A

APPENDIX A

Public Participation Materials

1

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of a Lake Management Planning Project
  - Data & Information
  - Planning Process
- Early-Season AIS Survey Results

Onterra, LLC
Lake Management Planning

2

Onterra, LLC

- Founded in 2005
- Staff
  - Four lead ecologists
  - Three field technicians
  - Five summer interns
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

Onterra, LLC
Lake Management Planning

3

Why create a lake management plan?

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

Onterra, LLC
Lake Management Planning

4

Why create a lake management plan?

- WDNR strongly recommends lakes conducting active management update aspects of the plan every 5 years.
- Having a current and approved plan makes the sponsor eligible for WDNR grants that implement an action.
- Conducting large-scale management requires a current and approved plan.

Onterra, LLC
Lake Management Planning

5

Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

Onterra, LLC
Lake Management Planning

6

Data and information gathering

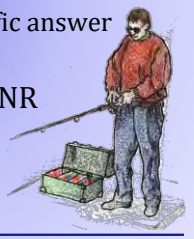
- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Shoreline Assessment (Waupaca County)
  - Stakeholder Survey

Onterra, LLC
Lake Management Planning

7

Stakeholder Survey

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



Onterra, LLC
Lake Management Planning

8

Planning Process

Planning Committee Meetings

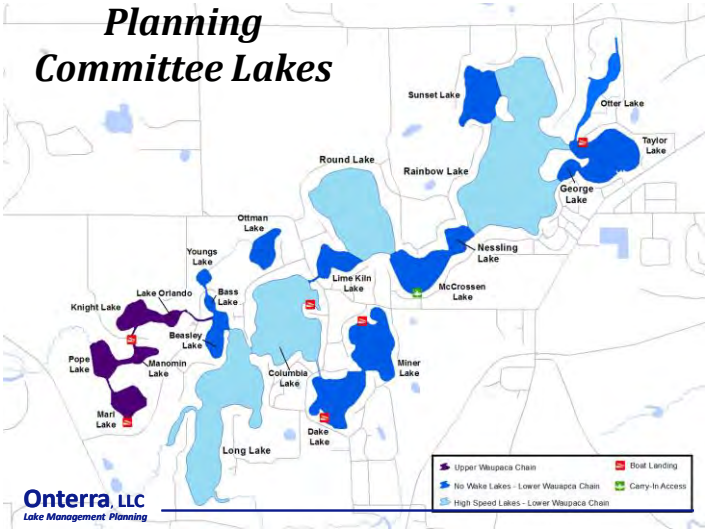
Study Results (including a stakeholder survey)
Conclusions & Initial Recommendations
Management Goals
Management Actions
Timeframe
Facilitator(s)

Implementation Plan

Onterra, LLC
Lake Management Planning

9

Planning Committee Lakes



Onterra, LLC
Lake Management Planning

10

Non-native Aquatic Plants

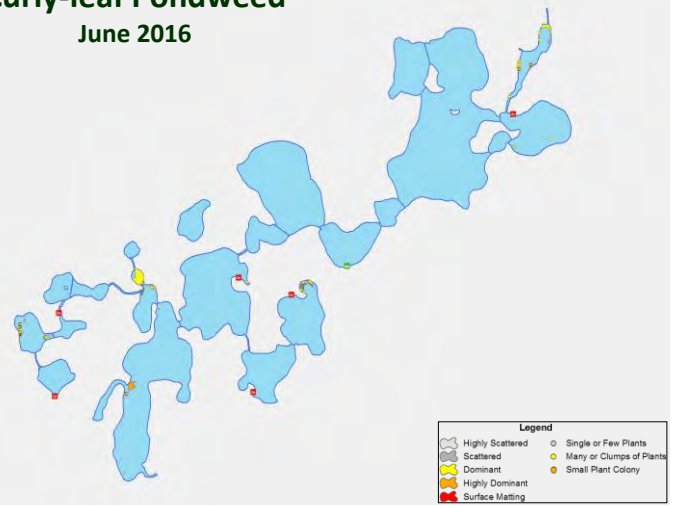
Curly-leaf Pondweed

Onterra, LLC
Lake Management Planning

11

Curly-leaf Pondweed

June 2016



12

Non-native Aquatic Plants

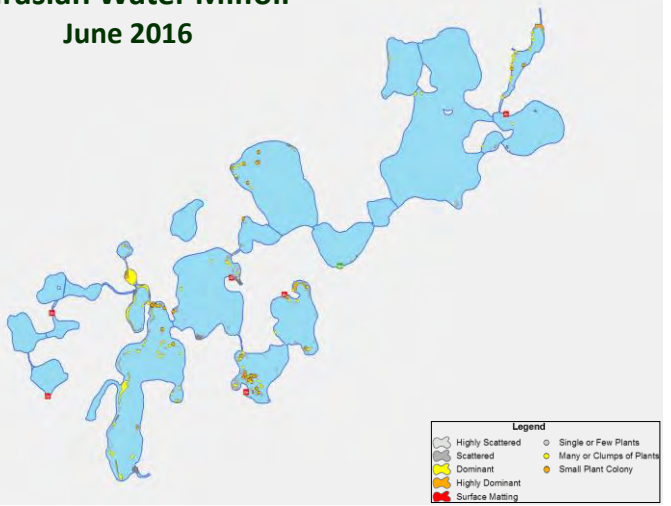
Eurasian Water Milfoil

Onterra, LLC
Lake Management Planning

13

Eurasian Water Milfoil

June 2016



14

Thank You

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

Onterra, LLC
Lake Management Planning

15

1

Presentation Outline

- Aquatic Plant Survey Results
- Aquatic Plant Management
  - Alternatives Analysis
  - Herbicide 101
    - Spot vs Whole-lake
    - Defining the strategy: restore ecosystem function or improve ecosystem services
    - HWM & herbicide tolerance
    - Alternative herbicide options & testing
- Discussion

Onterra, LLC
Lake Management Planning

2

Aquatic Plant Surveys

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

Onterra, LLC
Lake Management Planning

3

Species List

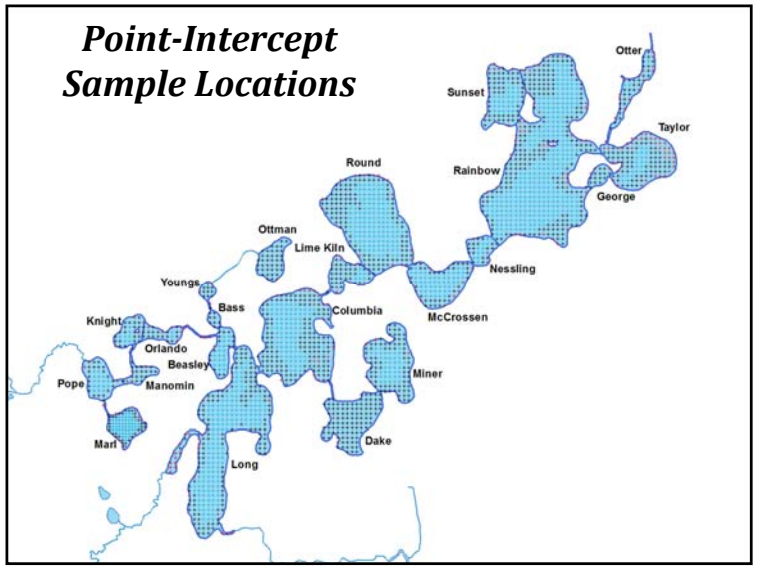
44 Native Species in 2016 (29 on rake)

- 5 non-native species
  - Sweet flag (naturalized)
  - Pale yellow iris
  - Purple loosestrife
  - Curly-leaf pondweed
  - Eurasian watermilfoil (hybrid)
    - Taylor in 2013
    - Sunset, Round George, Rainbow, Otter in 2016
- No native species listed as *endangered*, *threatened* or of *special concern*

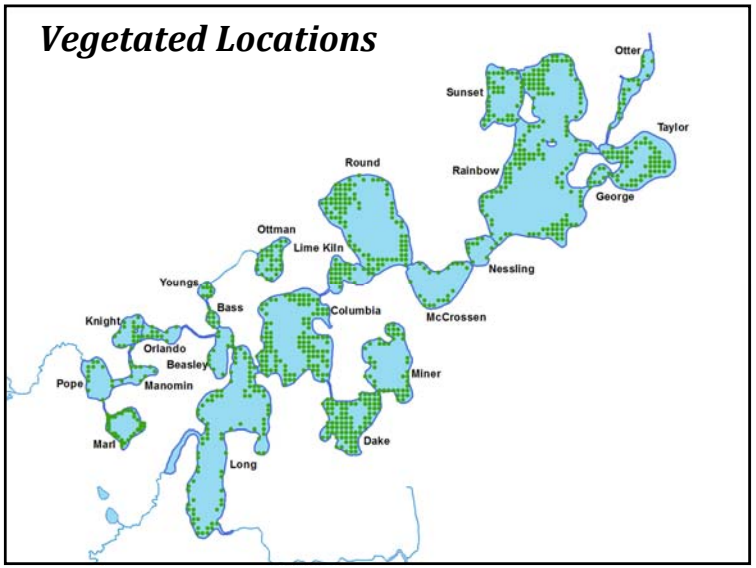
Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2016 (Onterra)
Emergent	*Acorus calamus*	Sweetflag	Naturalized	I
	Calla palustris	Water arum	9	I
	Carex sp. 1	Sedge sp. 1	N/A	I
	Cladium mariscoides	Smooth sawgrass	10	I
	Decodon verticillatus	Water-willow	7	I
	Eleocharis palustris	Creeping spikerush	6	I
	Eleocharis sp.	Spikerush sp.	N/A	I
	Iris pseudacorus	Pale-yellow iris	Exotic	I
	Iris versicolor	Northern blue flag	5	I
	Lythrum salicaria	Purple loosestrife	Exotic	I
	Sagittaria latifolia	Common arrowhead	3	I
	Sagittaria sp. (sterile)	Arrowhead sp. (sterile)	N/A	I
	Schoenoplectus acutus	Hardstem bulrush	5	X
	Schoenoplectus pungens	Three-square rush	5	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Typha spp.	Cattail spp.	1	I
FL	*Brasenia schreberi*	Watershield	7	X
	Nuphar variegata	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
	Persicaria amphibia	Water smartweed	5	I
Submergent	*Ceratophyllum demersum*	Coontail	3	X
	Chara spp.	Muskgrasses	7	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Myriophyllum sibiricum	Nothern water milfoil	7	X
	Myriophyllum spicatum	Eurasian water milfoil	Exotic	X
	Najas flexilis	Slender naiad	6	X
	Nitella spp.	Stoneworts	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton crispus	Curly-leaf pondweed	Exotic	X
	Potamogeton foliosus	Leafy pondweed	6	X
	Potamogeton friesii	Fries' pondweed	8	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X
	Potamogeton illinoensis	Illinois pondweed	6	X
	Potamogeton natans	Floating-leaf pondweed	5	X
	Potamogeton nodosus	Long-leaf pondweed	5	I
	Potamogeton pusillus	Small pondweed	7	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton strictifolius	Stiff pondweed	8	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Ranunculus aquatilis	White water crowfoot	8	X
	Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	N/A	X
	Stuckenia pectinata	Sago pondweed	3	X
	Utricularia gibba	Creeping bladderwort	9	X
	Utricularia vulgaris	Common bladderwort	7	X
	Vallisneria americana	Wild celery	6	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X
	Sagittaria graminea	Grass-leaved arrowhead	9	I
FF	*Spirodela polyrhiza*	Greater duckweed	5	X

Onterra, LLC
Lake Management Planning

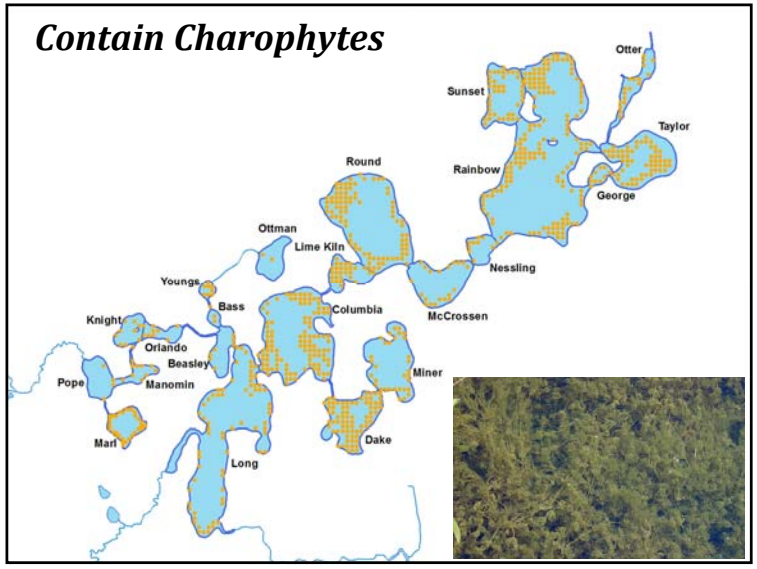
4


Point-Intercept
Sample Locations
Otter
Sunset
Taylor
Round
Rainbow
George
Ottman
Lime Kiln
Nessling
Youngs
Bass
Columbia
McCrossen
Knight
Orlando
Beasley
Miner
Pope
Manomin
Dake
Mari
Long

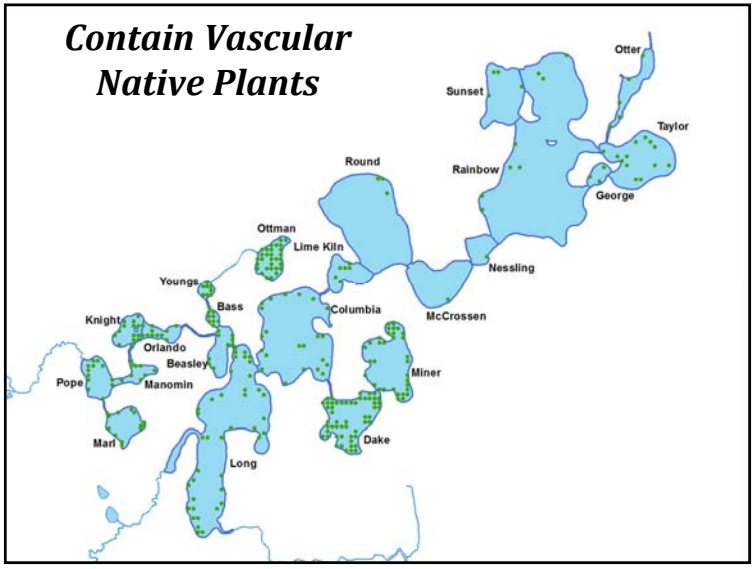
5


Vegetated Locations
Otter
Sunset
Taylor
Round
Rainbow
George
Ottman
Lime Kiln
Nessling
Youngs
Bass
Columbia
McCrossen
Knight
Orlando
Beasley
Miner
Pope
Manomin
Dake
Mari
Long

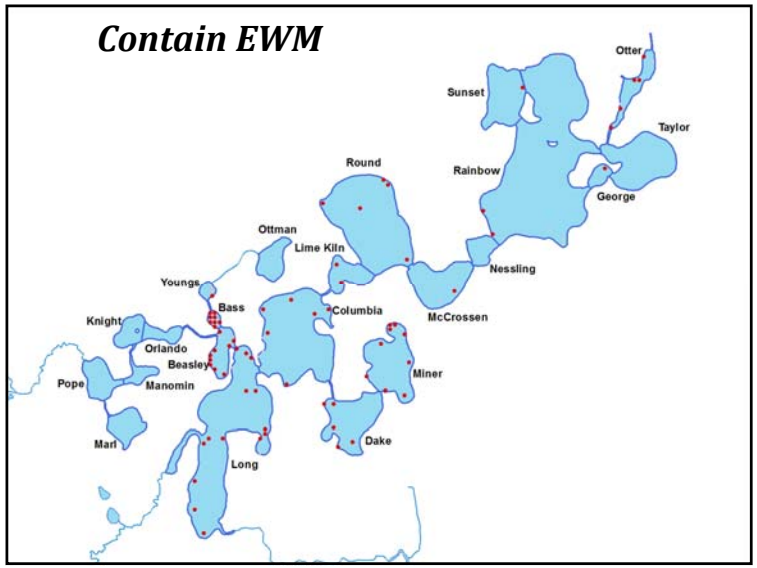
6


Contain Charophytes
Otter
Sunset
Taylor
Round
Rainbow
George
Ottman
Lime Kiln
Nessling
Youngs
Bass
Columbia
McCrossen
Knight
Orlando
Beasley
Miner
Pope
Manomin
Dake
Mari
Long

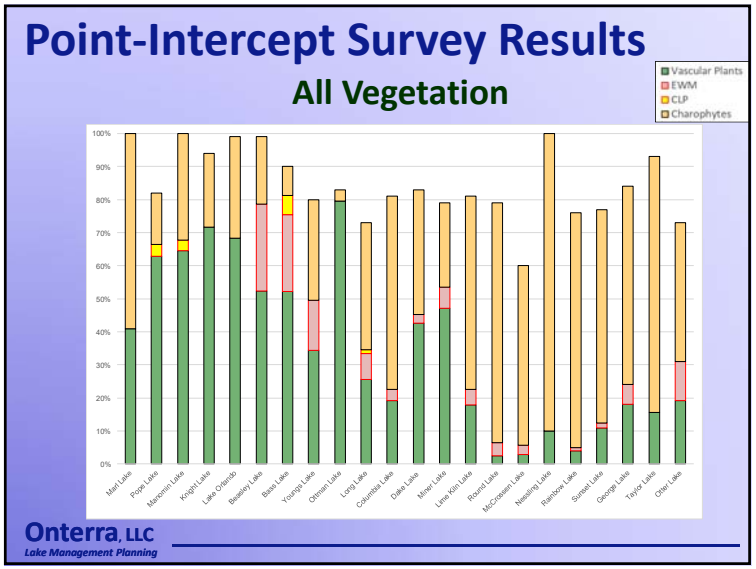
7


Contain Vascular
Native Plants
Otter
Sunset
Taylor
Round
Rainbow
George
Ottman
Lime Kiln
Nessling
Youngs
Bass
Columbia
McCrossen
Knight
Orlando
Beasley
Miner
Pope
Manomin
Dake
Mari
Long

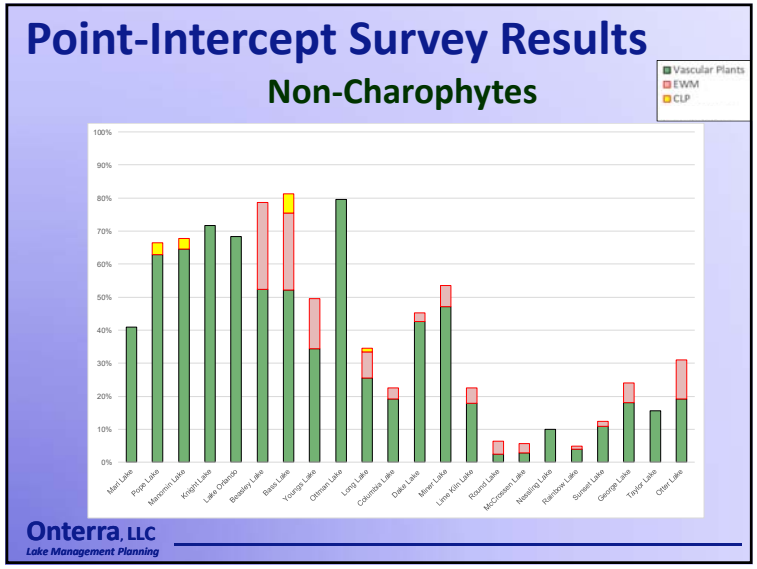
8


Contain EWM
Otter
Sunset
Taylor
Round
Rainbow
George
Ottman
Lime Kiln
Nessling
Young
Bass
Columbia
Knight
McCrossen
Orlando
Beasley
Miner
Pope
Manomin
Dake
Mari
Long

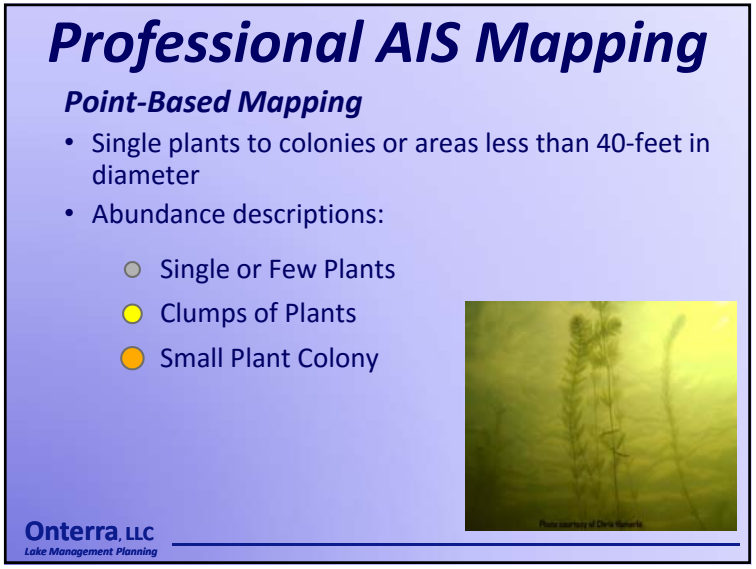
9


Point-Intercept Survey Results
All Vegetation
Vascular Plants
EWM
CLP
Charophytes
Onterra, LLC
Lake Management Planning

10


Point-Intercept Survey Results
Non-Charophytes
Vascular Plants
EWM
CLP
Onterra, LLC
Lake Management Planning

11


Professional AIS Mapping
Point-Based Mapping
• Single plants to colonies or areas less than 40-feet in diameter
• Abundance descriptions:
Single or Few Plants
Clumps of Plants
Small Plant Colony
Onterra, LLC
Lake Management Planning

12

Professional AIS Mapping

Polygon-Based Mapping

- Colonies or areas over 40-feet diameter
- Boundary at target plant extent or morphological feature (depth contour, shoreline)
- Density ratings:

May not represent true colonies or "beds"

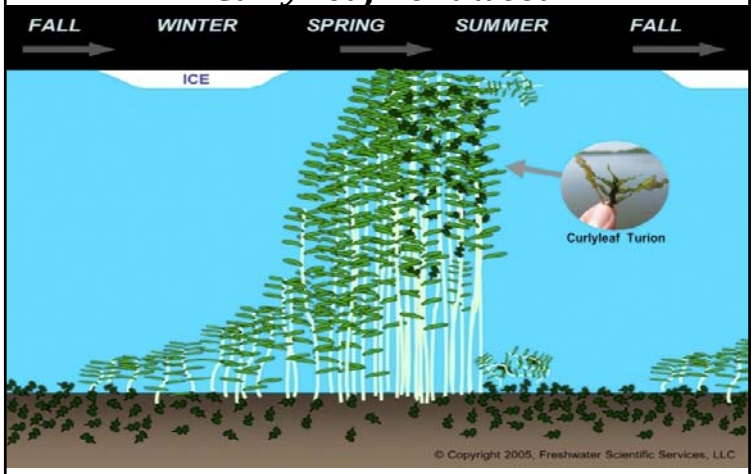
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting

Increase in Ecological Impact

Onterra, LLC
Lake Management Planning

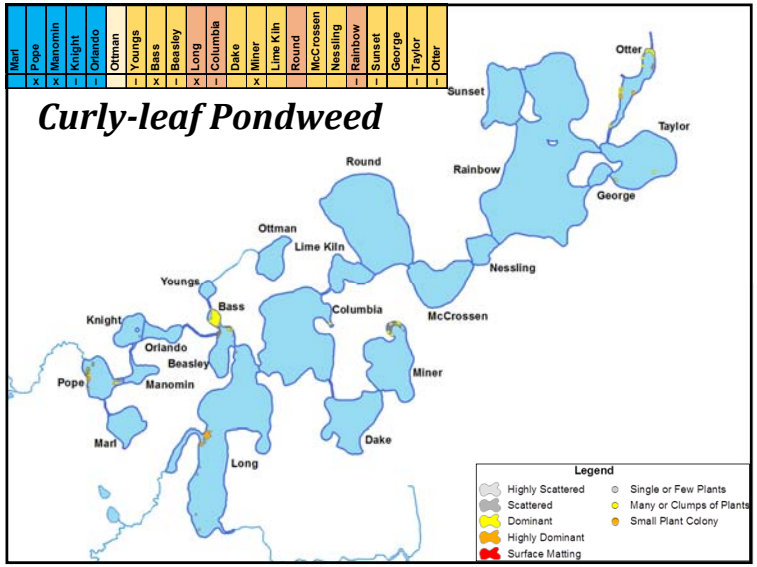
13

Curly-leaf Pondweed

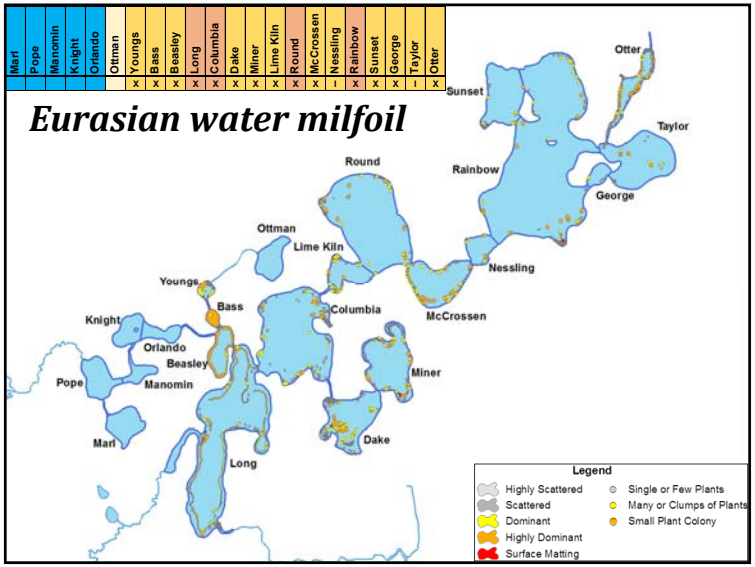


Onterra, LLC
Lake Management Planning

14



15



16

AIS Control Strategies

- Do nothing (monitor)
- Biocontrol (weevils)
- Herbicide treatment
- Hand removal (& DASH)
- Winter drawdown
- Mechanical harvesting



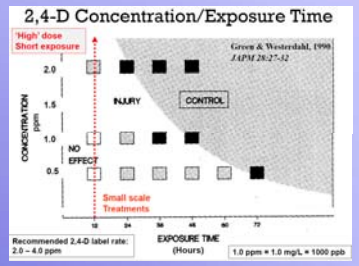


Onterra, LLC
Lake Management Planning

17

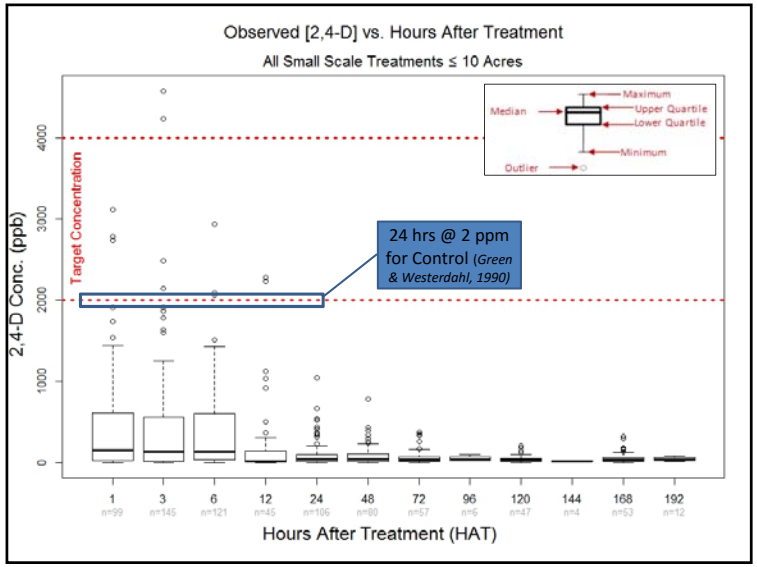
Herbicide Spot Treatment

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

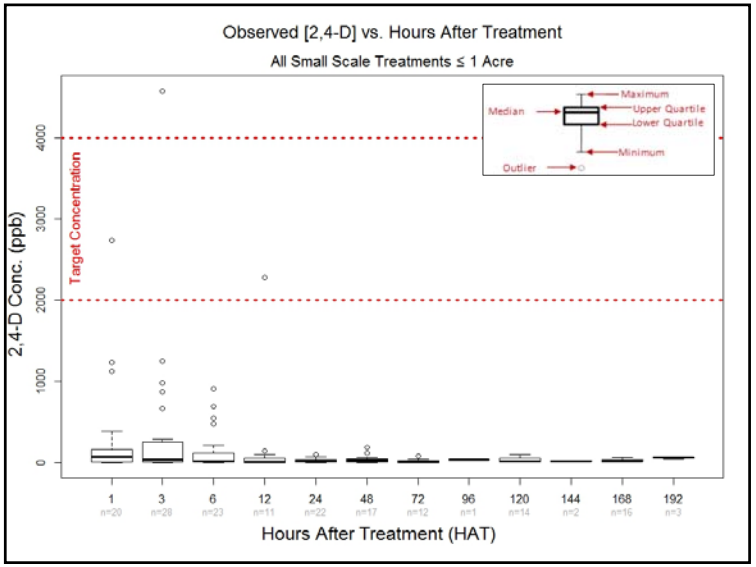


Onterra, LLC
Lake Management Planning

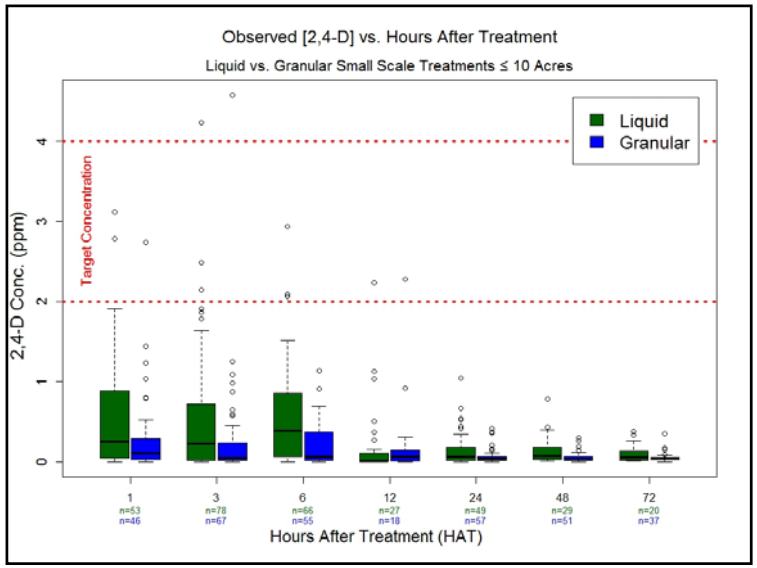
18



19



20



21

Spot Treatment Specifications

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

Onterra, LLC
Lake Management Planning

22

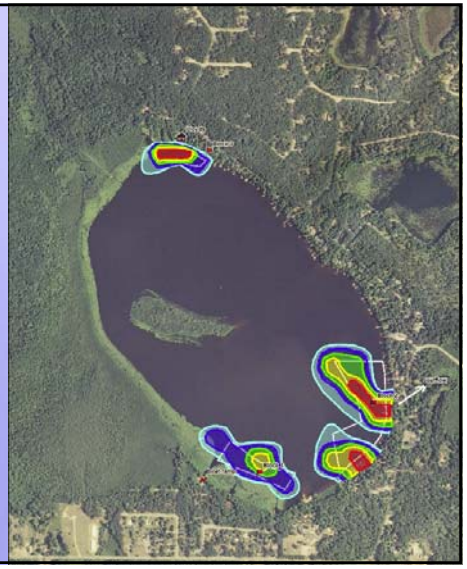
2015 Treatment on Loon Lake

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

23

1 HAT

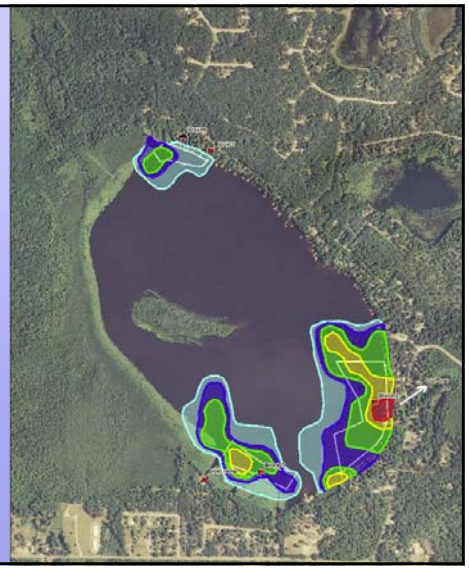
75-100%
50-75%
25-50%
10-25%
5-10%



24

2.5 HAT

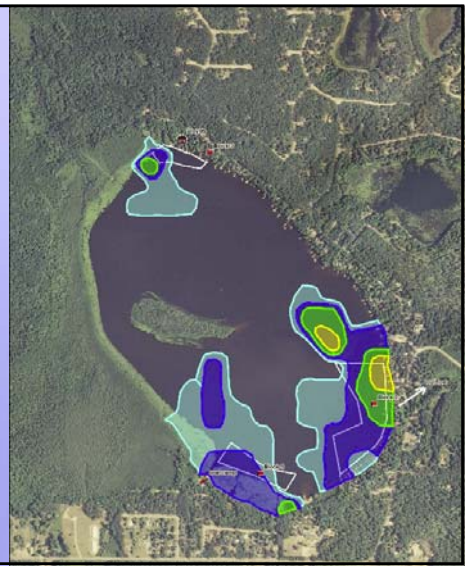
75-100%
50-75%
25-50%
10-25%
5-10%



25

4 HAT

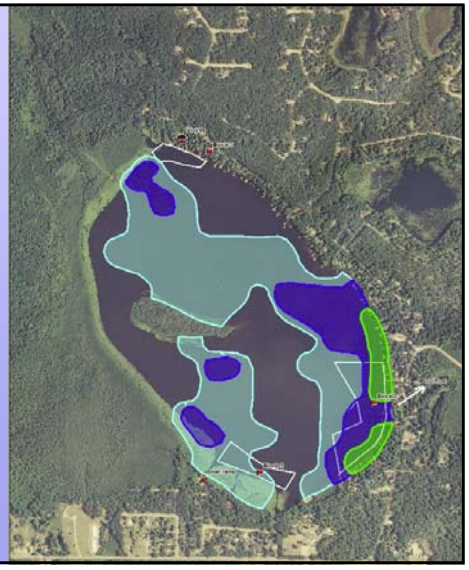
75-100%
50-75%
25-50%
10-25%
5-10%



26

6 HAT

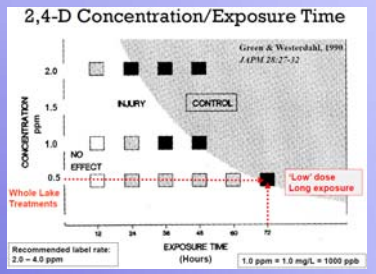
75-100%
50-75%
25-50%
10-25%
5-10%

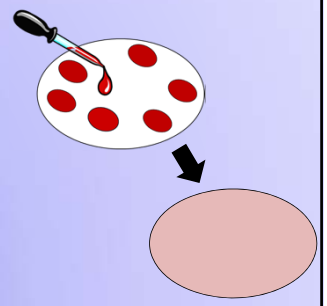


27

Large-Scale (Whole-lake) Treatment

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

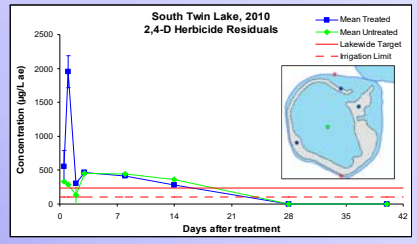


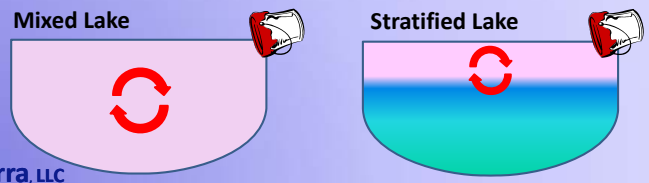


28

Large-Scale (Whole-lake) Treatment

- Herbicide Mixing
  - Horizontal
  - Vertical

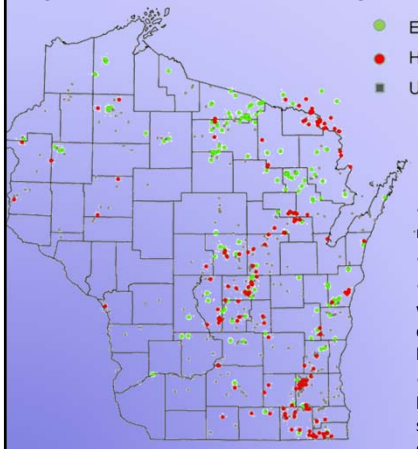




Onterra, LLC
Lake Management Planning

29

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

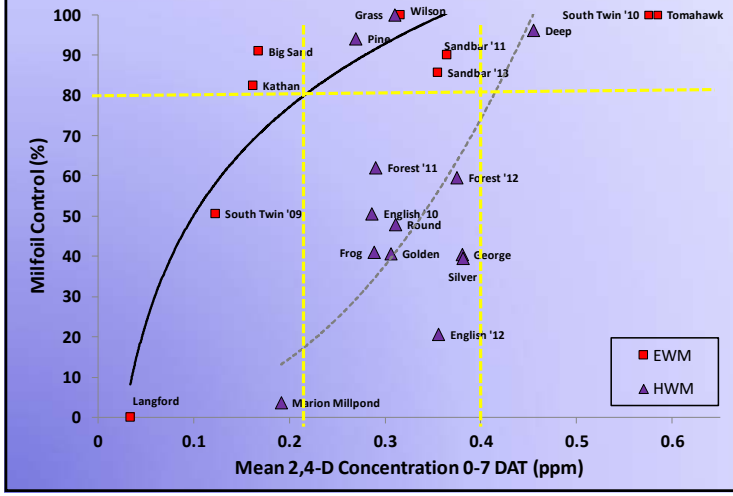


- Many misconceptions and misinformation regarding HWM
- ~150 lakes in WI have HWM confirmed
- There is not one 'single' hybrid watermilfoil, but it is rather a genetically diverse group that reflects recurrent hybridization
- Not all HWM appear to be tolerant to herbicides, but majority show statistically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

Onterra, LLC
Lake Management Planning

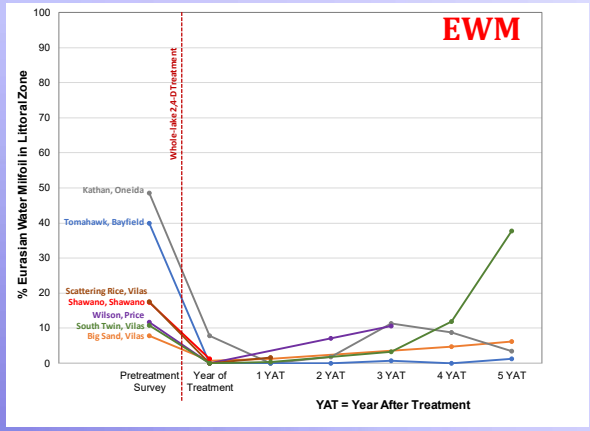
30

Results – Concentration vs Efficacy



31

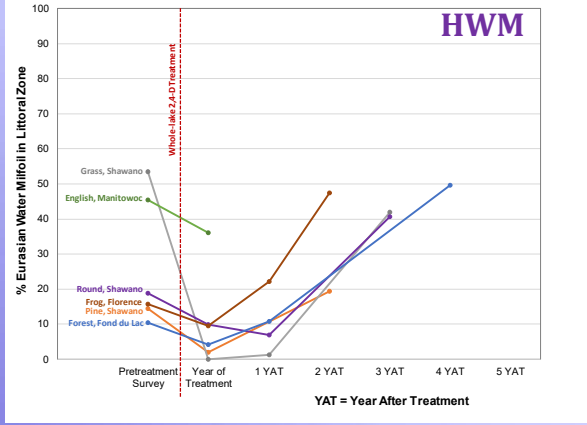
Results – Long-term Efficacy



Onterra, LLC
Lake Management Planning

32

Results – Long-term Efficacy



Onterra, LLC
Lake Management Planning

33

Large-Scale (Whole-lake) Treatment Specifications

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

Onterra, LLC
Lake Management Planning

34

Whole-Lake Herbicide Treatment Options

2,4-D

- Concerns about controlling HWM

2,4-D + Endothall Combo

- Single application, exposure time 21-35 days
- Combo treatments have provided good short-term control, but long term control has been variable, especially on HWM
- Native plants impacts have been variable

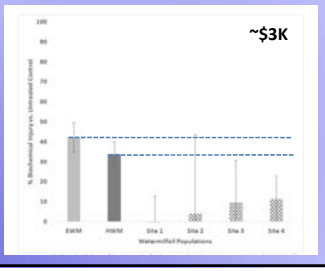
Fluridone

- Less commonly used in WI, mostly because trials in early 2000s showed impacts to common native plants
- Up to 3 applications (bumps) may be required in a year, exposure time entire growing season
- Emerging "low & long" trials are ongoing

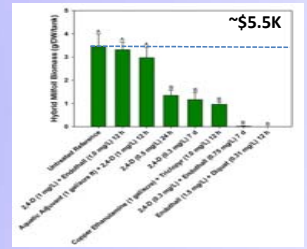
Onterra, LLC
Lake Management Planning

35

Aquaria Sensitivity Screening



Mesocosom Challenge Testing



36

Field Trials

Youngs, Bass, Beasley

- 2,4-D (0.4 ppm ae)
  - ~$5,500 for application
- 2,4-D+Endothall (0.3/0.53 ppm ae)
  - ~$13,500 for application
- Retention time (modeled)
  - 4.5 days for Youngs & Bass
  - 14 days for Beasley

Onterra, LLC
Lake Management Planning

37

Field Trials

Youngs, Bass, Beasley, & Long

- 2,4-D (0.4 ppm ae)
  - ~$25,000 for application
- 2,4-D+Endothall (0.3/0.53 ppm ae)
  - ~$98,000 for application
- Retention time (modeled)
  - 4.5 days for Youngs & Bass
  - 14 days for Beasley
  - 48 days for Long

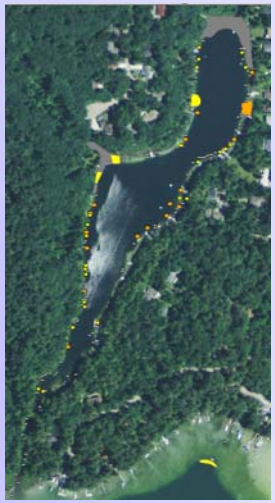
Onterra, LLC
Lake Management Planning

38

Field Trials

Otter

- 2,4-D (0.4 ppm ae)
  - ~$3,000 for application
- 2,4-D+Endothall (0.275/0.54 ppm ae)
  - ~$10,000 for application
- Retention time (modeled)
  - 480 days



Onterra, LLC
Lake Management Planning

39

Considerations for Waupaca Chain

- Is active management of CLP necessary?
- Especially in some lakes, EWM/HWM may be causing ecological and recreational impacts
  - Spot vs Whole-lake treatment strategies
  - Strategy to restore ecosystem function or improve ecosystem services
  - Lack of vascular plants in many lakes
    - Competition, restoration, etc
  - 2,4-D may not allow management goals to be reached
    - Trials (aquaria, mesocosom, or field)

Onterra, LLC
Lake Management Planning

40

Waupaca Chain O' Lakes District

Waupaca Chain O' Lakes Management Planning Project

Planning Committee Meeting I

April 21, 2017

Eddie Heath & Tim Hoyman
Onterra LLC
Lake Management Planning

Presentation Outline

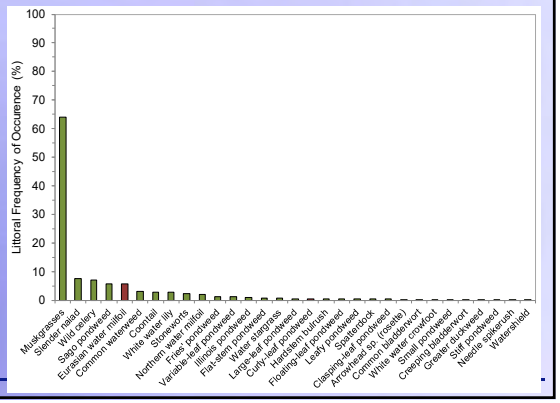
- Introductions
- Aquatic Plant summary from previous meeting
  - Focus on Eurasian watermilfoil (EWM) & Curly-leaf Pondweed (CLP)
  - Summary of AIS-EPC Grant
- Water Quality of Chain
- Watershed of Chain
- Shoreland & Coarse Woody Habitat of Chain
  - Overview only because Dan McFarlane already presented
- Next Steps – including setting up Planning Meeting II

Onterra LLC
Lake Management Planning

Species List

44 Native Species in 2016 (29 on rake)

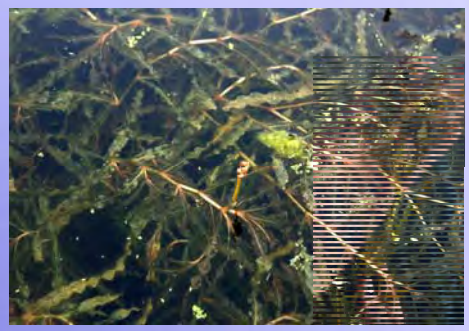
- EWM, CLP, & 5 emergent invasive plant species located
- No native species listed as *endangered*, *threatened* or of *special concern*



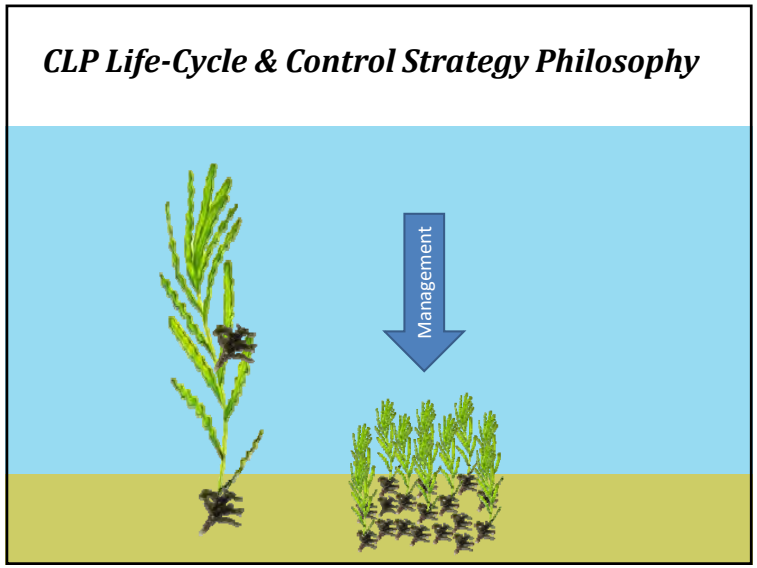
Onterra LLC
Lake Management Planning

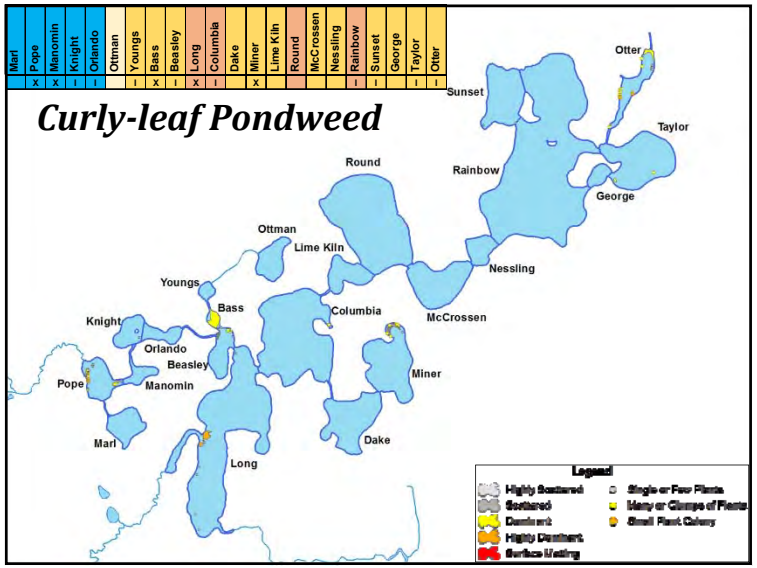
Non-native Aquatic Plants

Curly-leaf Pondweed

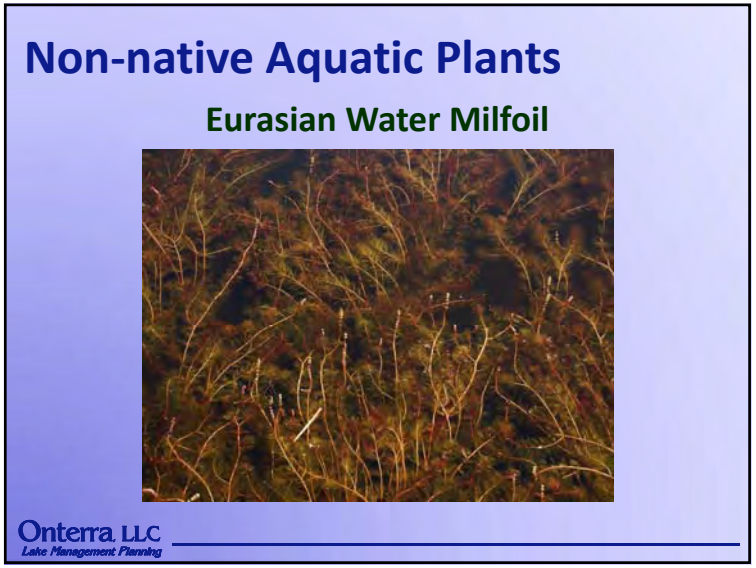


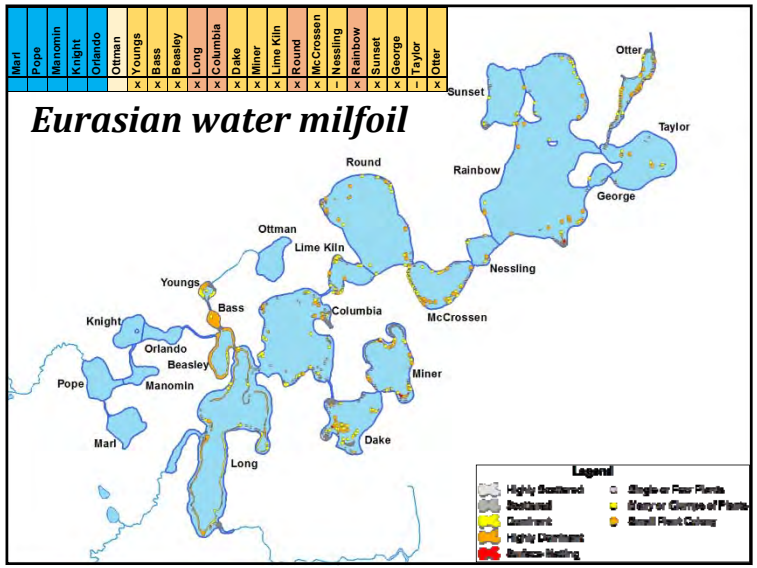
Onterra LLC
Lake Management Planning


CLP Life-Cycle & Control Strategy Philosophy
Management


Curly-leaf Pondweed
Marl
Pope
Manomin
Knight
Orlando
Ottman
Youngs
Bass
Beasley
Long
Columbia
Dake
Miner
Lime Kiln
Round
McCrossen
Nessling
Rainbow
Sunset
George
Taylor
Otter
Otter
Taylor
Sunset
Rainbow
Round
George
Ottman
Lime Kiln
Nessling
Youngs
Bass
Columbia
McCrossen
Knight
Orlando
Beasley
Miner
Pope
Manomin
Marl
Dake
Long
Legend


Upper


Non-native Aquatic Plants
Eurasian Water Milfoil
Onterra LLC
Lake Management Planning



Aquatic Plant Management

Ecosystem Restoration

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

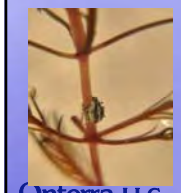
Restore Ecosystem Services

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

Onterra LLC
Lake Management Planning

APM Control Strategies

- Do nothing (monitor)
- Biocontrol (weevils)
- Herbicide treatment
- Hand removal (& DASH)
- Winter drawdown
- Mechanical harvesting



Onterra LLC
Lake Management Planning

Aquatic Plant Management Implementation Challenges

Herbicide Control Strategies

- Duration of CLP projects
- Heterosis (hybrid vigor) of EWM
- Herbicide tolerance evolution
- Native plant & other secondary ecosystem impacts
- Large-scale (whole-lake) vs spot treatments
- Water exchange/flow
- Herbicide use-pattern

Hand Removal Strategies

- Difficulties targeting CLP
- Efficiencies & limitations of Diver Assisted Suction Harvesting

Onterra LLC
Lake Management Planning

2017-2019 AIS-EPC Grant

- **Management Goal 1: Conduct Aquatic Invasive Species Population Management in the Waupaca Chain O' Lakes**
  - *Management Action 1: Conduct Three Year Field Trial Herbicide Control Program to Restore Ecosystem*
    - Lakes with longer residence times
      - Conduct large-scale 2,4-D treatment on Dake and Miner Lakes in 2017
      - Conduct large-scale 2,4-D/endothall treatment on Otter Lake in 2017
    - Lakes with shorter residence times
      - Monitor water discharge during early season on Youngs, Bass, Beasley, and Long Lakes in 2017 (Waupaca County assistance)
      - Large-scale treatments plans of 2018 would be developed for these lakes, if applicable, based on 1) results of 2017 large-scale treatments, & 2) water discharge study

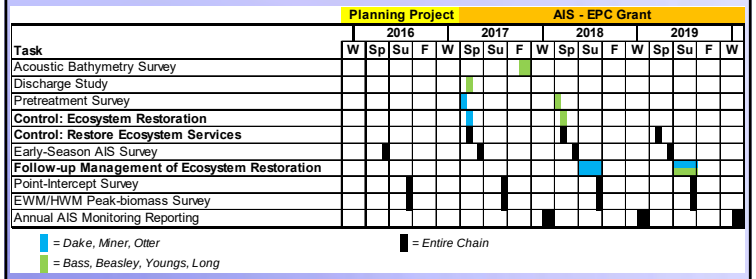
Onterra LLC
Lake Management Planning

2017-2019 AIS-EPC Grant

- **Management Goal 1: Conduct Aquatic Invasive Species Population Management in the Waupaca Chain O' Lakes**
  - *Management Action 2: Restore Ecosystem Services HWM Populations are Impairing*
    - If the following trigger is met, consider conducting herbicide spot treatments: "colonized areas of where a sufficiently large treatment area can be constructed to hold CETs (preference to dominant or greater density) for herbicide use pattern"
    - If trigger is not met but management is desired, consider implementing hand-harvesting (traditional or DASH methods)
  - *Management Action 3: Monitor CLP Population*
    - CLP can assimilate into plant communities on some lakes
    - Access if active management is appropriate after population trends are understood
  - *Management Action 4: Conduct Clean Boats Clean Waters*
    - 200 Hours per year target

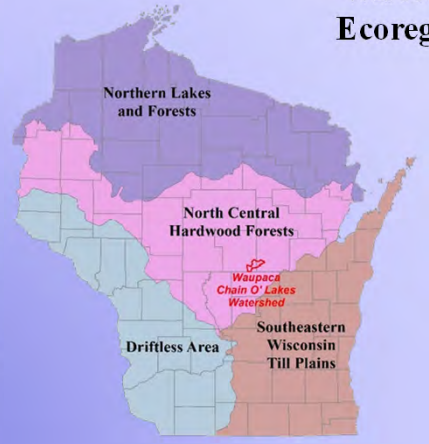
Onterra LLC
Lake Management Planning

2017-2019 AIS-EPC Grant

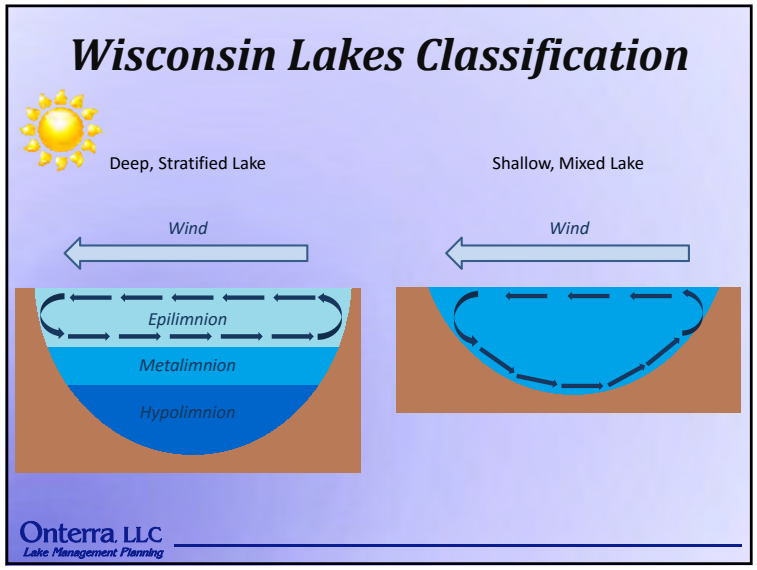


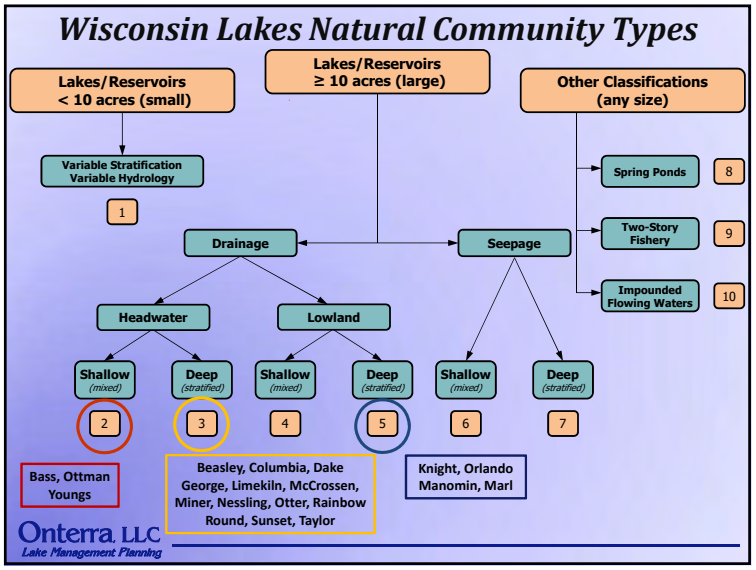
Onterra LLC
Lake Management Planning

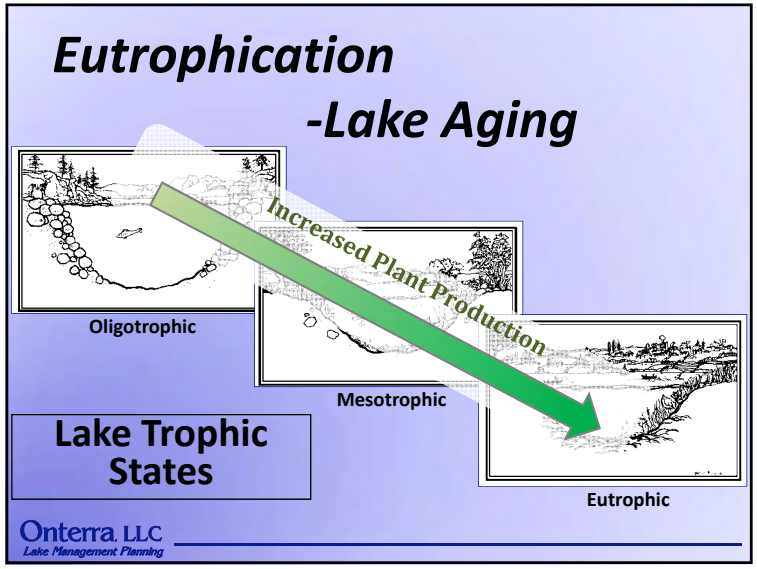
Wisconsin Ecoregions



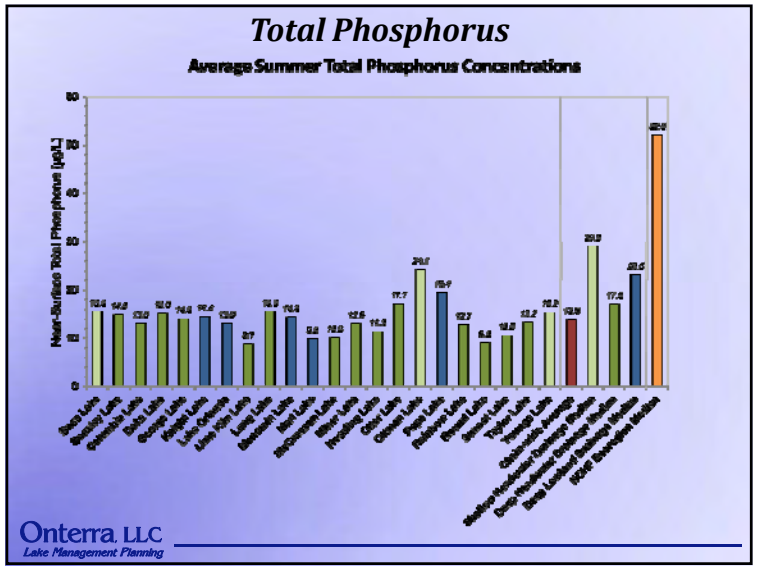
Onterra LLC
Lake Management Planning

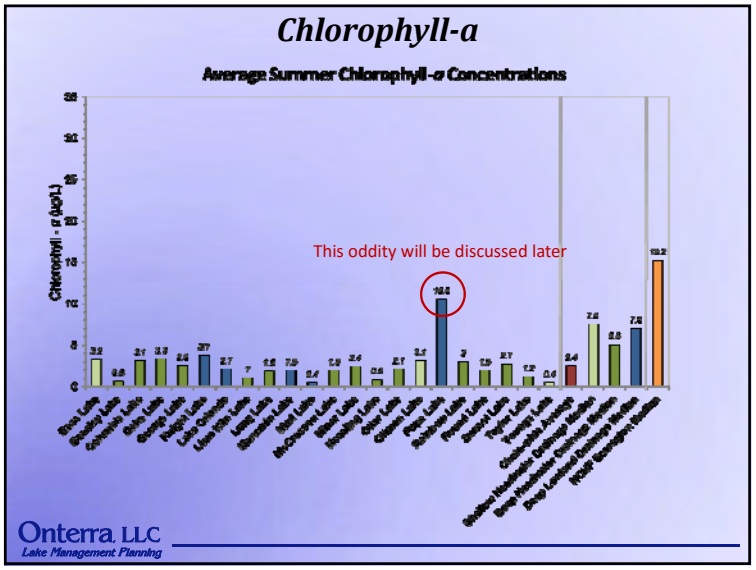

Wisconsin Lakes Classification
Deep, Stratified Lake
Shallow, Mixed Lake
Wind
Wind
Epilimnion
Metalimnion
Hypolimnion
Onterra LLC
Lake Management Planning

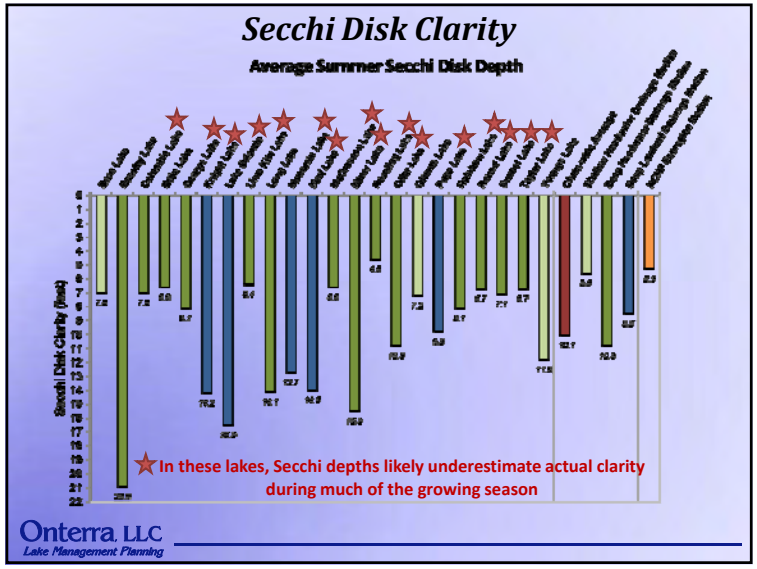

Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Drainage
Seepage
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Headwater
Lowland
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
2
3
4
5
6
7
Bass, Ottman Youngs
Beasley, Columbia, Dake George, Limekiln, McCrossen, Miner, Nessling, Otter, Rainbow Round, Sunset, Taylor
Knight, Orlando Manomin, Marl
Onterra LLC
Lake Management Planning

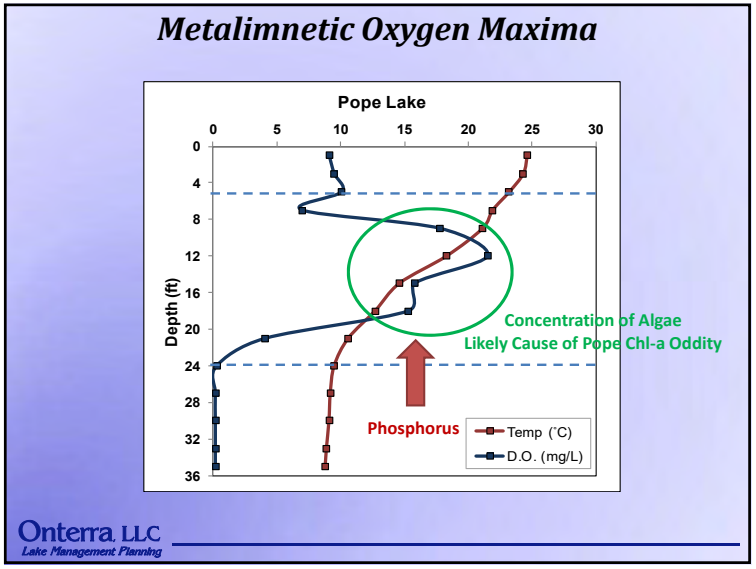

Eutrophication
-Lake Aging
Increased Plant Production
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
Onterra LLC
Lake Management Planning


Water Quality
Phosphorus (Limiting Plant Nutrient)
Reduced by marl precipitation
Chlorophyll-a (Algal Abundance)
Very Low
Water Clarity (Secchi Disk)
Interesting
Onterra LLC
Lake Management Planning


Total Phosphorus
Average Summer Total Phosphorus Concentrations
Near-Surface Total Phosphorus (µg/L)
Onterra LLC
Lake Management Planning

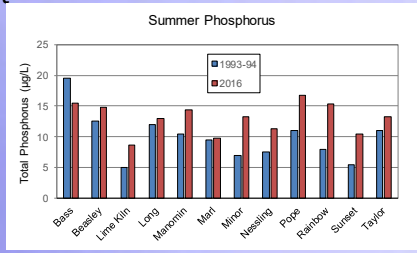

Chlorophyll-a
Average Summer Chlorophyll-a Concentrations
This oddity will be discussed later
Onterra LLC
Lake Management Planning


Secchi Disk Clarity
Average Summer Secchi Disk Depth
In these lakes, Secchi depths likely underestimate actual clarity during much of the growing season
Onterra LLC
Lake Management Planning


Metalimnetic Oxygen Maxima
Pope Lake
Depth (ft)
Concentration of Algae
Likely Cause of Pope Chl-a Oddity
Phosphorus
Temp (°C)
D.O. (mg/L)
Onterra LLC
Lake Management Planning

Long-Term Trends in Water Quality

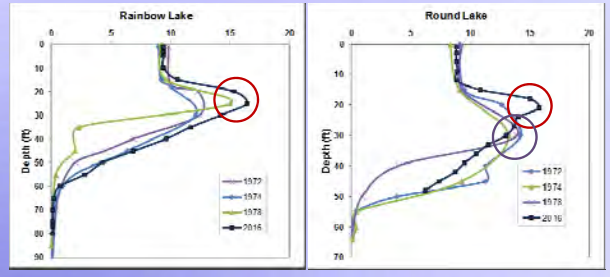
- Twelve lakes were sampled in 1993-94 and 2016 for phosphorus, chlorophyll-*a*, and clarity.
  - Eleven of the lakes experienced an increase in phosphorus over the 22 years
  - Chlorophyll-*a* and clarity were mixed, but due to metalimnetic oxygen maxima, are difficult to interpret



Onterra LLC
Lake Management Planning

Long-Term Trends in Water Quality

- Changes in metalimnetic oxygen maxima also indicate that some lakes in the Chain are experiencing changes in water quality

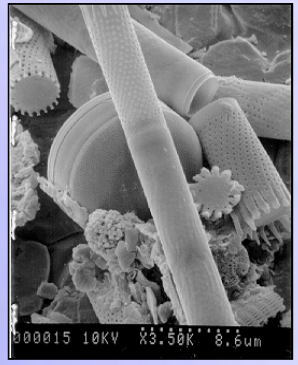


Increased maxima = increased nutrients
Earlier maxima in Round was deeper indicating greater water clarity

Onterra LLC
Lake Management Planning

Paleoecology

SEDIMENT CORE



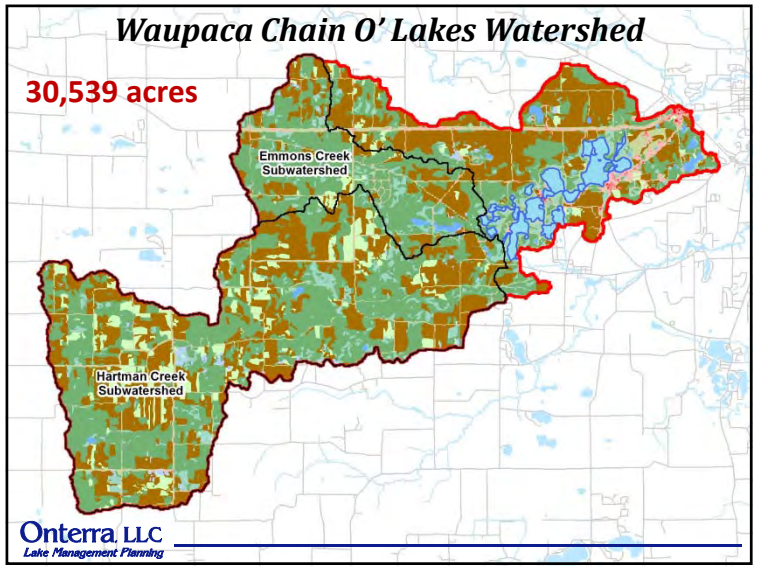
DIATOMS

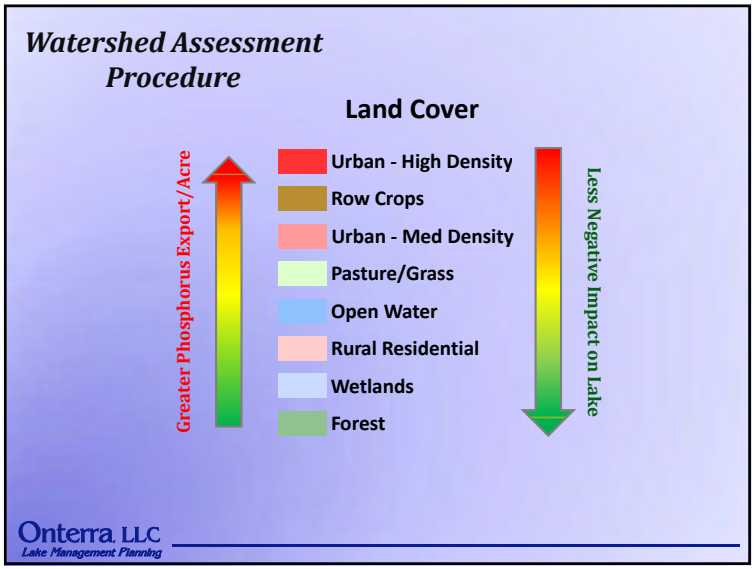
Onterra LLC
Lake Management Planning

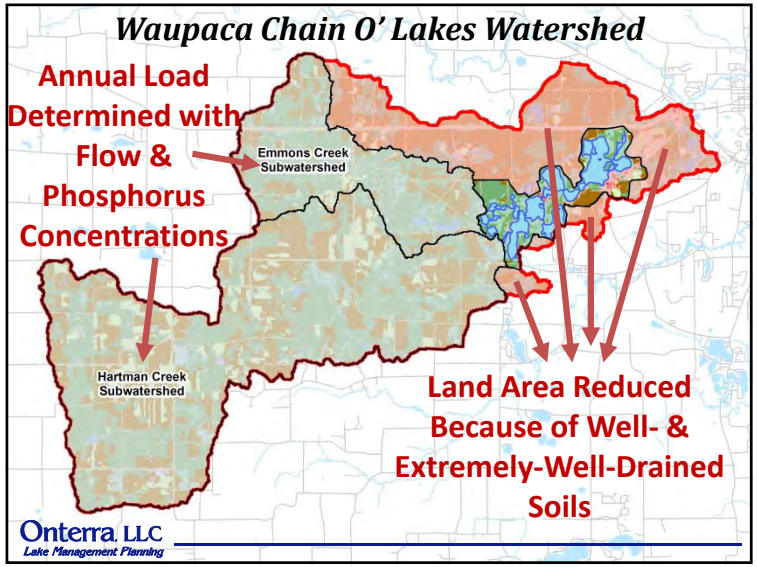
Long-Term Trends in Water Quality

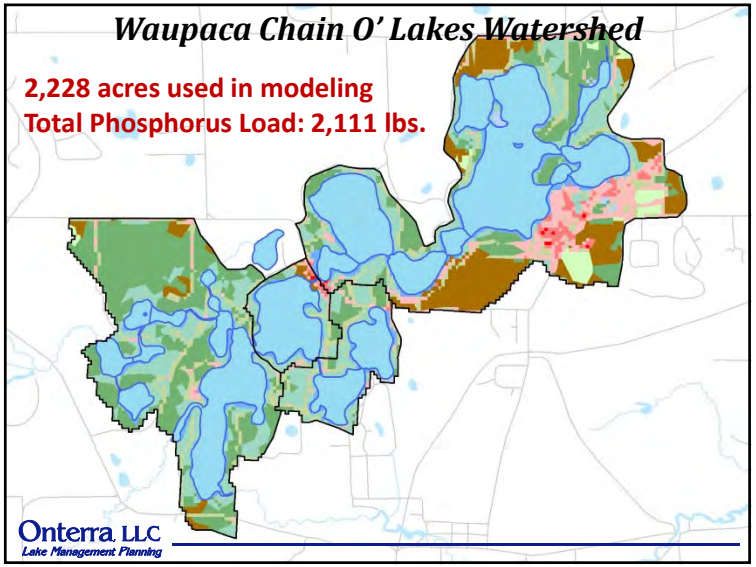
- Paleocores analyzed for Marl Lake indicate that pre-European settlement phosphorus levels were about 4 µg/L, compared to current levels of 10 µg/L.
- Paleocore from Youngs Lake revealed that pre-European settlement values were only slightly lower than they are now.

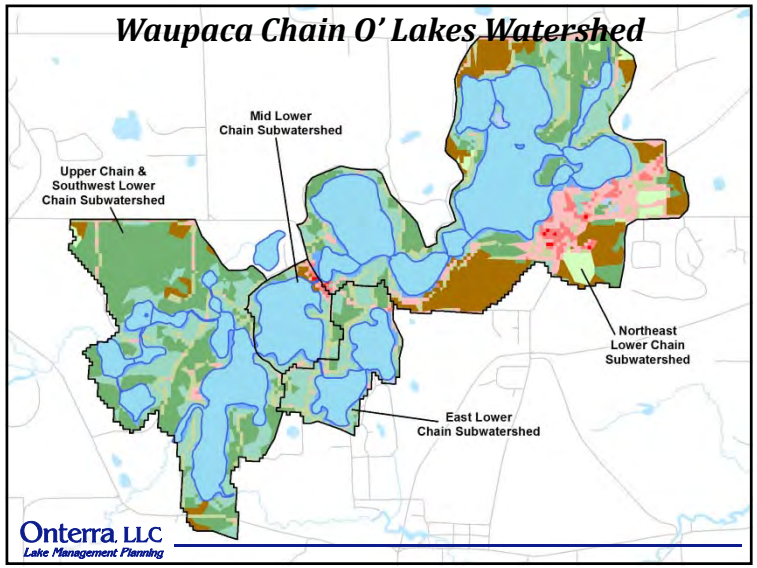
Onterra LLC
Lake Management Planning

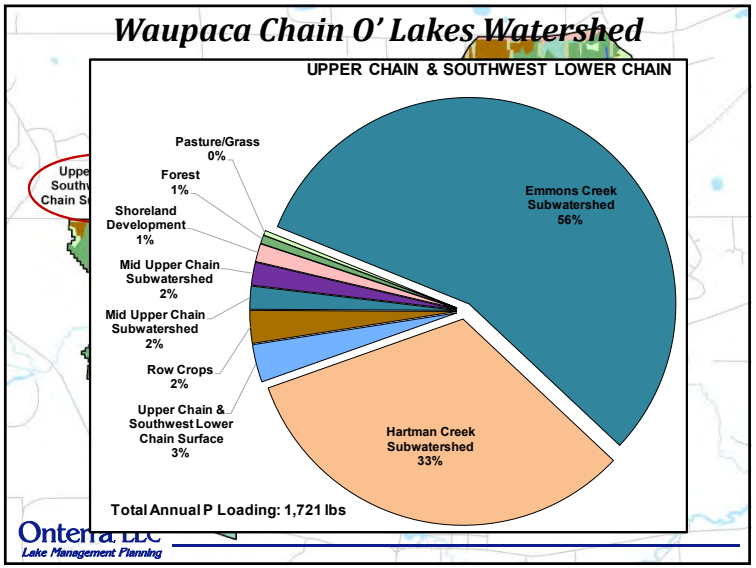

Waupaca Chain O' Lakes Watershed
30,539 acres
Emmons Creek Subwatershed
Hartman Creek Subwatershed
Onterra LLC
Lake Management Planning

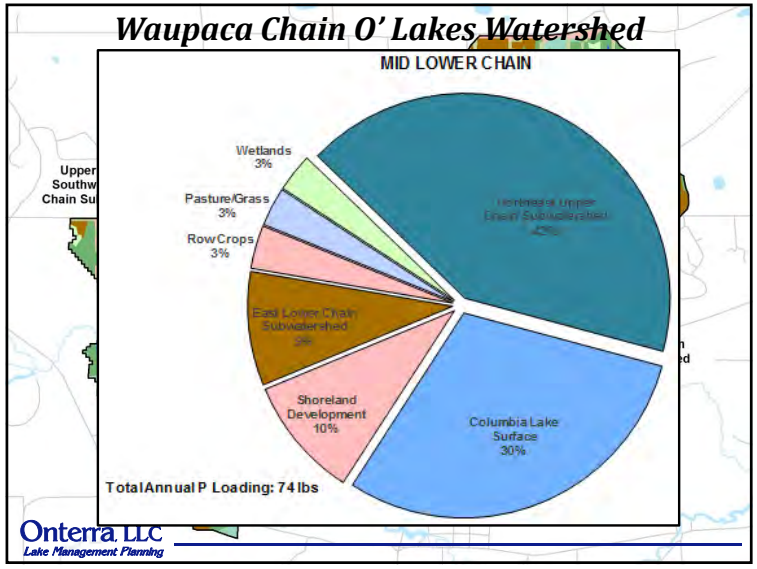

Watershed Assessment Procedure
Land Cover
Greater Phosphorus Export/Acre
Urban - High Density
Row Crops
Urban - Med Density
Pasture/Grass
Open Water
Rural Residential
Wetlands
Forest
Less Negative Impact on Lake
Onterra LLC
Lake Management Planning

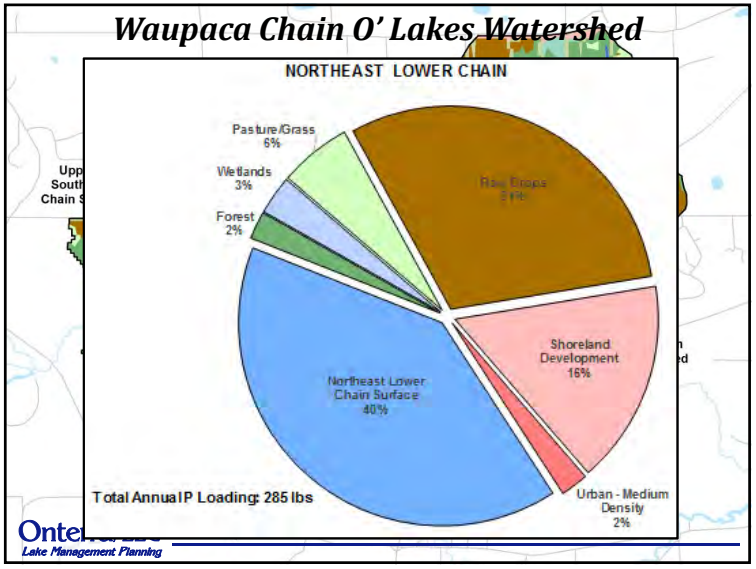

Waupaca Chain O' Lakes Watershed
Annual Load Determined with Flow & Phosphorus Concentrations
Emmons Creek Subwatershed
Hartman Creek Subwatershed
Land Area Reduced Because of Well- & Extremely-Well-Drained Soils
Onterra LLC
Lake Management Planning

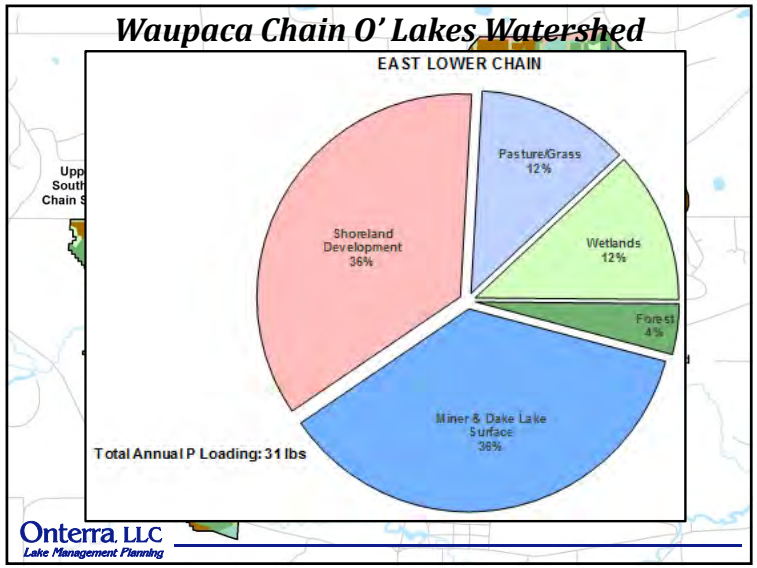

Waupaca Chain O' Lakes Watershed
2,228 acres used in modeling
Total Phosphorus Load: 2,111 lbs.
Onterra LLC
Lake Management Planning


Waupaca Chain O' Lakes Watershed
Mid Lower Chain Subwatershed
Upper Chain & Southwest Lower Chain Subwatershed
Northeast Lower Chain Subwatershed
East Lower Chain Subwatershed
Onterra LLC
Lake Management Planning

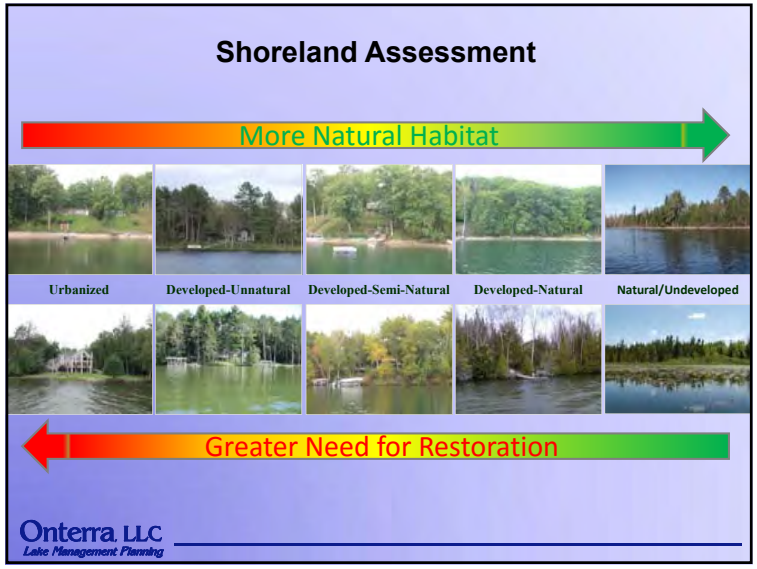

Waupaca Chain O' Lakes Watershed
UPPER CHAIN & SOUTHWEST LOWER CHAIN
Pasture/Grass 0%
Forest 1%
Shoreland Development 1%
Mid Upper Chain Subwatershed 2%
Mid Upper Chain Subwatershed 2%
Row Crops 2%
Upper Chain & Southwest Lower Chain Surface 3%
Emmons Creek Subwatershed 56%
Hartman Creek Subwatershed 33%
Total Annual P Loading: 1,721 lbs
Onterra LLC
Lake Management Planning

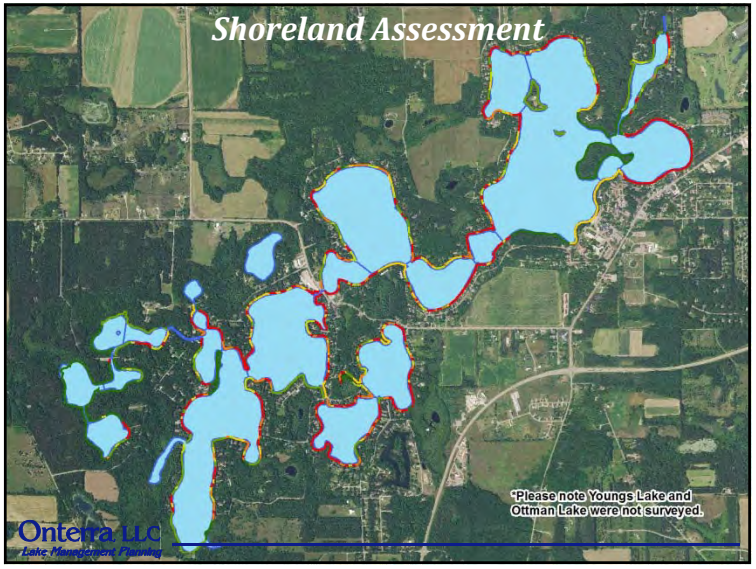

Waupaca Chain O' Lakes Watershed
MID LOWER CHAIN
Wetlands 3%
Pasture/Grass 3%
Row Crops 3%
Shoreland Development 10%
Columbia Lake Surface 30%
Total Annual P Loading: 74 lbs
Onterra LLC
Lake Management Planning

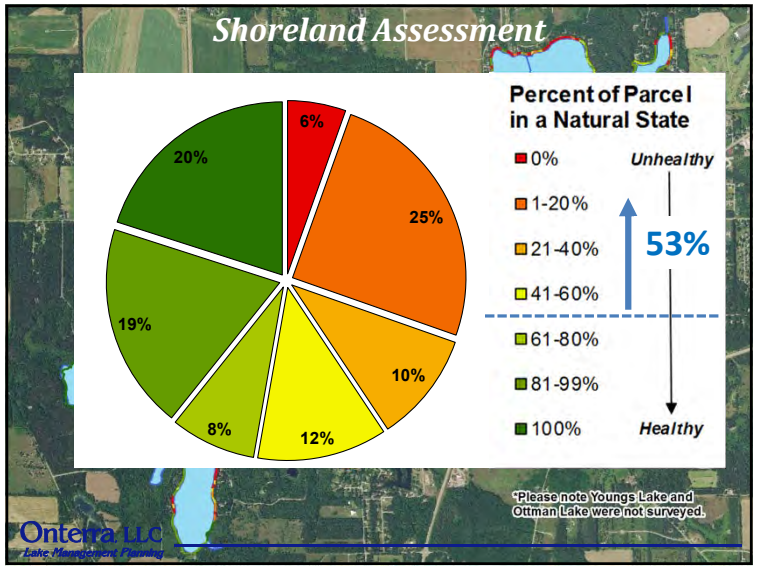

Waupaca Chain O' Lakes Watershed
NORTHEAST LOWER CHAIN
Pasture/Grass 6%
Wetlands 3%
Forest 2%
Shoreland Development 16%
Northeast Lower Chain Surface 40%
Urban - Medium Density 2%
Total Annual P Loading: 285 lbs
Onterra LLC
Lake Management Planning


Waupaca Chain O' Lakes Watershed
EAST LOWER CHAIN
Pasture/Grass 12%
Wetlands 12%
Forest 4%
Miner & Dake Lake Surface 36%
Shoreland Development 36%
Total Annual P Loading: 31 lbs
Onterra LLC
Lake Management Planning


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.
• Waupaca County assessment considered shoreland area from water's edge back 50 feet
Urbanized
Range
Natural
Onterra LLC
Lake Management Planning


Shoreland Assessment
More Natural Habitat
Urbanized
Developed-Unnatural
Developed-Semi-Natural
Developed-Natural
Natural/Undeveloped
Greater Need for Restoration
Onterra LLC
Lake Management Planning

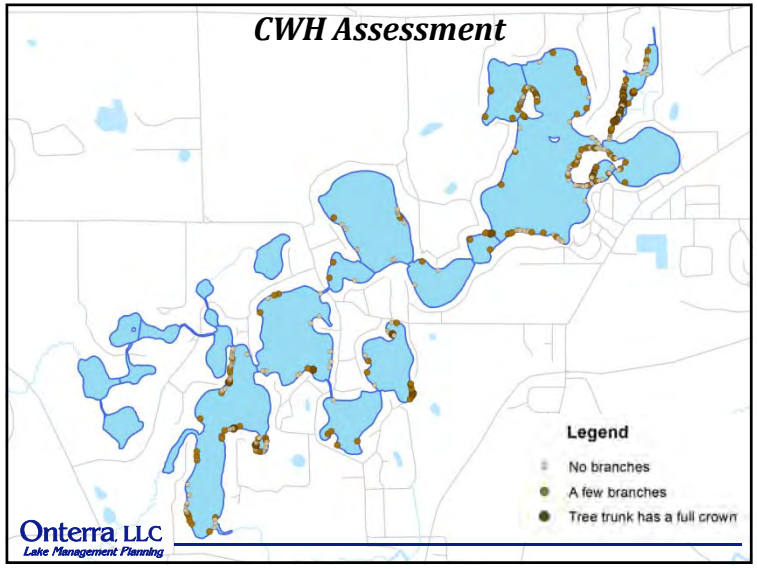

Shoreland Assessment
*Please note Youngs Lake and Ottman Lake were not surveyed.
Onterra LLC
Lake Management Planning

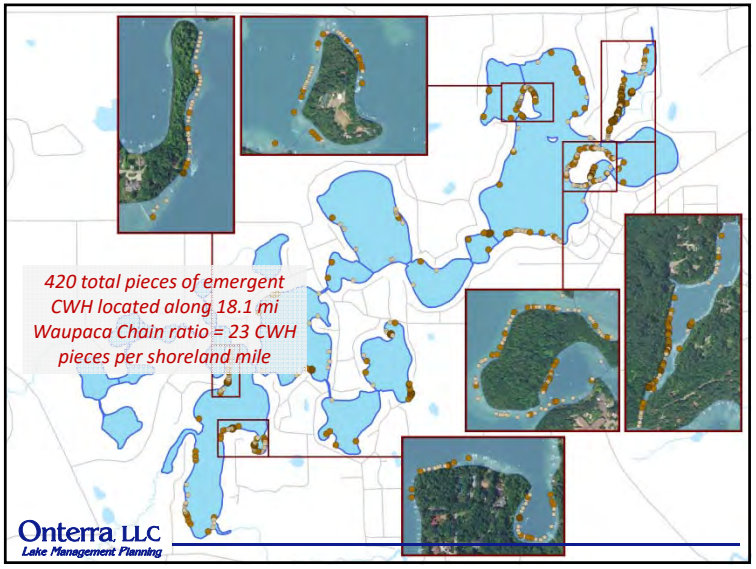


Coarse Woody Habitat

- 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 Waupaca Chain O' Lakes

Onterra LLC
Lake Management Planning





Conclusions

Water Quality

- Overall, Waupaca Chain O' Lakes has very good water quality
  - Marl precipitation is dominating factor in keeping Chain water quality good
- Evidence exists that the water quality of the Chain has decreased in recent decades
  - Cultural eutrophication
    - Watershed & shorelands

Watershed

- While the surface watershed is large, well-drained and excessively-well-drained soils reduce actual surface runoff
- The bulk of the phosphorus load enters the system through Hartman and Emmons creeks
- Shoreland disturbance is likely the best target to slow the eutrophication process

Onterra LLC
Lake Management Planning

Next Steps

- Schedule Planning Meeting II for May (or June)
  - Develop a list of challenges the Chain and District are facing
  - Convert challenges to management goals
  - Create actions that will allow District and its partners to meet goals
- Create draft implementation plan
  - Committee reviews and adjustments made
- First official draft of management plan created
  - District, WDNR, & partner reviews
- Final draft of plan created (Fall 2017)

Onterra LLC
Lake Management Planning

Thank You

Onterra LLC
Lake Management Planning

Waupaca Chain O' Lakes Management District

Waupaca Chain O' Lakes Management Planning Project

Wrap-up Meeting

August 12, 2017

Tim Hoyman, CLM

Onterra LLC

Waupaca Chain O' Lakes Management Plan

- **Management Goal (multiple)**
  - Management Action 1
  - Management Action 2…
- **Aquatic Plan Management Plan**
  - Centers on hybrid watermilfoil (HWM) control
  - Accepted by WDNR in December 2016
    - Made District eligible for $134,000 2017 AIS Grant

Onterra LLC

Management Goal:

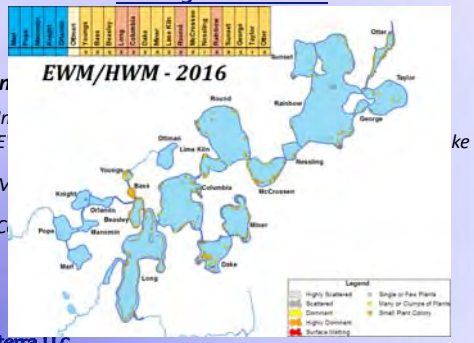
Conduct Aquatic Invasive Species Population Management

Management Actions

- *Initiate AIS Early Detection and Response Strategy if EWM/HWM is located in the Upper Chain or Ottman Lake*
- *Monitor CLP Population*
- *Continue Clean Boats Clean Waters Program*
  - 200 hours/year – combination of paid and volunteer
  - First 3 years are covered under current grants

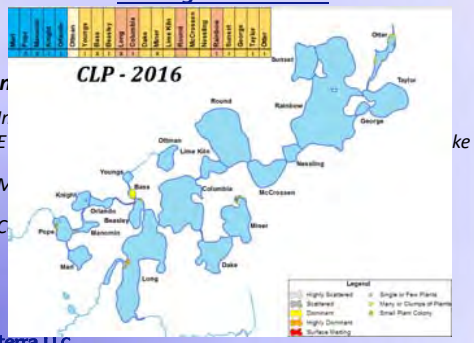
Onterra LLC

Management Goal:



Onterra LLC

Management Goal:



Onterra LLC

Management Goal:

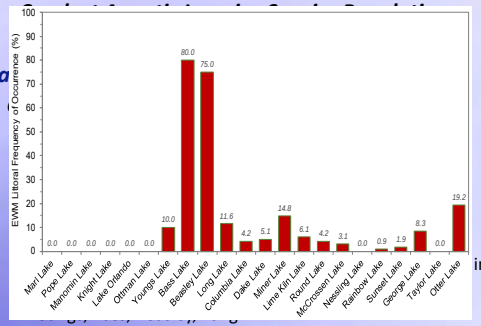
Conduct Aquatic Invasive Species Population Management

Management Actions

- *Conduct Three-Year Field Trial HWM Control Program*
  - Challenges of hybridity, water flow, and connectivity
  - Large-scale (AKA whole-lake) approach for ecological restoration
  - High HWM lakes with long residence times treated in 2017
    - Dake, Miner, Otter
  - High HWM Lakes with short residence times potential treat in 2018
    - Youngs, Bass, Beasley, Long

Onterra LLC

Management Goal:



Preliminary Results

Year 1 of 3 (2017)

Dake – Low Dose 2,4-D

- HWM (5% to 0%) ↓ 100%
- Sago pondweed & slender naiad negatively impacted

Miner – Low Dose 2,4-D

- HWM (16% to 3%) ↓ 80%
- Sago pondweed & slender naiad negatively impacted
- Reports of white water lily impacts (verified)

Otter – Low Dose 2,4-D/endothall

- HWM (19% to 0%) ↓ 100%
- Native plant impacts observed, but none statistically valid

Management Goal:

Conduct Aquatic Invasive Species Population Management

Management Actions

- *Restore Cultural Ecosystem Services that HWM Populations are Impairing (particularly recreation & navigation)*
  - Encourage native plant populations
  - Herbicide Treatment Trigger: colonized areas where a sufficiently large treatment area can be constructed to hold CETs (preference to dominant or greater)
  - If an herbicide treatment is not likely to be effective but management of the area is desired, consider hand-harvesting (includes Diver-Assisted Suction Harvest)

Management Goal:

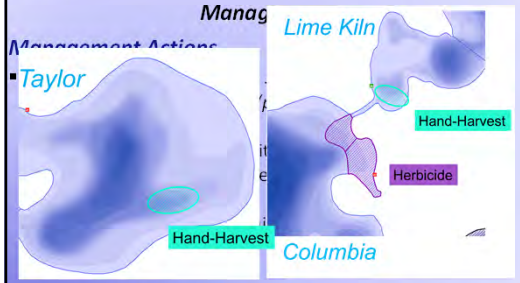
Conduct Aquatic Invasive Species Population Management

Management Actions

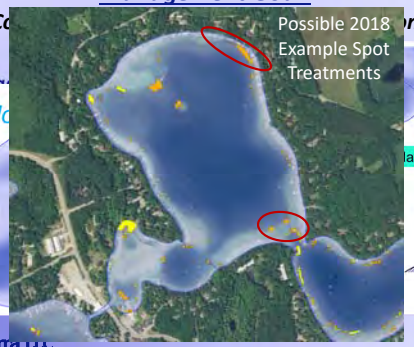
- *Restore Cultural Ecosystem Services that HWM Populations are Impairing (particularly recreation & navigation) – cont'*
  - WDNR will only issue permit to District, not individuals
  - District may defer management costs to affected riparians
  - 2017 Strategy included mix of herbicide and hand-harvesting

Management Goal:

Conduct Aquatic Invasive Species Population Manag



Management Goal:



Management Goal:

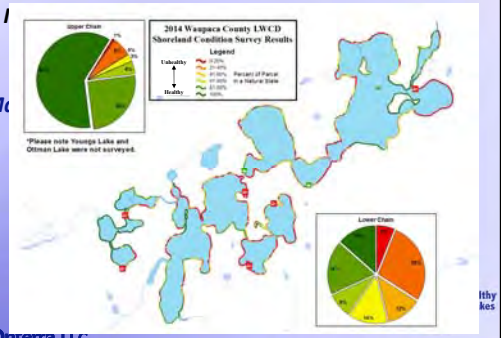
Improve Lake Resource by Protecting & Restoring Chain O' Lakes Shorelands (Aimed Primarily at Water Quality & Fishery)

Management Actions

- *Educate Riparians on the Importance of Shoreland Condition*
  - Phosphorus levels are increasing in the Chain
- *Protect Remaining Natural Shoreland Zones*
- *Expand Coarse Woody Habitat*

Onterra LLC Lake Management Planning

Management Goal:



Onterra LLC Lake Management Planning

Management Goal:

Onterra LLC Lake Management Planning

Management Goal:

Continue to Increase WCOLD's Communication Capacity & Work with other Management Units

Management Actions

- *Provide Information to Riparians to Promote Lake Protection and Enjoyment*
  - AIS identification
  - Basic lake ecology
  - Boater Safety
- *Continue WCOLD Involvement with other Entities that have Hand in Managing the Waupaca Chain O' Lakes*
  - Waupaca Chain O' Lakes Association
  - Waupaca County LWCD
  - Golden Sands RC&D

Onterra LLC Lake Management Planning