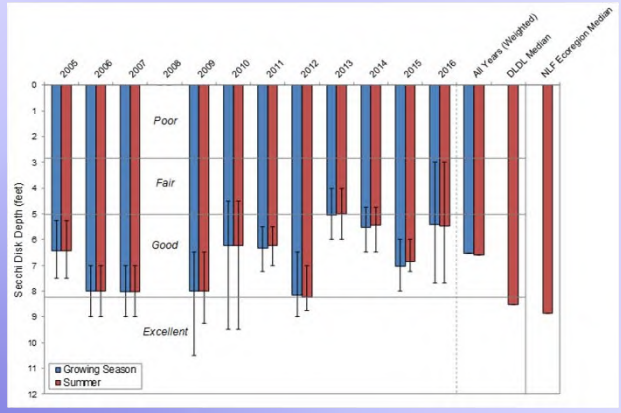
Rainbow Lake Secchi Disk Depth



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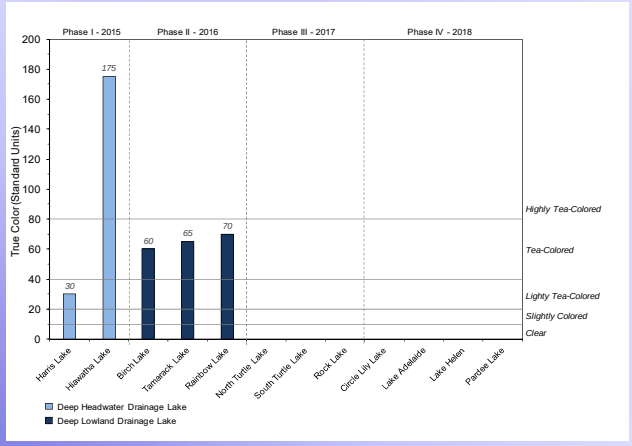
Town of Winchester – Phase I Lakes True Color



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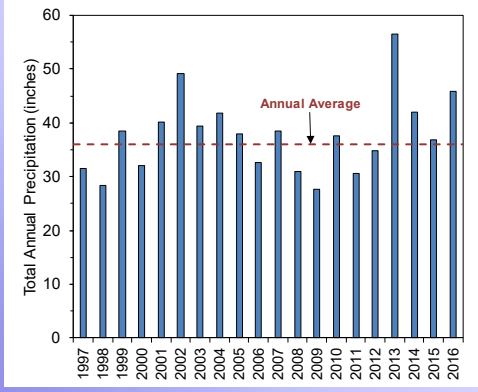
Annual Precipitation Data – Hurley, WI



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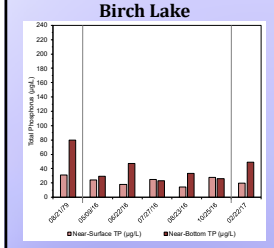
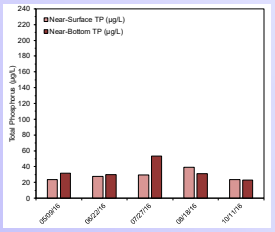
Internal Phosphorus Loading

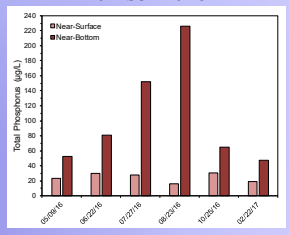
Birch Lake



Tamarack Lake



Rainbow Lake



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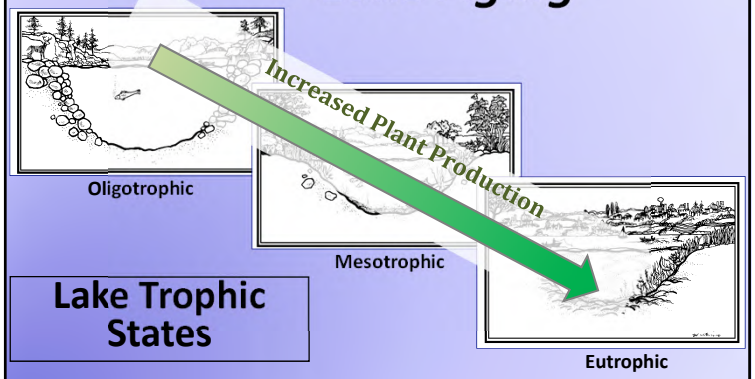
Eutrophication -Lake Aging



Lake Trophic States

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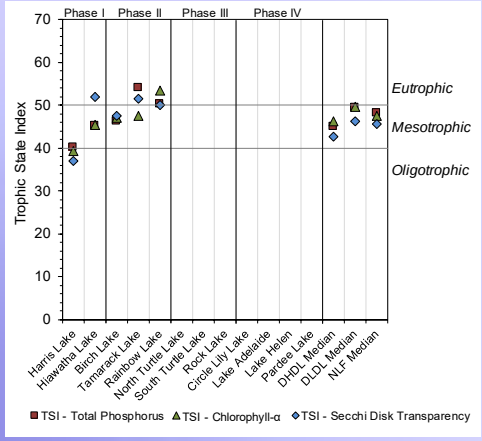
Winchester Lakes Trophic State Index



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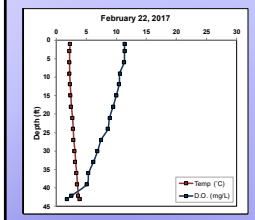
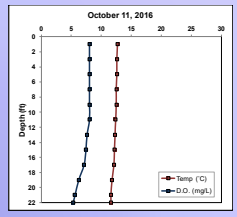
Temperature & Dissolved Oxygen

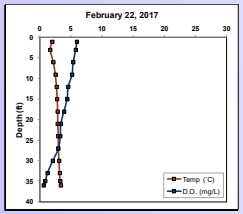
Birch Lake



Tamarack Lake



Rainbow Lake



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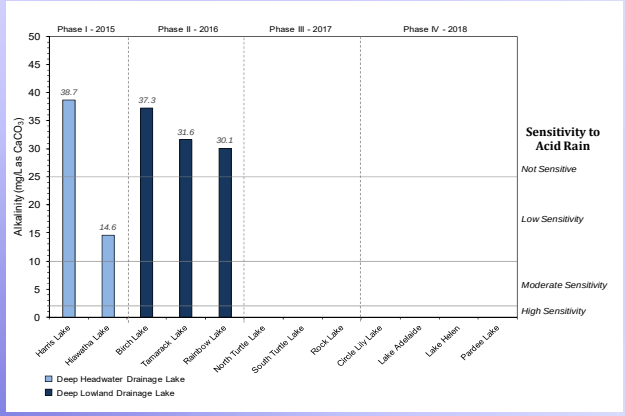
Additional Water Quality Parameters
Alkalinity



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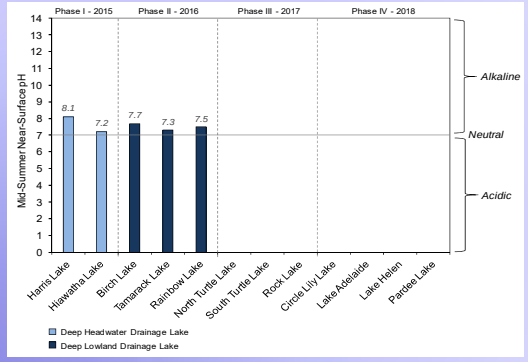
Additional Water Quality Parameters
pH



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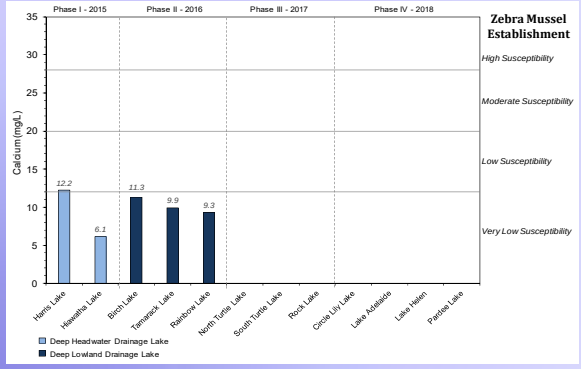
Additional Water Quality Parameters
Calcium



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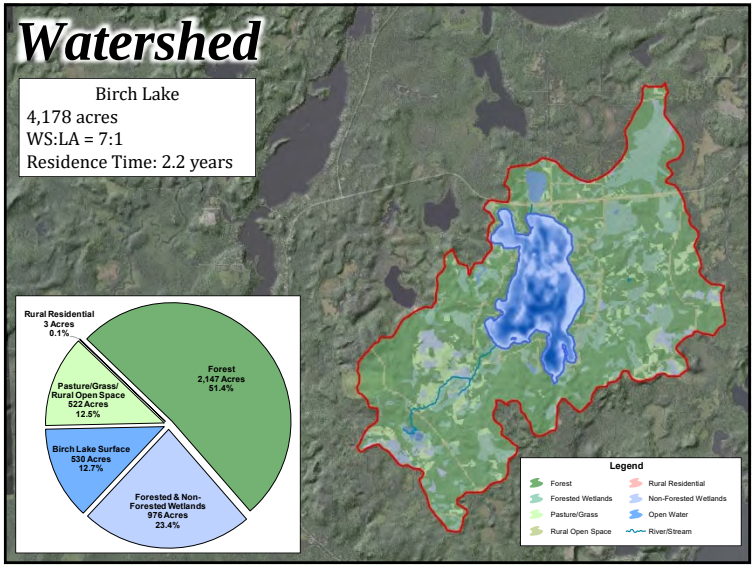
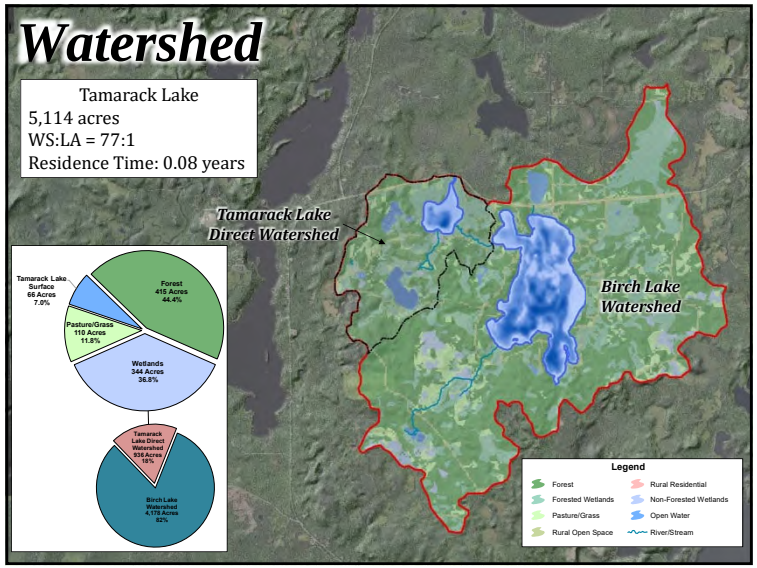
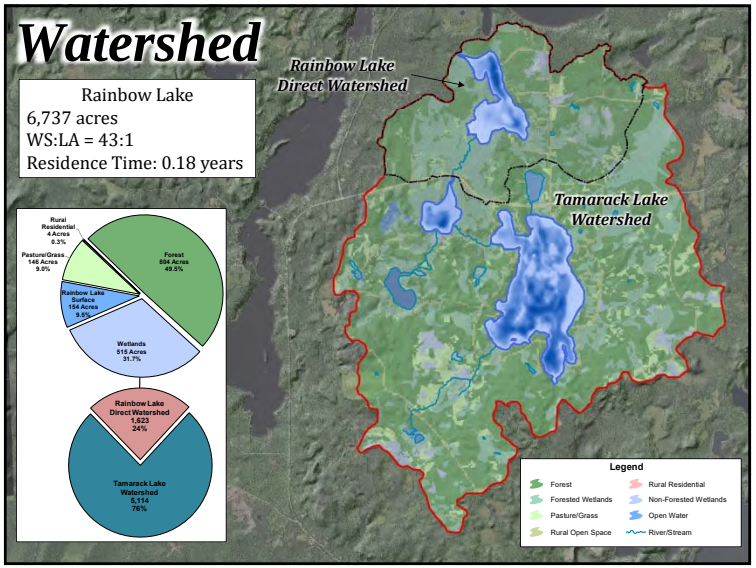
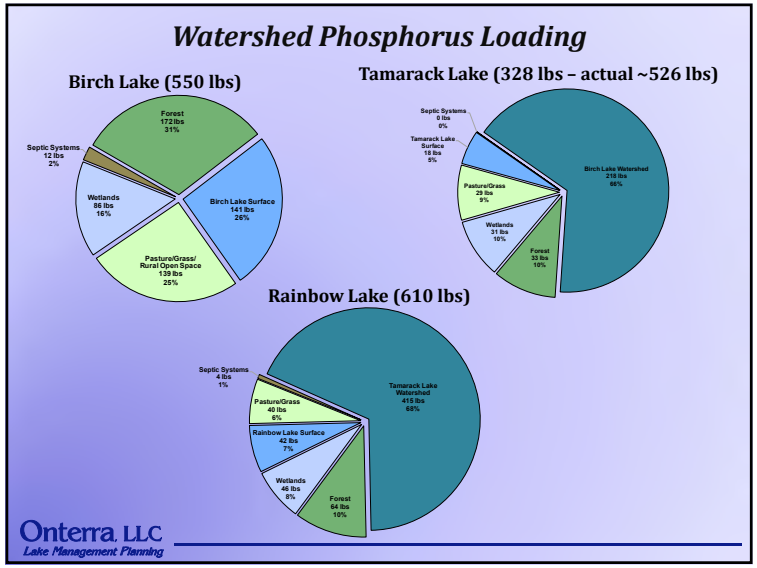
Watershed




Watershed
Tamarack Lake
5,114 acres
WS:LA = 77:1
Residence Time: 0.08 years
Tamarack Lake Direct Watershed
Birch Lake Watershed
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed
Rainbow Lake
6,737 acres
WS:LA = 43:1
Residence Time: 0.18 years
Rainbow Lake Direct Watershed
Tamarack Lake Watershed
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed Phosphorus Loading
Birch Lake (550 lbs)
Tamarack Lake (328 lbs – actual ~526 lbs)
Rainbow Lake (610 lbs)
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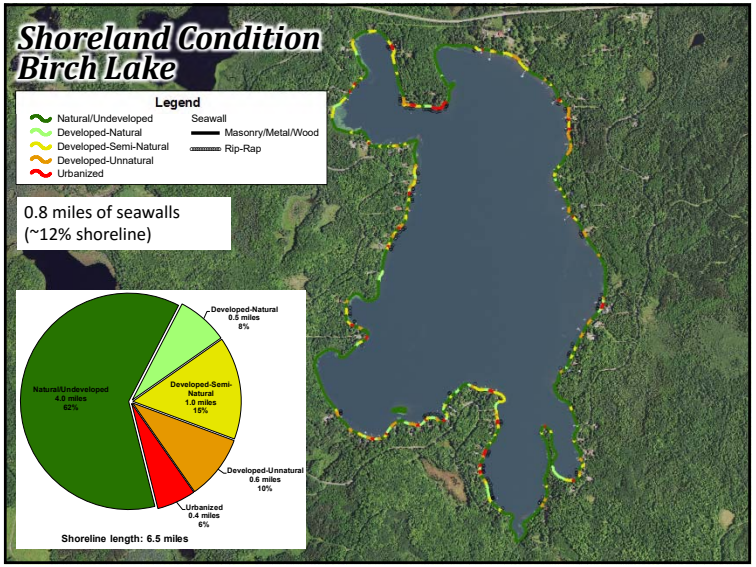
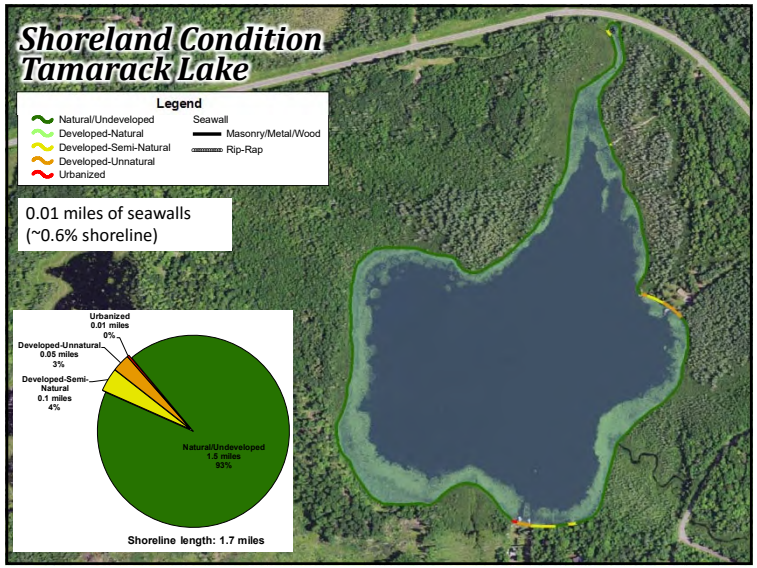
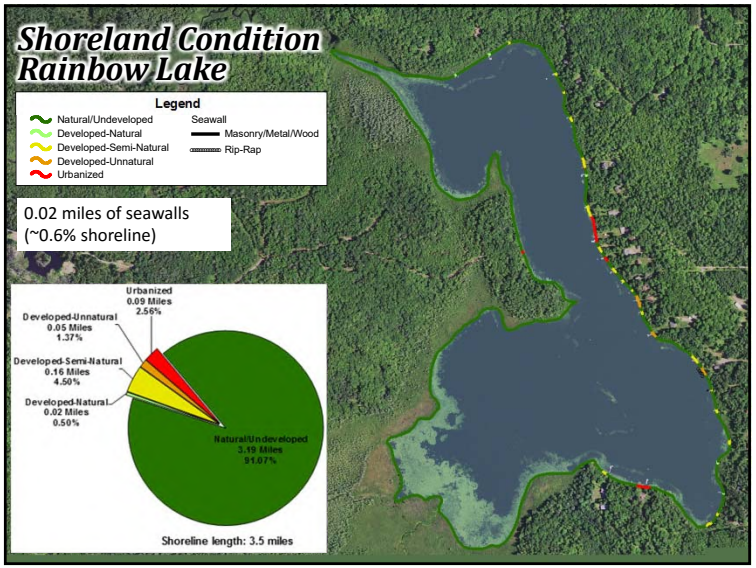
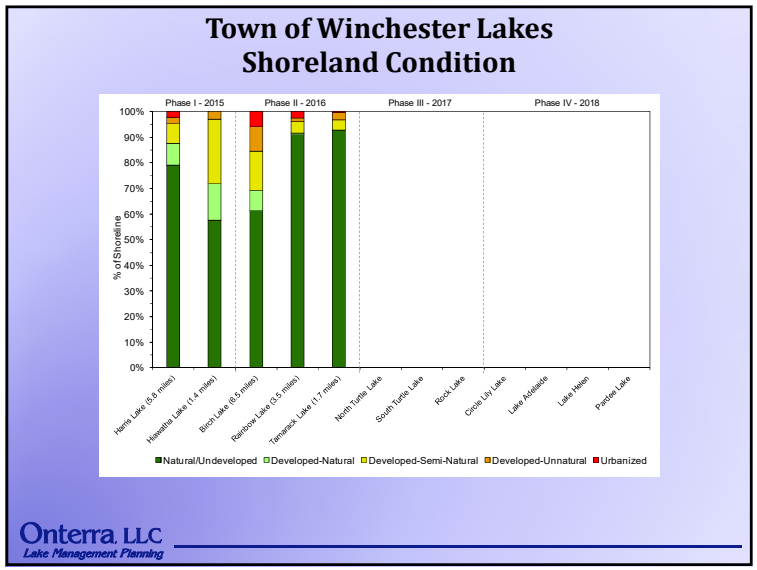

Shoreland Condition
Birch Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.8 miles of seawalls
(~12% shoreline)
Shoreline length: 6.5 miles


Shoreland Condition
Tamarack Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.01 miles of seawalls
(~0.6% shoreline)
Urbanized
0.01 miles
0%
Developed-Unnatural
0.05 miles
3%
Developed-Semi-Natural
0.1 miles
4%
Natural/Undeveloped
1.5 miles
93%
Shoreline length: 1.7 miles


Shoreland Condition
Rainbow Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.02 miles of seawalls
(~0.6% shoreline)
Urbanized
0.09 Miles
2.56%
Developed-Unnatural
0.05 Miles
1.37%
Developed-Semi-Natural
0.16 Miles
4.50%
Developed-Natural
0.02 Miles
0.50%
Natural/Undeveloped
3.19 Miles
91.07%
Shoreline length: 3.5 miles


Town of Winchester Lakes
Shoreland Condition
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
% of Shoreline
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Harris Lake (6.8 miles)
Hiawatha Lake (1.4 miles)
Birch Lake (6.5 miles)
Rainbow Lake (3.5 miles)
Tamarack Lake (1.7 miles)
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
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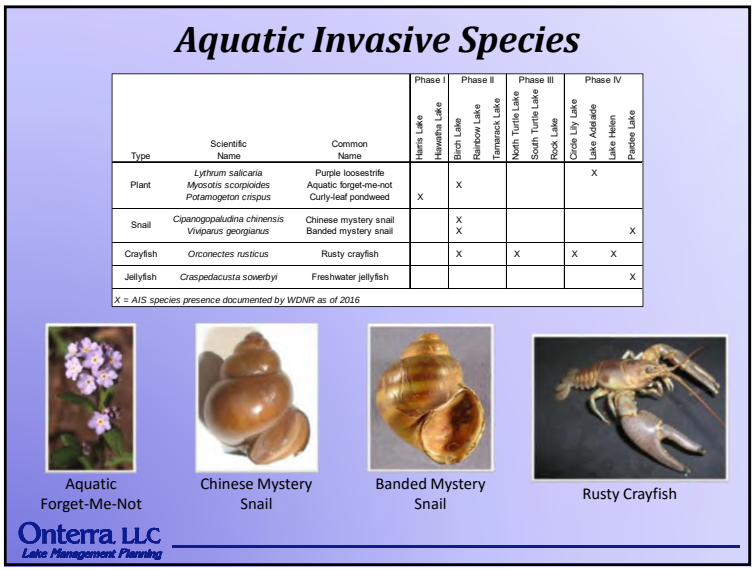
Lake Management Planning


Aquatic Invasive Species
Phase I
Phase II
Phase III
Phase IV
Harris Lake
Hiawatha Lake
Birch Lake
Rainbow Lake
Tamarack Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
Type
Scientific Name
Common Name
Plant
Lythrum salicaria
Myosotis scorpioides
Potamogeton crispus
Purple loosestrife
Aquatic forget-me-not
Curly-leaf pondweed
Snail
Cipanogopaludina chinensis
Viviparus georgianus
Chinese mystery snail
Banded mystery snail
Crayfish
Orconectes rusticus
Rusty crayfish
Jellyfish
Craspedacusta sowerbyi
Freshwater jellyfish
X = AIS species presence documented by WDNR as of 2016
Aquatic Forget-Me-Not
Chinese Mystery Snail
Banded Mystery Snail
Rusty Crayfish
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Conclusions

Water Quality

- Overall very good for deep lowland drainage lakes
- Recent increase in precipitation likely cause of recent decline in clarity
- Water clarity largely influenced by dissolved tannins

Watershed & Immediate Shoreland

- Watershed mainly comprised of natural land cover
- Model-predicted phosphorus aligns with measured phosphorus in Birch Lake
- Slightly higher phosphorus in Tamarack and Rainbow due to underestimates from model
- Minimal development within shoreland areas
- High occurrence of CWH in Birch Lake; lower occurrence in Tamarack and Rainbow lakes

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Conclusions

Aquatic Plant Community

- High native species richness
- Quality of species present very high and indicative of high-quality environment
- No non-native plants located

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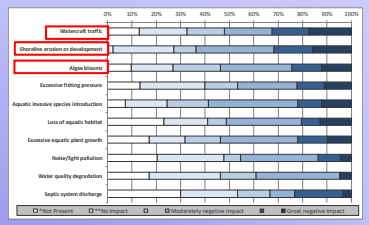
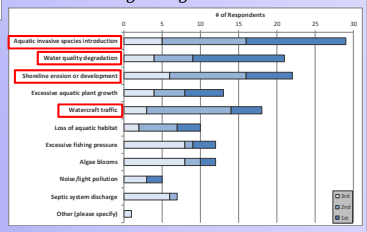
Birch Lake

To what level do you believe the following factors may be negatively impacting the lake?



Please rank your top three concerns regarding the lake.



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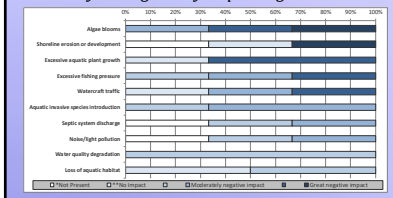
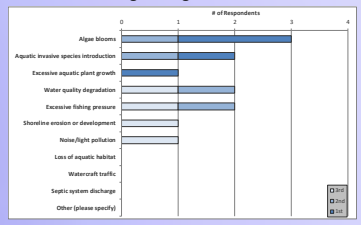
Tamarack Lake

To what level do you believe the following factors may be negatively impacting the lake?



Please rank your top three concerns regarding the lake.



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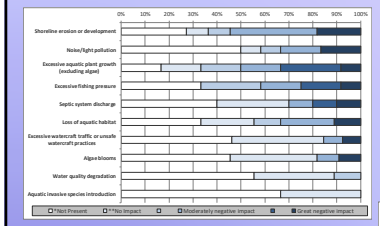
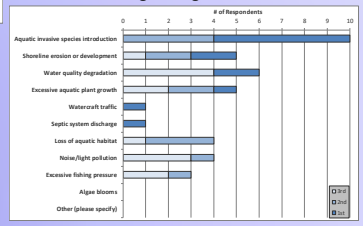
Rainbow Lake

To what level do you believe the following factors may be negatively impacting the lake?



Please rank your top three concerns regarding the lake.



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Bryozoans

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Presentation Outline

- Project Goals
- Overall Study Conclusions
- Key Study Results
- Management Goals and Actions
- Questions

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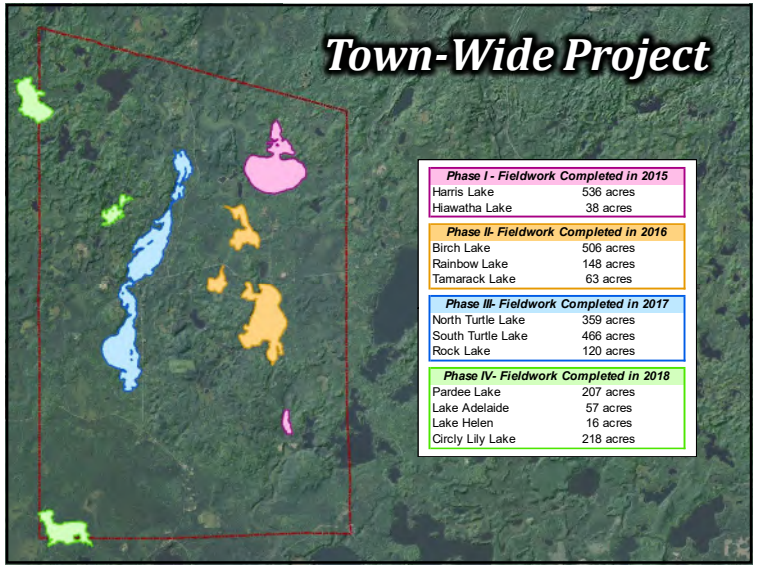

Study and Plan Goals

- Collect & Analyze Data
  - 2016/2017
- Construct Long-Term & Useable Plan
  - Planning Meetings 2017
  - Final Plan approved by WDNR in winter 2018

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Data and information gathering

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

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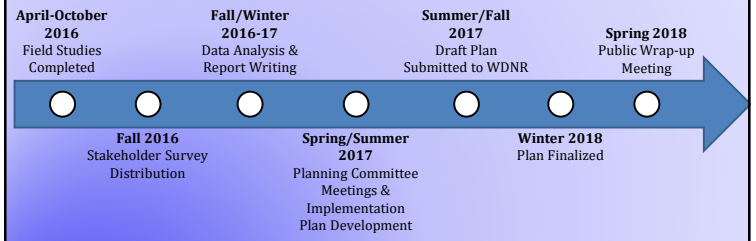
Phase II Timeline



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Overall Project Conclusions

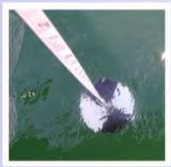
- **Water Quality (nutrients and algae)**
  - Overall very good for deep lowland drainage lakes
  - Recent decline in water clarity likely due to increases in precipitation (humic substances)
- **Watersheds (drainage basin)**
  - Excellent shape; majority comprised of forests & wetlands
  - Measured phosphorus in Tamarack & Rainbow slightly higher than model predictions – likely natural
- **Immediate shoreland zone**
  - Largely natural/minimal development
  - Always room for improvement
- **Aquatic Plant Community**
  - Native plant communities are of high quality and indicative of a healthy ecosystem

Introduction to Lake Water Quality

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

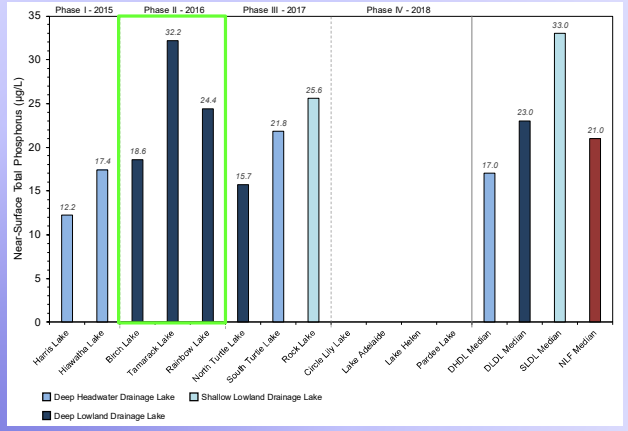
Chlorophyll-*a*
Pigment used in photosynthesis
Used as surrogate for phytoplankton biomass

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



Onterra, LLC
Lake Management Planning

Summer Total Phosphorus



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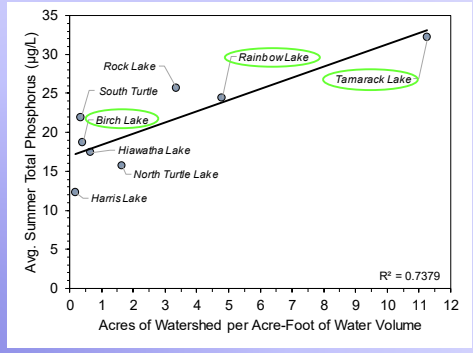
Lake Management Planning

Summer Total Phosphorus



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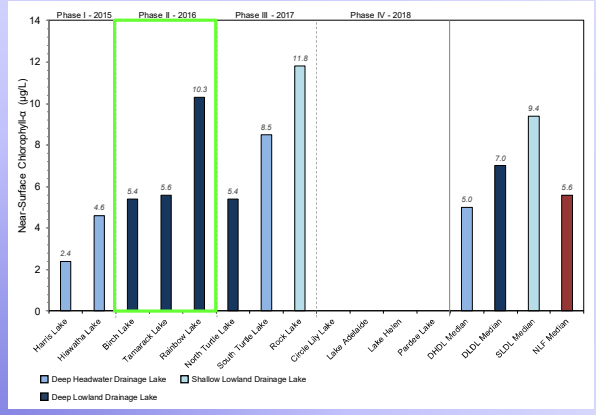
Summer Chlorophyll



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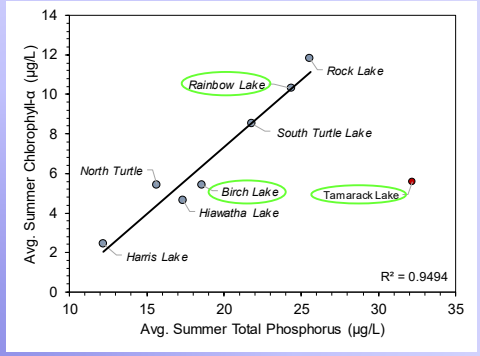
Town of Winchester Lakes
Phosphorus vs Chlorophyll-*a*



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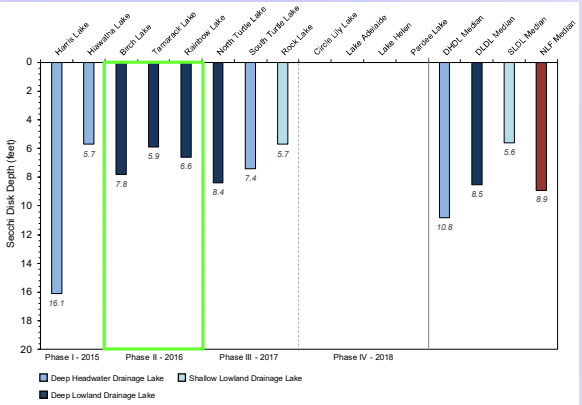
Summer Water Clarity
(Secchi Disk Depth)



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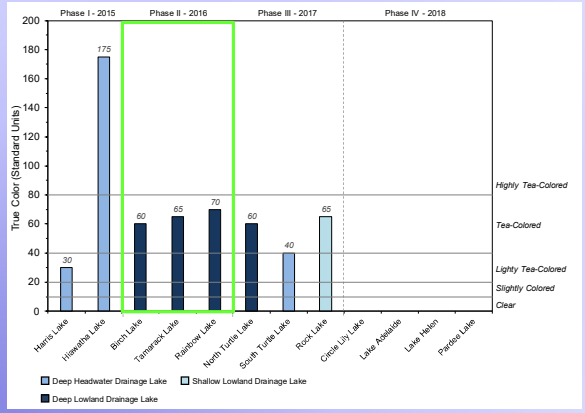
True Color



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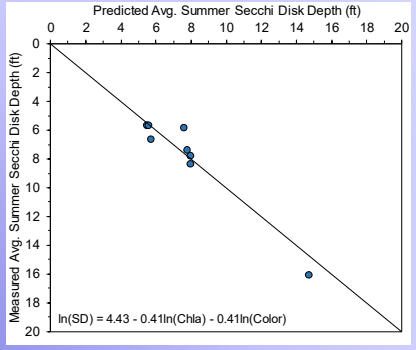
Water Clarity



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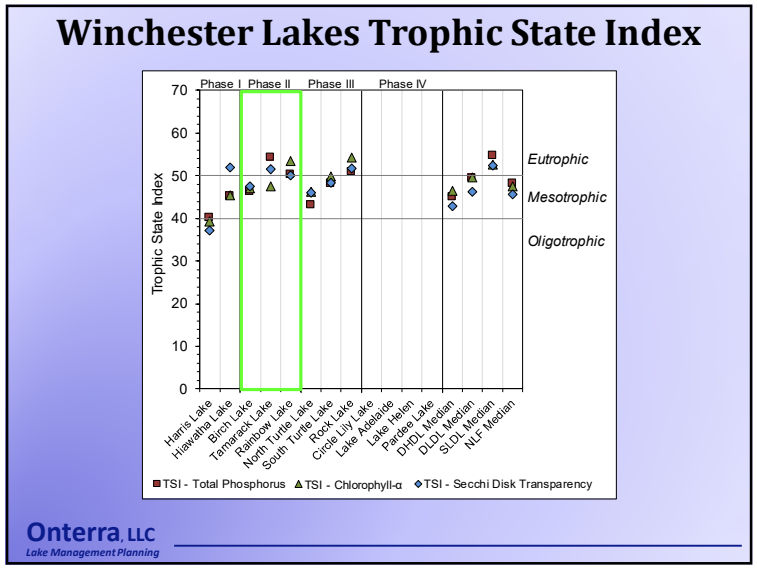
Winchester Lakes Trophic State Index
Phase I
Phase II
Phase III
Phase IV
Trophic State Index
70
60
50
40
30
20
10
0
Eutrophic
Mesotrophic
Oligotrophic
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
DHDL Median
DLDL Median
SLDL Median
NLF Median
TSI - Total Phosphorus
TSI - Chlorophyll-α
TSI - Secchi Disk Transparency
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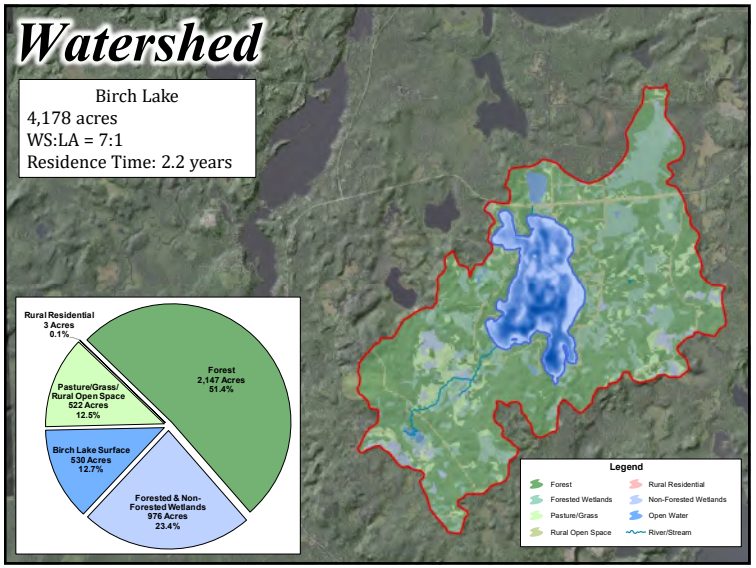
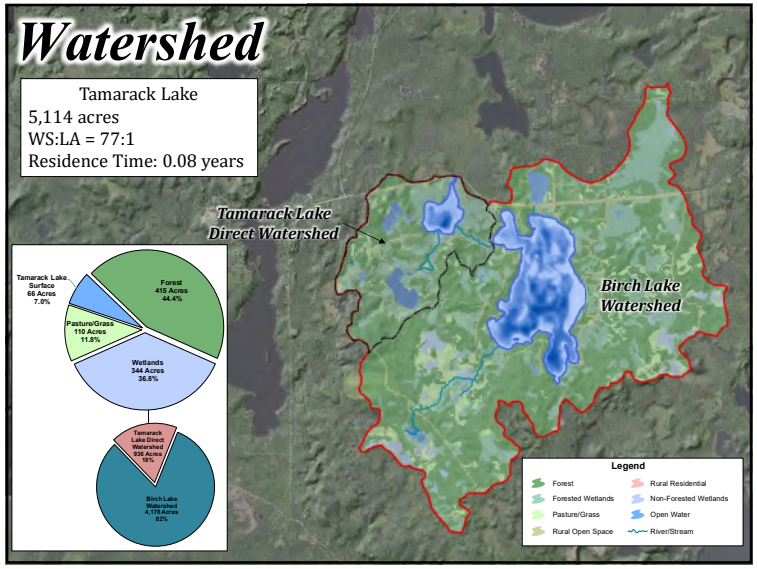
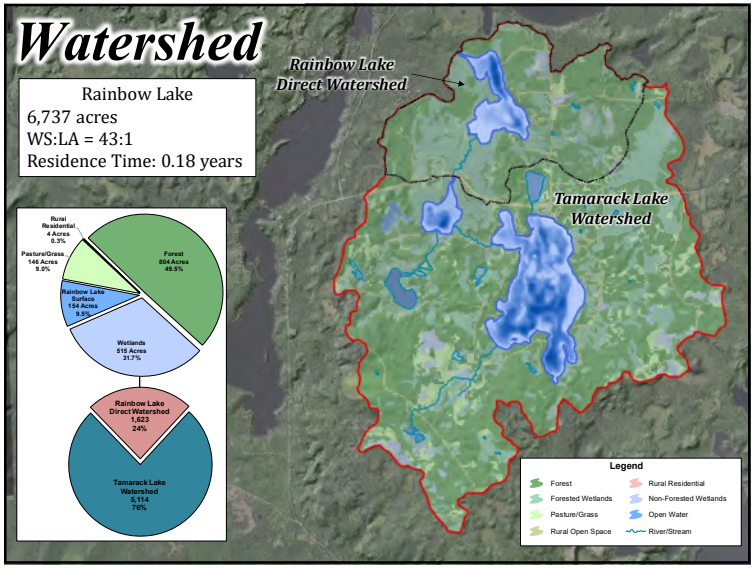
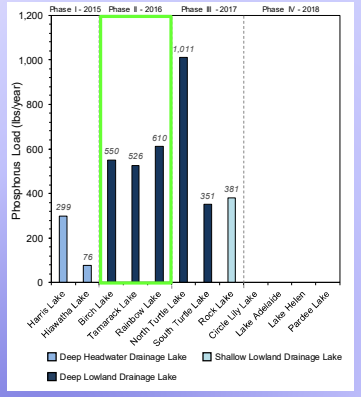
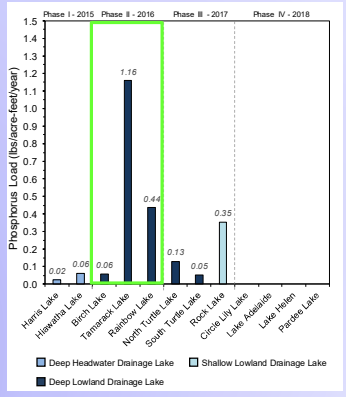

Watershed
Birch Lake
4,178 acres
WS:LA = 7:1
Residence Time: 2.2 years
Rural Residential
3 Acres
0.1%
Forest
2,147 Acres
51.4%
Pasture/Grass/
Rural Open Space
522 Acres
12.5%
Birch Lake Surface
530 Acres
12.7%
Forested & Non-
Forested Wetlands
976 Acres
23.4%
Legend
Forest
Rural Residential
Forested Wetlands
Non-Forested Wetlands
Pasture/Grass
Open Water
Rural Open Space
River/Stream


Watershed
Tamarack Lake
5,114 acres
WS:LA = 77:1
Residence Time: 0.08 years
Tamarack Lake
Direct Watershed
Birch Lake
Watershed
Tamarack Lake Surface
66 Acres
7.0%
Forest
415 Acres
44.4%
Pasture/Grass
110 Acres
11.8%
Wetlands
344 Acres
36.8%
Tamarack
Lake Direct
Watershed
338 Acres
18%
Birch Lake
Watershed
4,178 Acres
82%
Legend
Forest
Rural Residential
Forested Wetlands
Non-Forested Wetlands
Pasture/Grass
Open Water
Rural Open Space
River/Stream


Watershed
Rainbow Lake
Direct Watershed
Rainbow Lake
6,737 acres
WS:LA = 43:1
Residence Time: 0.18 years
Tamarack Lake
Watershed
Rural
Residential
4 Acres
0.3%
Pasture/Grass
146 Acres
9.9%
Forest
804 Acres
49.5%
Rainbow Lake
Surface
154 Acres
9.5%
Wetlands
515 Acres
31.7%
Rainbow Lake
Direct Watershed
1,623
24%
Tamarack Lake
Watershed
5,114
76%
Legend
Forest
Rural Residential
Forested Wetlands
Non-Forested Wetlands
Pasture/Grass
Open Water
Rural Open Space
River/Stream

Watershed Phosphorus Loading





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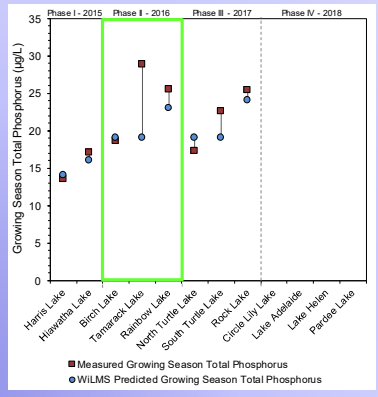
Predicted vs Measured Total Phosphorus



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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

Urbanized **Natural**

Range

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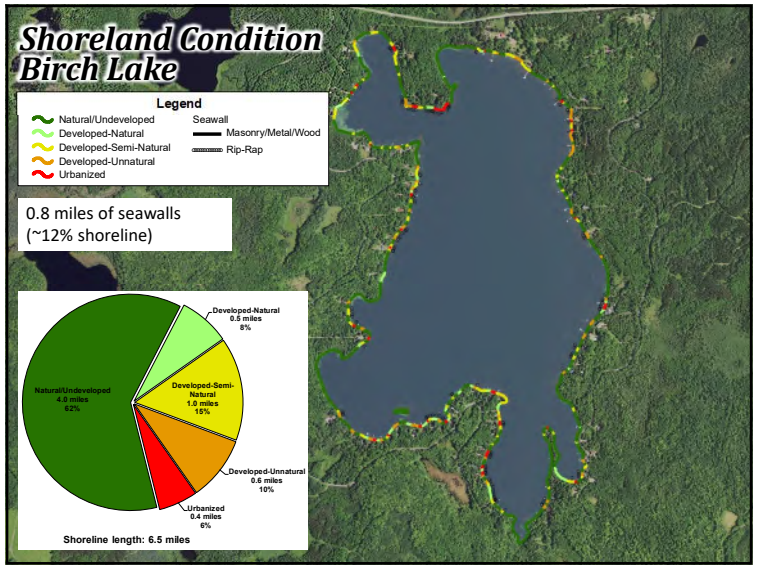
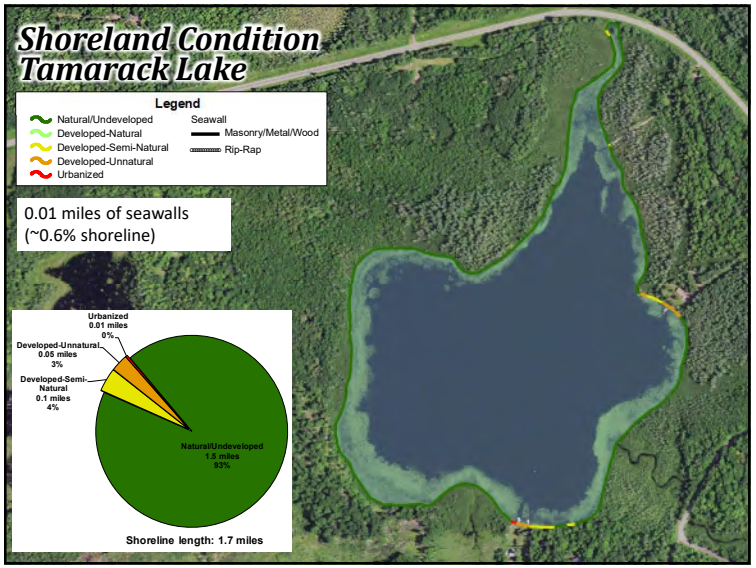
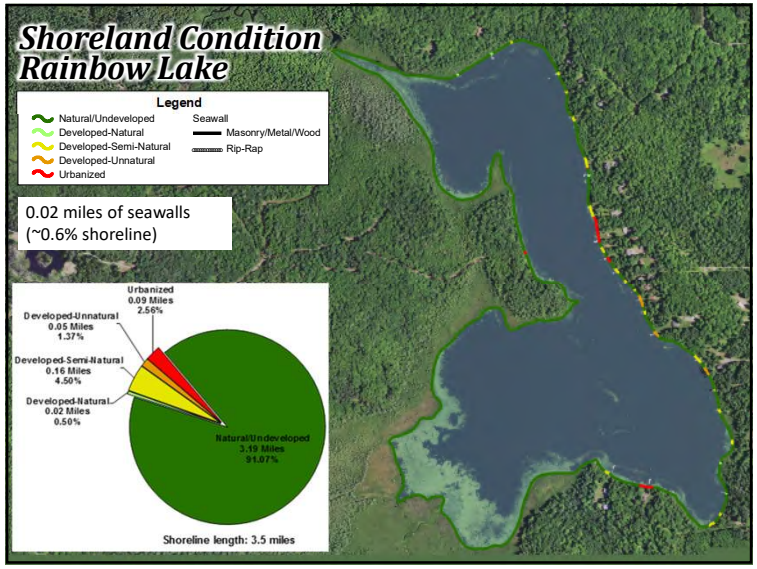
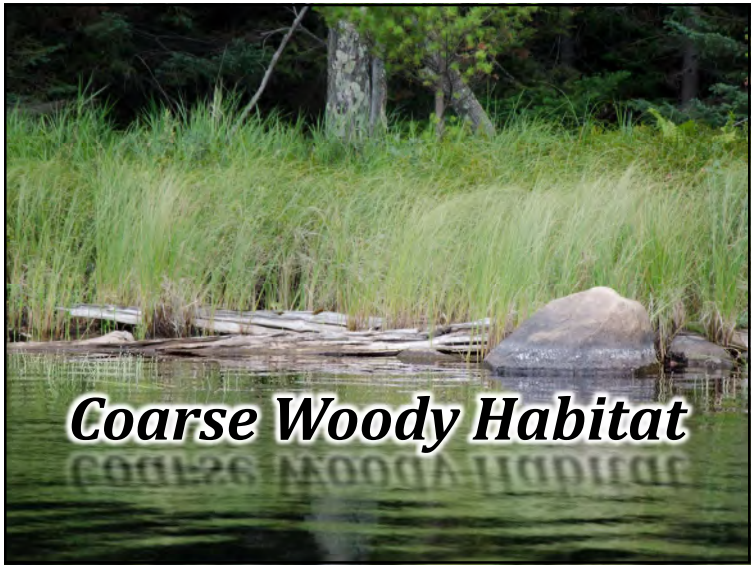
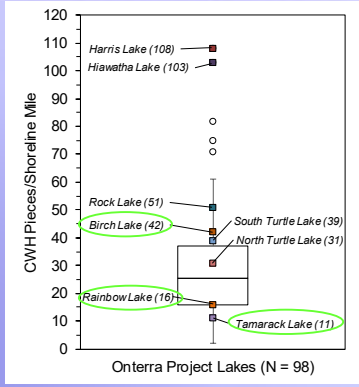

Shoreland Condition
Birch Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.8 miles of seawalls
(~12% shoreline)
Developed-Natural
0.5 miles
8%
Developed-Semi-Natural
1.0 miles
15%
Developed-Unnatural
0.6 miles
10%
Urbanized
0.4 miles
6%
Natural/Undeveloped
4.0 miles
62%
Shoreline length: 6.5 miles


Shoreland Condition
Tamarack Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.01 miles of seawalls
(~0.6% shoreline)
Urbanized
0.01 miles
0%
Developed-Unnatural
0.05 miles
3%
Developed-Semi-Natural
0.1 miles
4%
Natural/Undeveloped
1.5 miles
93%
Shoreline length: 1.7 miles


Shoreland Condition
Rainbow Lake
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.02 miles of seawalls
(~0.6% shoreline)
Urbanized
0.09 Miles
2.56%
Developed-Unnatural
0.05 Miles
1.37%
Developed-Semi-Natural
0.16 Miles
4.50%
Developed-Natural
0.02 Miles
0.50%
Natural/Undeveloped
3.19 Miles
91.07%
Shoreline length: 3.5 miles


Coarse Woody Habitat

Town of Winchester Lakes
Coarse Woody Habitat



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Lake Management Planning

Management Goal:
Maintain Current Water Quality Conditions

Management Actions

1. **Continue monitoring of lakes' water quality through WDNR Citizens Lake Monitoring Network (CLMN)**
   Important for tracking long-term changes.
2. **Continue volunteer-based water level monitoring**
3. **Preserve natural & restore highly developed shoreland areas**
4. **Preserve natural land cover within the watershed beyond the immediate shoreland zone**

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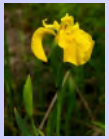
Plant Data Overview

- 89 native plant species located to date
  - 2 listed as special concern: Northeastern bladderwort & Vasey's pondweed

- 2 non-native plant species
  - Curly-leaf pondweed (Harris Lake)
  - Pale-yellow iris (Turtle Chain)



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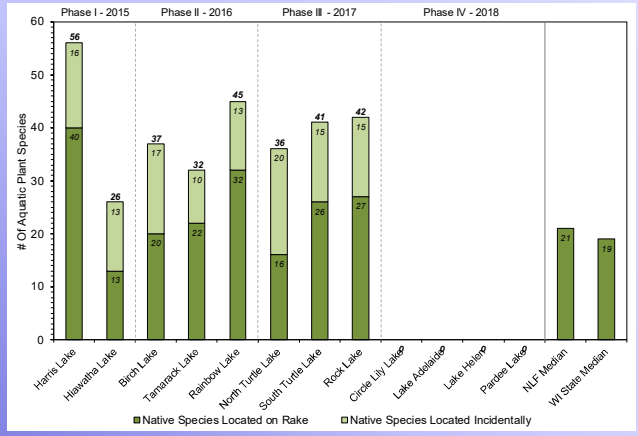
Native Species Richness



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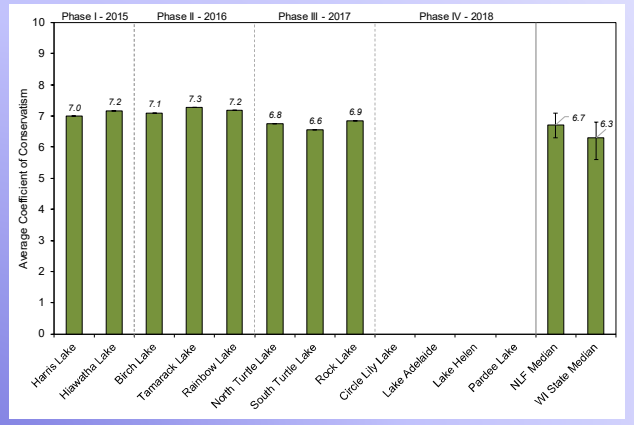
Average Conservatism



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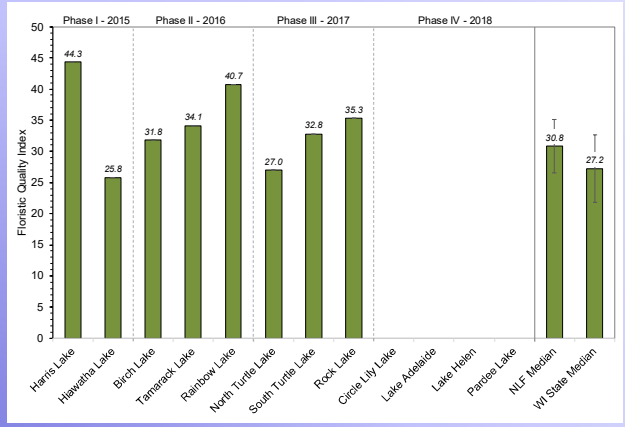
Floristic Quality



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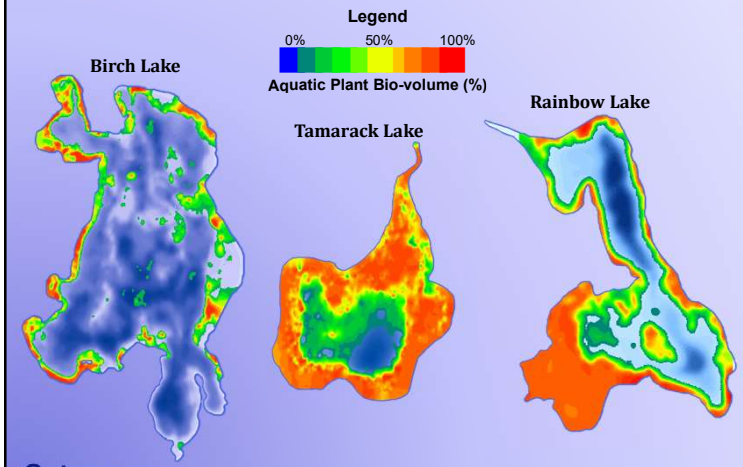
Aquatic Plant Bio-Volume



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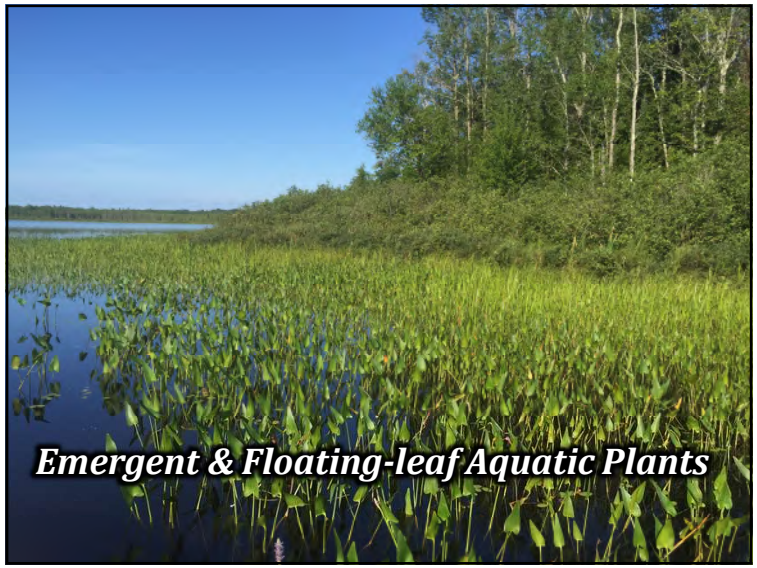
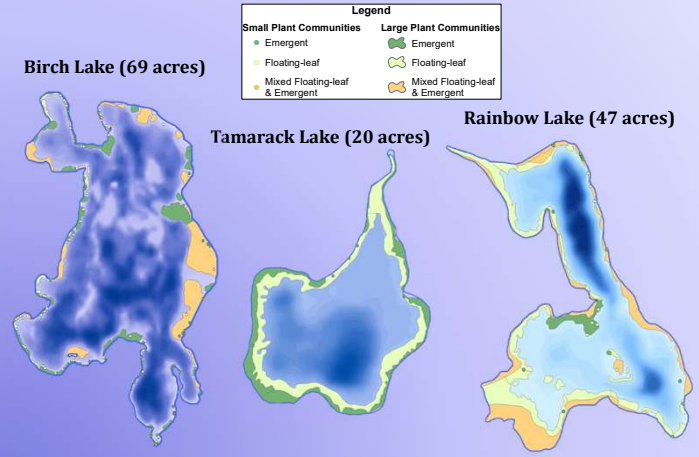


Emergent & Floating-leaf Aquatic Plants



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Aquatic Invasive Species

Type	Scientific Name	Common Name	Phase I: Harris Lake	Phase I: Hiawatha Lake	Phase II: Birch Lake	Phase II: Rainbow Lake	Phase II: Tamarack Lake	Phase III: North Turtle Lake	Phase III: South Turtle Lake	Phase III: Rock Lake	Phase IV: Circle Lily Lake	Phase IV: Lake Adelaide	Phase IV: Lake Helen	Phase IV: Pardee Lake
Plant	*Lythrum salicaria*	Purple loosestrife										X		
	Myosotis scorpioides	Aquatic forget-me-not				X								
	Potamogeton crispus	Curly-leaf pondweed	X											
Snail	*Cipangopaludina chinensis*	Chinese mystery snail				X								
	Viviparus georgianus	Banded mystery snail				X								X
Crayfish	*Orconectes rusticus*	Rusty crayfish				X		X			X		X	
Jellyfish	*Craspedacusta sowerbyi*	Freshwater jellyfish												X

X = AIS species presence documented by WDNR as of 2016

Aquatic Forget-Me-Not

Chinese Mystery Snail

Banded Mystery Snail

Rusty Crayfish

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Management Goal:
Prevent New Aquatic Invasive Species Introductions

Management Actions

1. **Continue volunteer monitoring for aquatic invasive species**
2. **Initiate AIS rapid response plan upon discovery of new infestation**
3. **Install aquatic invasive species signage at Tamarack/Rainbow lakes' carry-in access location**
4. **Continue Clean Boats Clean Waters watercraft inspections (Birch Lake)**

Management Goal:
Enhance the fishery of Birch, Tamarack, & Rainbow lakes

Management Actions

1. **Continue work with WDNR fisheries managers to enhance the fishery**

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Management Goal:
Increase navigation safety on Birch, Tamarack, & Rainbow lakes

Management Actions

1. **Consider placement of waterway markers to indicate areas in Birch & Tamarack lakes that are hazardous to vessel operation**

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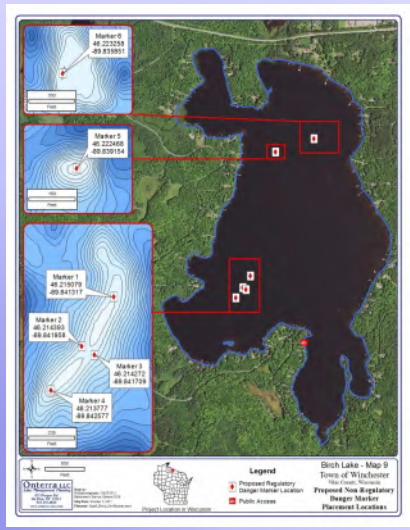

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Management Goal:
Increase navigation safety on Birch, Tamarack, & Rainbow lakes

Management Actions

1. **Consider placement of waterway markers to indicate areas in Birch & Tamarack lakes that are hazardous to vessel operation**
2. **Install signage at public access locations to inform lake users of watercraft regulations**

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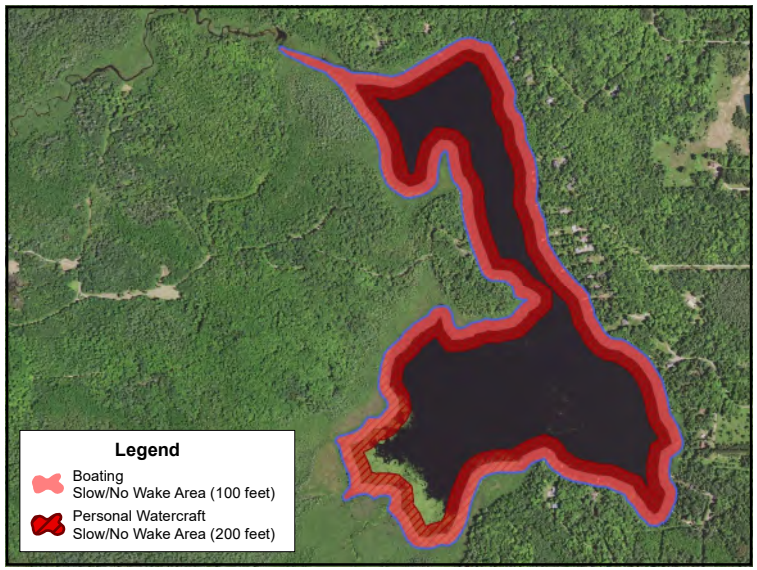

Management Goal:
Assure and Enhance the Communication and outreach of the BLA, RLA, & Tamarack Lake stakeholders

Management Actions

1. **Promote stakeholder involvement, inform stakeholders on various lake issues, as well as the quality of life on Birch, Tamarack, & Rainbow lakes**

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Thank You

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

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North Lakeland Discovery Center
Town of Winchester

Phase III
Rock, North Turtle, & South Turtle Lakes
Management Planning Project
Kick-off Meeting
May 20, 2017

Brenton Butterfield
Onterra LLC
Lake Management Planning

1

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of this Lake Management Planning Project
  - Data & Information
  - AIS Education & Volunteer Involvement
  - Planning Process
- Project Phasing
- Project Deliverables

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2

Onterra, LLC

- Founded in 2005
- Staff
  - Three full-time & one part-time ecologist
  - Four field technicians
  - Four to five 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.
- Snapshot of lake's current status or health.
- Foster realistic expectations and dispel any misconceptions.

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Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

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Data and information gathering

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

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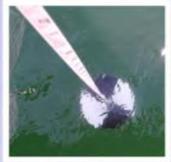
Water Quality Analysis

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

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

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



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Watershed Assessment

- Delineation of drainage basins
- Modeling
  - Land cover
  - Phosphorus loading
  - Lakes are modeled in series
  - Scenario development

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early-Season AIS Survey
  - Whole-lake point-intercept surveys
  - Bio-Acoustic Survey
  - Emergent/Floating-leaf Mapping Survey

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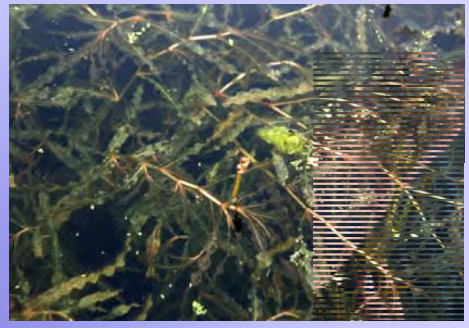
9

Non-native Aquatic Plants

Curly-leaf Pondweed



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Non-native Aquatic Plants

Eurasian Water Milfoil

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11

Non-native Aquatic Plants

Purple Loosestrife & Pale-yellow Iris

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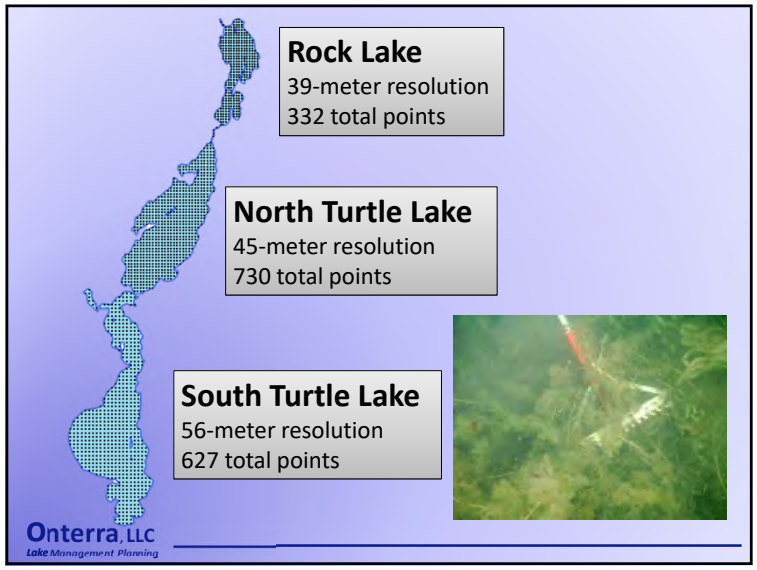
12


Rock Lake
39-meter resolution
332 total points
North Turtle Lake
45-meter resolution
730 total points
South Turtle Lake
56-meter resolution
627 total points
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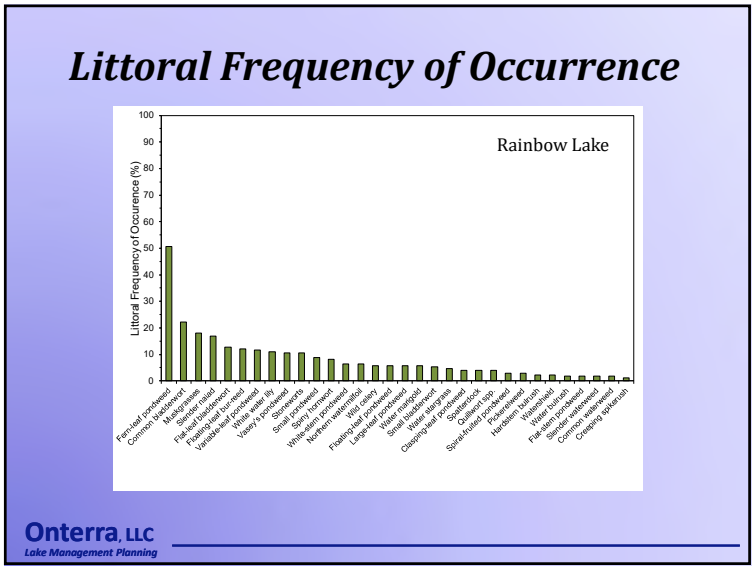
13


Littoral Frequency of Occurrence
Rainbow Lake
Littoral Frequency of Occurence (%)
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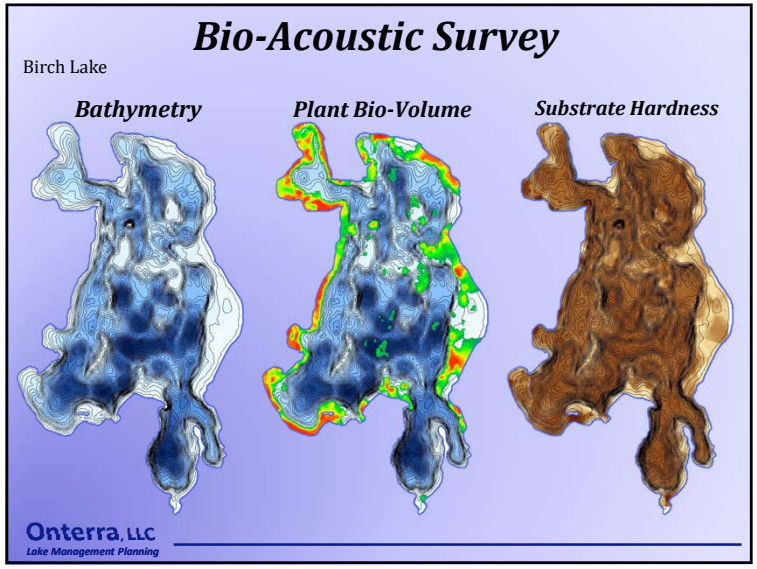
Bio-Acoustic Survey
Birch Lake
Bathymetry
Plant Bio-Volume
Substrate Hardness
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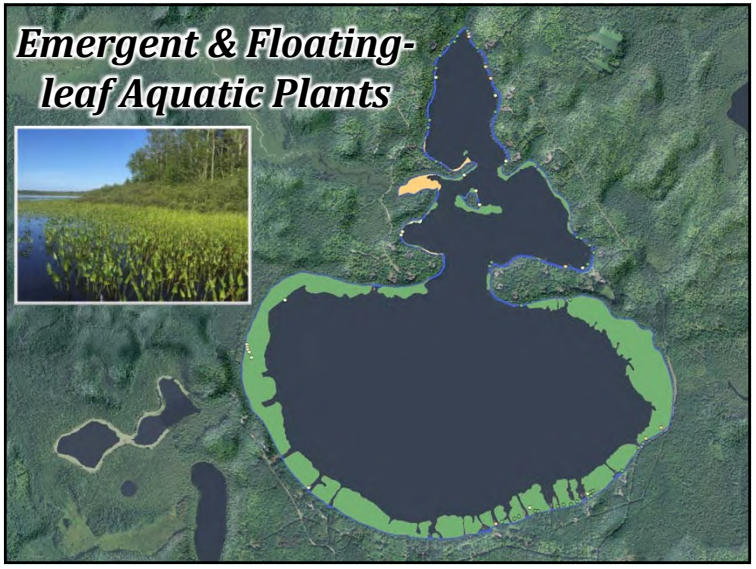
Emergent & Floating-leaf Aquatic Plants

16

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**

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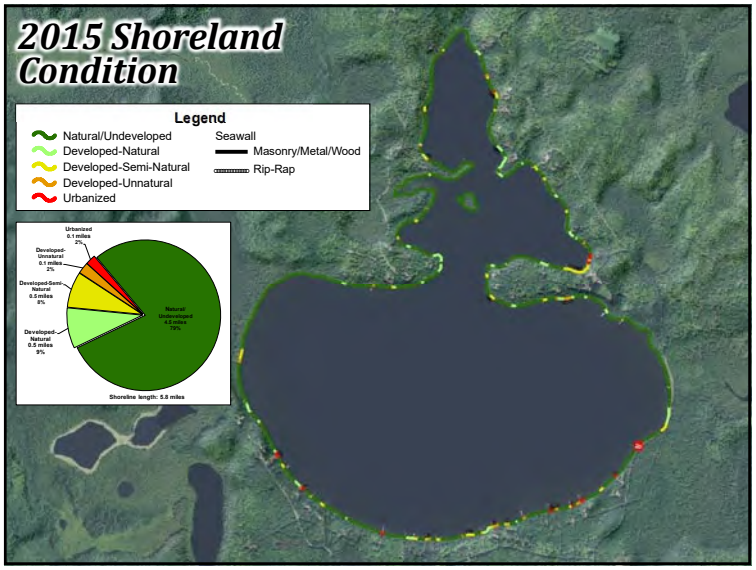
2015 Shoreland Condition



18

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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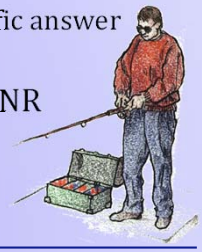
Stakeholder Survey

- Standard survey used as base
  - Planning committee 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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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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Town of Winchester Lake Management Plan Documents

- Multiple documents
- Town of Winchester Lake Management Plan
  - Town-wide Compilation
  - Lake-Specific Results and Conclusions
  - Lake-Specific Implementation Plan
  - Appendices (raw data, etc.)

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Phase III Project Timeline

April-October 2017
Field Studies Completed

Fall 2017
Stakeholder Survey Distribution

Fall/Winter 2017-18
Data Analysis & Report Writing

Spring/Summer 2018
Planning Committee Meetings & Implementation Plan Development

Summer/Fall 2018
Draft Plan Submitted to WDNR

Winter 2018/19
Plan Finalized

Summer 2019
Public Wrap-up Meeting

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Thank You
Many of the graphics used in this presentation were supplied by:
Wisconsin
Lakes
Partnership
UW
Extension
WISCONSIN
DEPT. OF NATURAL RESOURCES
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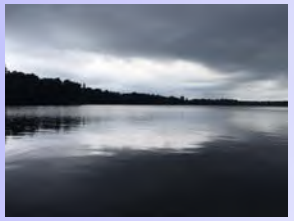
Presentation Outline

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

  Stakeholder Survey
- "Big Picture"
- Implementation Plan Development



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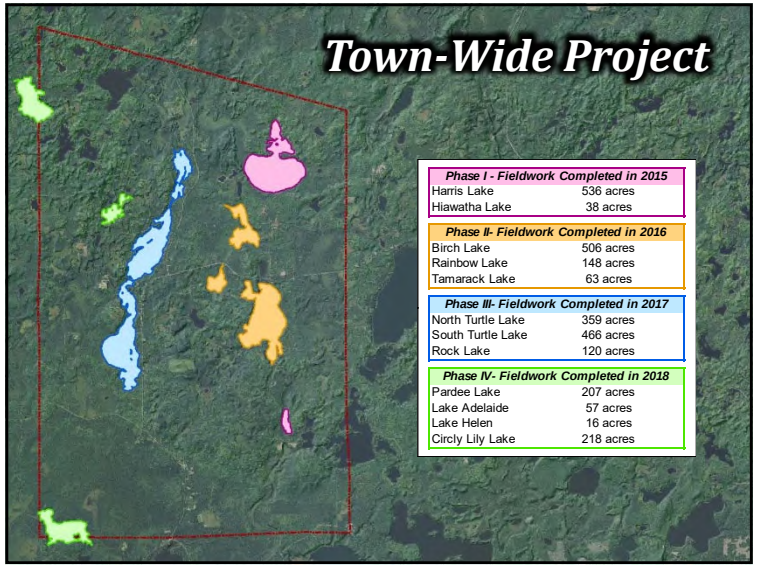

Management Planning Project Overview

- Collect & analyze data – completed
  - Technical & sociological
- Construct long-term & useable plan

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Summary of Project Results

Water Quality
- Good to excellent for respective lake type, but…
- Increasing trend in phosphorus concentration in South Turtle Lake

Watershed & Immediate Shoreline
- Watersheds in excellent shape – primarily forests & wetlands
- Majority of shoreland contains little to no development, but always room for improvement

Aquatic Plant Community
- High-quality native species present
- One non-native species: Pale-yellow iris (*Iris pseudacorus*)

Fisheries
- Some survey/stocking data available
- Tribal spear-harvest records for North & South Turtle Lakes

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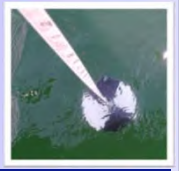
Introduction to Lake Water Quality

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

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

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



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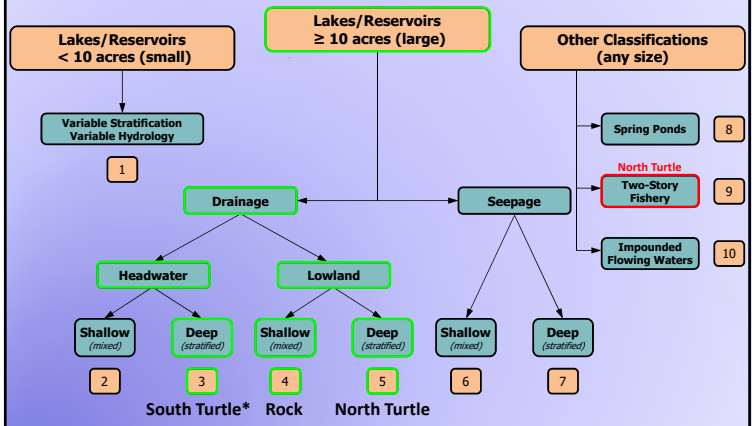
Wisconsin Lakes Natural Community Types



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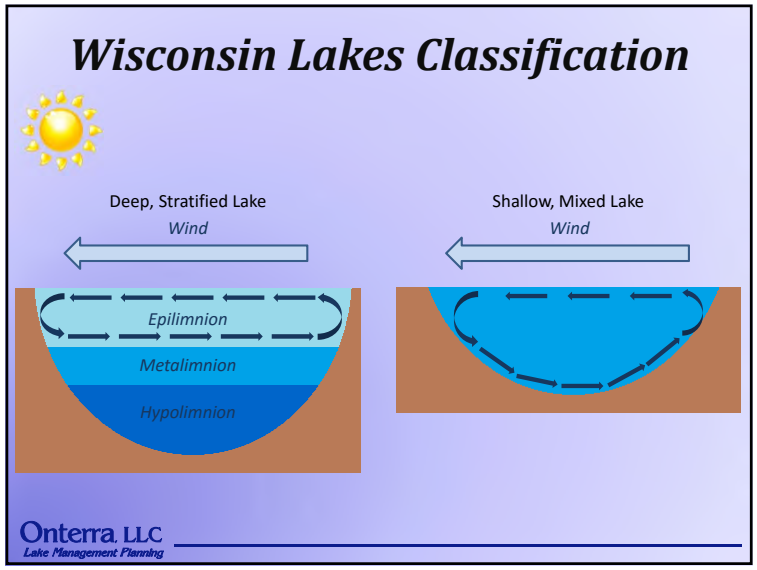
Wisconsin Lakes Classification
Deep, Stratified Lake
Wind
Epilimnion
Metalimnion
Hypolimnion
Shallow, Mixed Lake
Wind
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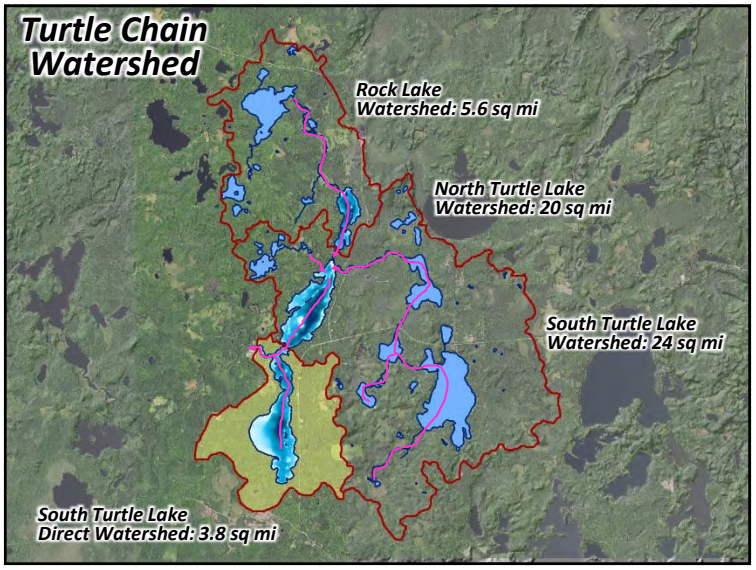
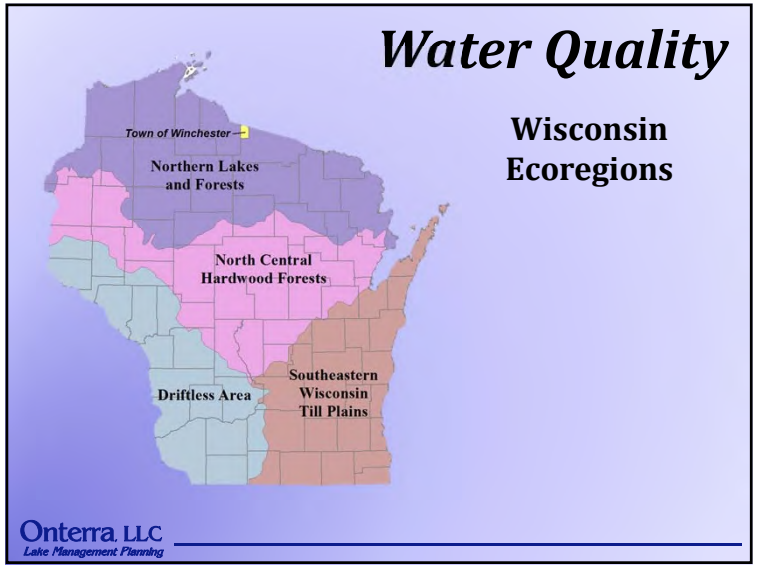

Turtle Chain Watershed
Rock Lake Watershed: 5.6 sq mi
North Turtle Lake Watershed: 20 sq mi
South Turtle Lake Watershed: 24 sq mi
South Turtle Lake Direct Watershed: 3.8 sq mi


Water Quality
Wisconsin Ecoregions
Town of Winchester
Northern Lakes and Forests
North Central Hardwood Forests
Driftless Area
Southeastern Wisconsin Till Plains
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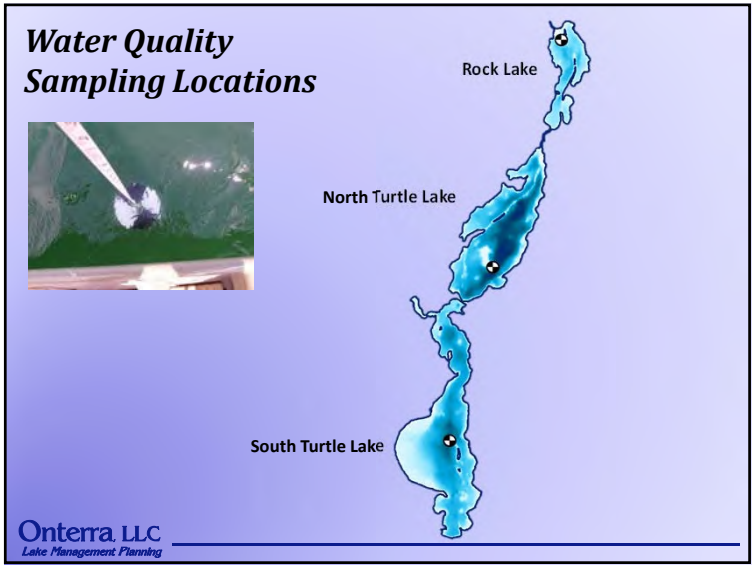
Water Quality Sampling Locations
Rock Lake
North Turtle Lake
South Turtle Lake
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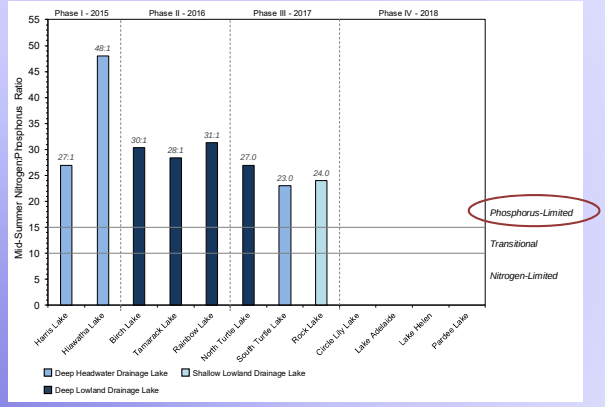
Town of Winchester Lakes
Mid-Summer Nitrogen:Phosphorus Ratios



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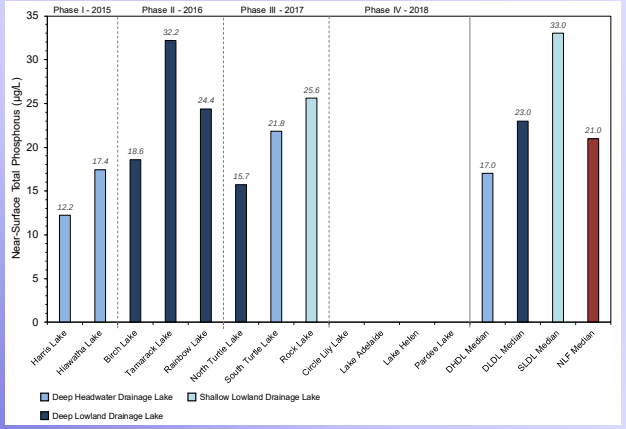
Town of Winchester Lakes
Near-Surface Summer Total Phosphorus



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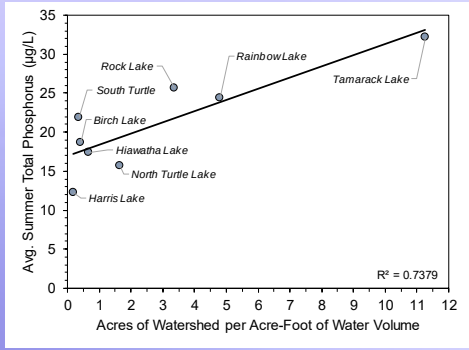
Town of Winchester Lakes
Near-Surface Summer Total Phosphorus



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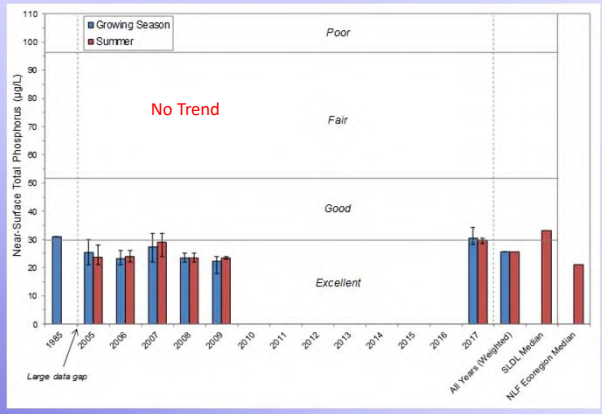
Rock Lake Total Phosphorus



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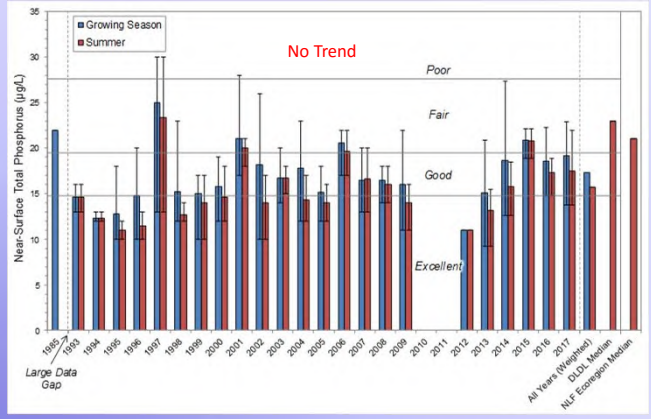
North Turtle Lake Total Phosphorus



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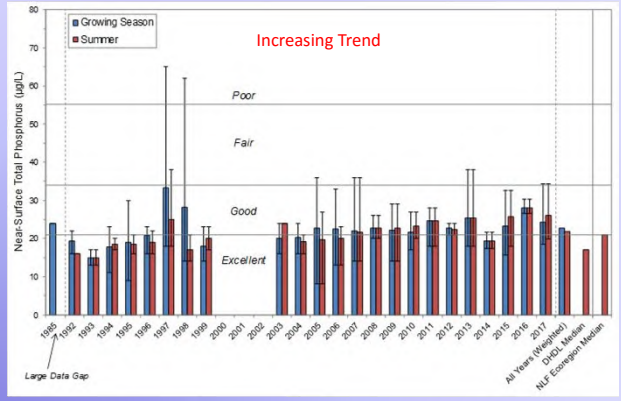
South Turtle Lake Total Phosphorus



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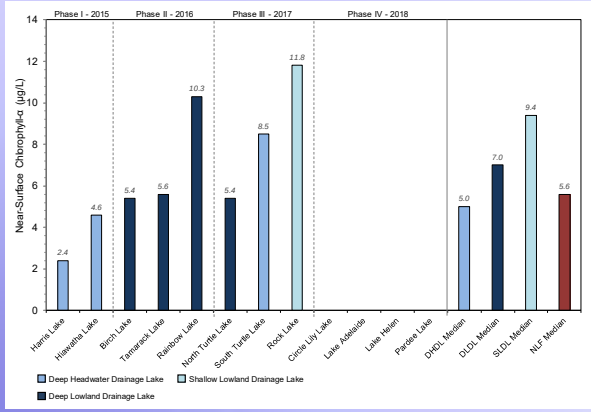
Town of Winchester Lakes Chlorophyll-*a*



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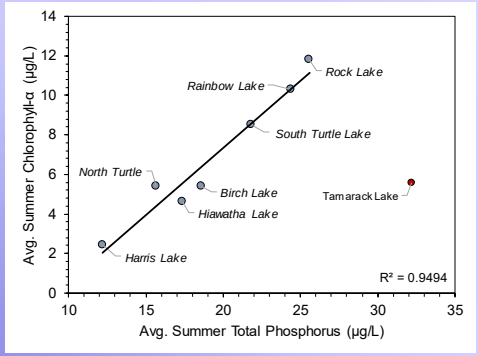
Town of Winchester Lakes Phosphorus vs Chlorophyll-*a*



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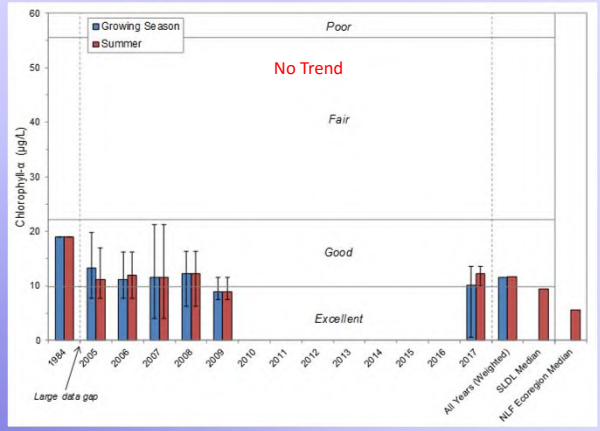
Rock Lake Chlorophyll-α



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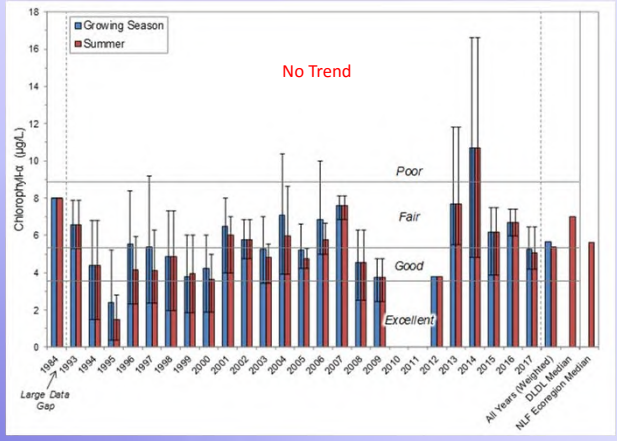
North Turtle Lake Chlorophyll-α



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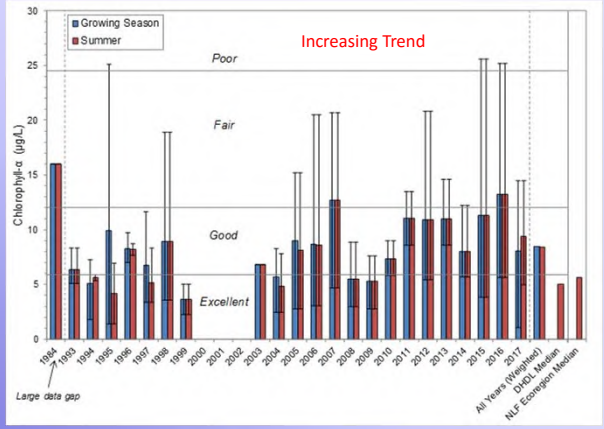
South Turtle Lake Chlorophyll-α



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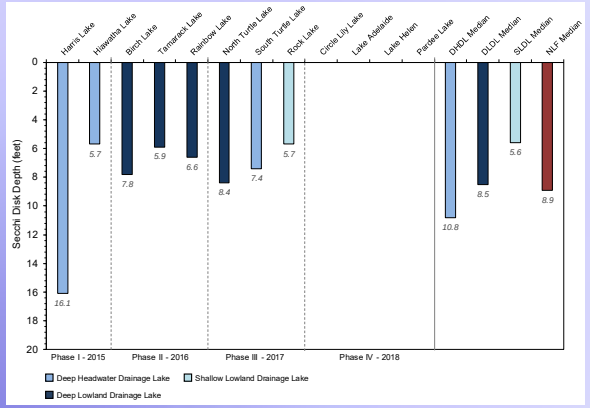
Town of Winchester Lakes
Secchi Disk Transparency



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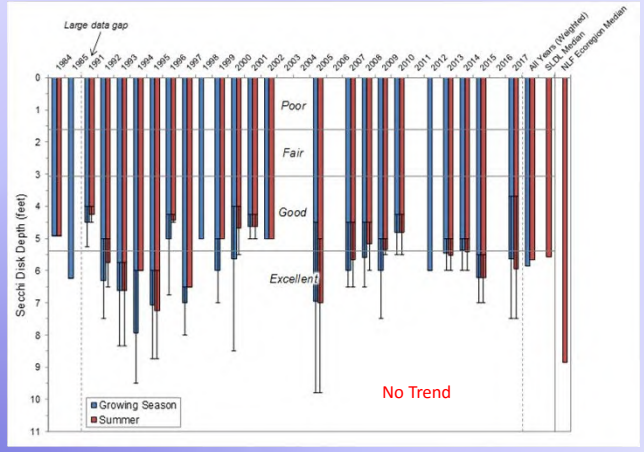
Rock Lake Secchi Disk Depth



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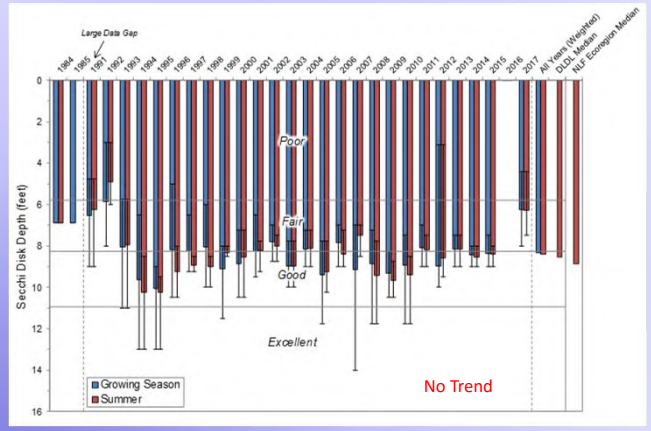
North Turtle Lake Secchi Disk Depth



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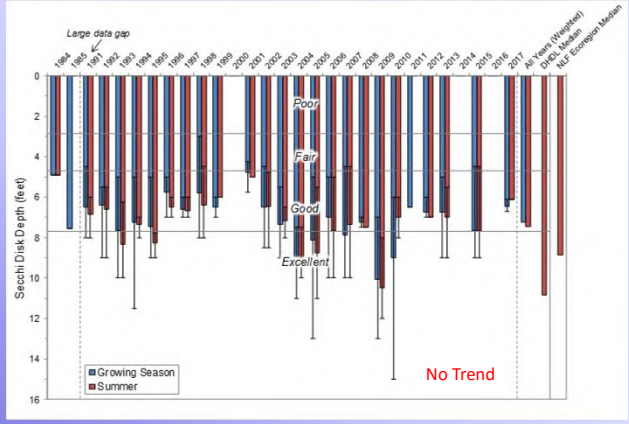
South Turtle Lake Secchi Disk Depth



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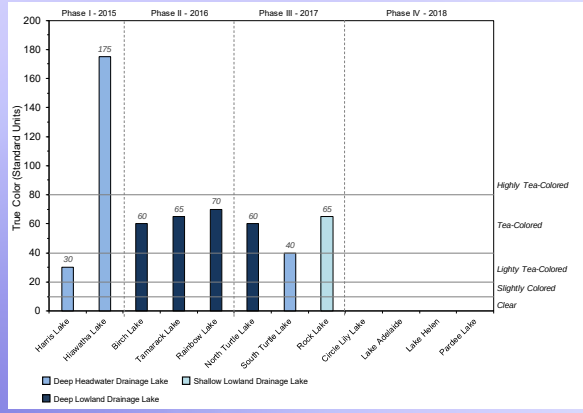
Town of Winchester Lakes
True Color



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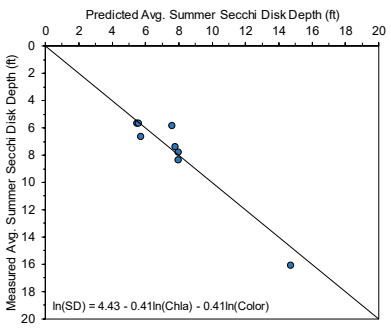
Town of Winchester Lakes
True Color & Chlorophyll



True Color & Chlorophyll explain 87% of variation in water clarity between the lakes

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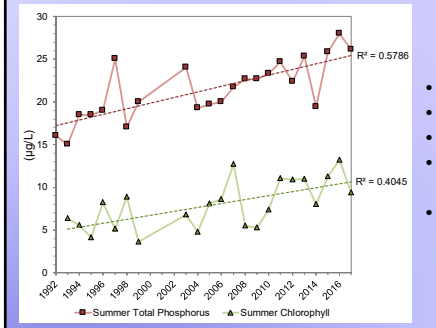
South Turtle Lake
Water Quality Trends



- Why is phosphorus increasing?
- Trend not observed in other lakes.
- Not correlated with precipitation.
- No apparent land-use changes within the watershed.
- Data indicate *internal nutrient loading* may be the cause.

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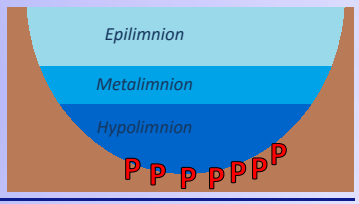
Internal Nutrient Loading

- In general, net movement of phosphorus to the sediment in lakes.
- Under certain conditions, phosphorus (and other nutrients) get released from bottom sediments into the overlying water.
- Anoxic (devoid of oxygen) conditions cause phosphorus release.
- Becomes problematic if phosphorus is mobilized to surface in summer (polymictic lakes).
- South Turtle: Phosphorus mobilized through *entrainment*.



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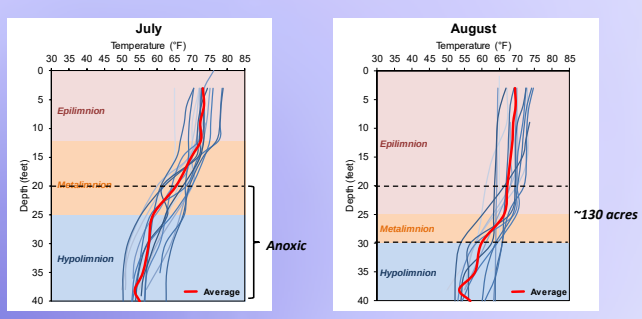
South Turtle Lake: Entrainment

- **Entrainment:** Continual deepening of the epilimnion and erosion of the metalimnion and hypolimnion
- Acts as a nutrient pump, delivering sediment-released nutrients to the surface.



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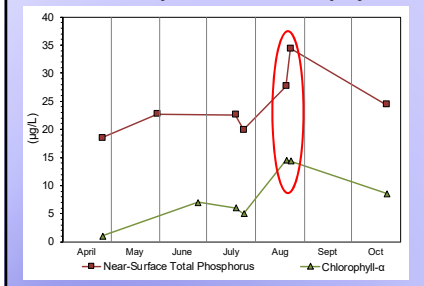
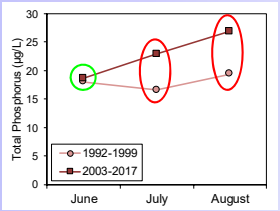
South Turtle Lake: Entrainment

2017 Phosphorus & Chlorophyll



Avg. Summer Phosphorus



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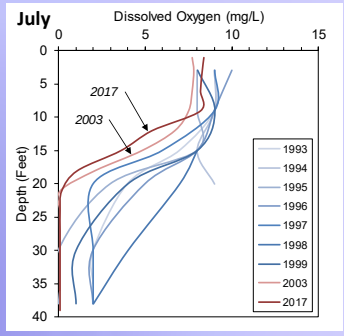
Internal Nutrient Loading

- Dissolved oxygen profiles indicate increase in productivity



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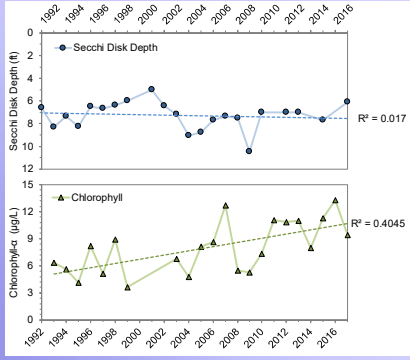
Internal Nutrient Loading

- No trend in water clarity



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Internal Nutrient Loading

- Water quality overall still *good* in South Turtle Lake, but…
- Lake listed on 303(d) list as impaired in 2017 for chlorophyll exceeding recreational use threshold
  - >5% of days from July 15 – Sept. 15 chl-a >20 µg/L
  - WDNR classification as deep **lowland** drainage
  - Low priority waterbody for Total Maximum Daily Load (TMDL) development
- Continue CLMN monitoring to determine if phosphorus continues to increase
- Determine possible management strategies

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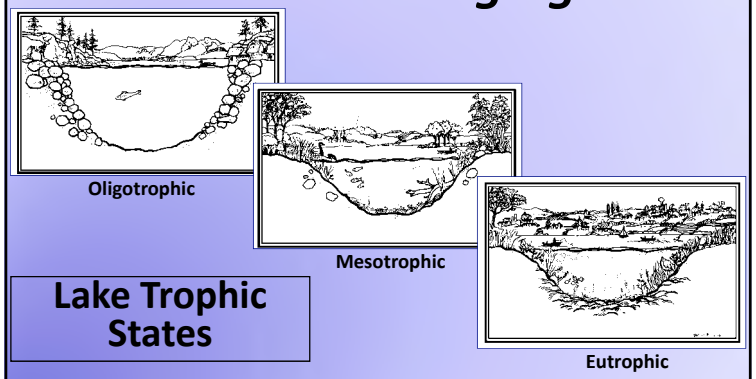
Eutrophication -Lake Aging



Lake Trophic States

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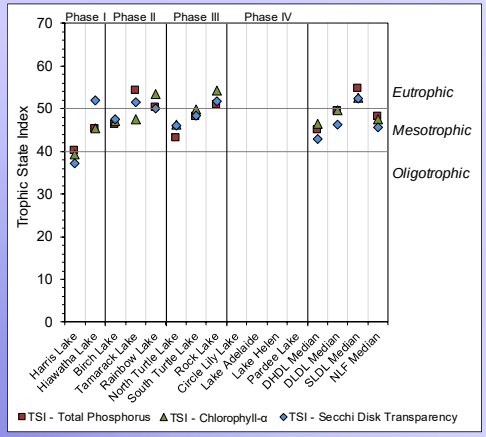
Winchester Lakes Trophic State Index



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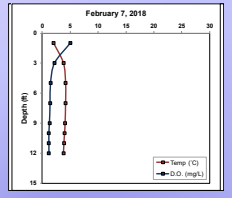
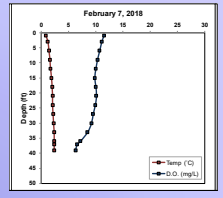
Temperature & Dissolved Oxygen

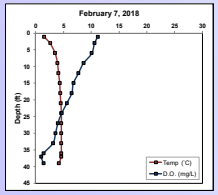
Rock Lake



North Turtle Lake



South Turtle Lake



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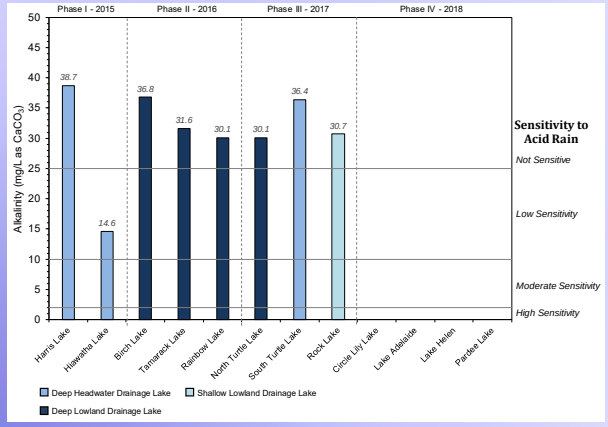
Additional Water Quality Parameters

Alkalinity



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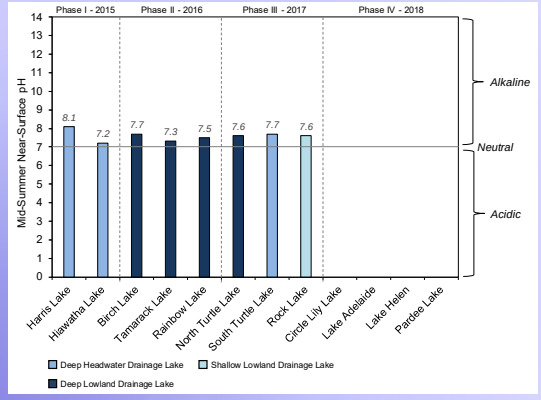
Additional Water Quality Parameters
pH



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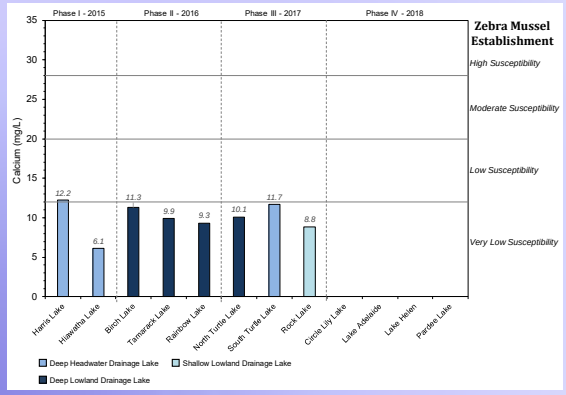
Additional Water Quality Parameters
Calcium



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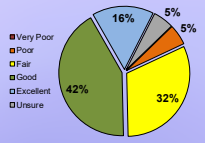
Stakeholder Perceptions of Water Quality

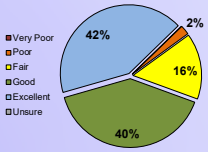
How would you describe the current water quality of your lake?

Rock Lake



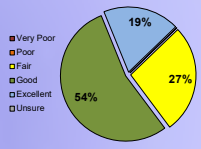
19 respondents (37%)

North Turtle Lake



45 respondents (39%)

South Turtle Lake



37 respondents (31%)

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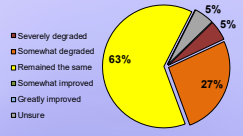
Lake Management Planning

Stakeholder Perceptions of Water Quality

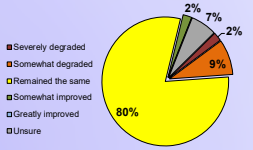
How has the water quality changed in your lake since you first visited?

Rock Lake



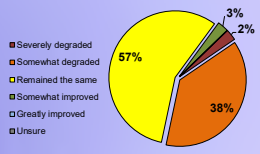
19 respondents (37%)

North Turtle Lake



45 respondents (39%)

South Turtle Lake



37 respondents (31%)

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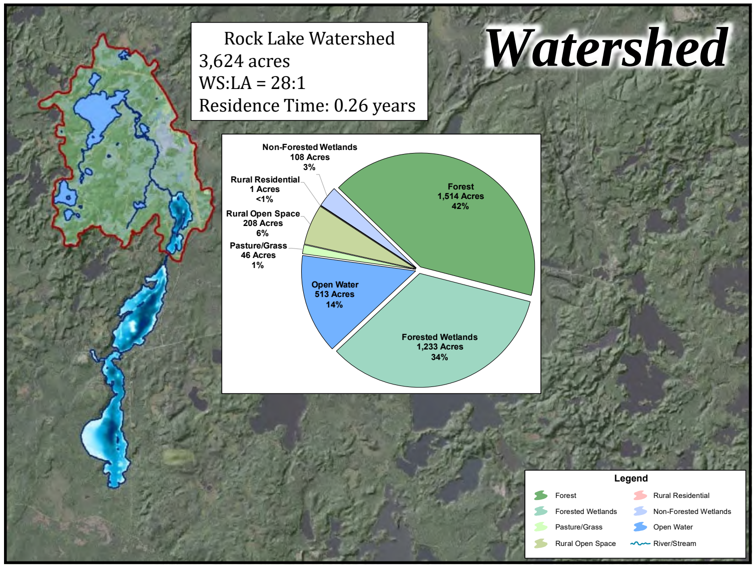
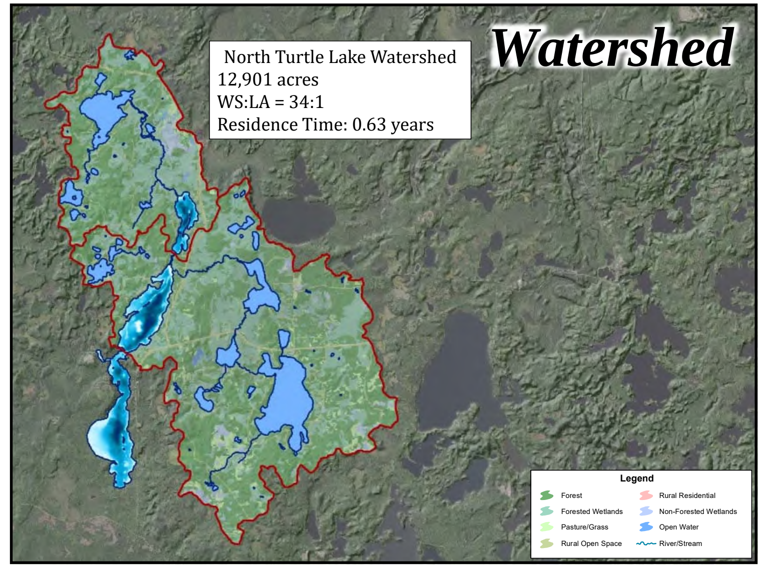
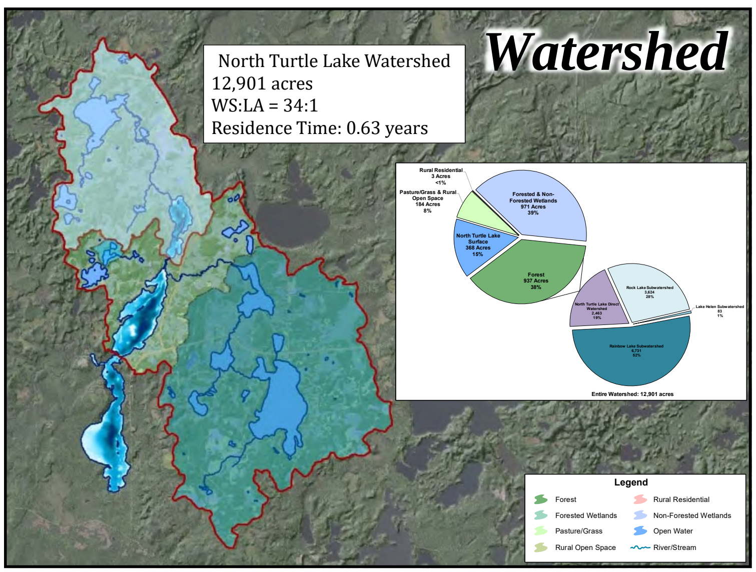
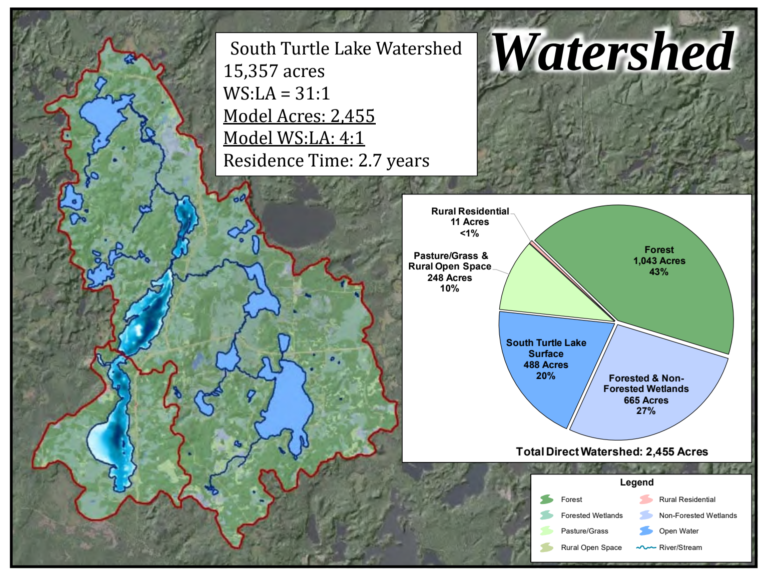
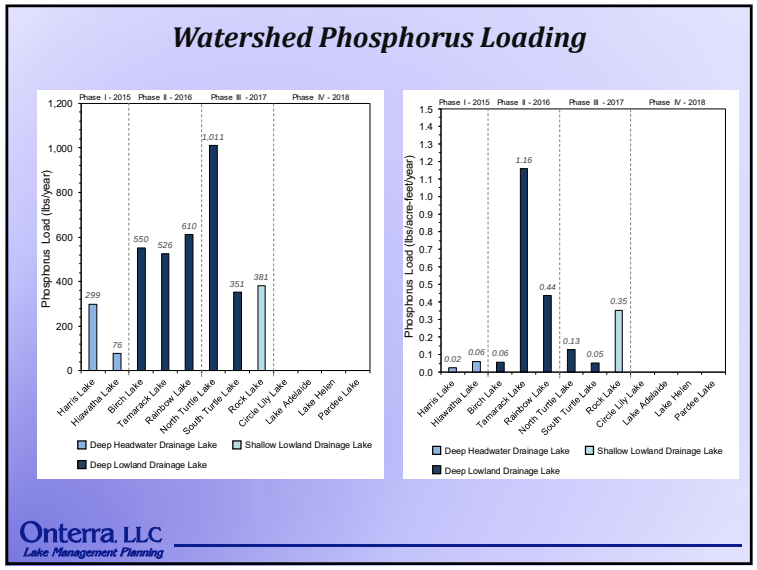
Lake Management Planning


Watershed
Rock Lake Watershed
3,624 acres
WS:LA = 28:1
Residence Time: 0.26 years
Non-Forested Wetlands
108 Acres
3%
Rural Residential
1 Acres
<1%
Rural Open Space
208 Acres
6%
Pasture/Grass
46 Acres
1%
Forest
1,514 Acres
42%
Open Water
513 Acres
14%
Forested Wetlands
1,233 Acres
34%
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed
North Turtle Lake Watershed
12,901 acres
WS:LA = 34:1
Residence Time: 0.63 years
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed
North Turtle Lake Watershed
12,901 acres
WS:LA = 34:1
Residence Time: 0.63 years
Rural Residential
3 Acres
<1%
Pasture/Grass & Rural Open Space
184 Acres
8%
Forested & Non-Forested Wetlands
971 Acres
39%
North Turtle Lake Surface
368 Acres
15%
Forest
937 Acres
38%
North Turtle Lake Direct Watershed
2,463
19%
Rock Lake Subwatershed
3,624
28%
Lake Helen Subwatershed
83
1%
Rainbow Lake Subwatershed
6,731
52%
Entire Watershed: 12,901 acres
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed
South Turtle Lake Watershed
15,357 acres
WS:LA = 31:1
Model Acres: 2,455
Model WS:LA: 4:1
Residence Time: 2.7 years
Rural Residential
11 Acres
<1%
Pasture/Grass & Rural Open Space
248 Acres
10%
Forest
1,043 Acres
43%
South Turtle Lake Surface
488 Acres
20%
Forested & Non-Forested Wetlands
665 Acres
27%
Total Direct Watershed: 2,455 Acres
Legend
Forest
Forested Wetlands
Pasture/Grass
Rural Open Space
Rural Residential
Non-Forested Wetlands
Open Water
River/Stream


Watershed Phosphorus Loading
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Phosphorus Load (lbs/year)
299
76
550
526
610
1,011
351
381
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
Deep Headwater Drainage Lake
Shallow Lowland Drainage Lake
Deep Lowland Drainage Lake
Phosphorus Load (lbs/acre-feet/year)
0.02
0.06
0.06
1.16
0.44
0.13
0.05
0.35
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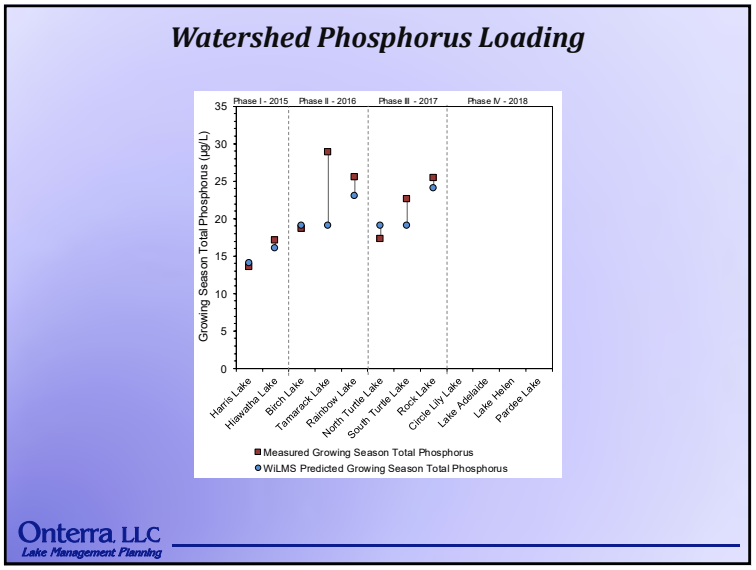
Watershed Phosphorus Loading
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Growing Season Total Phosphorus (µg/L)
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Lake Adelaide
Lake Helen
Pardee Lake
Measured Growing Season Total Phosphorus
WiLMS Predicted Growing Season Total Phosphorus
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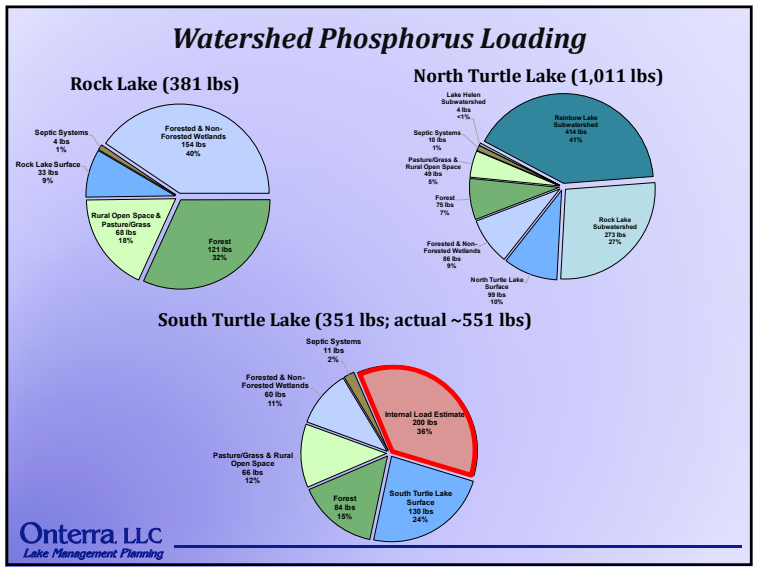
Watershed Phosphorus Loading
Rock Lake (381 lbs)
Septic Systems
4 lbs
1%
Forested & Non-Forested Wetlands
154 lbs
40%
Rock Lake Surface
33 lbs
9%
Rural Open Space & Pasture/Grass
68 lbs
18%
Forest
121 lbs
32%
North Turtle Lake (1,011 lbs)
Lake Helen Subwatershed
4 lbs
<1%
Septic Systems
10 lbs
1%
Pasture/Grass & Rural Open Space
49 lbs
5%
Forest
75 lbs
7%
Forested & Non-Forested Wetlands
86 lbs
9%
North Turtle Lake Surface
99 lbs
10%
Rainbow Lake Subwatershed
414 lbs
41%
Rock Lake Subwatershed
273 lbs
27%
South Turtle Lake (351 lbs; actual ~551 lbs)
Septic Systems
11 lbs
2%
Forested & Non-Forested Wetlands
60 lbs
11%
Pasture/Grass & Rural Open Space
66 lbs
12%
Forest
84 lbs
15%
Internal Load Estimate
200 lbs
36%
South Turtle Lake Surface
130 lbs
24%
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Shoreland Condition

Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.
- 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**

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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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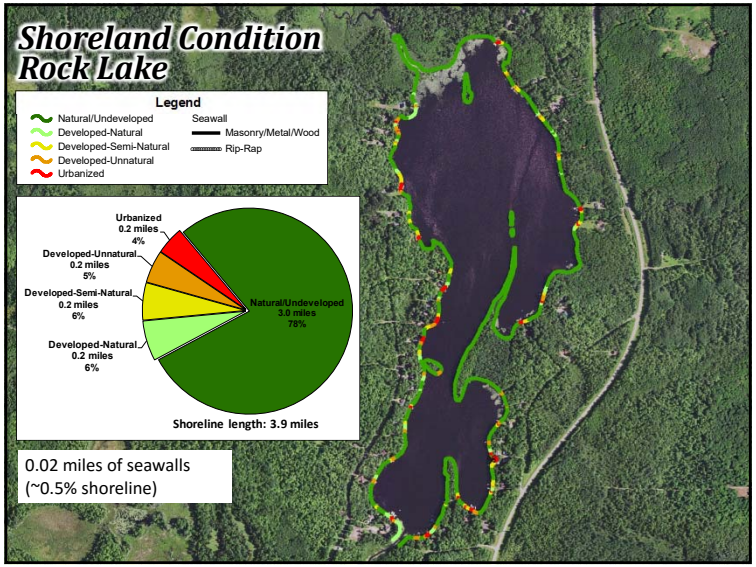
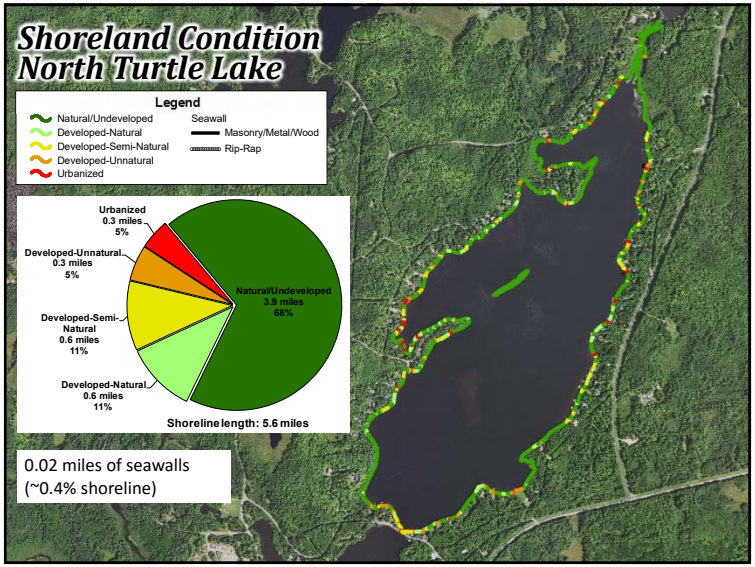
Shoreland Condition Rock Lake

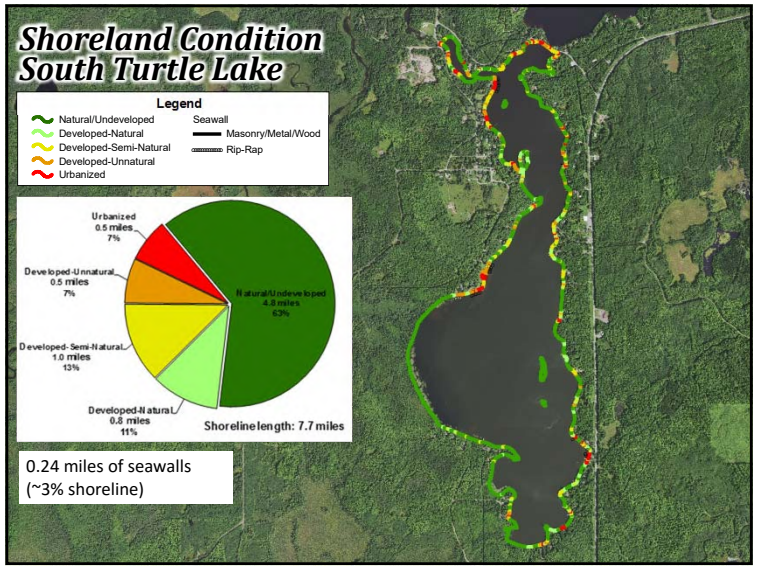


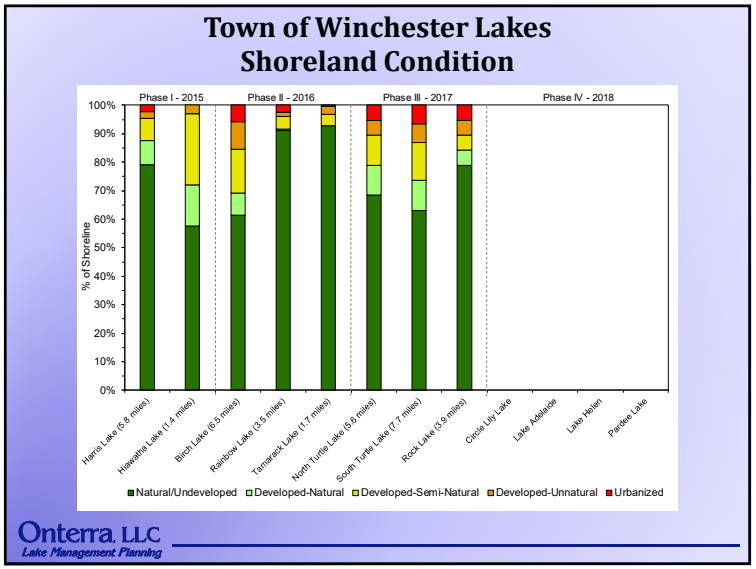
0.02 miles of seawalls
(~0.5% shoreline)

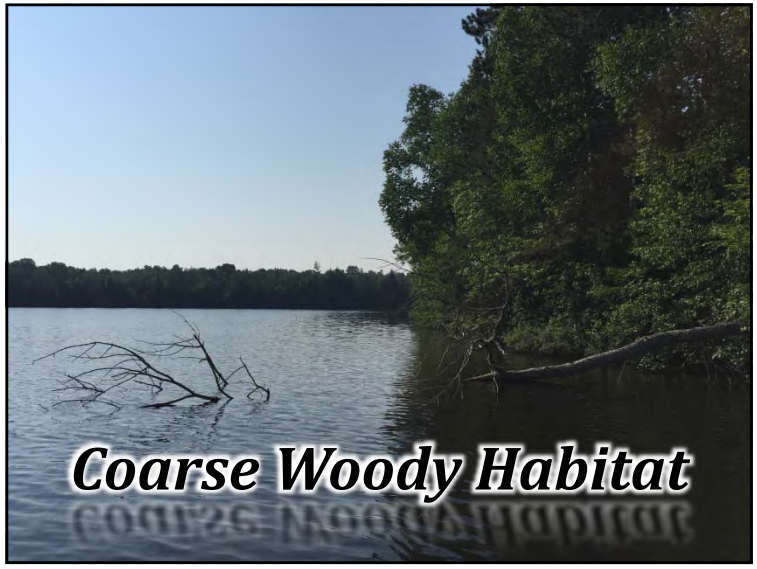
Shoreland Condition North Turtle Lake



0.02 miles of seawalls
(~0.4% shoreline)







Coarse Woody Habitat

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

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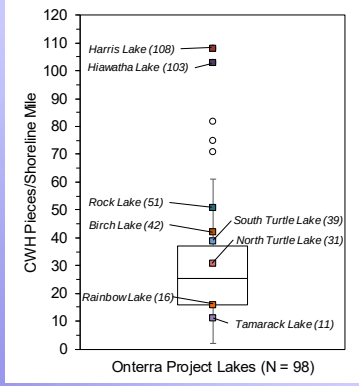
Lake Management Planning

Town of Winchester Lakes
Coarse Woody Habitat



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Lake Management Planning

Aquatic Plant Surveys

- Assess both non-native & native species
- Four surveys completed in 2017
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Acoustic Survey
    - Water depth (bathymetry)
    - Substrate hardness
    - Aquatic plant bio-volume
  - Emergent/Floating-Leaf Community Mapping Survey

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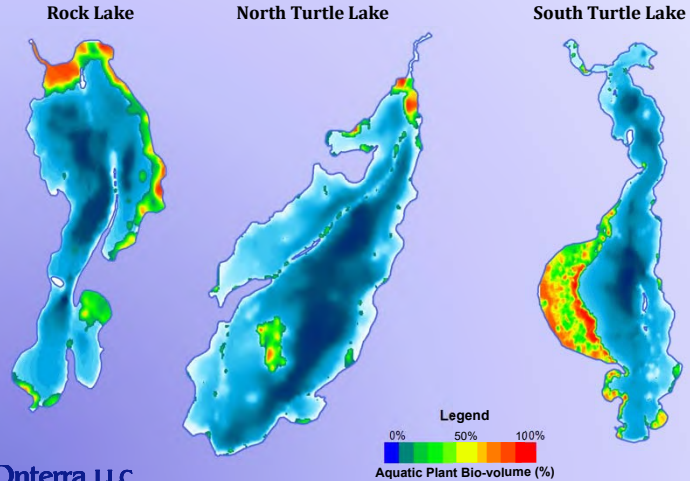
Aquatic Plant Bio-Volume



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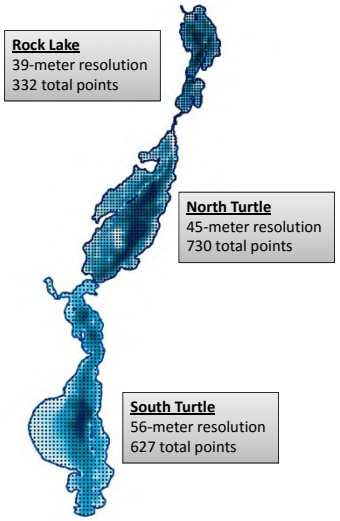
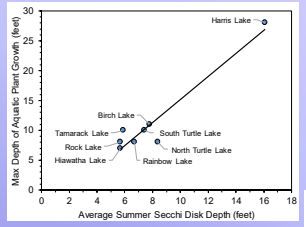
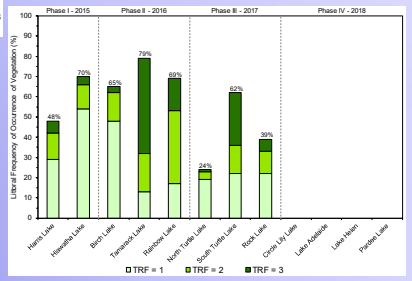
Whole-Lake Point-Intercept Survey



Frequency of Aquatic Plants





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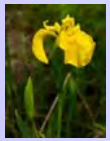
Plant Data Overview

- 89 native plant species located to date
  - 2 listed as special concern: Northeastern bladderwort & Vasey's pondweed

- 2 non-native plant species
  - Curly-leaf pondweed (Harris Lake)
  - Pale-yellow iris (Turtle Chain)



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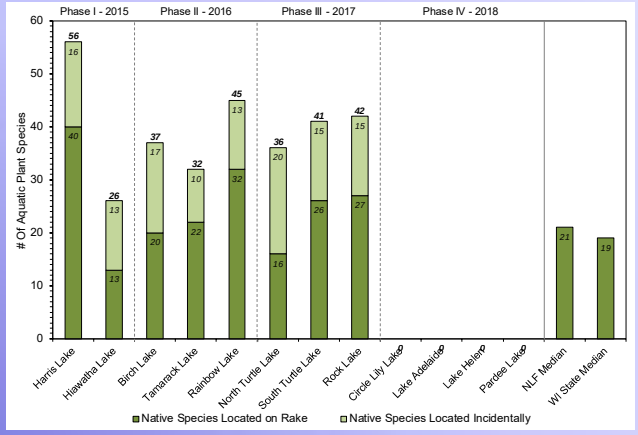
Native Species Richness



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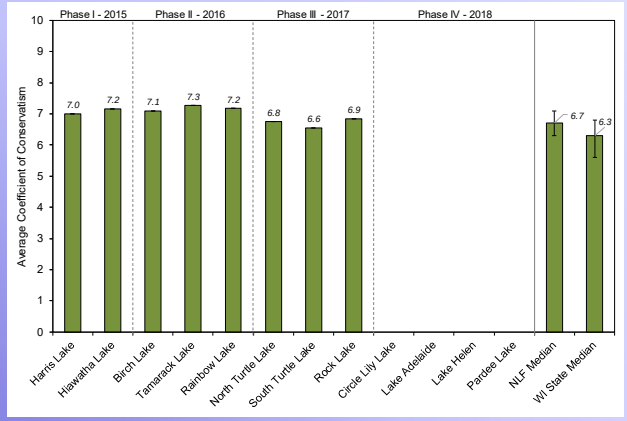
Average Conservatism



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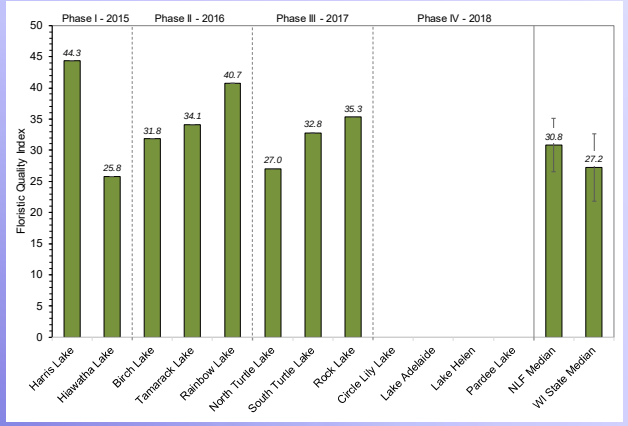
Floristic Quality



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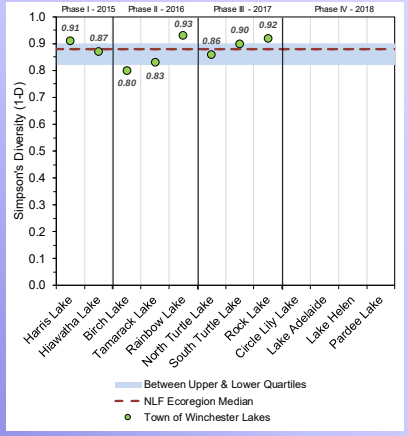
Simpson's Diversity Index



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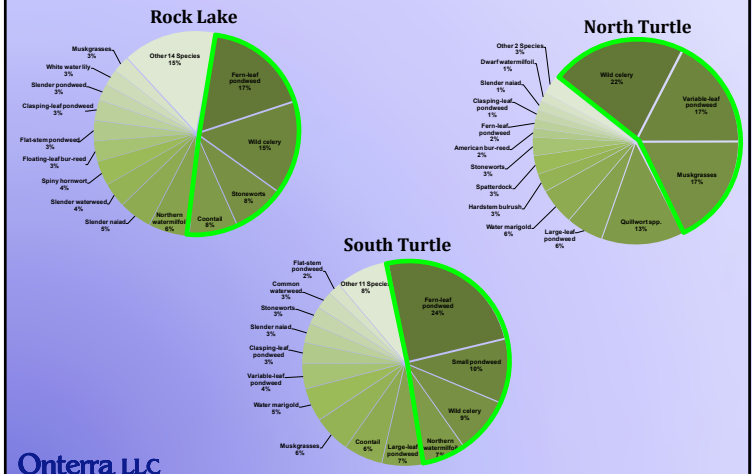
Relative Occurrence



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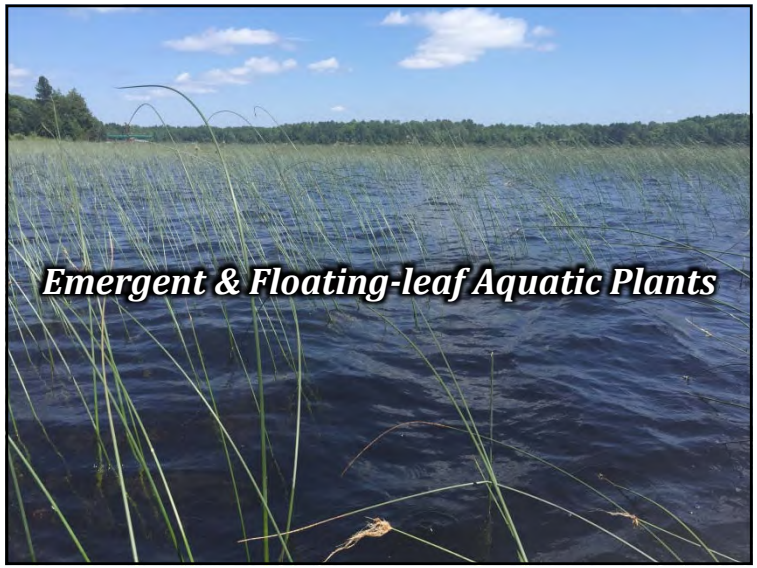

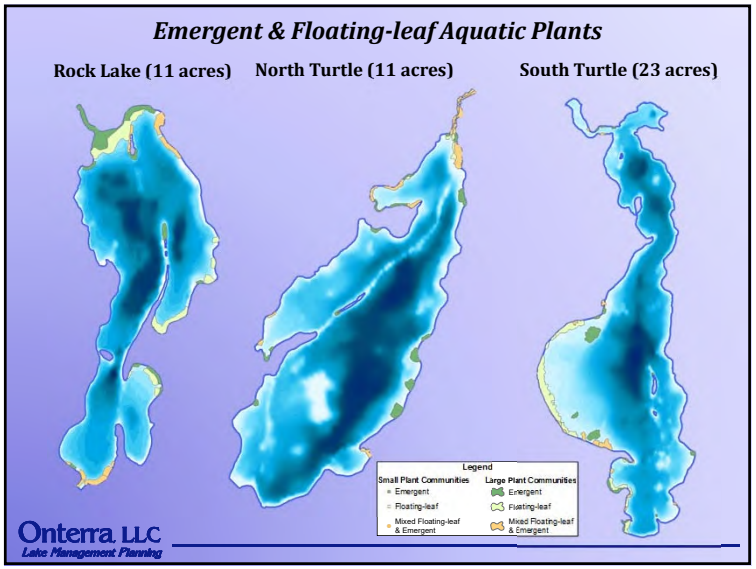

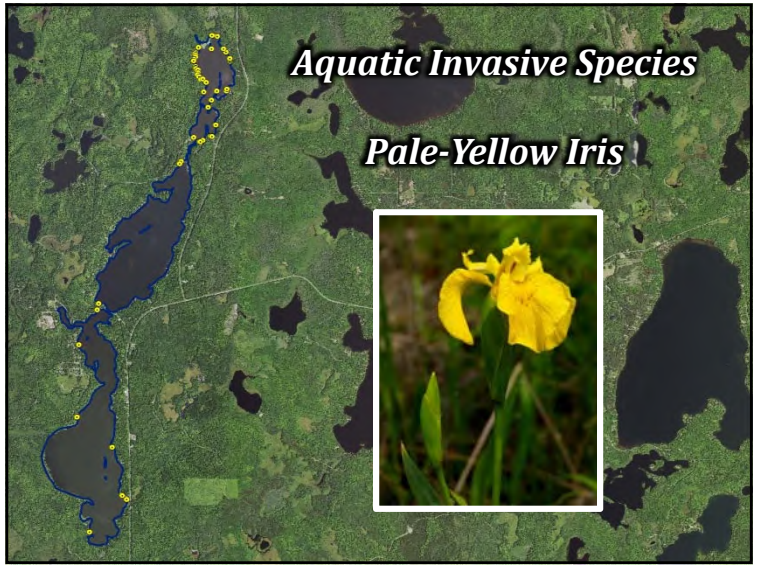

Other Aquatic Invasive Species

Type	Scientific Name	Common Name	Phase I: Hams Lake	Phase I: Hawetha Lake	Phase II: Birch Lake	Phase II: Rainbow Lake	Phase II: Tamarack Lake	Phase III: North Turtle Lake	Phase III: South Turtle Lake	Phase III: Rock Lake	Phase IV: Circle Lily Lake	Phase IV: Lake Adelaide	Phase IV: Lake Helen	Phase IV: Pastee Lake
Plant	*Lythrum salicaria*	Purple loosestrife										X		
	Myosotis scorpioides	Aquatic forget-me-not												
	Potamogeton crispus	Curly-leaf pondweed	X		X									
Snail	*Cipangopaludina chinensis*	Chinese mystery snail			X									
	Viviparus georgianus	Banded mystery snail			X									X
Crayfish	*Orconectes rusticus*	Rusty crayfish			X			X			X		X	
Jellyfish	*Craspedacusta sowerbyi*	Freshwater jellyfish												X

X = AIS species presence documented by WDNR as of 2016

Aquatic Forget-Me-Not

Chinese Mystery Snail

Banded Mystery Snail

Rusty Crayfish

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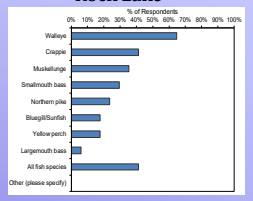
Lake Management Planning

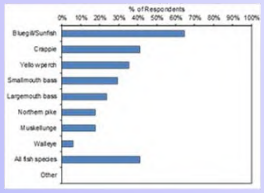
Stakeholder Survey

What species of fish do you like to catch in your lake?

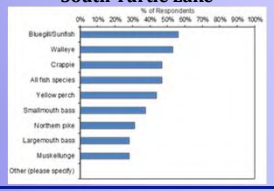
Rock Lake



North Turtle Lake



South Turtle Lake



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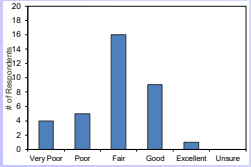
Stakeholder Survey

How would you describe the current quality of fishing in your lake?

Rock Lake

North Turtle Lake



South Turtle Lake

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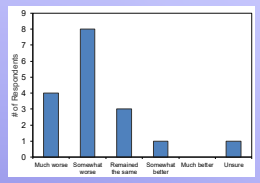
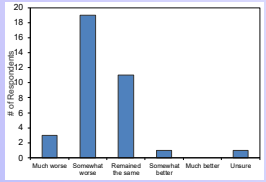
Stakeholder Survey

How has the quality of fishing changed since you first started fishing the lake?

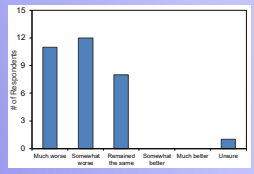
Rock Lake



North Turtle Lake



South Turtle Lake



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Native American Spear Harvest

- Town is within Treaty of 1842
- Tribal and State authorities establish *total allowable catch* based on population estimates (typically 35% for walleye & 27% for muskellunge)
- The total allowable catch number may be reduced based on confidence in population estimates: *safe harvest level*
- Tribal community claims percentage of safe harvest level, or *declaration*
- Bag limits for hook and line anglers set to accommodate declaration
- Can only harvest two walleye over 20 inches per night – one between 20 and 24" and one any size over 20"

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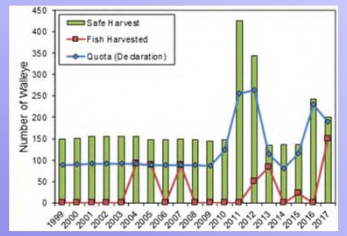
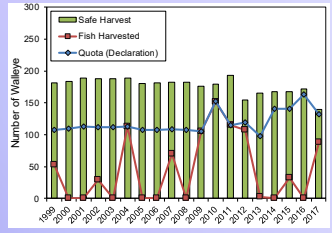
North & South Turtle Walleye Spear Harvest

North Turtle Lake



South Turtle Lake



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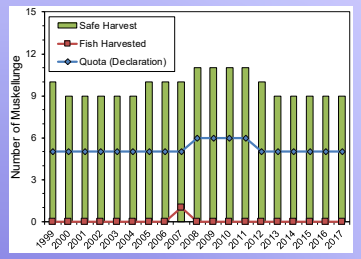
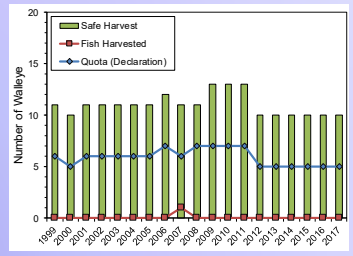
North & South Turtle Muskellunge Spear Harvest

North Turtle Lake



South Turtle Lake



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Conclusions

Water Quality

- Good to excellent for respective lake type, but…
- Increasing trend in phosphorus concentration in South Turtle Lake

Watershed & Immediate Shoreline

- Watersheds in excellent shape – primarily forests & wetlands
- Majority of shoreland contains little to no development, but always room for improvement

Aquatic Plant Community

- High-quality native species present
- One non-native species: Pale-yellow iris (*Iris pseudacorus*)

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

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Meeting Objective

- Present highlights of study results from Turtle Lakes Chain
  - Focusing on primarily on water quality and aquatic plants
- Answer questions (throughout)
- Outline management plan goals and actions

Presentation Outline

- Summary of Project Conclusions
- Specific Results Discussion
- Proposed Management Plan (Mixed In)

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3

Study Conclusions

Water Quality
- Good to excellent for respective lake type, but…
- Increasing trend in phosphorus concentration in South Turtle Lake

Watershed & Immediate Shoreline
- Watersheds in excellent shape – primarily forests & wetlands
- Majority of shoreland contains little to no development, but always room for improvement

Aquatic Plant Community
- High-quality native species present
- One non-native species: Pale-yellow iris (Iris pseudacorus)

Fisheries
- Anglers target walleye and panfish in chain
- Many believe the fishing is ok, but has gotten worse in recent years
- North and South Turtle experience Native American spearing

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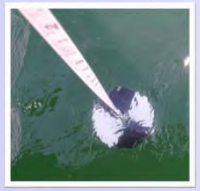
Lake Water Quality – Trophic Parameters

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

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

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



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Water Quality - Comparables

Wisconsin Ecoregions

An area containing similar geology, physiography, hydrology, climate, and soils. As well as common terrestrial and aquatic fauna.

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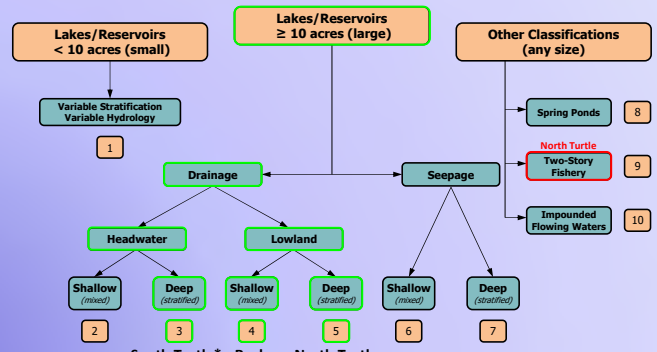
Water Quality - Comparables

Wisconsin Lakes Natural Community Types



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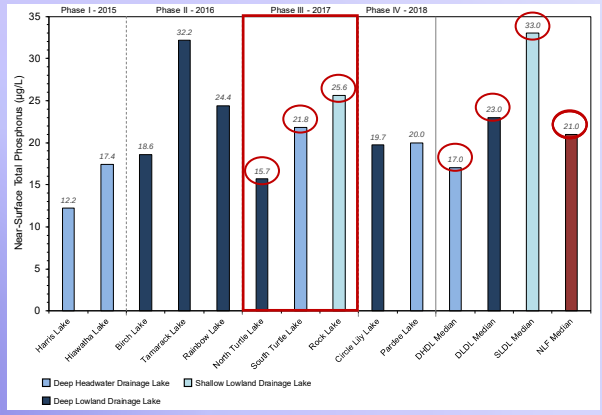
Total Phosphorus



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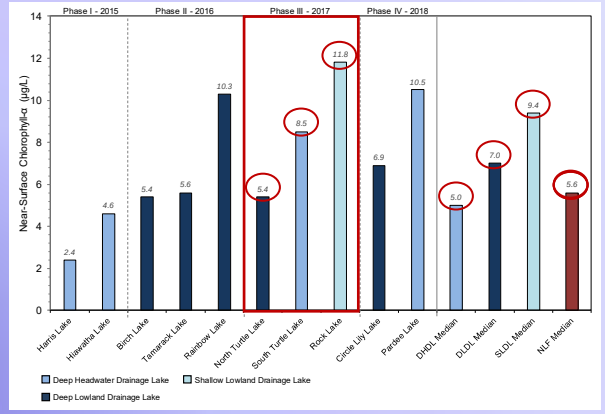
Chlorophyll-a



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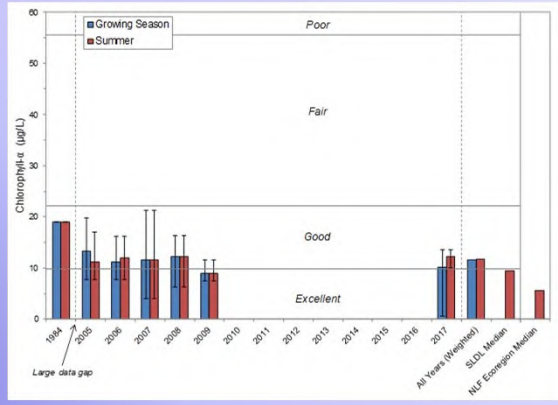
Rock Lake Chlorophyll-a



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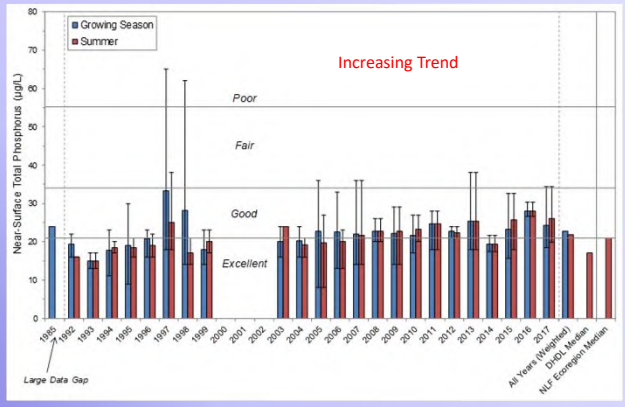
South Turtle Lake Phosphorus



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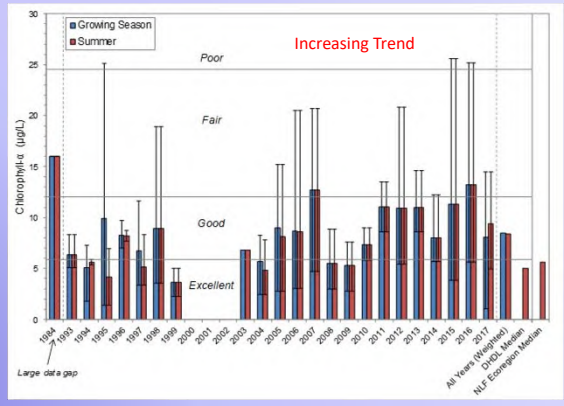
South Turtle Lake Chlorophyll-a



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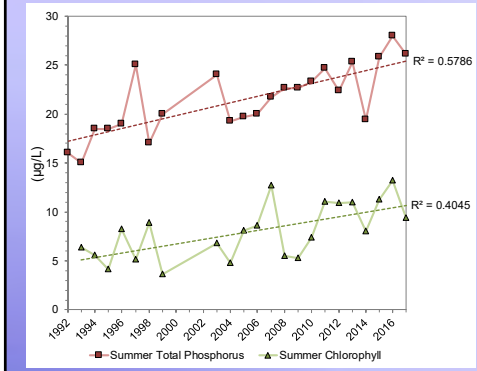
South Turtle Lake Water Quality Trends



- Why is phosphorus increasing?
- Trend not observed in other lakes.
- Not correlated with precipitation.
- No apparent land-use changes within the watershed.
- Data indicate *internal nutrient loading* may be the cause.

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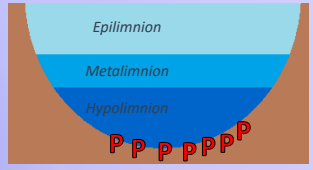
South Turtle Lake Water Quality Trends

Internal Nutrient Loading

- In general, net movement of phosphorus to the sediment in lakes.
- Under certain conditions, phosphorus (and other nutrients) get released from bottom sediments into the overlying water.
- Anoxic (devoid of oxygen) conditions cause phosphorus release.



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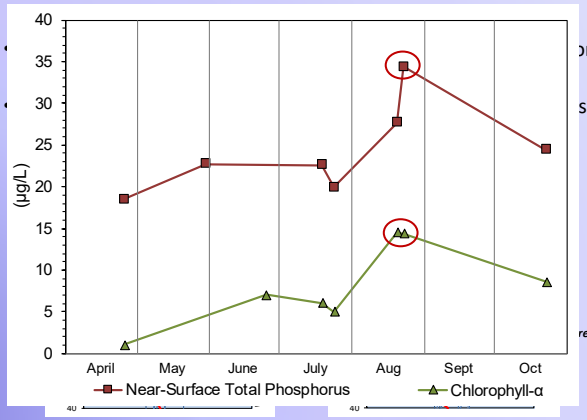
South Turtle Lake Water Quality Trends



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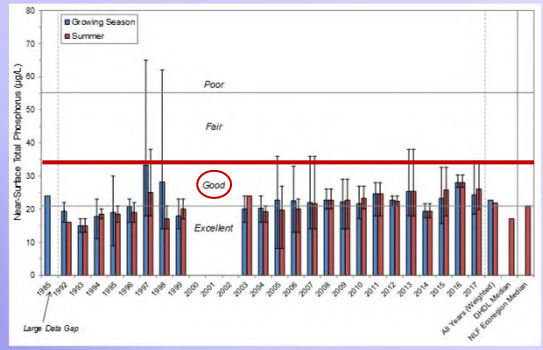
South Turtle Lake Phosphorus



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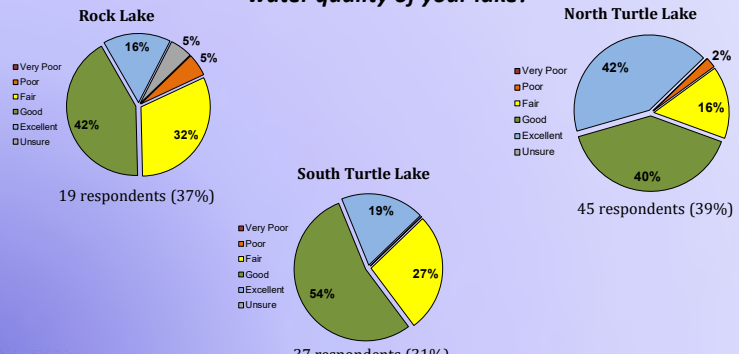
Stakeholder Perceptions of Water Quality

How would you describe the current water quality of your lake?



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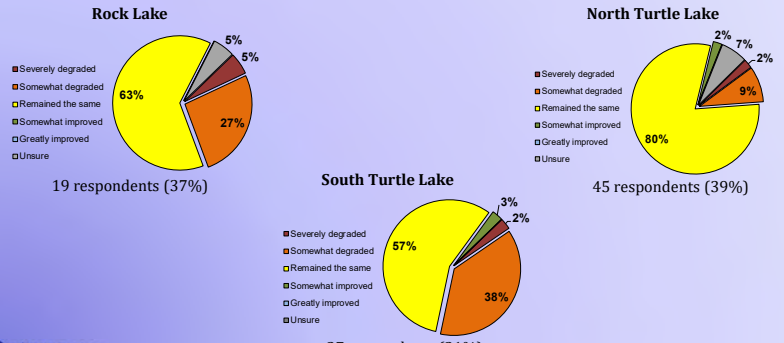
Stakeholder Perceptions of Water Quality

How has the water quality changed in your lake since you first visited?



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Management Goal:

Maintain Current Water Quality Conditions

Management Actions

1. **Continue monitoring of Turtle Lakes Chain water quality through the WDNR Citizens Lake Monitoring Network (CLMN).**

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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

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Shoreline Assessment Category Descriptions

More Natural Habitat

Greater Need for Restoration

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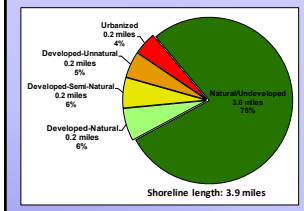
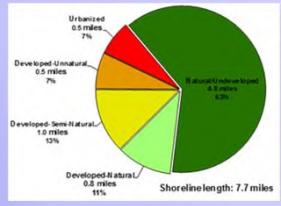
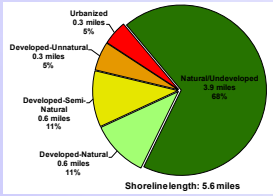
Turtle Lakes Chain Shoreland Assessment



Rock Lake

South Turtle Lake





North Turtle Lake

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Coarse Woody Habitat

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

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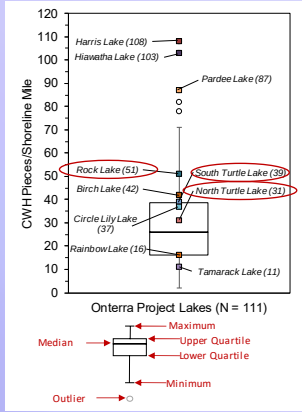
Town of Winchester Lakes Coarse Woody Habitat



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Management Goal:

Improve Turtle Lakes Chain Ecological Health and Fishery Resource

Management Actions

1. **Educate stakeholders on the importance of shoreland condition and shoreland restoration on Turtle Lakes Chain.**
2. **Coordinate with WDNR and private landowners to expand coarse woody habitat in Turtle Lakes Chain**

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Aquatic Plant Surveys

- Assess both non-native & native species
- Four surveys completed in 2017
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Acoustic Survey
    - Water depth (bathymetry)
    - Substrate hardness
    - Aquatic plant bio-volume
  - Emergent/Floating-Leaf Community Mapping Survey

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Whole-Lake Point-Intercept Survey

Rock Lake
39-meter resolution
332 total points

North Turtle
45-meter resolution
730 total points

South Turtle
56-meter resolution
627 total points

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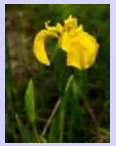
Plant Data Overview

- 98 native plant species located to date
  - 2 listed as special concern: Northeastern bladderwort & Vasey's pondweed

- 2 non-native plant species
  - Curly-leaf pondweed (Harris Lake)
  - Pale-yellow iris (Turtle Chain, Pardee Lake)
  - Aquatic Forget Me Not (Pardee Lake)



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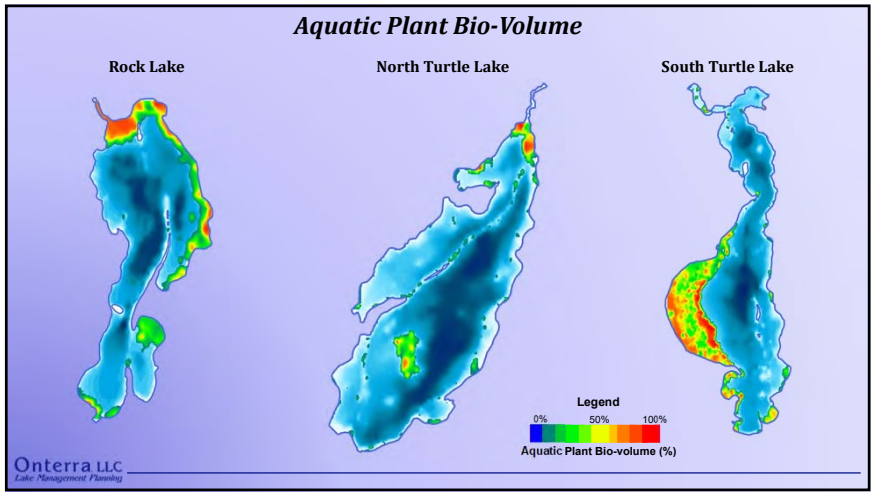
Aquatic Plant Bio-Volume
Rock Lake
North Turtle Lake
South Turtle Lake
Legend
0%
50%
100%
Aquatic Plant Bio-volume (%)
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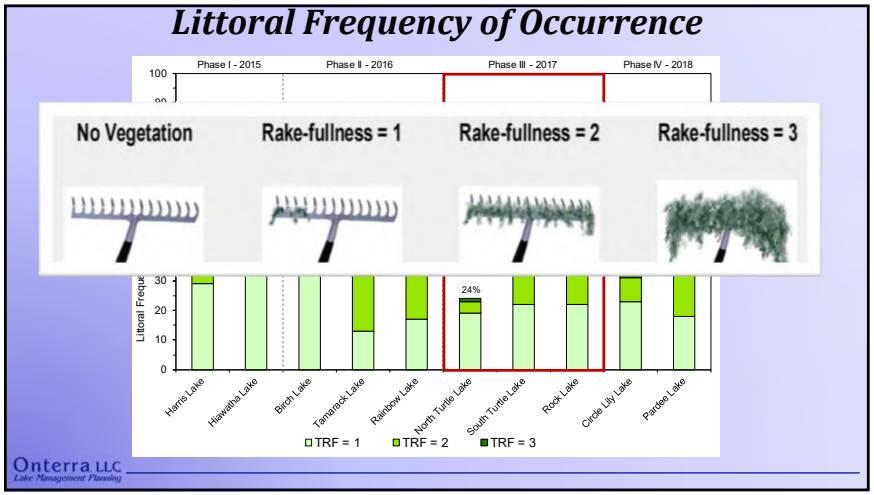
Littoral Frequency of Occurrence
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
No Vegetation
Rake-fullness = 1
Rake-fullness = 2
Rake-fullness = 3
24%
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
TRF = 1
TRF = 2
TRF = 3
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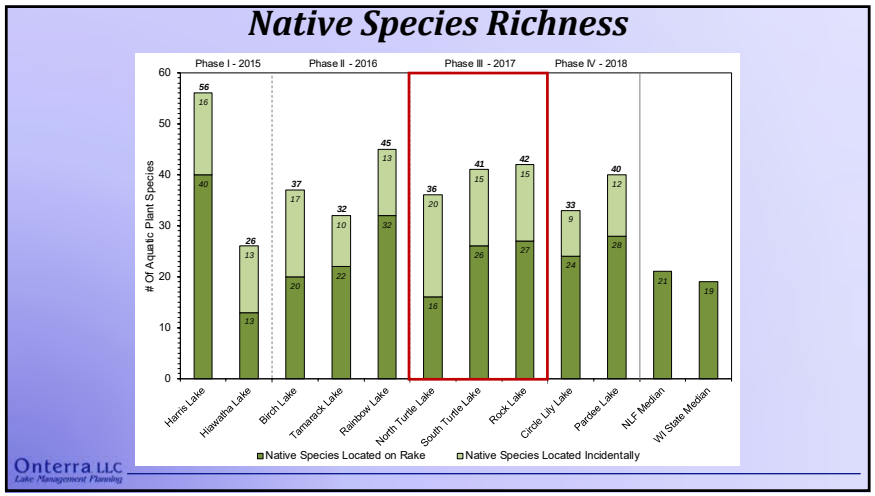
Native Species Richness
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Of Aquatic Plant Species
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
NLF Median
WI State Median
Native Species Located on Rake
Native Species Located Incidentally
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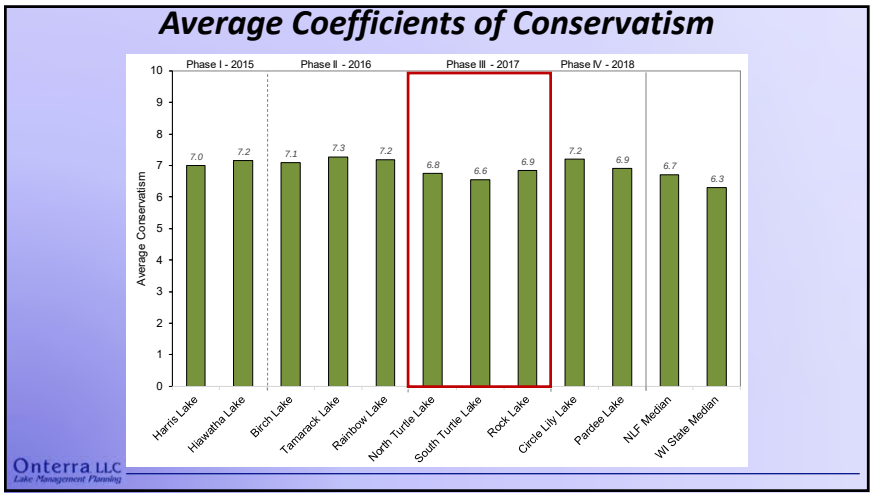
Average Coefficients of Conservatism
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Average Conservatism
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
NLF Median
WI State Median
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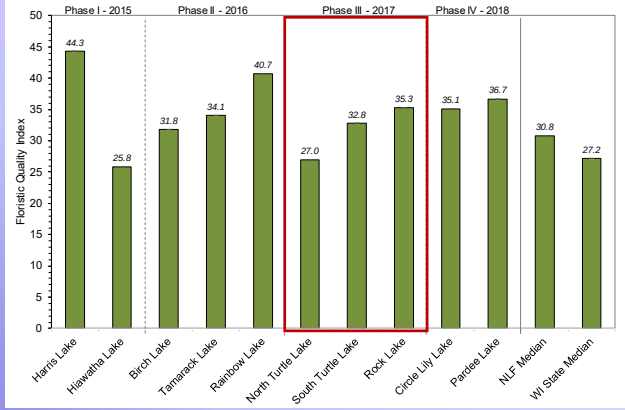
Floristic Quality



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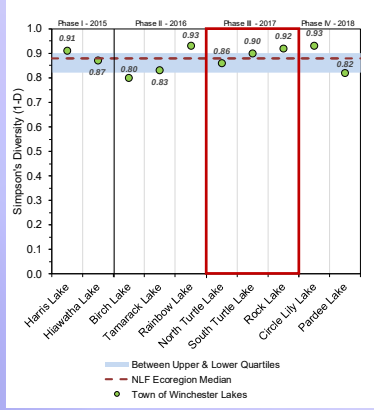
Species Diversity



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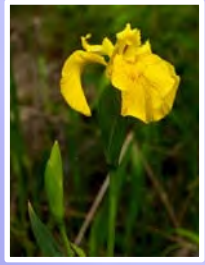
Aquatic Invasive Plant Species

No curly-leaf pondweed or Eurasian watermilfoil

Pale-yellow iris located throughout chain.



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Management Goal:

Control Existing AIS in the Turtle Lakes Chain and Prevent Further AIS Introductions

Management Actions

1. **Continue Clean Boats Clean Waters watercraft inspections at Turtle Lakes Chain public access sites.**
2. **Coordinate annual volunteer monitoring for Aquatic Invasive Species in the Turtle Lakes Chain.**
   - ***Pale-yellow iris harvesting with NLDC***
   - ***AIS Alert section added to www.thetlca.org***
3. **Initiate rapid response plan following detection of new AIS**

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Management Goal:

Increase the TLCA's Capacity to Communicate with Lake Stakeholders and Facilitate Partnerships with Other Management Entities

Management Actions

1. **Promote lake protection and enjoyment through stakeholder education**
2. **Continue TLCA's involvement with other entities that have responsibilities in managing (management units) the Turtle Lakes Chain**

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Thank You

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North Lakeland Discovery Center
Town of Winchester

Phase IV
Circle Lily, Pardee, Adelaide, & Helen Lakes Management Planning Project
Kick-off Meeting
May 19, 2018

Tim Hoyman
Onterra LLC
Lake Management Planning

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of this Lake Management Planning Project
  - Data & Information
  - AIS Education & Volunteer Involvement
  - Planning Process
- Project Phasing
- Project Deliverables

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Onterra, LLC

- Founded in 2005
- Staff
  - Three full-time ecologists
  - One part-time paleoecologist
  - Three full-time field technicians
  - Four to five summer interns
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

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Why create a lake management plan?

- Preserve/restore ecological function to ensure cultural services
- 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.
- Snapshot of lake's current status or health.
- Foster realistic expectations and dispel any misconceptions.

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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
  - Shoreline Assessment
  - Fisheries Data Integration
  - Stakeholder Survey

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Water Quality Analysis

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

Chlorophyll-*a*
Pigment used in photosynthesis
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Secchi Disk Transparency
Measure of water clarity
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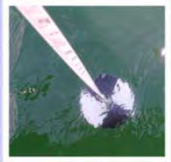

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Watershed Assessment

- Delineation of drainage basins
- Modeling
  - Land cover
  - Phosphorus loading
  - Lakes are modeled in series
  - Scenario development

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early-Season AIS Survey (all Phase IV lakes)

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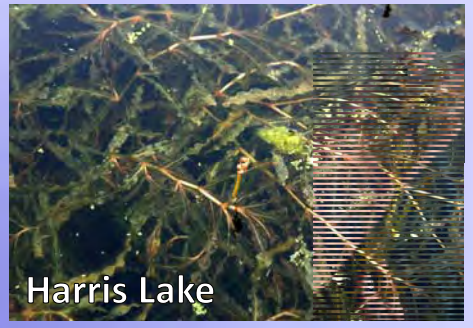
Non-native Aquatic Plants

Curly-leaf Pondweed



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Non-native Aquatic Plants

Eurasian Water Milfoil

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Non-native Aquatic Plants

Purple Loosestrife & Pale-yellow Iris

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early-Season AIS Survey (all Phase IV lakes)
  - Whole-lake point-intercept surveys (Circle Lily & Pardee)

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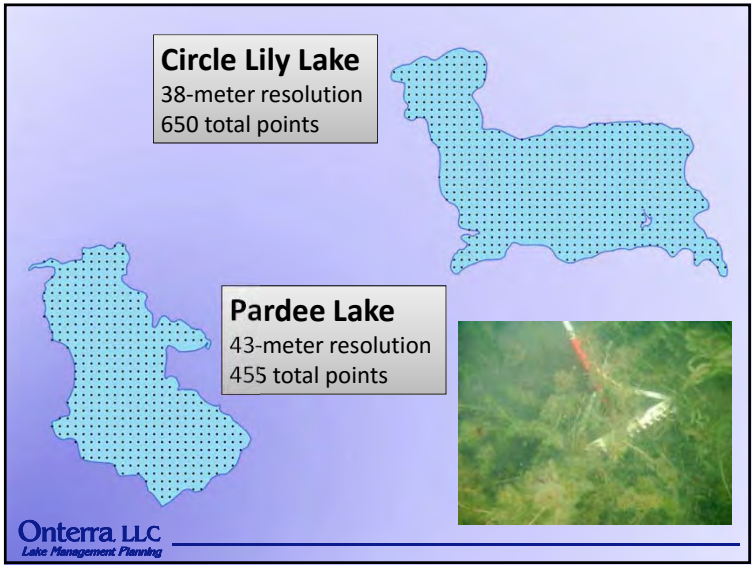

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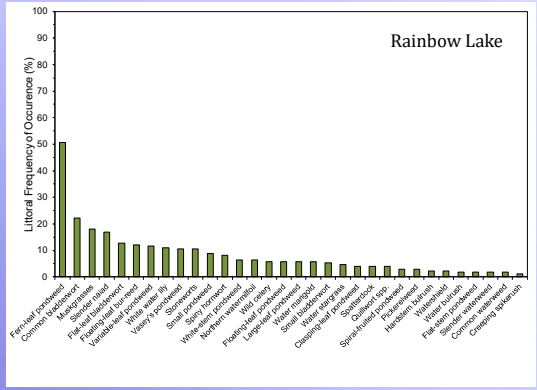
Littoral Frequency of Occurrence



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Aquatic Plant Surveys

- Concerned with both native and non-native plants
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  - Whole-lake point-intercept surveys (Circle Lily & Pardee)
  - Bio-Acoustic Survey (Circle Lily & Pardee)

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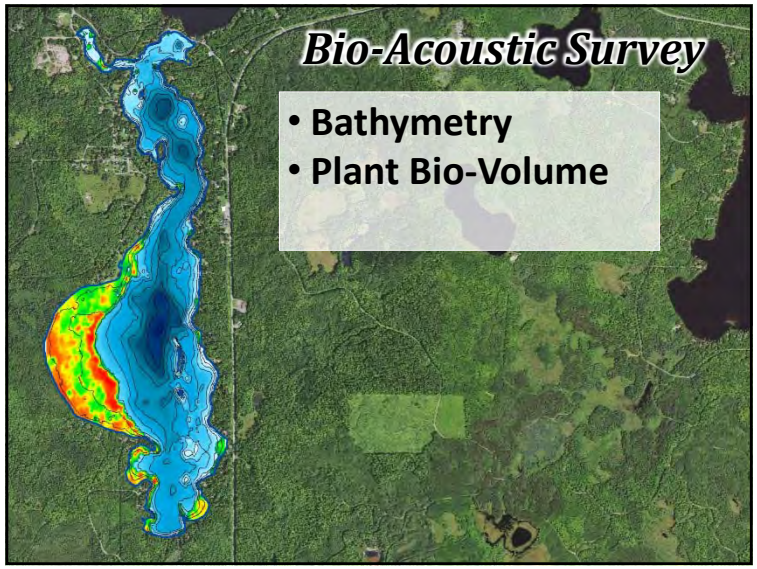

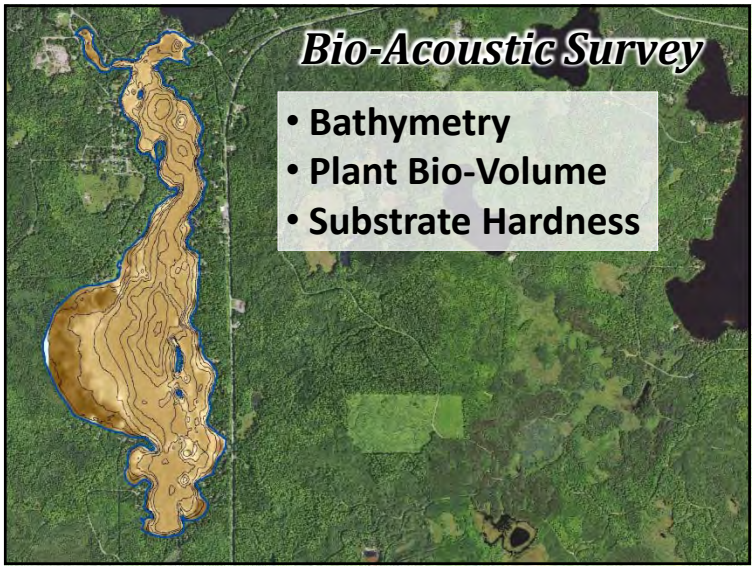

Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early-Season AIS Survey (all Phase IV lakes)
  - Whole-lake point-intercept surveys (Circle Lily & Pardee)
  - Bio-Acoustic Survey (Circle Lily & Pardee)
  - Emergent/Floating-leaf Mapping Survey (Circle Lily & Pardee)

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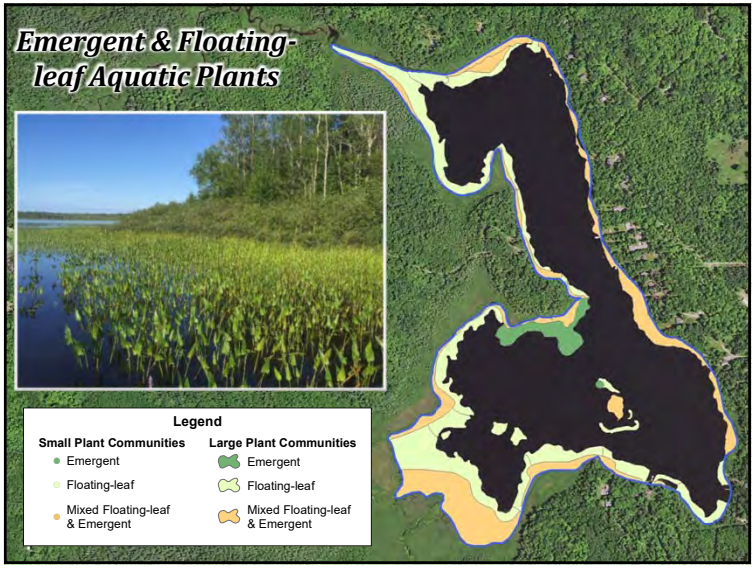

Shoreland Assessment

- 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**

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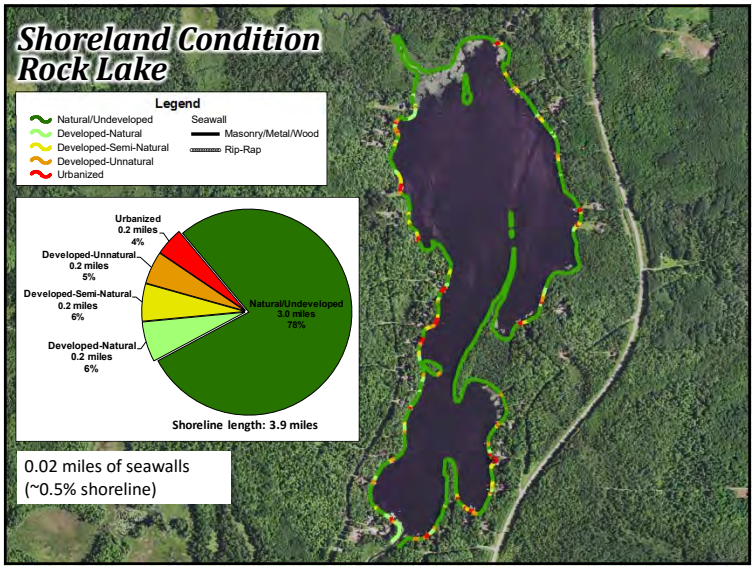

Fisheries Data Integration

- 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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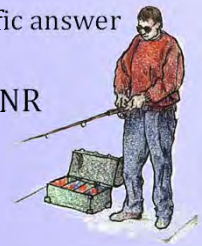
Stakeholder Survey

- Standard survey used as base
  - Planning committee 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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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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Town of Winchester Lake Management Plan Documents

- Multiple documents
- Town of Winchester Lake Management Plan
  - Town-Wide Report
    - Compare/Contrast data from all project lakes
    - Town-Wide Implementation Plan
  - Individual Lake Reports
    - Lake-Specific Results and Conclusions
    - Lake-Specific Implementation Plan
  - Appendices (raw data, etc.)

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Phase IV Project Timeline

April-October 2018
Field Studies Completed

Fall 2018
Stakeholder Survey Distribution

Fall/Winter 2018-19
Data Analysis & Report Writing

Spring/Summer 2019
Planning Committee Meetings & Implementation Plan Development

Summer/Fall 2019
Draft Plan Submitted to WDNR

Winter 2019/20
Plan Finalized

Summer 2020
Public Wrap-up Meeting

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

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Presentation Outline

- Lake Management Planning Project Overview
- Meeting Objective
- Study Results
  - Water Quality
  - Watershed
  - Shoreland Condition/Coarse Woody Habitat
  - Aquatic Plants
  - Fishery (Next Meeting)
- "Big Picture"
- Planning Meeting II

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Management Planning Project Overview

Collect and compile information about Pardee and Circle Lily lakes
- *Includes both environmental & sociological*
- *Historical & current information*
- *Past management actions*

Planning Meeting I
Report Sections

Create a realistic and implementable management plan
- *Challenges facing lakes and lake groups*
- *Create goals that will address challenges*
- *Develop actions that will meet goals*
- *Assign timeframes & facilitators*

Planning Meeting II
Implementation Plan

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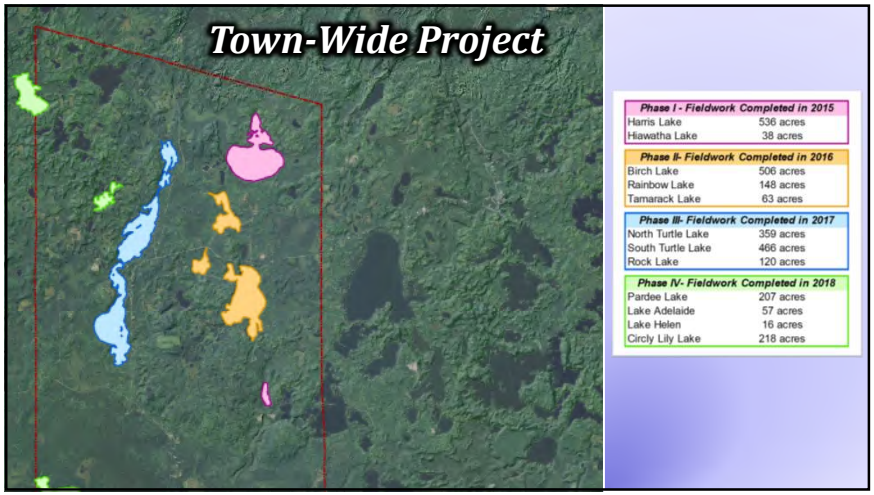

General Study Results of Circle Lily & Pardee Lakes

Water Quality

- Both lakes have good water quality as expected for their lake type.
- Each lake has some oddities in their results, but they are explainable.

Watershed & Immediate Shoreline

- Watersheds in excellent shape and are largely responsible for water quality.
- Both lakes have large areas with no development.

Aquatic Plant Community

- Aquatic plant communities indicate that lakes are healthy
- Neither lake has Eurasian watermilfoil or curly-leaf pondweed, but Pardee has small occurrences of two exotic wetland emergents

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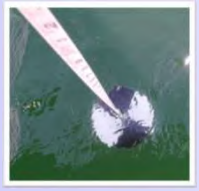
Lake Water Quality – Trophic Parameters

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

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

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



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Water Quality - Comparables

Wisconsin Ecoregions

An area containing similar geology, physiography, hydrology, climate, and soils. As well as common terrestrial and aquatic fauna.

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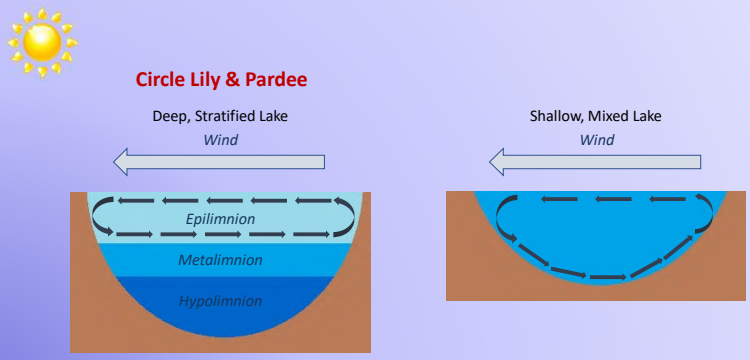
Wisconsin Lakes Classification



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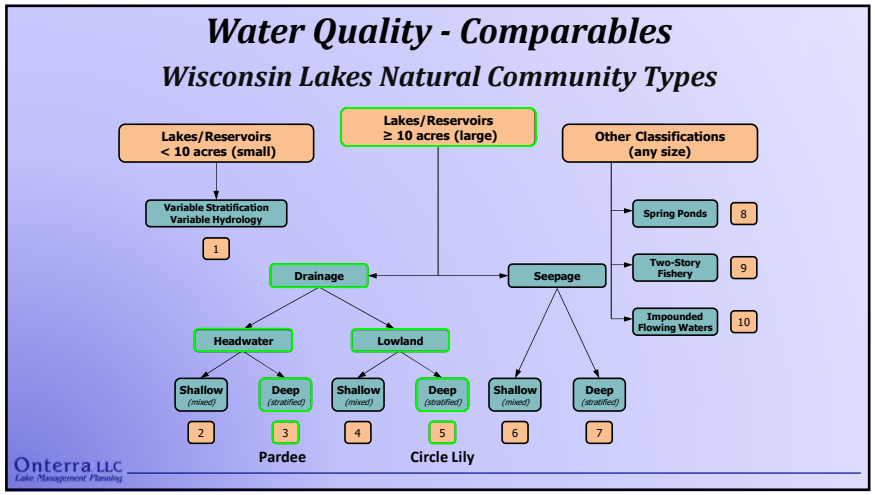
Water Quality - Comparables
Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Drainage
Seepage
Headwater
Lowland
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
2
3
4
5
6
7
Pardee
Circle Lily
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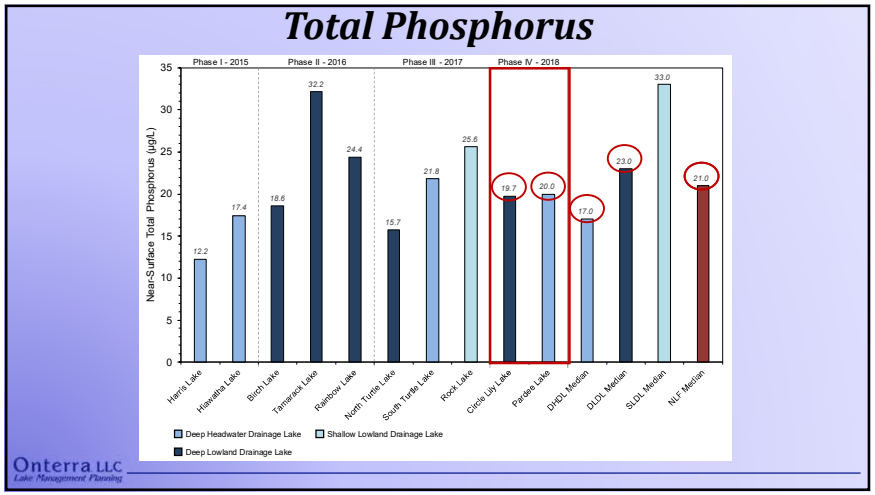
Total Phosphorus
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Near-Surface Total Phosphorus (µg/L)
12.2
17.4
18.6
32.2
24.4
15.7
21.8
25.6
19.7
20.0
17.0
23.0
33.0
21.0
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
DHDL Median
DLDL Median
SLDL Median
NLF Median
Deep Headwater Drainage Lake
Shallow Lowland Drainage Lake
Deep Lowland Drainage Lake
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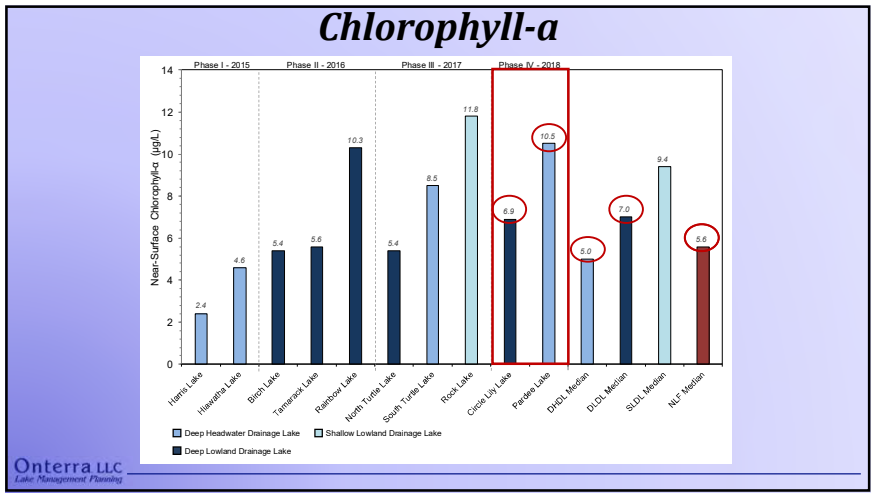
Chlorophyll-a
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Near-Surface Chlorophyll-a (µg/L)
2.4
4.6
5.4
5.6
10.3
5.4
8.5
11.8
6.9
10.5
5.0
7.0
9.4
5.6
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
DHDL Median
DLDL Median
SLDL Median
NLF Median
Deep Headwater Drainage Lake
Shallow Lowland Drainage Lake
Deep Lowland Drainage Lake
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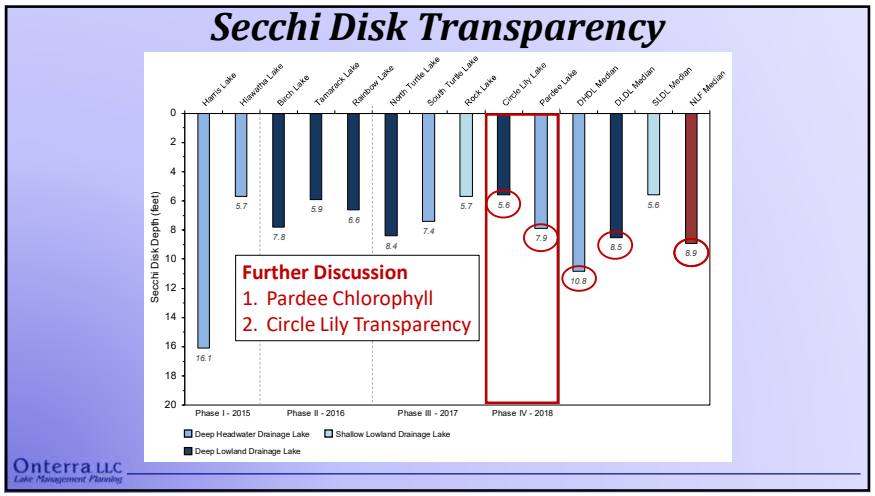
Secchi Disk Transparency
Secchi Disk Depth (feet)
16.1
5.7
7.8
5.9
6.6
8.4
7.4
5.7
5.6
7.9
10.8
8.5
5.6
8.9
Further Discussion
1. Pardee Chlorophyll
2. Circle Lily Transparency
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Deep Headwater Drainage Lake
Shallow Lowland Drainage Lake
Deep Lowland Drainage Lake
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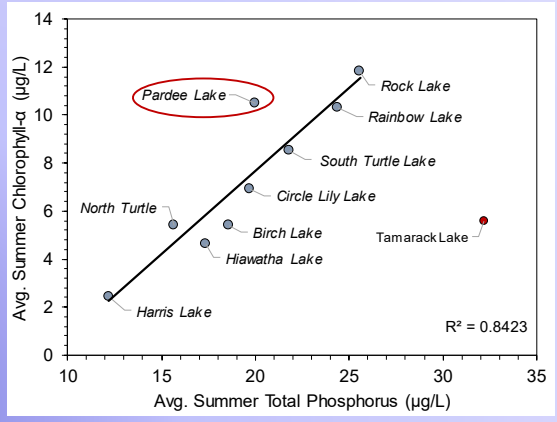
Chl-a & Phosphorus Relationship



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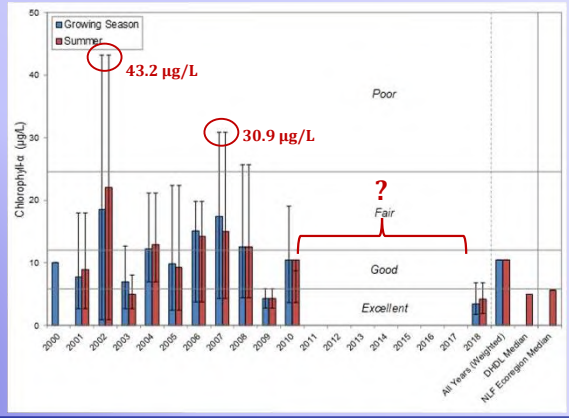
Pardee Lake Chlorophyll-a



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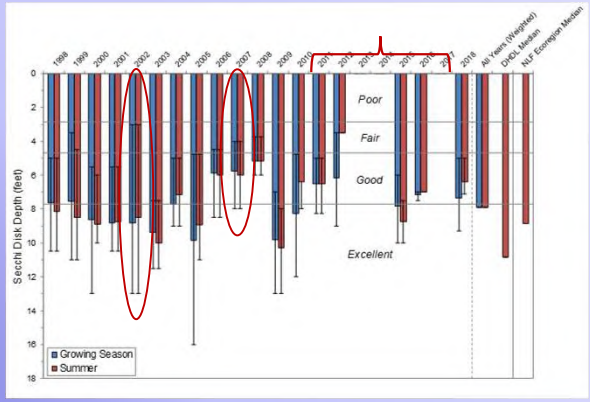
Pardee Lake Secchi Disk Transparency



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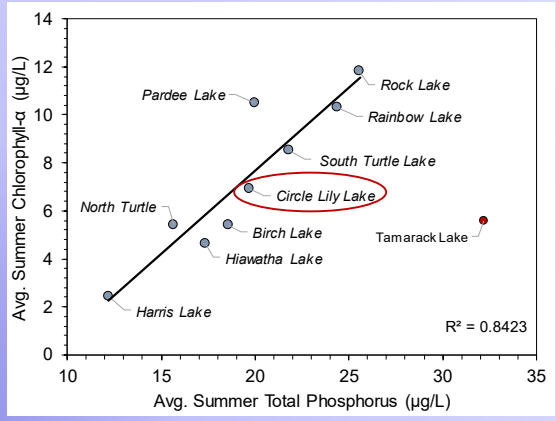
Chl-a & Phosphorus Relationship



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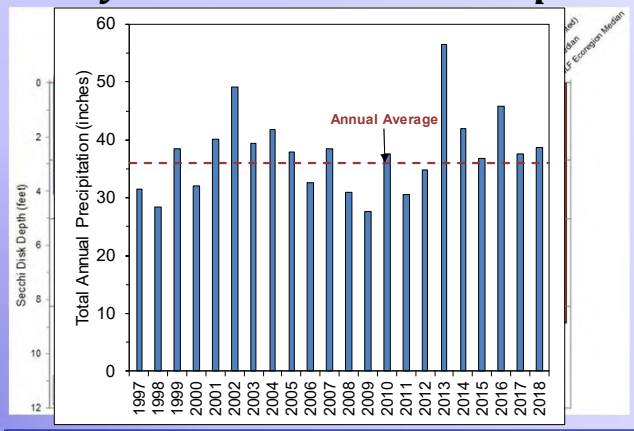
Circle Lily Lake Secchi Disk Transparency



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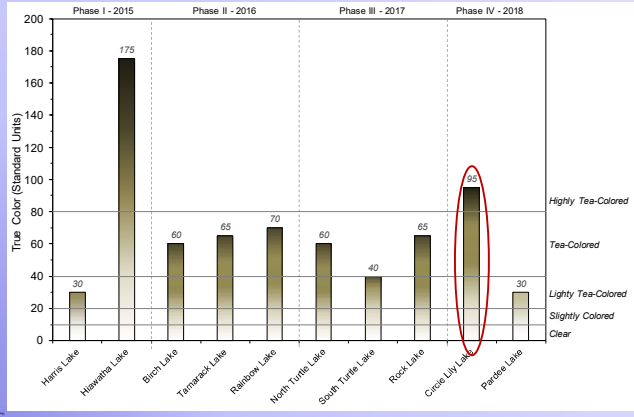
True Color



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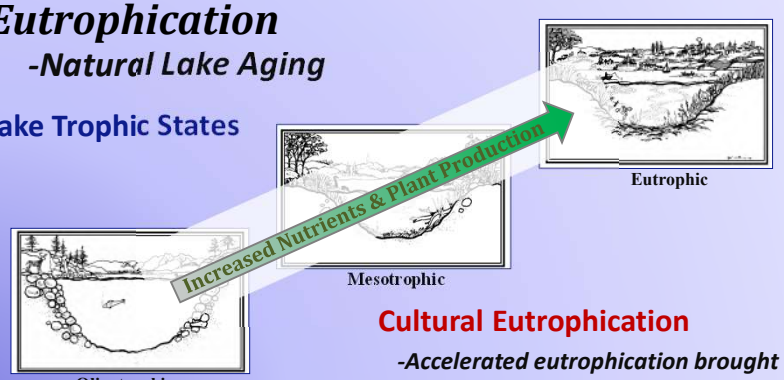
Eutrophication

-Natural Lake Aging

Lake Trophic States



Cultural Eutrophication

-Accelerated eutrophication brought on by human activities.

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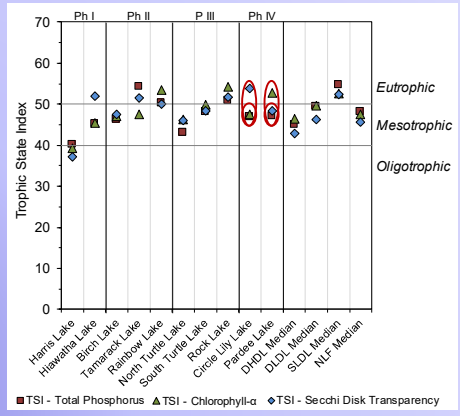
Winchester Lakes Trophic State Index



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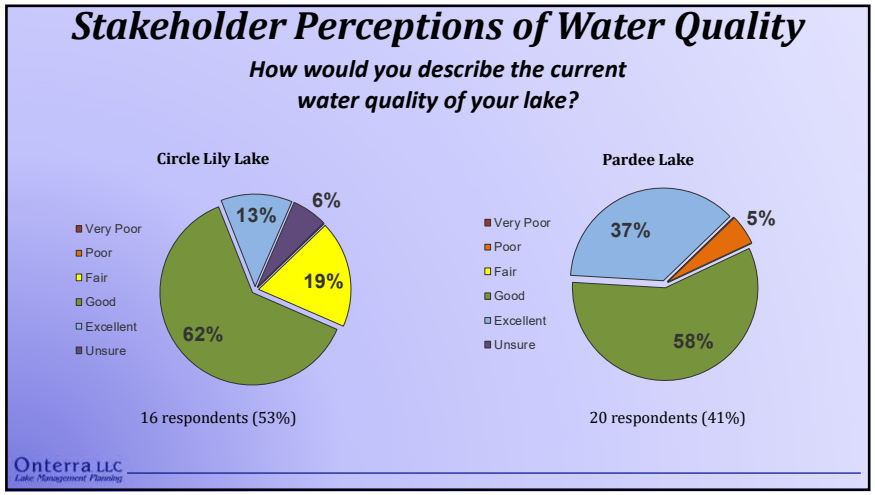
Stakeholder Perceptions of Water Quality
How would you describe the current water quality of your lake?
Circle Lily Lake
Very Poor
Poor
Fair
Good
Excellent
Unsure
13%
6%
19%
62%
16 respondents (53%)
Pardee Lake
Very Poor
Poor
Fair
Good
Excellent
Unsure
37%
5%
58%
20 respondents (41%)
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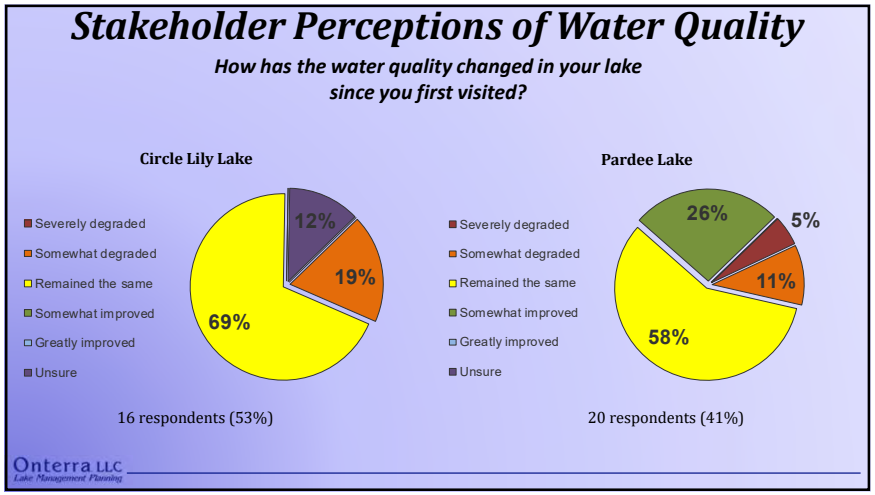
Stakeholder Perceptions of Water Quality
How has the water quality changed in your lake since you first visited?
Circle Lily Lake
Severely degraded
Somewhat degraded
Remained the same
Somewhat improved
Greatly improved
Unsure
12%
19%
69%
16 respondents (53%)
Pardee Lake
Severely degraded
Somewhat degraded
Remained the same
Somewhat improved
Greatly improved
Unsure
26%
5%
11%
58%
20 respondents (41%)
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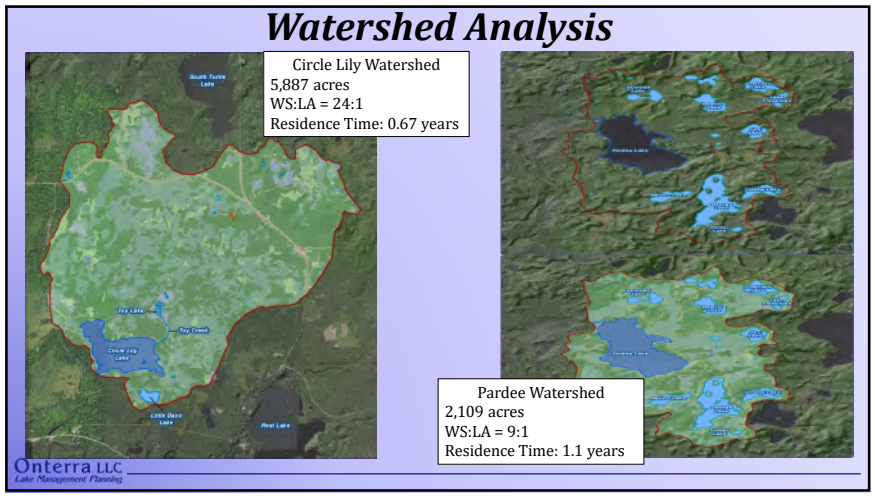
Watershed Analysis
Circle Lily Watershed
5,887 acres
WS:LA = 24:1
Residence Time: 0.67 years
Pardee Watershed
2,109 acres
WS:LA = 9:1
Residence Time: 1.1 years
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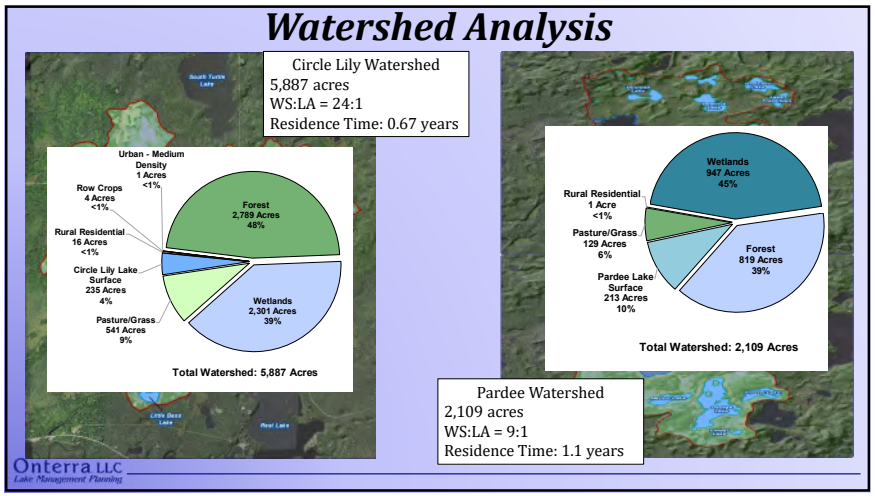
Watershed Analysis
Circle Lily Watershed
5,887 acres
WS:LA = 24:1
Residence Time: 0.67 years
Urban - Medium Density 1 Acres <1%
Row Crops 4 Acres <1%
Rural Residential 16 Acres <1%
Circle Lily Lake Surface 235 Acres 4%
Pasture/Grass 541 Acres 9%
Forest 2,789 Acres 48%
Wetlands 2,301 Acres 39%
Total Watershed: 5,887 Acres
Pardee Watershed
2,109 acres
WS:LA = 9:1
Residence Time: 1.1 years
Wetlands 947 Acres 45%
Rural Residential 1 Acre <1%
Pasture/Grass 129 Acres 6%
Pardee Lake Surface 213 Acres 10%
Forest 819 Acres 39%
Total Watershed: 2,109 Acres
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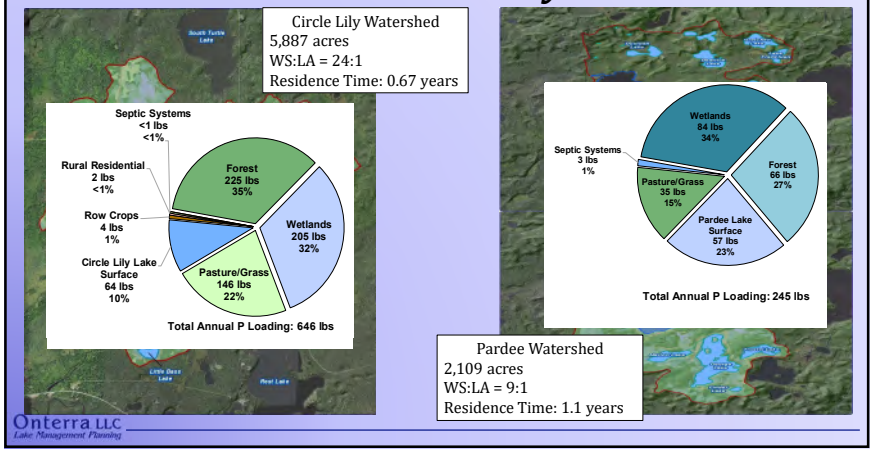
Watershed Analysis



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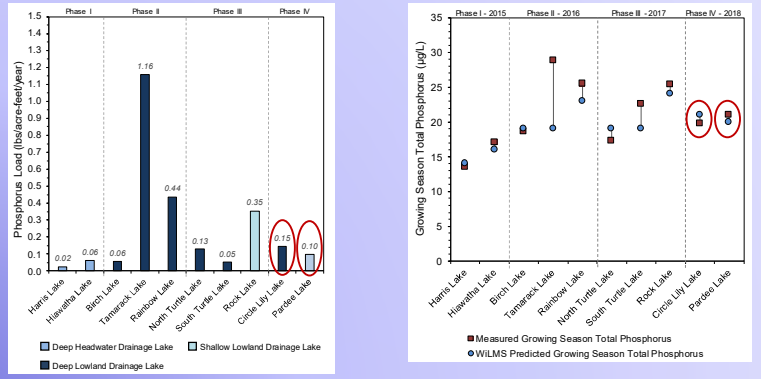
Watershed Analysis



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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.
- 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**

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Shoreline Assessment Category Descriptions

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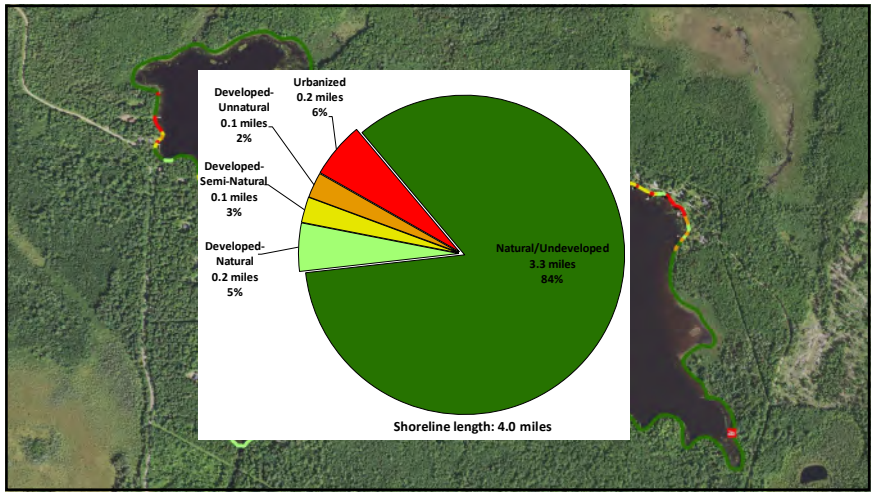

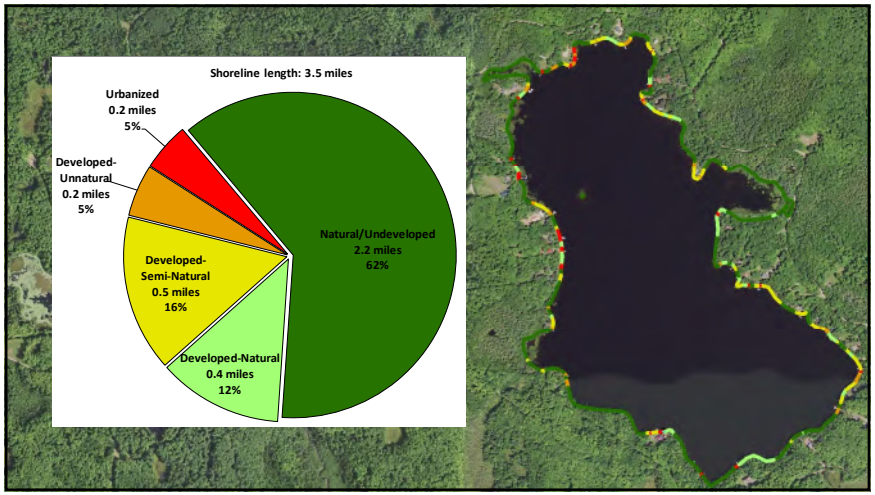

Coarse Woody Habitat

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

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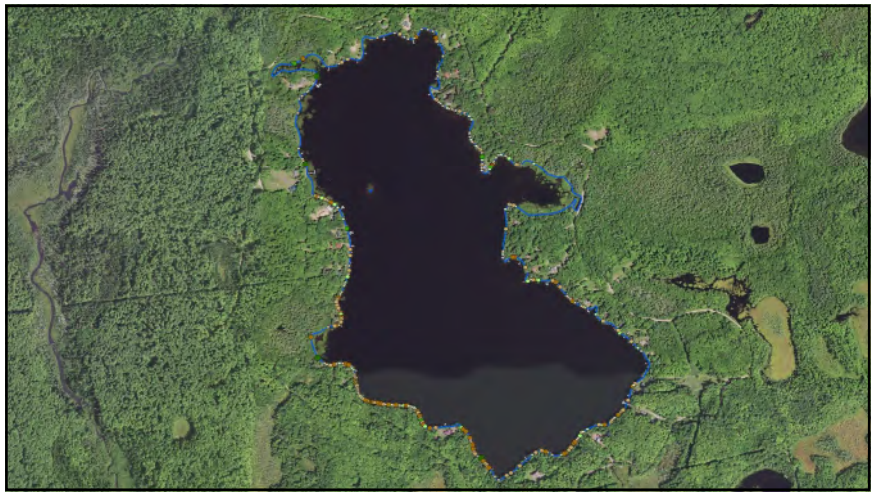

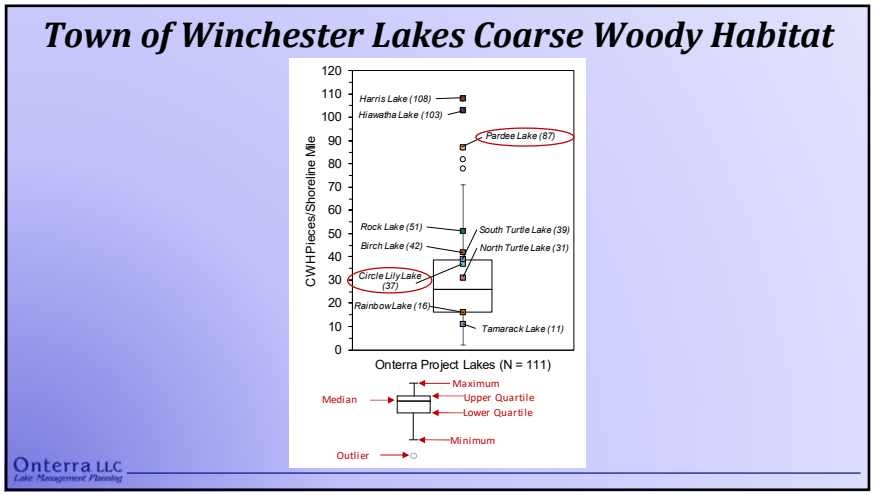
Town of Winchester Lakes Coarse Woody Habitat
CWHPieces/Shoreline Mile
120
110
100
90
80
70
60
50
40
30
20
10
0
Harris Lake (108)
Hiawatha Lake (103)
Pardee Lake (87)
Rock Lake (51)
Birch Lake (42)
Circle Lily Lake (37)
RainbowLake (16)
South Turtle Lake (39)
North Turtle Lake (31)
Tamarack Lake (11)
Onterra Project Lakes (N = 111)
Maximum
Upper Quartile
Median
Lower Quartile
Minimum
Outlier
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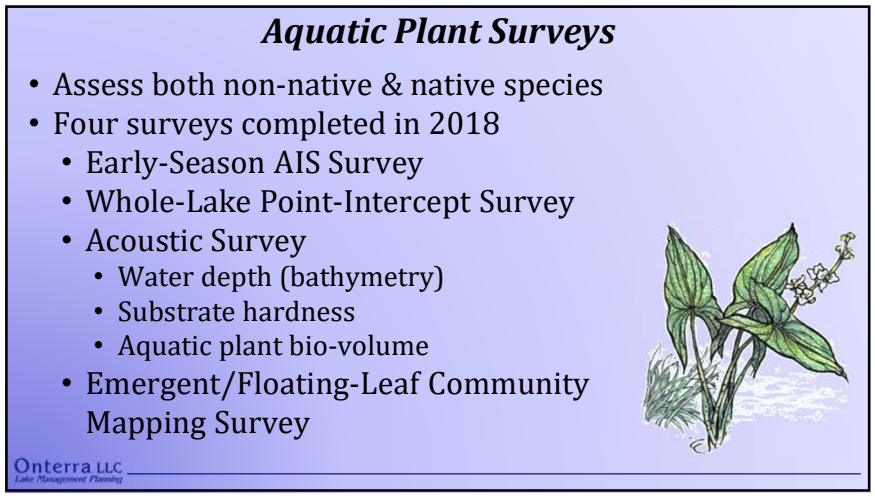
Aquatic Plant Surveys
• Assess both non-native & native species
• Four surveys completed in 2018
• Early-Season AIS Survey
• Whole-Lake Point-Intercept Survey
• Acoustic Survey
• Water depth (bathymetry)
• Substrate hardness
• Aquatic plant bio-volume
• Emergent/Floating-Leaf Community Mapping Survey
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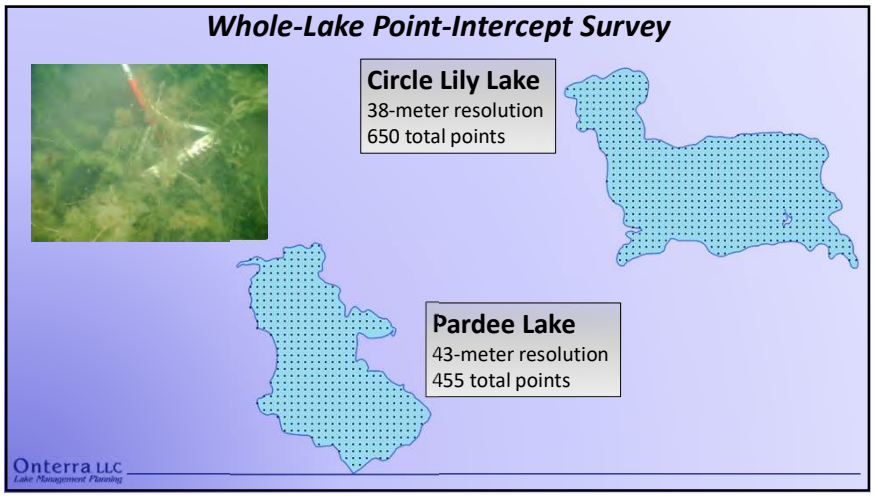
Whole-Lake Point-Intercept Survey
Circle Lily Lake
38-meter resolution
650 total points
Pardee Lake
43-meter resolution
455 total points
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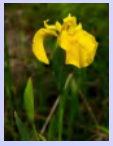
Plant Data Overview

- 98 native plant species located to date
  - 2 listed as special concern: Northeastern bladderwort & Vasey's pondweed

- 2 non-native plant species
  - Curly-leaf pondweed (Harris Lake)
  - Pale-yellow iris (Turtle Chain, Pardee Lake)
  - Aquatic Forget Me Not (Pardee Lake)



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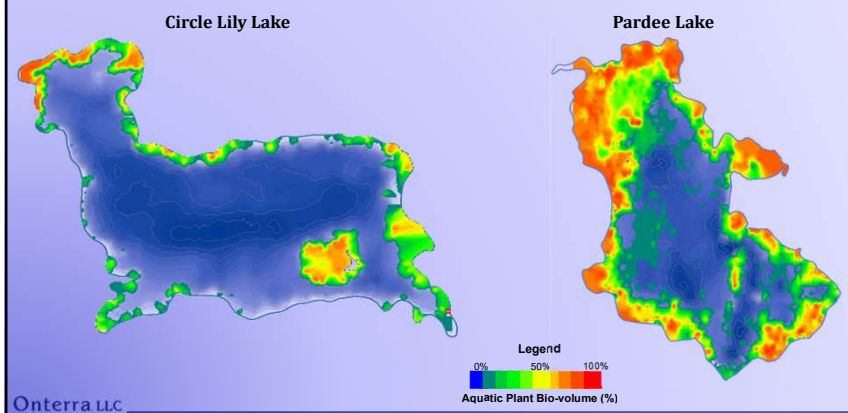
Aquatic Plant Bio-Volume



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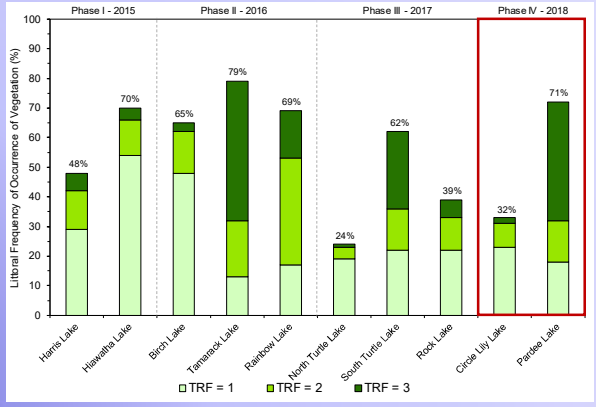
Lake Management Planning

Littoral Frequency of Occurrence



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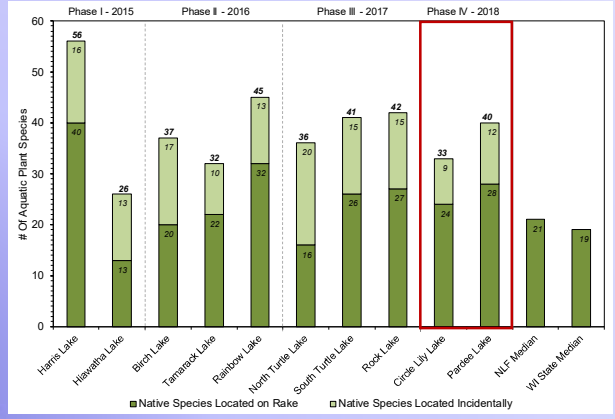
Native Species Richness



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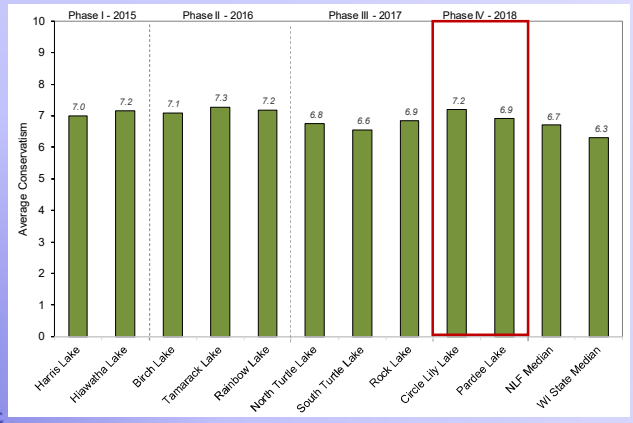
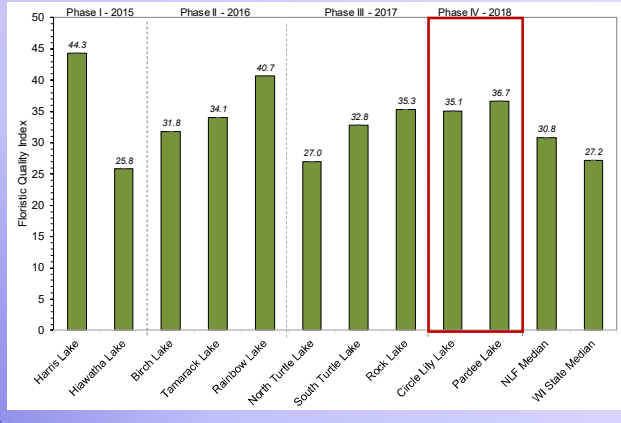
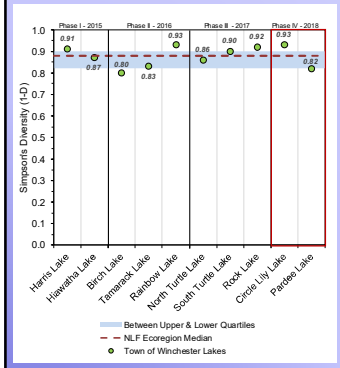
Average Coefficients of Conservatism



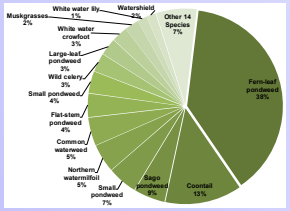
Floristic Quality



Species Diversity

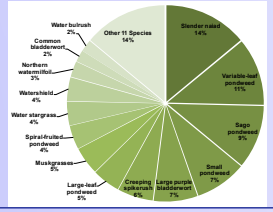


Relative Frequency of Occurrence

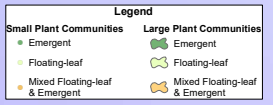


Pardee Lake

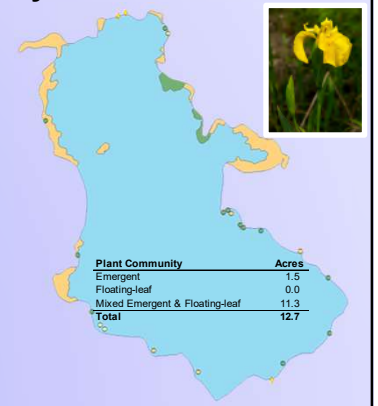
Circle Lily Lake



Emergent and Floating-Leaf Communities



Plant Community	Acres
Emergent	4.2
Floating-leaf	1.8
Mixed Emergent & Floating-leaf	19.3
Total	**25.3**



Plant Community	Acres
Emergent	1.5
Floating-leaf	0.0
Mixed Emergent & Floating-leaf	11.3
Total	**12.7**

Study Conclusions

Water Quality

- Both lakes have good water quality as expected for their lake type.
- Precipitation and water color impact Circle Lily's water clarity.
- Pardee's somewhat high average chlorophyll-a is not supported by other trophic parameters, so some results are suspect.

Watershed & Immediate Shoreline

- Watersheds in excellent shape – primarily forests & wetlands
- Majority of shoreland contains little to no development, but always room for improvement

Aquatic Plant Community

- All aquatic plant assessments further indicate good health of lakes.
- Neither lake has EWM or CLP, but Pardee has small occurrences of two exotic wetland emergents (pale-yellow iris and aquatic forget me not)

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Lake Management Planning

Planning Meeting II

Primary Objective: Create implementation plan framework

Steps to Achieve Objective:

1. Discuss challenges facing lakes and lake groups
2. Convert challenges to management goals
3. Create management actions to meet management goals
4. Determine timeframes and facilitators to carry out actions

Assignment for Planning Meeting II

1. Create list of challenges facing lake and lake group – keep for meeting
2. Review stakeholder survey results (Tim! - Handout)
3. Send potential report section edits and questions to Tim

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Lake Management Planning

Thank You

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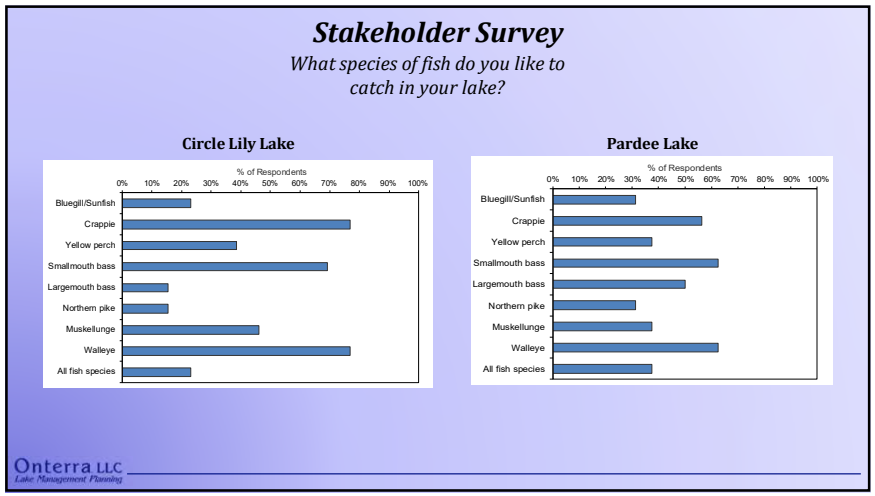
Lake Management Planning


North Lakeland Discovery Center
Town of Winchester
Phase IV
Pardee and Circle Lily Lakes
Management Planning Project
Planning Meeting II
July 18, 2019
Tim Hoyman, CLM
Onterra LLC
Lake Management Planning


Fisheries


Stakeholder Survey
What species of fish do you like to catch in your lake?
Circle Lily Lake
Pardee Lake
% of Respondents
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Bluegill/Sunfish
Crappie
Yellow perch
Smallmouth bass
Largemouth bass
Northern pike
Muskellunge
Walleye
All fish species
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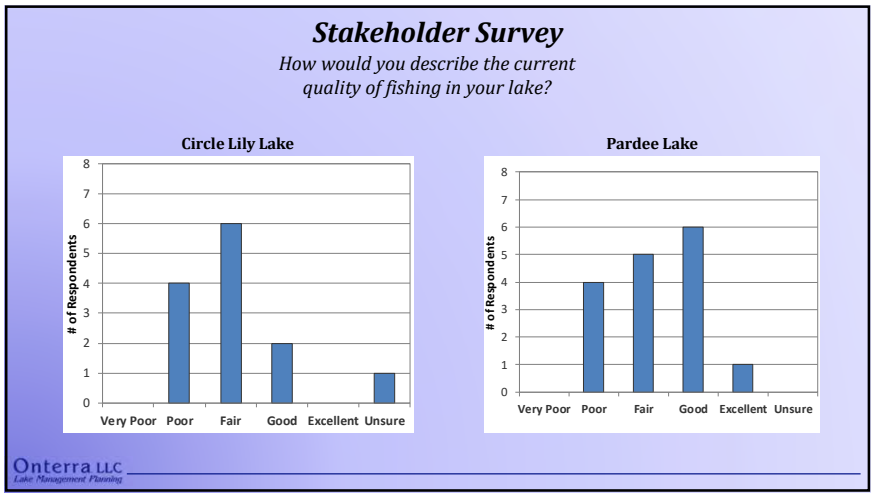
Stakeholder Survey
How would you describe the current quality of fishing in your lake?
Circle Lily Lake
Pardee Lake
# of Respondents
0 1 2 3 4 5 6 7 8
Very Poor Poor Fair Good Excellent Unsure
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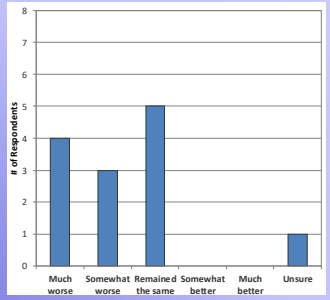
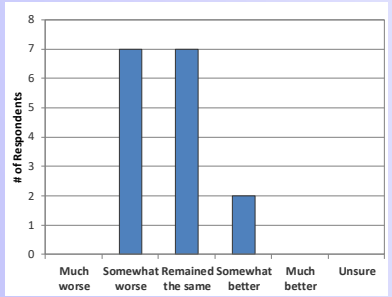
Stakeholder Survey

How has the quality of fishing changed since you first started fishing the lake?

Circle Lily Lake



Pardee Lake



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Fish Stocking

Circle Lily Lake

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1982	Muskellunge	Unspecified	Fingerling	400	13
1976	Muskellunge	Unspecified	Fingerling	400	13
2015	Walleye	Mississippi Headwaters	Small Fingerling	7,584	1.7
2013	Walleye	Mississippi Headwaters	Small Fingerling	7,805	2
2011	Walleye	Mississippi Headwaters	Small Fingerling	7,805	1.6
2000	Walleye	Unspecified	Small Fingerling	2,900	4.1
1998	Walleye	Unspecified	Small Fingerling	11,425	2.05
1996	Walleye	Unspecified	Fingerling	11,044	1.8
1994	Walleye	Unspecified	Fingerling	11,017	2.05
1991	Walleye	Unspecified	Fingerling	5,103	3
1989	Walleye	Unspecified	Fingerling	15,480	2.5
1988	Walleye	Unspecified	Fingerling	11,000	2
1987	Walleye	Unspecified	Fingerling	33,000	2
1986	Walleye	Unspecified	Fingerling	11,000	2
1979	Walleye	Unspecified	Fingerling	11,000	2
1975	Walleye	Unspecified	Fingerling	6,000	3
1973	Walleye	Unspecified	Fingerling	6,000	3

Pardee Lake

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1965	Walleye	Fingerling	1000	-
1970	Walleye	Fingerling	3000	2
1971	Walleye	Fingerling	1900	3
1972	Walleye	Fingerling	2000	3
1974	Walleye	Fingerling	4000	3
1975	Walleye	Fingerling	2000	-
1976	Walleye	Fingerling	1200	2.5
1979	Walleye	Fingerling	600	3
1992	Walleye	Large Fingerling	1000	6
1993	Walleye	Large Fingerling	900	8
1994	Walleye	Large Fingerling	522	6.5
1995	Walleye	Large Fingerling	462	7
1996	Walleye	Large Fingerling	600	6
1997	Walleye	Large Fingerling	700	7.5
1998	Walleye	Large Fingerling	1200	4
2010	Walleye	Large Fingerling	1000	7
2012	Walleye	Large Fingerling	1000	8
2014	Walleye	Large Fingerling	1500	7
2016	Walleye	Large Fingerling	1500	7
2013	Muskellunge	Large Fingerling	70	11
2014	Muskellunge	Large Fingerling	75	11
2016	Muskellunge	Large Fingerling	75	10

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Native American Spear Harvest

- Town is within Treaty of 1842
- Tribal and State authorities establish *total allowable catch* based on population estimates (typically 35% for walleye & 27% for muskellunge)
- The total allowable catch number may be reduced based on confidence in population estimates: *safe harvest level*
- Tribal community claims percentage of safe harvest level, or *declaration*
- Bag limits for hook and line anglers set to accommodate declaration
- Can only harvest two walleye over 20 inches per night – one between 20 and 24" and one any size over 20"

Circle Lily: 2 Walleye in 2012

Pardee: No spearing recorded

Both lakes have small quota set each year

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Lake Management Planning

Management Planning Project Overview

Collect and compile information about Pardee and Circle Lily lakes

Includes both environmental & sociological

Historical & current information

Past management actions

Planning Meeting I
Report Sections

Create a realistic and implementable management plan

Challenges facing lakes and lake groups

Create goals that will address challenges

Develop actions that will meet goals

Assign timeframes & facilitators

Planning Meeting II
Implementation Plan

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Lake Management Planning

Planning Meeting II

Primary Objective: Create implementation plan framework

Steps to Achieve Objective:

1. Discuss challenges facing lakes and lake groups
2. Convert challenges to management goals
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Lake Management Planning

Study Conclusions

Water Quality

- Both lakes have good water quality as expected for their lake type.
- Precipitation and water color impact Circle Lily's water clarity.
- Pardee's somewhat high average chlorophyll-a is not supported by other trophic parameters, so some results are suspect.

Watershed & Immediate Shoreline

- Watersheds in excellent shape – primarily forests & wetlands
- Majority of shoreland contains little to no development, but always room for improvement

Aquatic Plant Community

- All aquatic plant assessments further indicate good health of lakes.
- Neither lake has EWM or CLP, but Pardee has small occurrences of two exotic wetland emergents (pale-yellow iris and aquatic forget me not)

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Lake Management Planning

Town of Winchester Phase IV

Circle Lily and Pardee Lakes

Challenges Discussion

✓Maintain water quality
✓Protect habitat
✓ Raise public interest in lake health
✓ Preach beyond the choir
✓Buffer zones
✓Enhancing fishery (need data)
✓Pardee is a private lake so WDNR input
Boating safety
✓Boats entering from other lakes (Pardee)
✓Riparians taking boats off and on (Pardee)
✓ Creating a lake association (Circle Lily)
✓ Circle lily landing in poor shape (determine if riparians want that)
✓ Engaging people
✓Realistic expectations for fishery
✓Coarse woody habitat
✓Understanding dam resolution (Pardee)

Goals and Actions

MAINTAIN ECOLOGICAL HEALTH OF LAKE

Educational initiative

Protect and enhance buffers and shoreland habitat

Pardee Lake is private lake so must be mostly self-funding

Maybe have a separate fund fish

Boats being taken out and put back in Pardee and family transient boaters

Realistic expectations for fishery

Understanding dam resolution (Pardee)

Monitor water quality consistently

Pardee is not in CLMN program, but should get back on through a team-effort

Enhance fishery in lake

Complete fishery study and plan (potential cost) for Pardee

Discuss the need for CWH in both lakes – first step is speaking with WDNR fish biologist

INCREASE RIPARIAN STAKEHOLDER PARTICIPATION IN LAKE MANAGEMENT AND ACTIVITIES

Create lake association

Circle Lily Lake

Determine boat landing needs

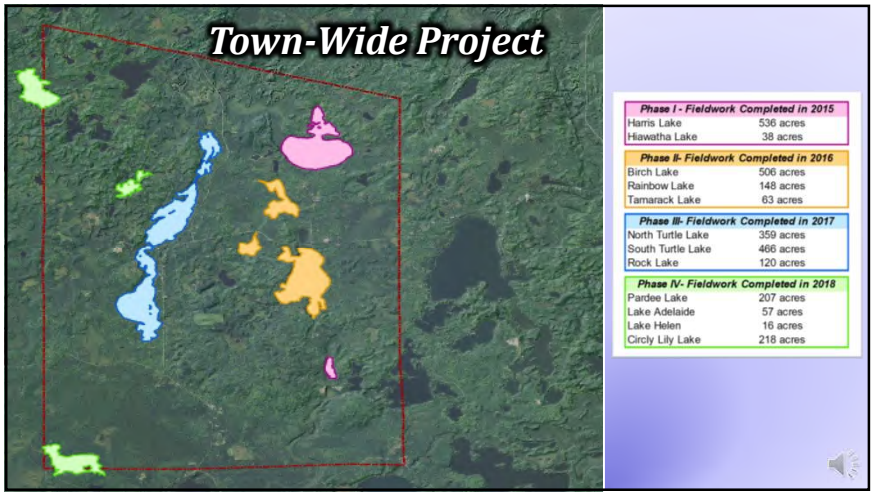
Determine fishery actions

Dock-to-dock membership/volunteer drive

Pardee Lake & Circle Lily

New property ownership orientation (basket and/or handbook)

There is a handbook on website, but it needs updating (2004 last edits).



Management Planning Project Overview

Collect and compile information about lake

- *Includes both environmental & sociological data*
- *Historical & current information*
- *Past management actions*

Create a realistic and implementable management plan

- *Challenges facing lake and lake group*
- *Create goals that will address challenges*
- *Develop actions that will meet goals*
- *Assign timeframes & facilitators*

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Lake Management Planning

Summary Results for Circle Lily Lake

Overarching Conclusion: Circle Lily Lake is ecologically healthy.

Water Quality

- Circle Lily Lake has good water quality as expected for its lake type.
- The lake has some oddities in results, but they are explainable.

Watershed & Immediate Shoreline

- Watershed is in excellent shape and is largely responsible for water quality.
- Circle Lily Lake has large areas with no shoreland development.

Aquatic Plant Community

- Aquatic plant community indicate that lake is healthy.
- No Eurasian watermilfoil or curly-leaf pondweed were found during surveys.

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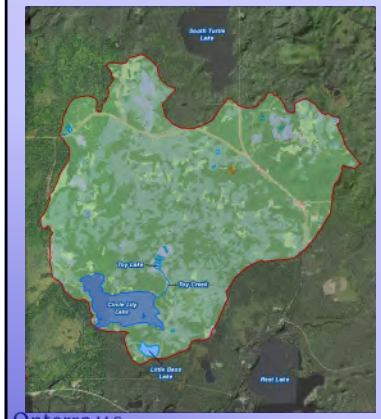
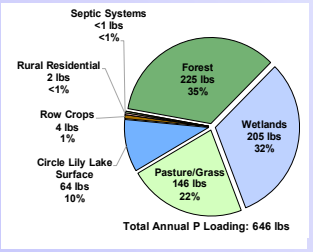
Lake Management Planning

Watershed Analysis





Circle Lily Watershed
5,887 acres
WS:LA = 24:1
Residence Time: 0.67 years

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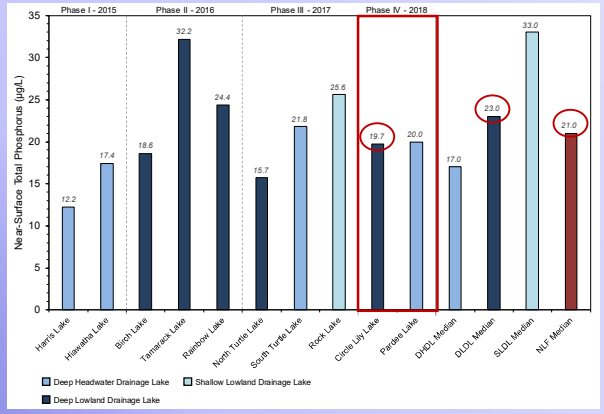
Total Phosphorus



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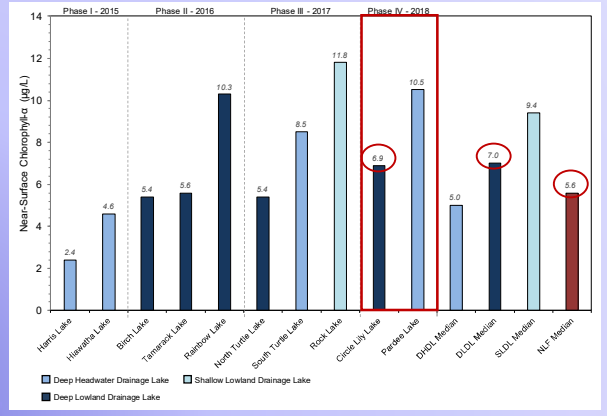
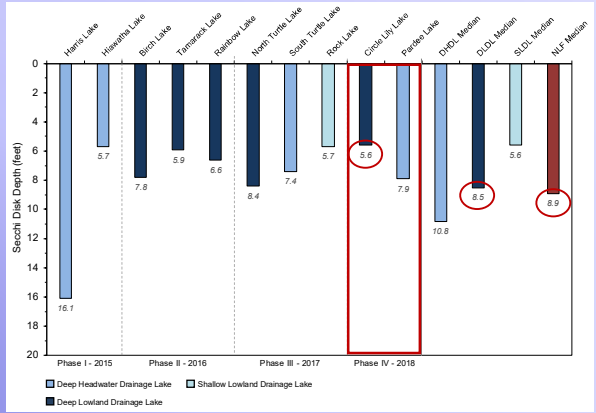
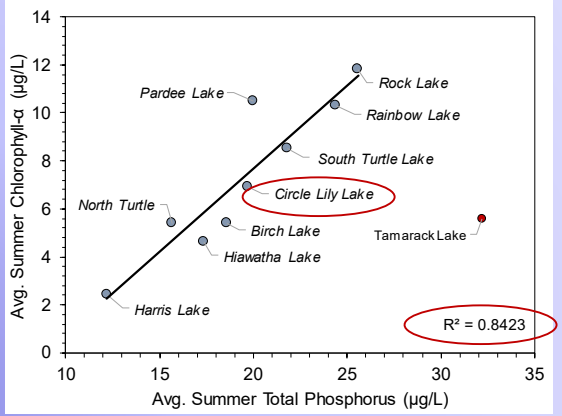
Chlorophyll-a



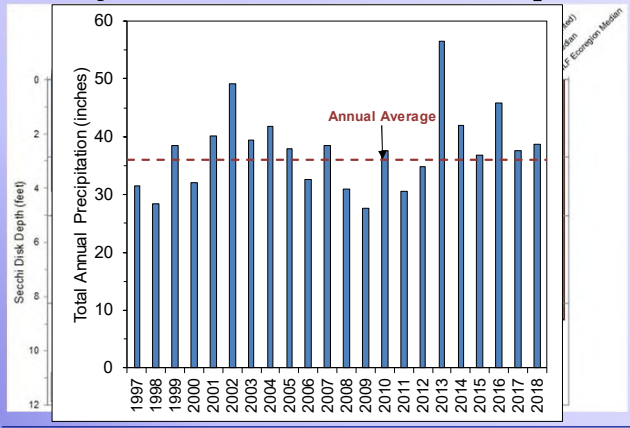
Secchi Disk Transparency



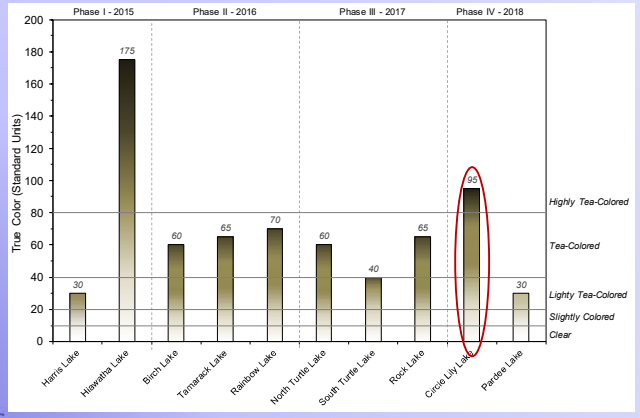
Chl-a & Phosphorus Relationship



Circle Lily Lake Secchi Disk Transparency



True Color



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Aquatic Plant Surveys

- Assess both non-native & native species
- Four surveys completed in 2018
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Acoustic Survey
    - Water depth (bathymetry)
    - Substrate hardness
    - Aquatic plant bio-volume
  - Emergent/Floating-Leaf Community Mapping Survey

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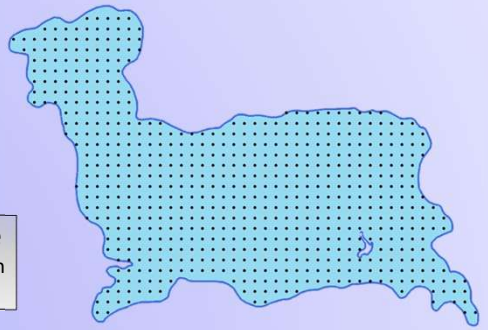
Whole-Lake Point-Intercept Survey



Circle Lily Lake
38-meter resolution
650 total points

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Vegetation Analysis Matrices

Floristic Quality Analysis

Evaluates the closeness of an area's flora to undisturbed conditions.

$$I = \bar{C} \times \sqrt{N}$$

I Floristic Quality Index

$\bar{C}$ Average Species Conservatism
1 – 10, higher number requires less disturbed condition

N Number of Native Species (Species Richness)
Only species encountered on the rake are used (no incidentals)

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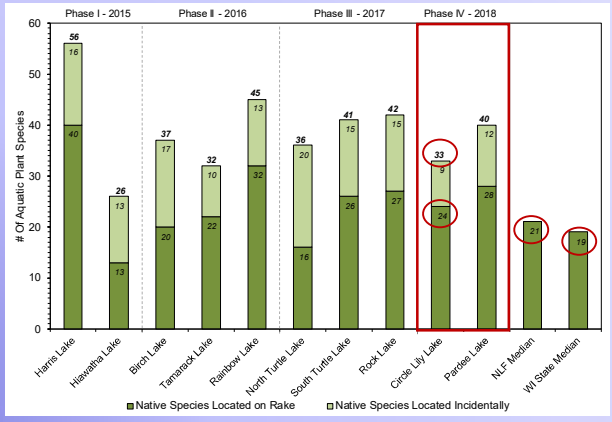
Native Species Richness



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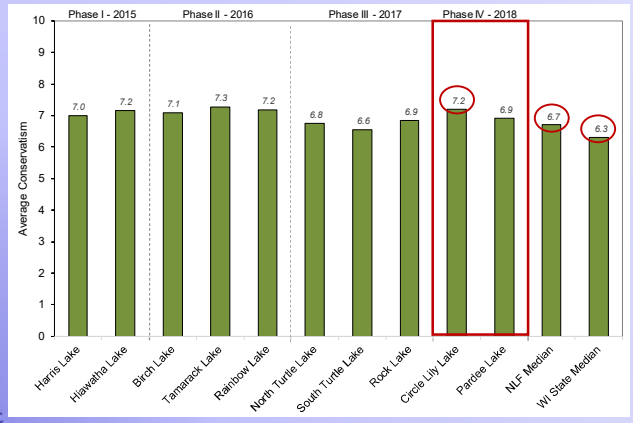
Average Coefficients of Conservatism



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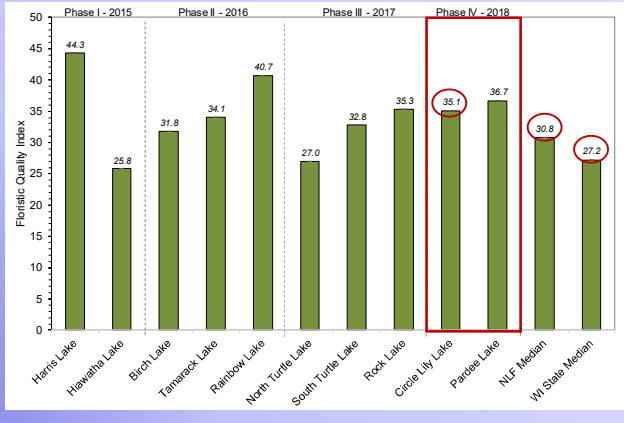
Floristic Quality



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Circle Lily Lake Implementation Plan

Goal: Increase Riparian Stakeholder Participation in Lake Management Activities

- *Action:* Create an official lake association for Circle Lily Lake.
- *Action:* Perform door-to-door or dock-to-dock recruitment of new association members.

Goal: Maintain Ecological Health of Circle Lily Lake

- *Action:* Promote lake protection and enjoyment through stakeholder education.
- *Action:* Enhance CLLA's involvement with other entities that have responsibilities in managing Circle Lily Lake.
- *Action:* Continue monitoring water quality through WDNR Citizens Lake Monitoring Network.
- *Action:* Work with WDNR fisheries staff to increase proper fish habitat and determine appropriate stocking routine.
- *Action:* Coordinate annual volunteer monitoring and control of AIS on Circle Lily Lake.
- *Action:* Initiate rapid response plan following detection of new AIS.

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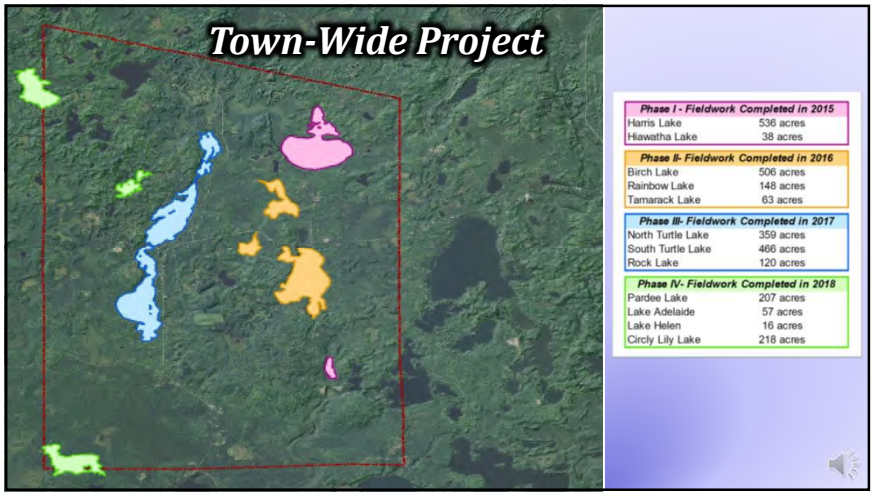

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Summary Results for Pardee Lake

Overarching Conclusion: Pardee Lake is ecologically healthy.

Water Quality

- Pardee Lake has good water quality as expected for its lake type.
- Lake has some oddities in results, but they are explainable.

Watershed & Immediate Shoreline

- Watershed is in excellent shape and is largely responsible for water quality.
- Pardee Lake has large areas with no shoreland development.

Aquatic Plant Community

- Aquatic plant community indicate that lake is healthy.
- No Eurasian watermilfoil or curly-leaf pondweed was found, but Pardee Lake has small occurrences of two exotic wetland emergents.

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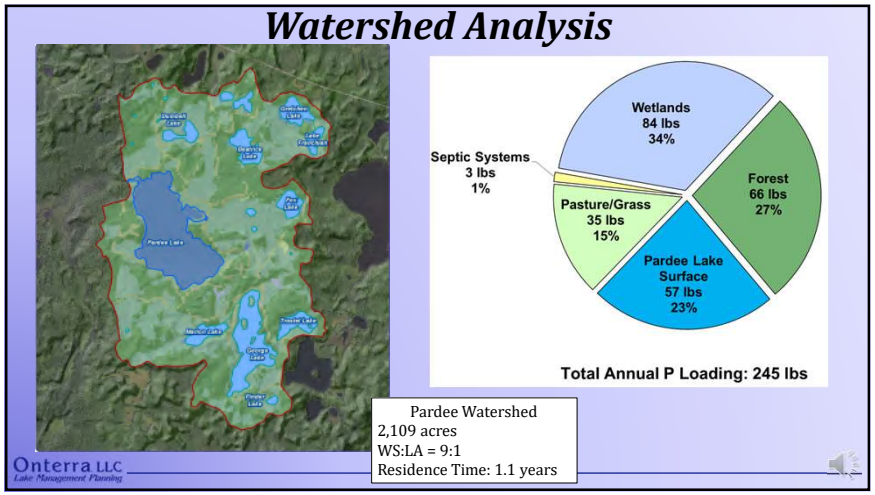
Watershed


Watershed Analysis
Wetlands
84 lbs
34%
Forest
66 lbs
27%
Septic Systems
3 lbs
1%
Pasture/Grass
35 lbs
15%
Pardee Lake
Surface
57 lbs
23%
Total Annual P Loading: 245 lbs
Pardee Watershed
2,109 acres
WS:LA = 9:1
Residence Time: 1.1 years
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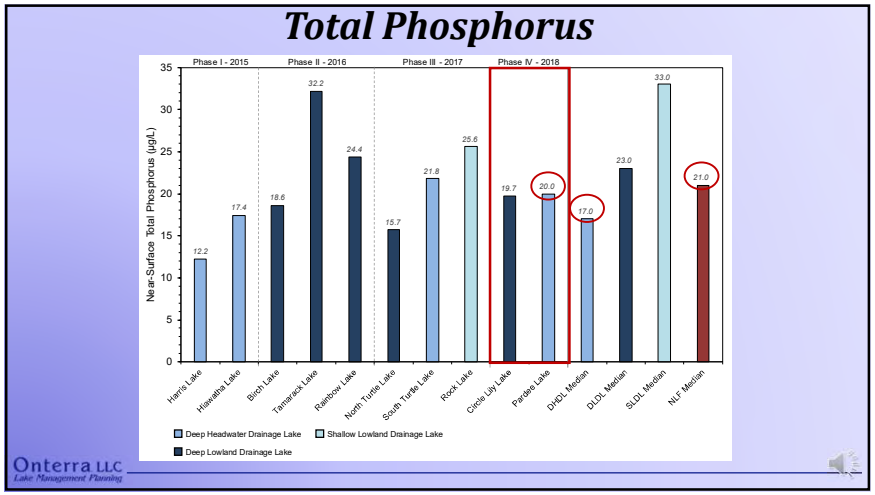
Water Quality


Total Phosphorus
Phase I - 2015
Phase II - 2016
Phase III - 2017
Phase IV - 2018
Near-Surface Total Phosphorus (µg/L)
0
5
10
15
20
25
30
35
12.2
17.4
18.6
32.2
24.4
15.7
21.8
25.6
19.7
20.0
17.0
23.0
33.0
21.0
Harris Lake
Hiawatha Lake
Birch Lake
Tamarack Lake
Rainbow Lake
North Turtle Lake
South Turtle Lake
Rock Lake
Circle Lily Lake
Pardee Lake
DHDL Median
DLDL Median
SLDL Median
NLF Median
Deep Headwater Drainage Lake
Shallow Lowland Drainage Lake
Deep Lowland Drainage Lake
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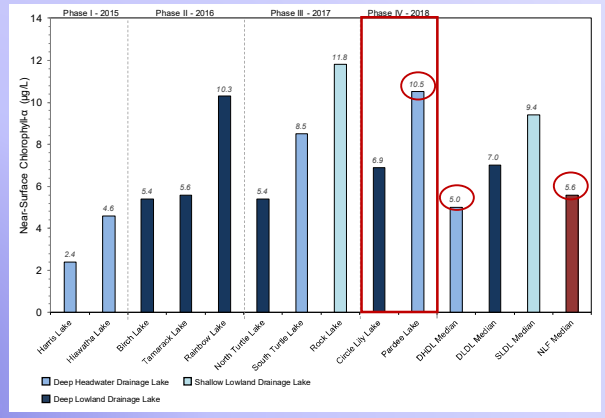
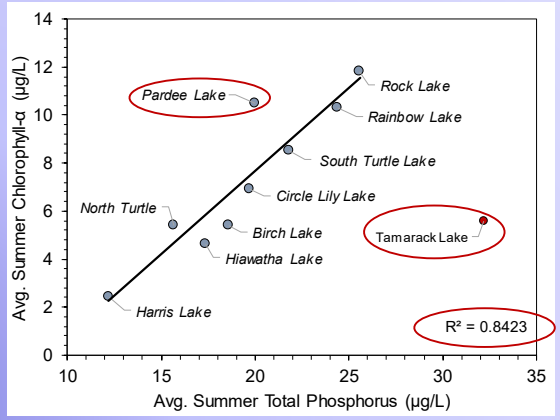
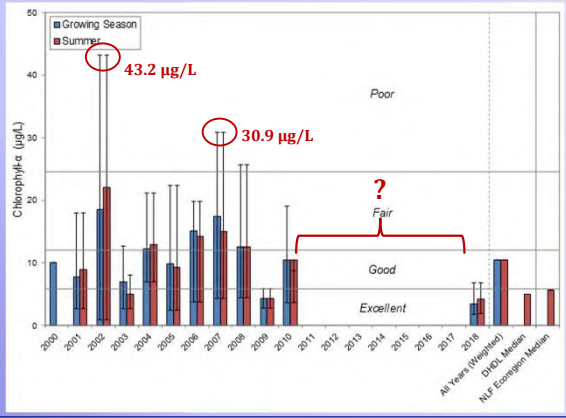
Chlorophyll-a



Chlorophyll-a & Phosphorus Relationship



Pardee Lake Chlorophyll-a



Aquatic Plant Surveys

- Assess both non-native & native species
- Four surveys completed in 2018
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Acoustic Survey
    - Water depth (bathymetry)
    - Substrate hardness
    - Aquatic plant bio-volume
  - Emergent/Floating-Leaf Community Mapping Survey

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Whole-Lake Point-Intercept Survey

Pardee Lake
43-meter resolution
455 total points

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Vegetation Analysis Matrices

Floristic Quality Analysis

Evaluates the closeness of an area's flora to undisturbed conditions.

$$I = \bar{C} \times \sqrt{N}$$

I Floristic Quality Index

$\bar{C}$ Average Species Conservatism
1 – 10, higher number requires less disturbed condition

N Number of Native Species (Species Richness)
Only species encountered on the rake are used (no incidentals)

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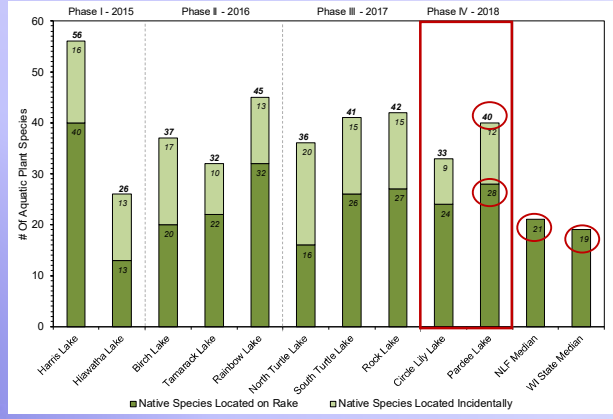
Native Species Richness



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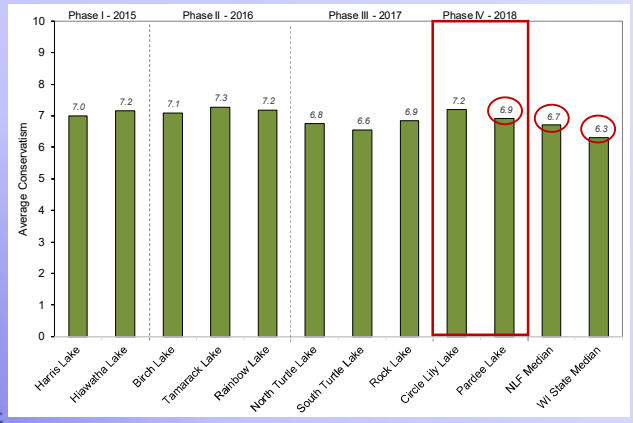
Average Coefficients of Conservatism



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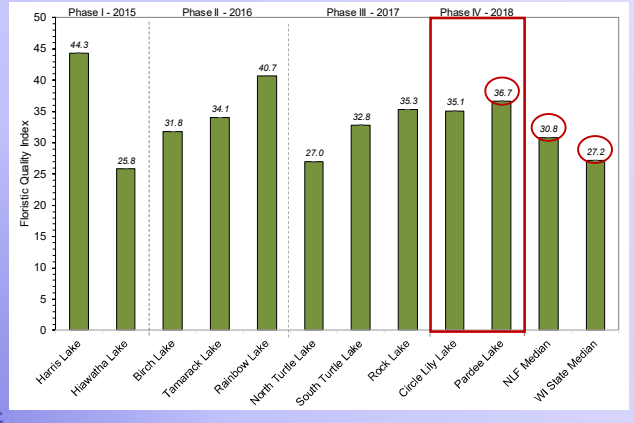
Floristic Quality



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Pardee Lake Implementation Plan

Goal: Increase Riparian Stakeholder Participation in Lake Management Activities

- *Action:* Perform door-to-door or dock-to-dock recruitment of new association members.
- *Action:* Update and distribute PLIA new property owner handbook.

Goal: Maintain Ecological Health of Pardee Lake

- *Action:* Promote lake protection and enjoyment through stakeholder education.
- *Action:* Continue PLIA's involvement with other entities that have responsibilities in managing Pardee Lake.
- *Action:* Monitor water quality through WDNR Citizens Lake Monitoring Network.
- *Action:* Work with WDNR fisheries staff to increase proper fish habitat and determine appropriate stocking routine.
- *Action:* Coordinate annual volunteer monitoring and control of AIS on Pardee Lake.
- *Action:* Initiate rapid response plan following detection of new AIS.

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Thank You
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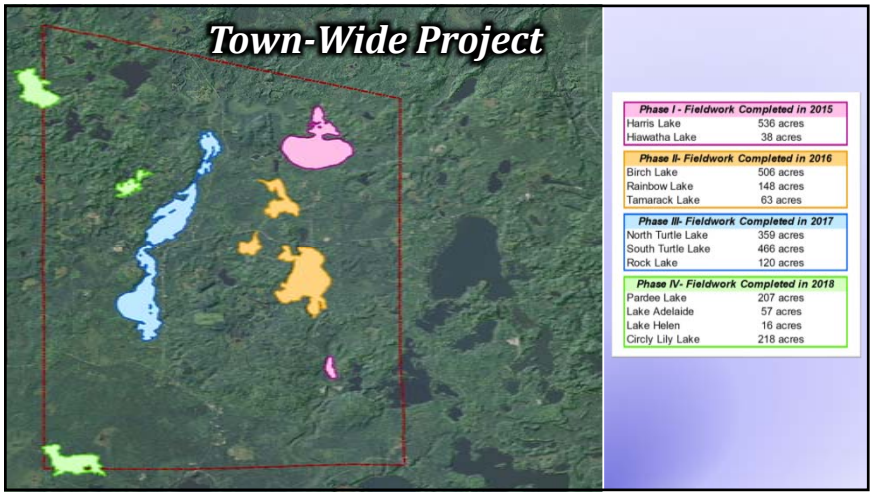
North Lakeland Discovery Center Email (Emily Heald):
water@discoverycenter.net
Subject Line: Pardee Lake Wrap-up Meeting Presentation
Include name(s) of individuals who viewed this presentation



Management Planning Project Overview

Collect and compile information about lake

- *Includes both environmental & sociological data*
- *Historical & current information*
- *Past management actions*

Create a realistic and implementable management plan

- *Challenges facing lake and lake group*
- *Create goals that will address challenges*
- *Develop actions that will meet goals*
- *Assign timeframes & facilitators*

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Summary Results for Winchester Lakes

Overarching Conclusion: All lakes are considered ecologically healthy.

Water Quality

- All lake water quality compare well with lakes in Ecoregion and type of lake

Watershed & Immediate Shoreline

- Watersheds are dominated by forests and wetlands which is major contributor to overall lake health.
- All lakes have large tracks of undeveloped shoreline.

Aquatic Plant Community

- Aquatic plant communities in the lakes also indicate good lake health.
- Some exotics found, but all are under management.

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Town of Winchester Lakes Implementation Plan

Goal: Protect the Current High Quality Ecological Health of Town of Winchester Lakes

- *Action:* Support Winchester Town Lakes Committee and their partnership with the North Lakeland Discovery Center.
- *Action:* Begin/continue the monitoring of town lakes' water quality through the WDNR Citizen Lake Monitoring Network.
- *Action:* Begin/continue monitoring lakes' water levels through NLDC citizen science lake level monitoring program.
- *Action:* Coordinate annual volunteer monitoring for AIS on Town of Winchester lakes.
- *Action:* Conduct periodic quantitative vegetation monitoring of Town Winchester Lakes.
- *Action:* Support Riparian property owners and lake groups in preserving natural and restoring high developed shorelines.
- *Action:* Promote stakeholder involvement, inform stakeholders on various lake issues, as well as the quality of life on the Town of Winchester lakes.
- *Action:* Continue the Town of Winchesters involvement with other entities that have responsibilities in managing (management units) town lakes.

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