# A

# APPENDIX A

## Public Participation Materials


## Presentation Outline

- Current Project Components
- Milestone Timeline
- Eurasian Water Milfoil in Upper Kaubashine 2013 – Early 2016

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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
  - Aquatic Plant Surveys
    - Early-Season AIS Survey
    - Point-Intercept Survey
    - Aquatic Plant Community Mapping
    - EWM Peak-Biomass Survey
  - Zebra Mussel Veliger Sampling
  - Stakeholder Survey

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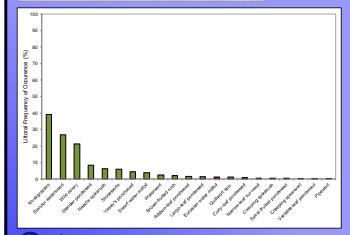
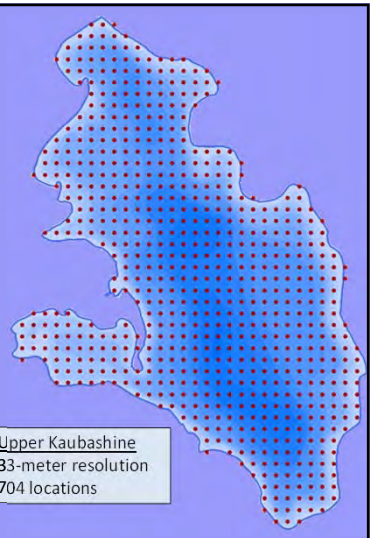
## *Aquatic Plant Point-Intercept Survey*





Upper Kaubashine
33-meter resolution
704 locations

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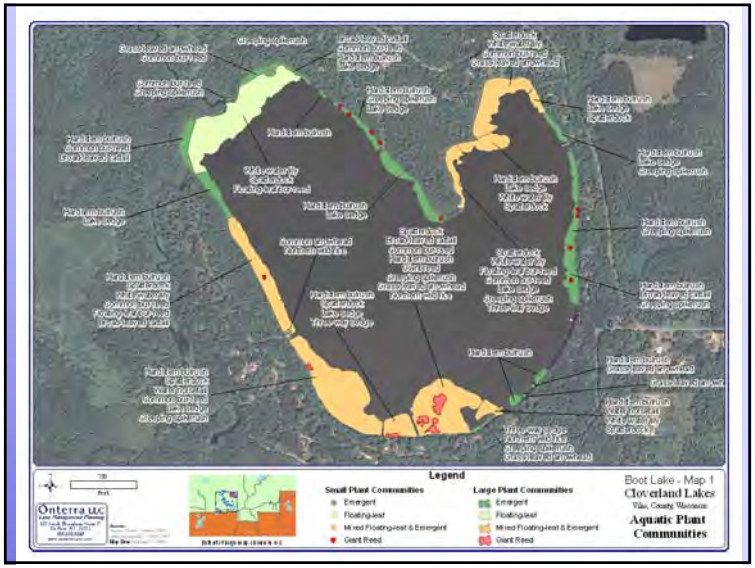


## *Planning Process*

### *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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## *Milestones*

Early- Season AIS Survey – June 16 (completed)
Point-Intercept Survey – July/August 16
Community Mapping Survey – July/August 16
Stakeholder Survey Disbursal – August 16
EWM Peak-Biomass Survey – September 16
Data Analysis/Report – Fall 16/Winter 17
Planning Meetings – Spring 17
Draft Plan – Spring 17
Final Plan – Summer 17
Project Wrap-Up Meeting – Summer 17

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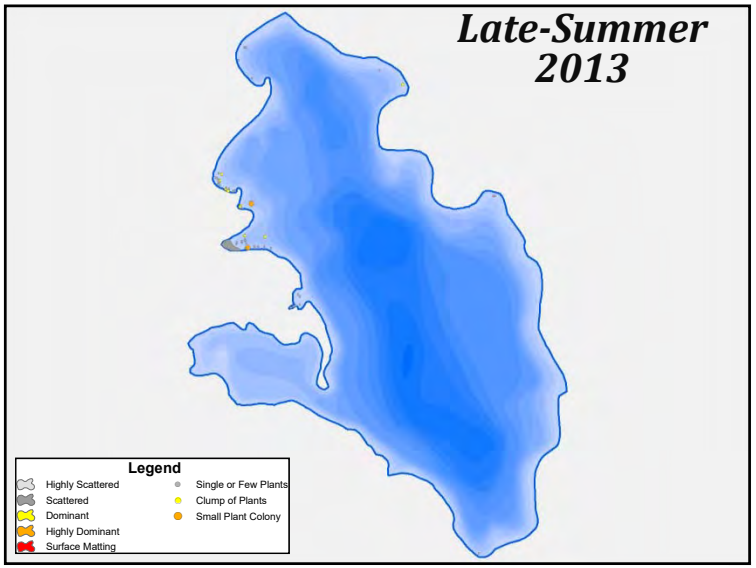
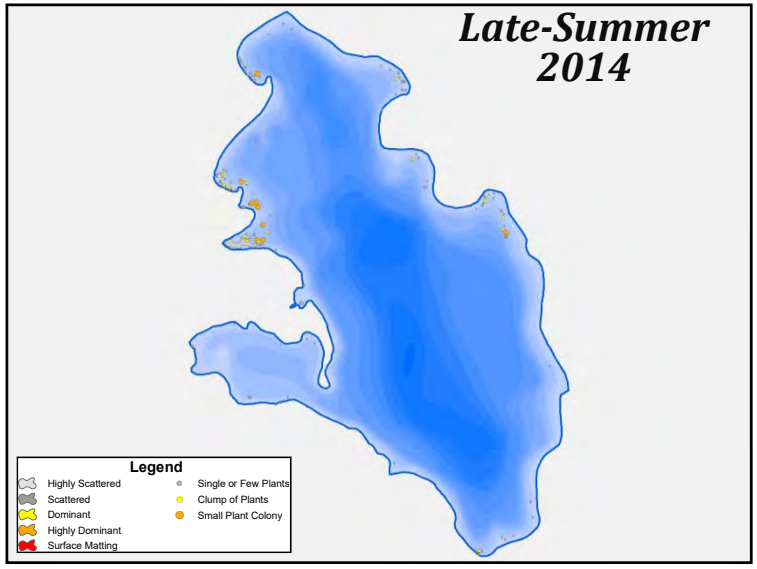
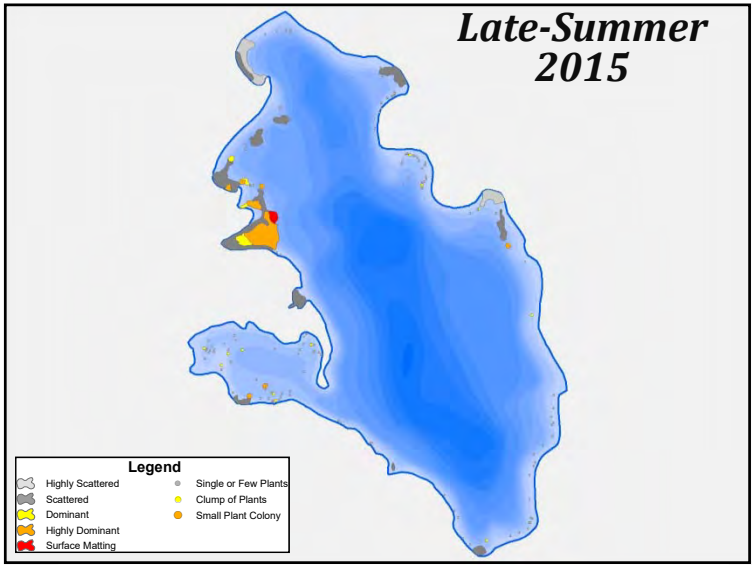
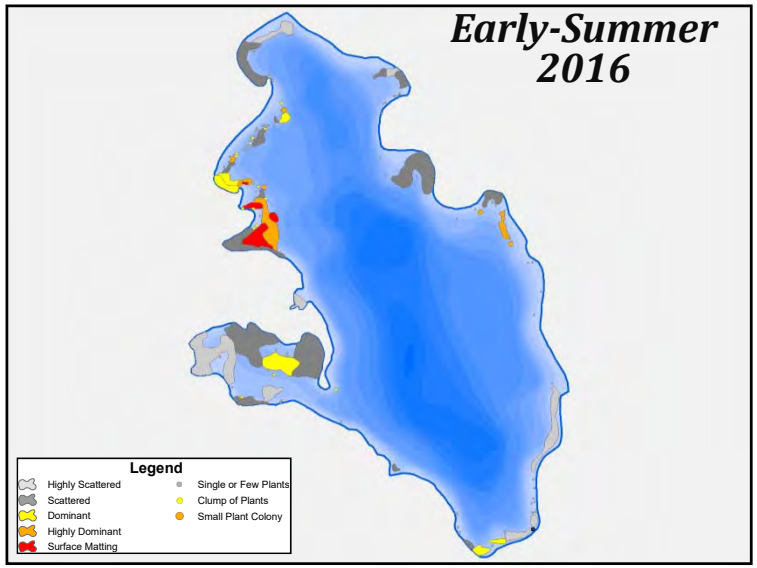
Upper Kaubashine Lake EWM

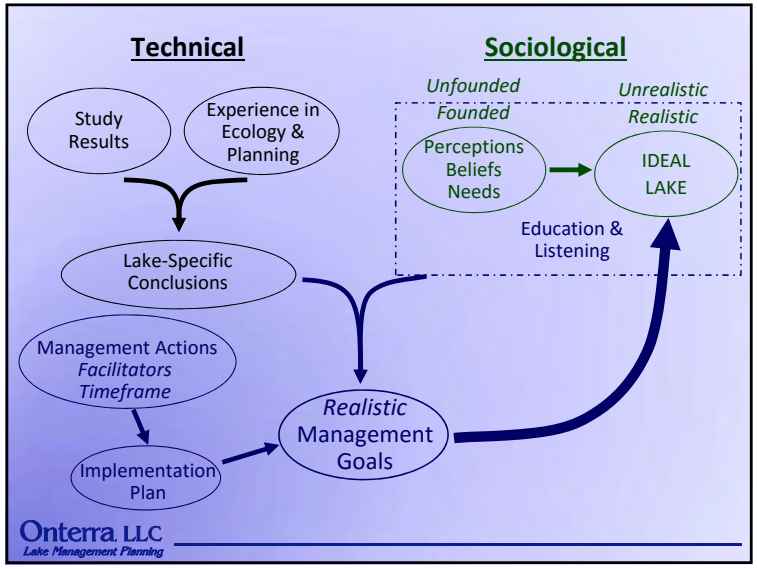

Late-Summer
2013
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


Late-Summer
2014
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


Late-Summer
2015
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


Early-Summer 2016
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


The Planning Process
…it's not as easy as you may think.


Technical
Sociological
Study Results
Experience in Ecology & Planning
Lake-Specific Conclusions
Management Actions
Facilitators
Timeframe
Implementation Plan
Realistic Management Goals
Unfounded
Founded
Unrealistic
Realistic
Perceptions Beliefs Needs
IDEAL LAKE
Education & Listening
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AIS Control Project Strategy
1. Lake-wide assessment of AIS when plant is at peak-biomass
2. Development of control strategy & monitoring plan for following year
3. Verification and refinement of plan immediately prior to implementation
4. Initiate control strategy
5. Assessment of results
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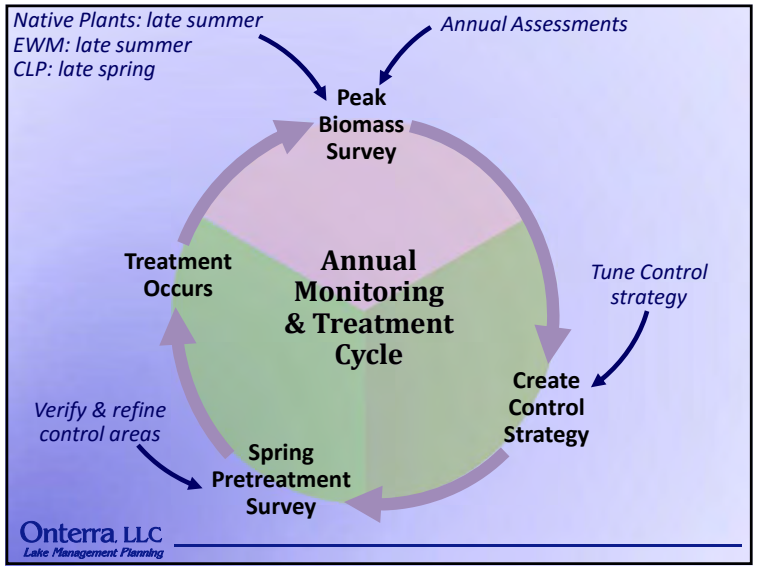
Native Plants: late summer
EWM: late summer
CLP: late spring
Annual Assessments
Peak Biomass Survey
Annual Monitoring & Treatment Cycle
Tune Control strategy
Create Control Strategy
Spring Pretreatment Survey
Verify & refine control areas
Treatment Occurs
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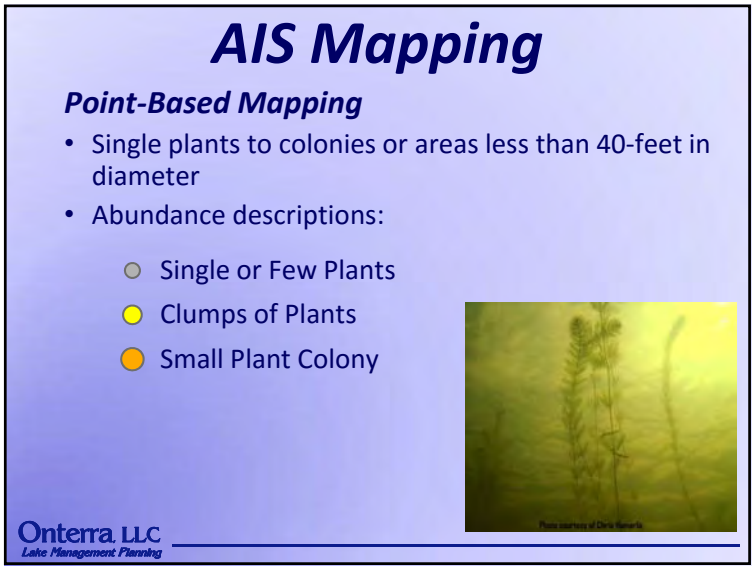
AIS Mapping
Point-Based Mapping
• Single plants to colonies or areas less than 40-feet in diameter
• Abundance descriptions:
Single or Few Plants
Clumps of Plants
Small Plant Colony
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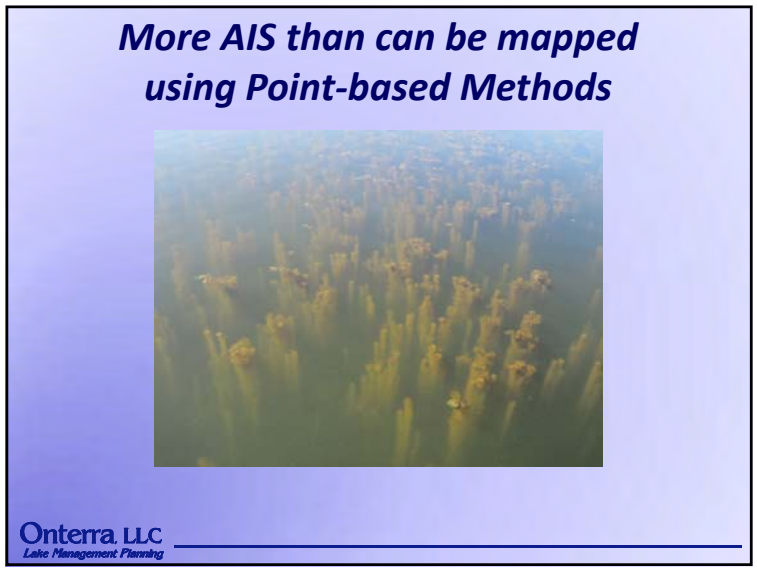
More AIS than can be mapped using Point-based Methods
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More AIS than can be mapped using Point-based Methods
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# AIS Mapping

***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

Increase in Ecological Impact

- Dominant
- Highly Dominant
- Surface Matting

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# AIS Control Alternatives

- Do nothing
- Hand-removal
- Herbicide treatment
- Winter drawdown
- Mechanical harvesting?

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# Hand-Removal

***Snorkel/Scuba Hand-Removal***

- Can be volunteer-based
- Useful for small colonies and scattered individual plants
- Contractors are available
- Does not require a permit

***Diver-Assisted Suction Harvester (DASH)***

- Typically used by contractors utilizing scuba
- Useful for colonies (not highly maneuverable)
- Requires mechanical harvesting permit

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## Common Aquatic Herbicides

- **2,4-D –** absorbed by plant tissue; inhibits plant growth and cell division (auxin hormone mimic)
- **Triclopyr –** absorbed by plant tissue; inhibits plant growth and cell division(auxin hormone mimic)
- **Endothall –** commonly referred to as a contact herbicide, inhibits respiration and protein synthesis, disrupts cell membranes
- **Fluridone –** inhibits plant-specific enzyme (carotene) which protects chlorophyll from UV (sun) damage
- **Diquat –** Inhibits photosynthesis & destroys cell membranes

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## Are herbicides "safe?"

- Registration by the EPA does not mean that the use of the herbicide poses no risk to humans or the environment, only that the benefits have been determined to outweigh the risks .
- Because product use is not without risk, the EPA does not define any pesticide as "safe."
- Risk-Risk factors must be considered in determining treatment strategy
- Strategy objective must be to effectively control target species with minimal impact to native habitat

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## AIS Control Strategies: Herbicide Use

**Spot Treatment**

- Herbicide applied to a treatment area, with site-specific considerations.
- Effectiveness hard to reach due to dilution and dissipation.
  - Seasonal vs. long-term effectiveness

**Whole Lake Treatment**

- Herbicide is applied to treatment areas with whole-lake considerations.
- Dilution and dissipation accounted for in application strategy.

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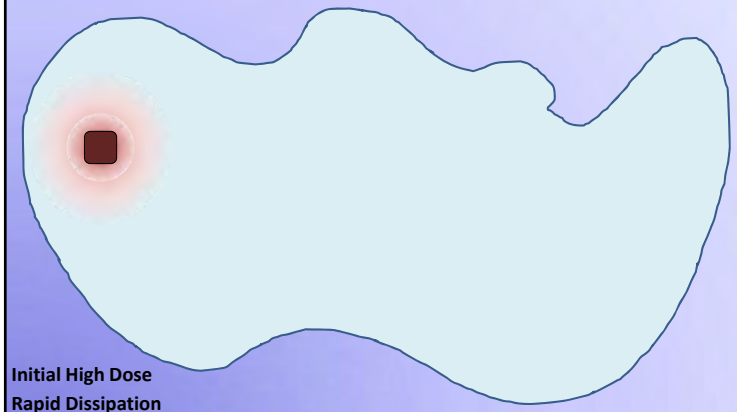
## Spot Treatment Use Pattern



**Initial High Dose**
**Rapid Dissipation**
**Herbicide concentrations too low outside of Treatment Area to cause impact**

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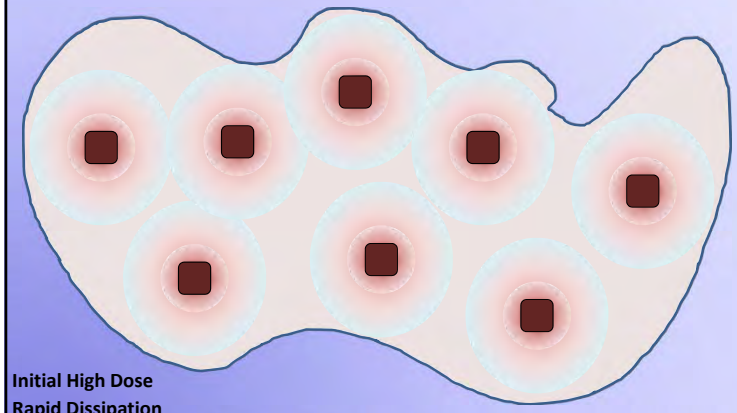
## Whole-lake Use Pattern



Initial High Dose
Rapid Dissipation
Low-dose lake-wide concentration significant to cause control

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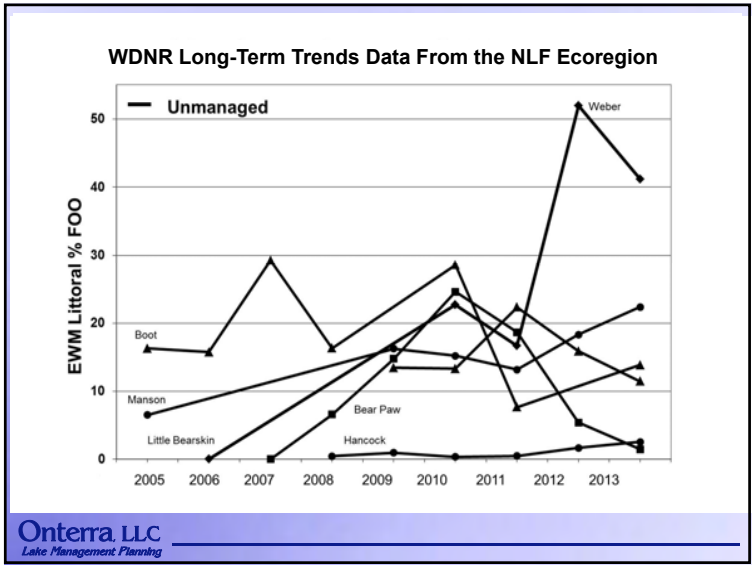


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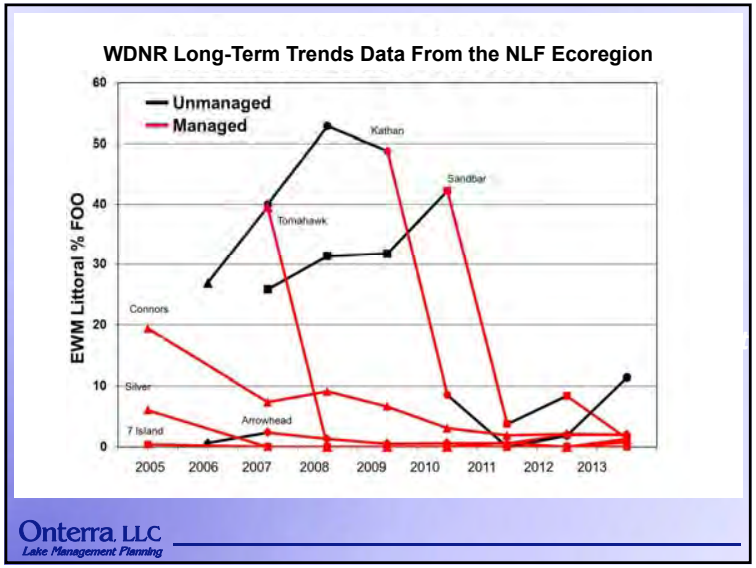


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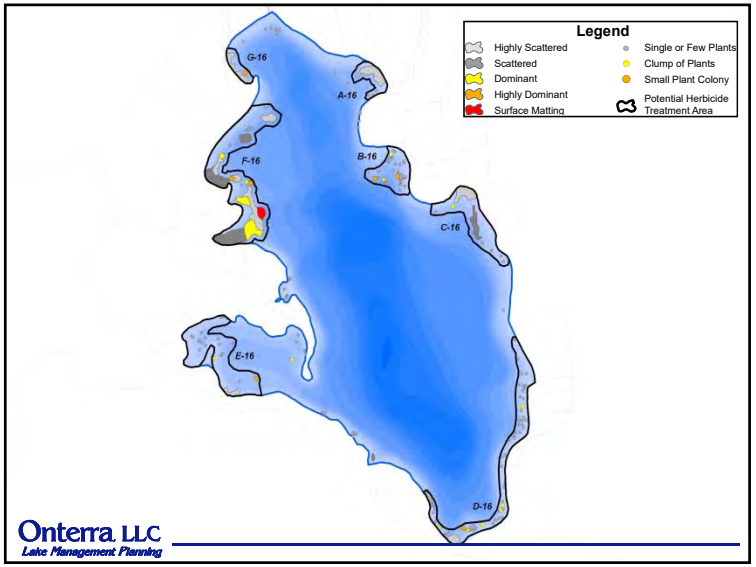


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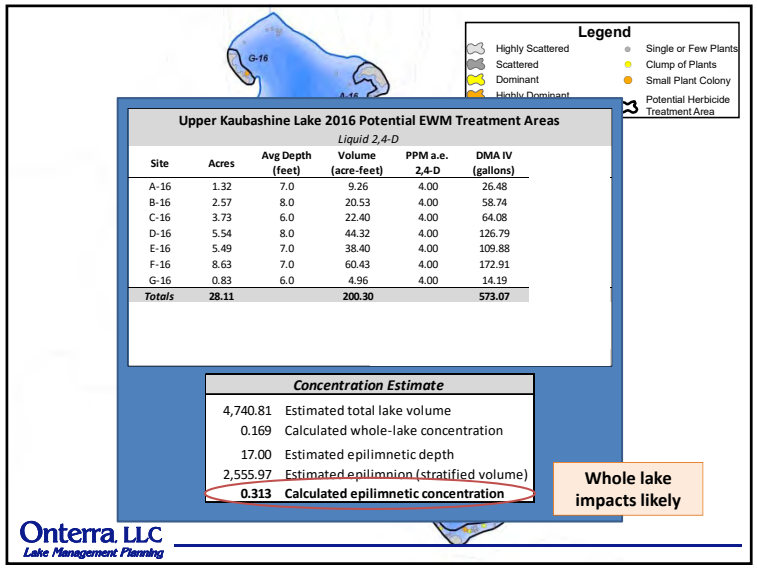
Legend
Highly Scattered
Scattered
Dominant
Single or Few Plants
Clump of Plants
Small Plant Colony
Potential Herbicide Treatment Area
G-16
A-16
Upper Kaubashine Lake 2016 Potential EWM Treatment Areas
Liquid 2,4-D
Site | Acres | Avg Depth (feet) | Volume (acre-feet) | PPM a.e. 2,4-D | DMA IV (gallons)
A-16 | 1.32 | 7.0 | 9.26 | 4.00 | 26.48
B-16 | 2.57 | 8.0 | 20.53 | 4.00 | 58.74
C-16 | 3.73 | 6.0 | 22.40 | 4.00 | 64.08
D-16 | 5.54 | 8.0 | 44.32 | 4.00 | 126.79
E-16 | 5.49 | 7.0 | 38.40 | 4.00 | 109.88
F-16 | 8.63 | 7.0 | 60.43 | 4.00 | 172.91
G-16 | 0.83 | 6.0 | 4.96 | 4.00 | 14.19
Totals | 28.11 | | 200.30 | | 573.07
Concentration Estimate
4,740.81 Estimated total lake volume
0.169 Calculated whole-lake concentration
17.00 Estimated epilimnetic depth
2,555.97 Estimated epilimnion (stratified volume)
0.313 Calculated epilimnetic concentration
Whole lake impacts likely
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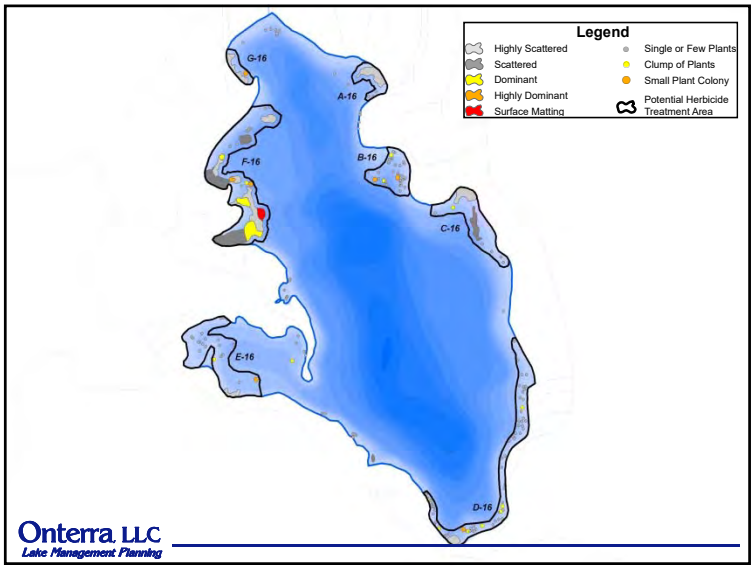
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Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony
Potential Herbicide Treatment Area
G-16
A-16
F-16
B-16
C-16
E-16
D-16
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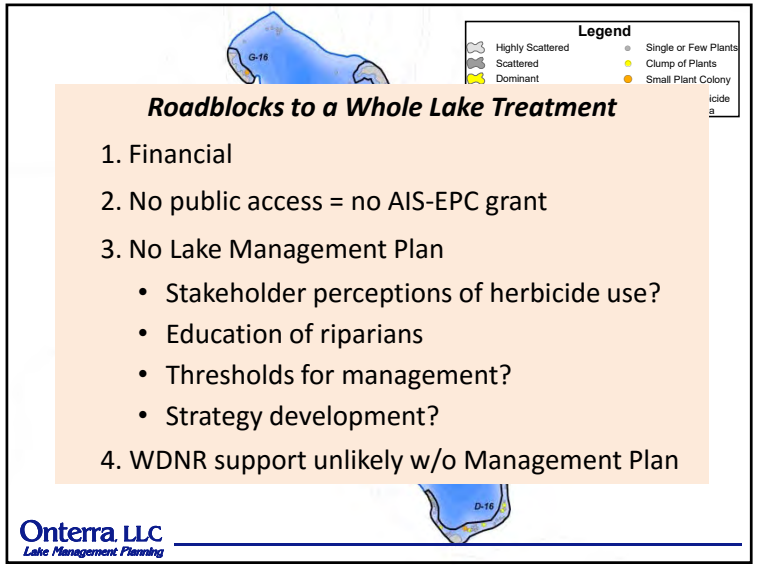
Legend
Highly Scattered
Scattered
Dominant
Single or Few Plants
Clump of Plants
Small Plant Colony
G-16
D-16
Roadblocks to a Whole Lake Treatment
1. Financial
2. No public access = no AIS-EPC grant
3. No Lake Management Plan
• Stakeholder perceptions of herbicide use?
• Education of riparians
• Thresholds for management?
• Strategy development?
4. WDNR support unlikely w/o Management Plan
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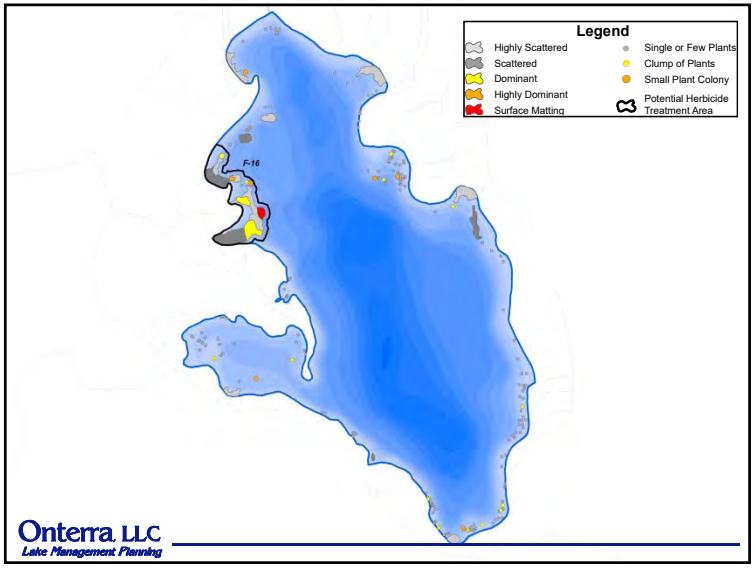
Legend
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Scattered
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Highly Dominant
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Single or Few Plants
Clump of Plants
Small Plant Colony
Potential Herbicide Treatment Area
F-16
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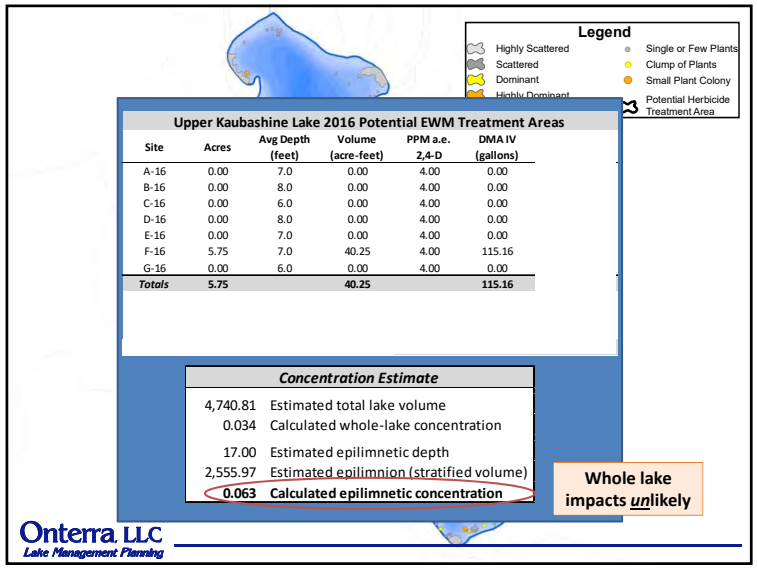
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Single or Few Plants
Clump of Plants
Small Plant Colony
Potential Herbicide Treatment Area
Upper Kaubashine Lake 2016 Potential EWM Treatment Areas
Site | Acres | Avg Depth (feet) | Volume (acre-feet) | PPM a.e. 2,4-D | DMA IV (gallons)
A-16 | 0.00 | 7.0 | 0.00 | 4.00 | 0.00
B-16 | 0.00 | 8.0 | 0.00 | 4.00 | 0.00
C-16 | 0.00 | 6.0 | 0.00 | 4.00 | 0.00
D-16 | 0.00 | 8.0 | 0.00 | 4.00 | 0.00
E-16 | 0.00 | 7.0 | 0.00 | 4.00 | 0.00
F-16 | 5.75 | 7.0 | 40.25 | 4.00 | 115.16
G-16 | 0.00 | 6.0 | 0.00 | 4.00 | 0.00
Totals | 5.75 | | 40.25 | | 115.16
Concentration Estimate
4,740.81 Estimated total lake volume
0.034 Calculated whole-lake concentration
17.00 Estimated epilimnetic depth
2,555.97 Estimated epilimnion (stratified volume)
0.063 Calculated epilimnetic concentration
Whole lake impacts unlikely
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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

- Management Plan Overview
- Results of Project Studies
  - Watershed (and Water Quality)
  - Shoreland & Coarse Woody Habitat
  - Aquatic Plants
- Aquatic Plant Management
  - AIS Control Strategies

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## Management Planning Project Overview

- **Project Objective**: study Upper Kaubashine Lake and utilizing those findings, in conjunction with available historical data, to develop a realistic management plan.
- Originally started with just aquatic plants, but has been expanded to include other components: watershed, shoreland condition, and water quality.
  - **Meeting Goal**: Develop a solid understanding of available Upper Kaubashine data among committee members and Onterra.
  - Second planning meeting will be used to develop framework of Implementation Plan.

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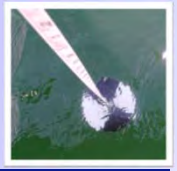
## Introduction to Lake Water Quality

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

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

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



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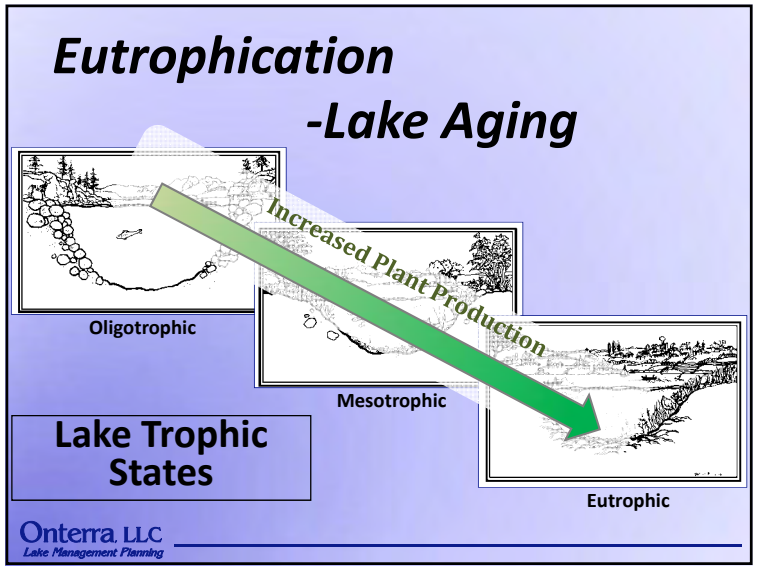
Eutrophication
-Lake Aging
Increased Plant Production
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
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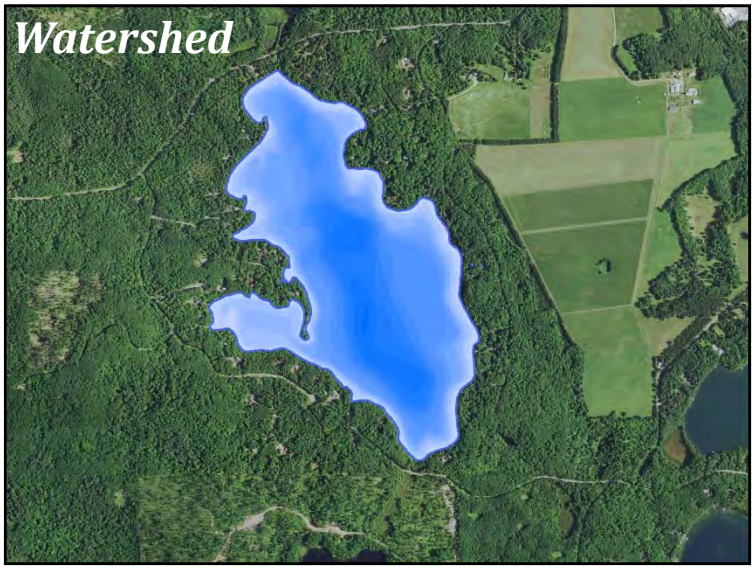
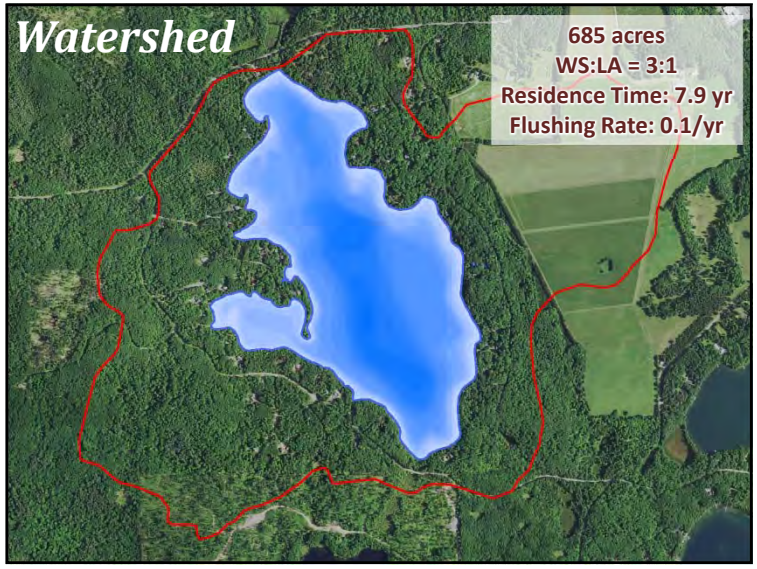
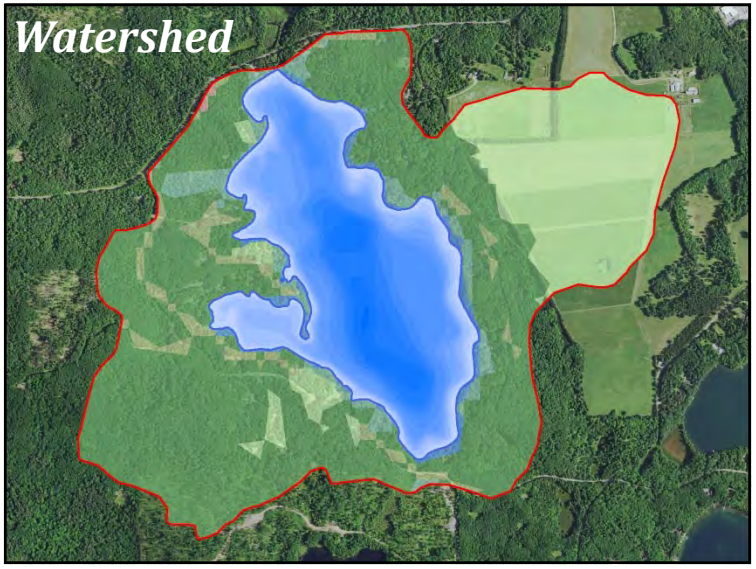
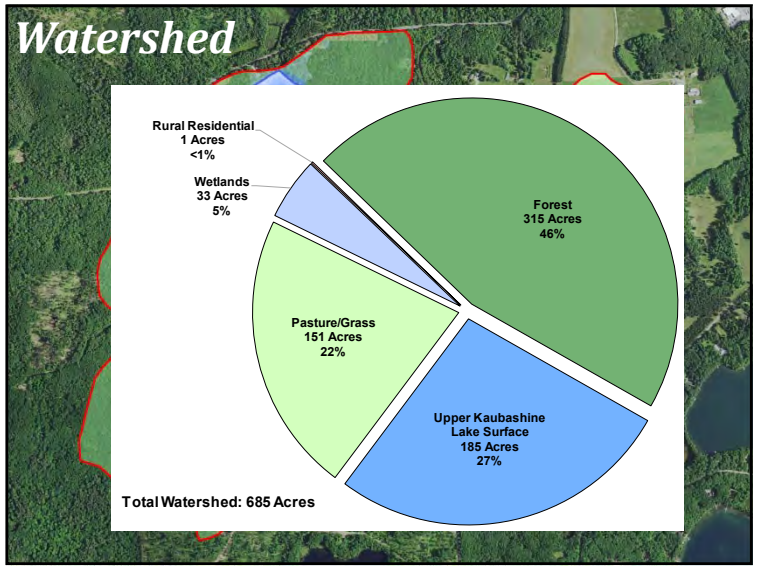
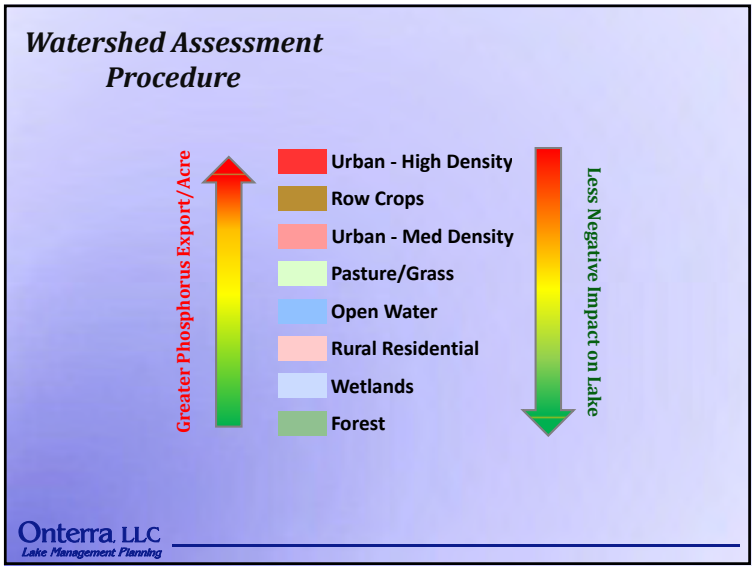

Watershed


Watershed
685 acres
WS:LA = 3:1
Residence Time: 7.9 yr
Flushing Rate: 0.1/yr


Watershed


Watershed
Rural Residential
1 Acres
<1%
Wetlands
33 Acres
5%
Forest
315 Acres
46%
Pasture/Grass
151 Acres
22%
Upper Kaubashine
Lake Surface
185 Acres
27%
Total Watershed: 685 Acres


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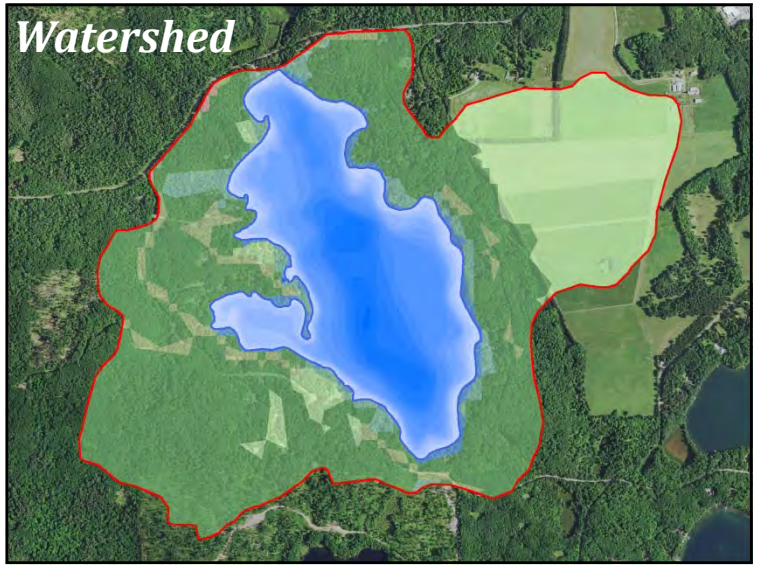
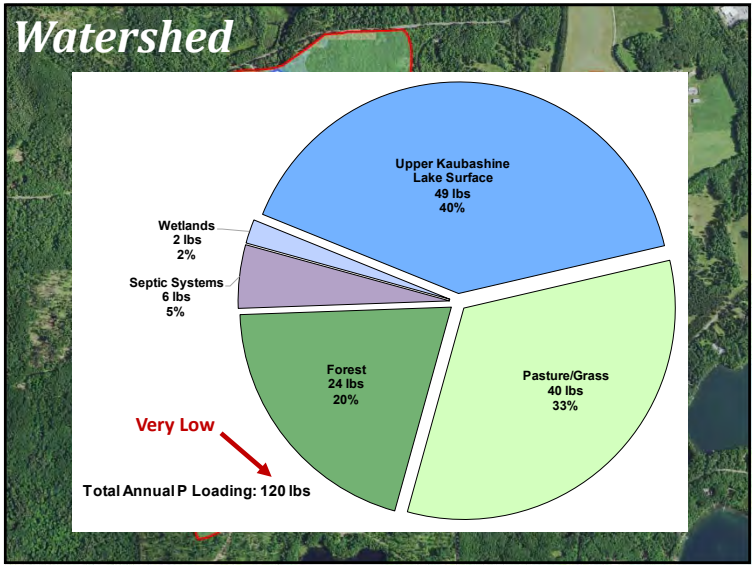
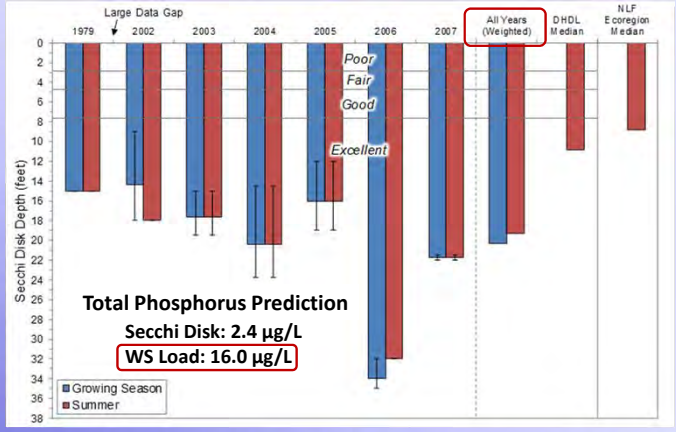

Watershed


Watershed
Upper Kaubashine
Lake Surface
49 lbs
40%
Wetlands
2 lbs
2%
Septic Systems
6 lbs
5%
Forest
24 lbs
20%
Pasture/Grass
40 lbs
33%
Very Low
Total Annual P Loading: 120 lbs

## Water Quality

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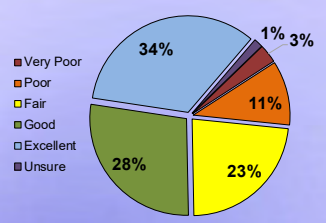
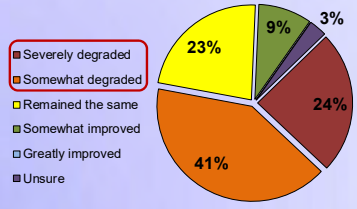
## Water Quality




18. How would you describe the current water quality of Upper Kaubashine Lake?




19. How has the current water quality changed in Upper Kaubashine Lake since you first visited the lake?

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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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## Shoreline Assessment Category Descriptions


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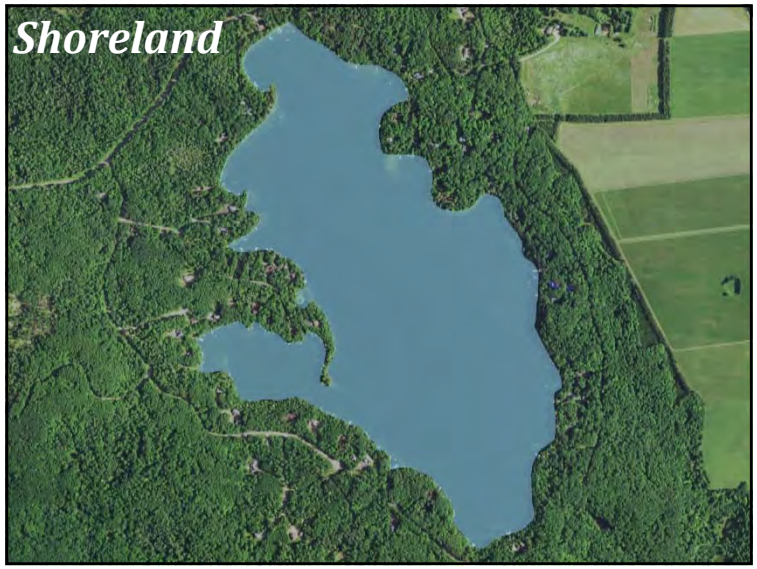


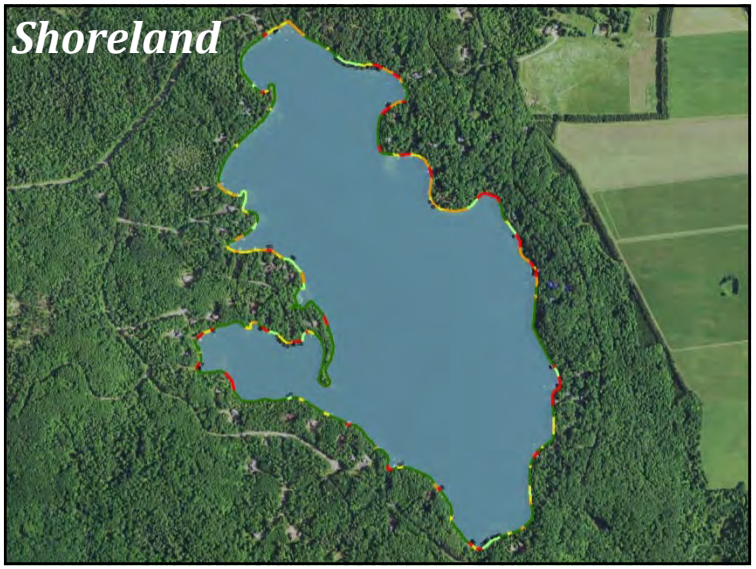


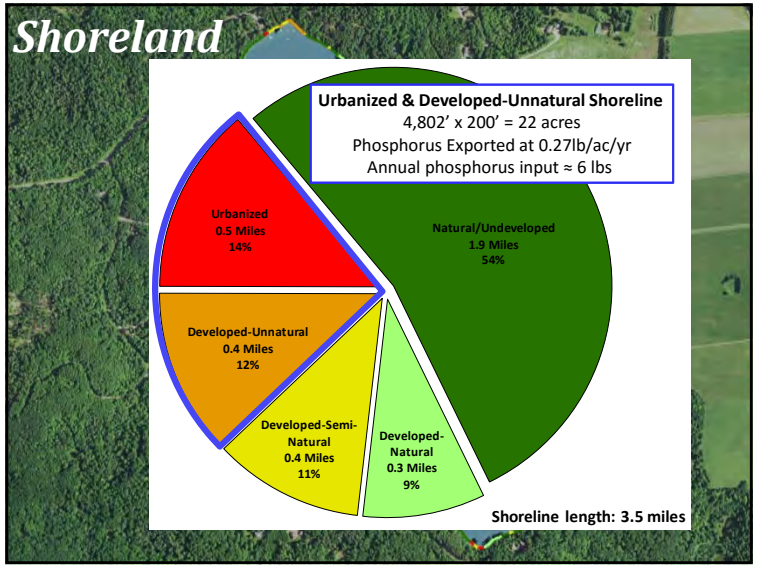


## Coarse Woody Habitat

- 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 Grand Lake

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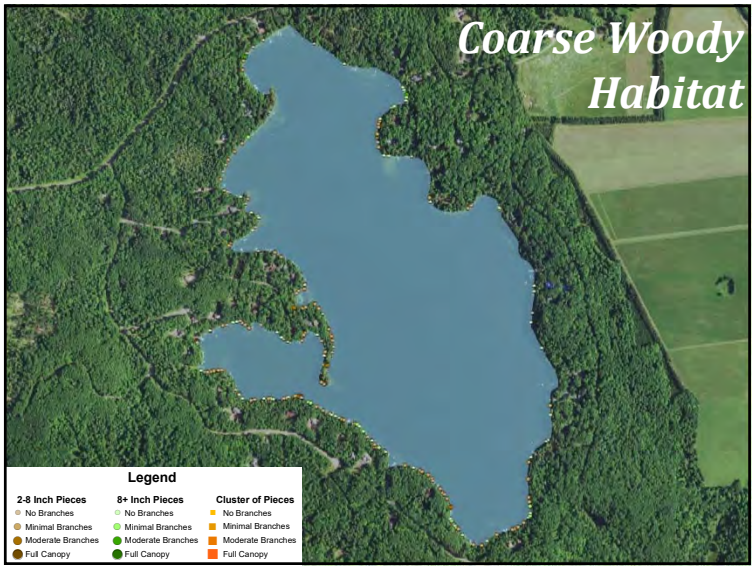
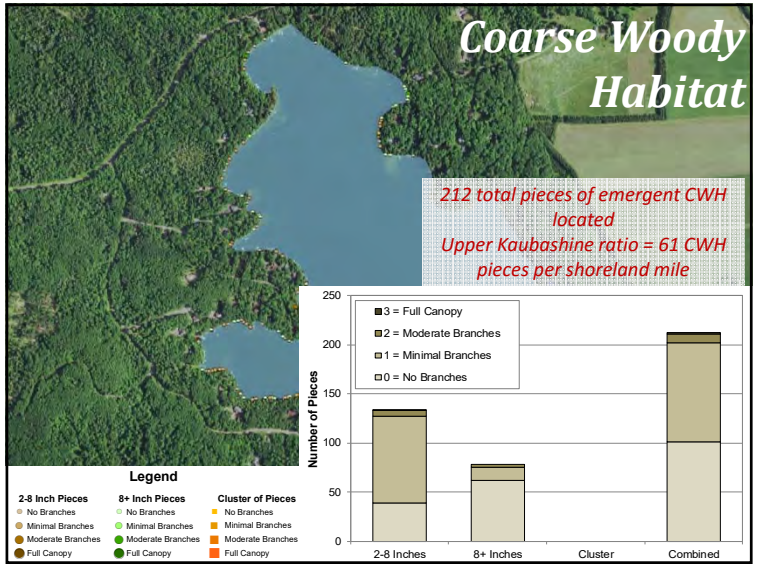
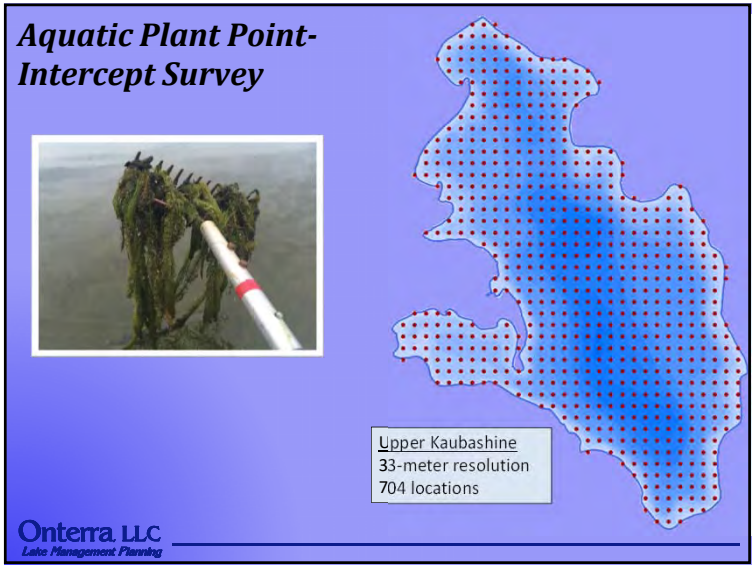
Coarse Woody Habitat


Coarse Woody Habitat
Legend
2-8 Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
8+ Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
Cluster of Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy


Coarse Woody Habitat
212 total pieces of emergent CWH located
Upper Kaubashine ratio = 61 CWH pieces per shoreland mile
Number of Pieces
250
200
150
100
50
0
3 = Full Canopy
2 = Moderate Branches
1 = Minimal Branches
0 = No Branches
2-8 Inches
8+ Inches
Cluster
Combined
Legend
2-8 Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
8+ Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
Cluster of Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy


Aquatic Plant Point-Intercept Survey
Upper Kaubashine
33-meter resolution
704 locations
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## Species List

27 Native Species
(20 on rake in 2016)

- 2 non-native Species
  - Eurasian watermilfoil
  - Purple loosestrife

| Growth Form | Scientific Name | Common Name | Coefficient of Conservatism (C) | 2013 WDNR | 2016 Onterra |
|---|---|---|---|---|---|
| Emergent | *Bolboschoenus fluviatilis* | River bulrush | 5 | | I |
| | *Carex aquatilis* | Long-bracted tussock sedge | 7 | | I |
| | *Carex comosa* | Bristly sedge | 5 | | I |
| | *Carex* sp. (sterile) | Sedge sp. (sterile) | N/A | | I |
| | *Lythrum salicaria* | Purple loosestrife | Exotic | | I |
| | *Scirpus cyperinus* | Wool grass | 4 | | I |
| FL | *Nymphaea odorata* | White water lily | 6 | X | |
| | *Nuphar variegata* | Spatterdock | 6 | X | X |
| | *Persicaria amphibia* | Water smartweed | 5 | X | |
| Submergent | *Ceratophyllum demersum* | Coontail | 3 | X | X |
| | *Chara* spp. | Muskgrasses | 7 | X | X |
| | *Elatine minima* | Waterwort | 9 | X | X |
| | *Elodea canadensis* | Common waterweed | 3 | X | X |
| | *Heteranthera dubia* | Water stargrass | 6 | X | X |
| | *Isoetes* spp. | Quillwort spp. | 8 | X | X |
| | *Myriophyllum sibiricum* | Northern watermilfoil | 7 | X | X |
| | *Myriophyllum spicatum* | Eurasian watermilfoil | Exotic | | X |
| | *Myriophyllum tenellum* | Dwarf watermilfoil | 10 | X | X |
| | *Najas flexilis* | Slender naiad | 6 | X | X |
| | *Nitella* spp. | Stoneworts | 7 | | X |
| | *Potamogeton amplifolius* | Large-leaf pondweed | 7 | | X |
| | *Potamogeton epihydrus* | Ribbon-leaf pondweed | 8 | X | X |
| | *Potamogeton foliosus* | Leafy pondweed | 6 | X | X |
| | *Potamogeton friesii* | Fries' pondweed | 8 | X | X |
| | *Potamogeton gramineus* | Variable-leaf pondweed | 7 | X | X |
| | *Potamogeton pusillus* | Small pondweed | 7 | | X |
| | *Potamogeton robbinsii* | Fern-leaf pondweed | 8 | X | X |
| | *Vallisneria americana* | Wild celery | 6 | X | X |
| S/E | *Eleocharis acicularis* | Needle spikerush | 5 | X | X |

*FL = Floating-leaf; S/E = Submergent and Emergent*
*X = Located on rake during point-intercept survey*

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## Community Mapping

Relatively sparse floating-leaf and emergent vegetation


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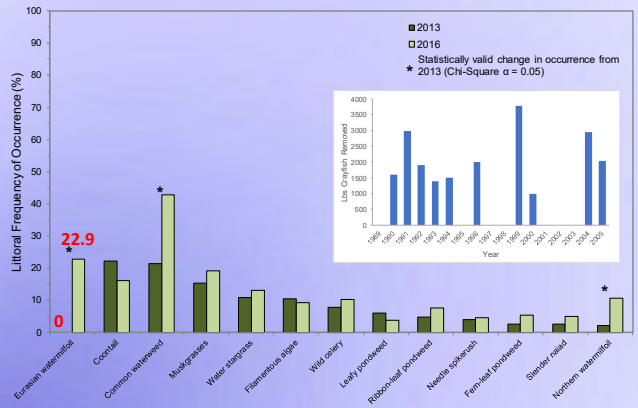
## Littoral Frequency of Occurrence

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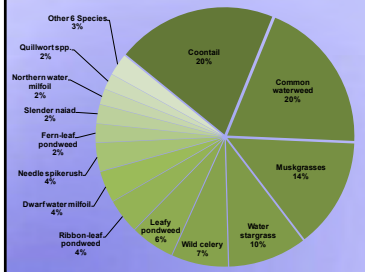
## Relative Frequency of Occurrence

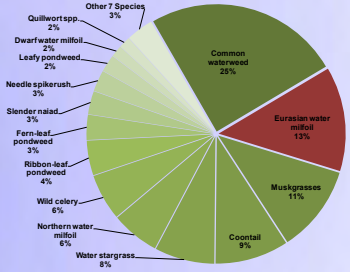
### 2013

- Coontail, Common waterweed, & muskgrasses = 54%




### 2016

- Coontail, Common waterweed, & muskgrasses = 45%

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# 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

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## More AIS than can be mapped using Point-based Methods

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# 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

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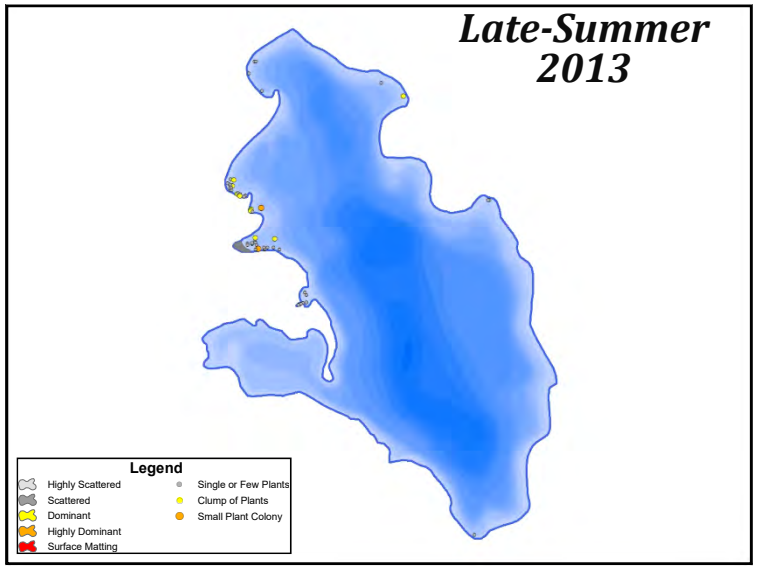
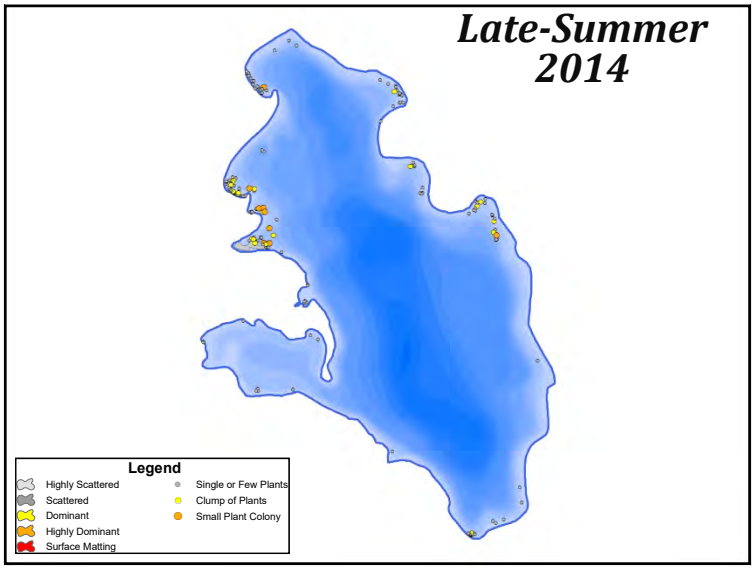
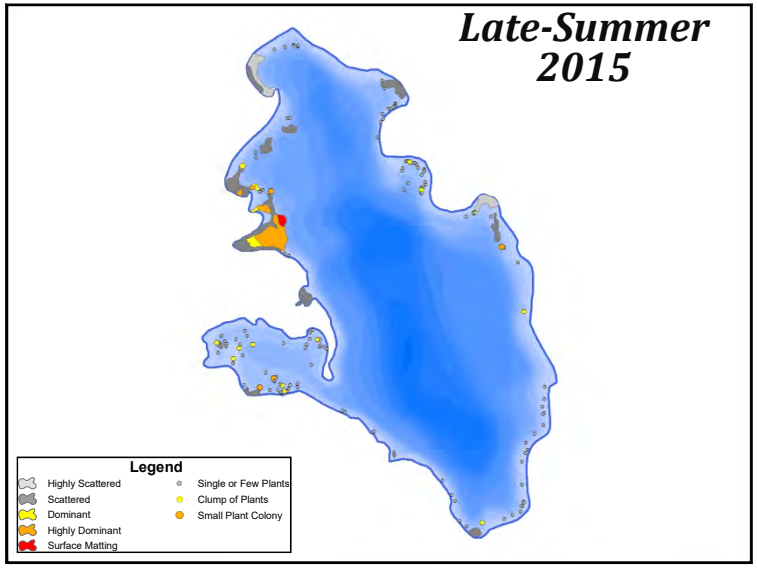
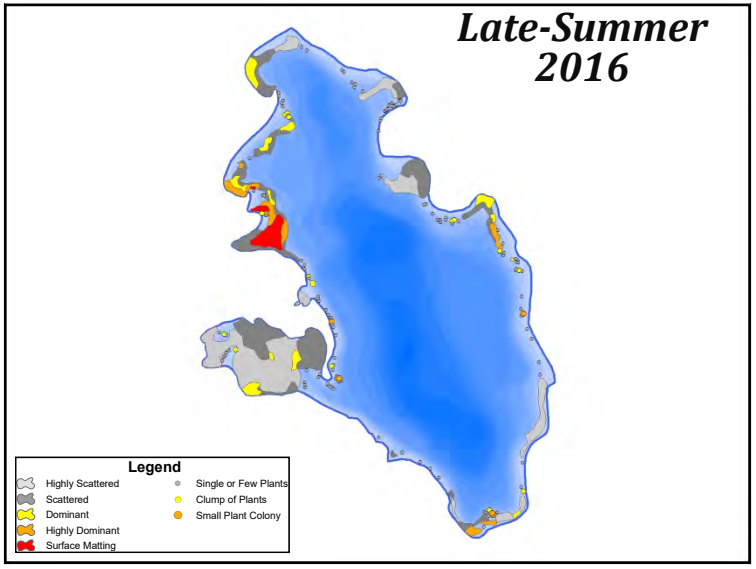

Late-Summer
2013
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony

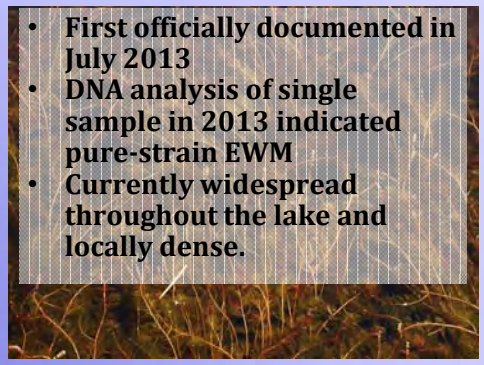

Late-Summer
2014
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


Late-Summer
2015
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony


Late-Summer
2016
Legend
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clump of Plants
Small Plant Colony

## Non-native Aquatic Plants

### Eurasian Water Milfoil



- First officially documented in July 2013
- DNA analysis of single sample in 2013 indicated pure-strain EWM
- Currently widespread throughout the lake and locally dense.

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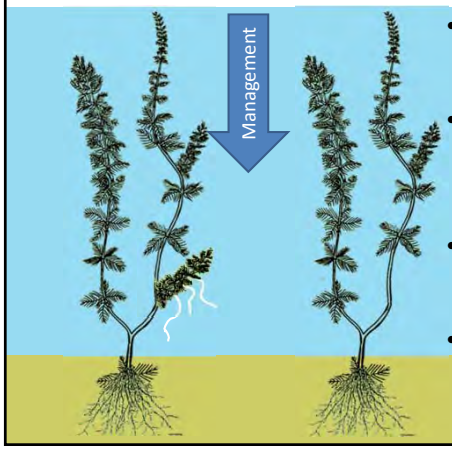
## *EWM Life-Cycle & Control Strategy Philosophy*




- Herbicide needs to translocate to root crown (*hard to kill*)
- Hand-harvesting can be effective (*extremely time intensive)*
- Winter drawdowns are effective (*but rarely possible*)
- Control strategy is straight-forward

## *AIS Active Management Discussion*

| Pros | Cons |
|---|---|
| • Keep AIS population low so native ecosystem can function as it did prior to AIS (***ecosystem restoration***) | • Management action itself may be damaging to the lake, so acknowledging potential known/unknown secondary impacts is important within the risk assessment. |
| • Keep AIS population low so it does not cause recreation, navigation, or aesthetic issues (***improve cultural ecosystem services***) | • Management action may not be fully supported by public |
| • Keep AIS population low so the lake is not a source population for other nearby lakes (***stewardship***) | • ***Unmanaged*** AIS population may be low enough to not cause measurable ecosystem impacts or reduce cultural ecosystem services |

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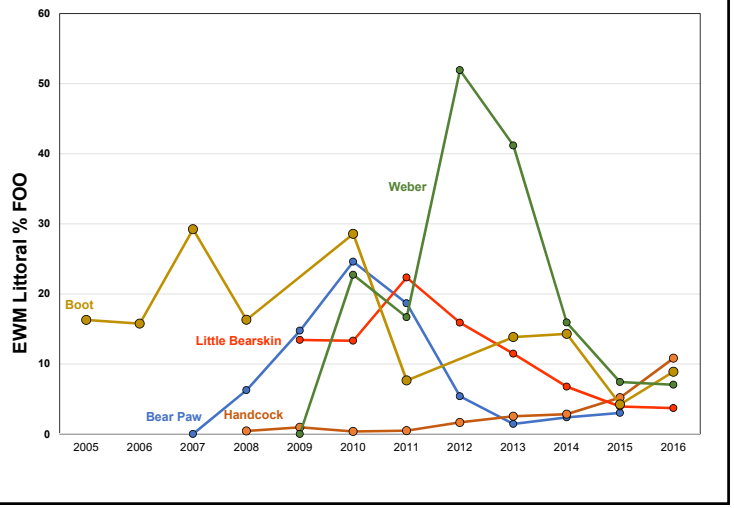
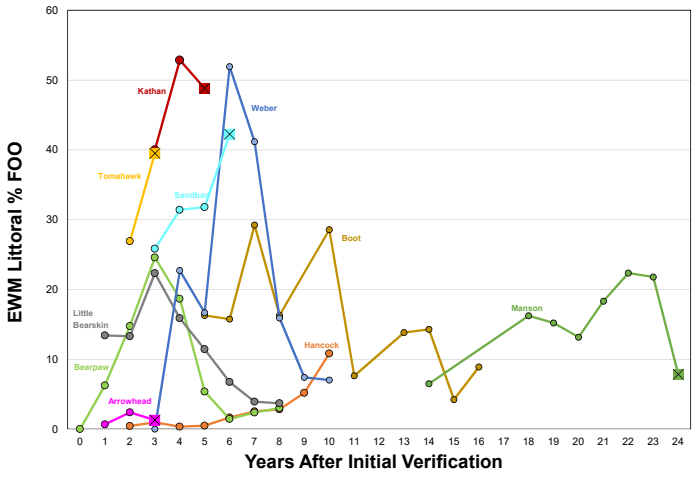
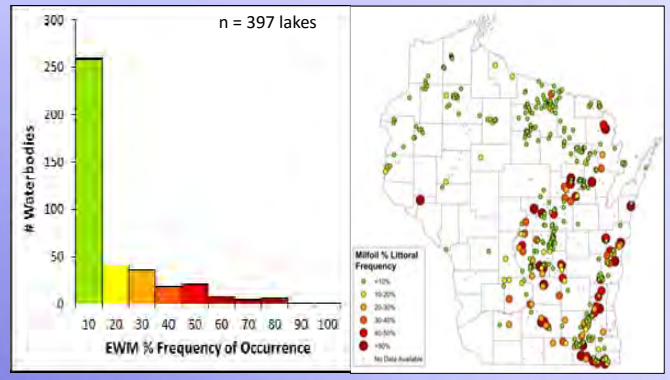
## *NLF Ecoregion – Unmanaged*



## NLF Ecoregion – Unmanaged




## State-wide EWM Population Trends

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## AIS Control Strategies

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

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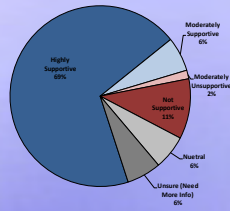
## Stakeholder Survey

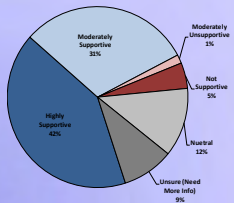
- What is your level of support for the responsible use of the following techniques on Upper Kaubashine Lake?

### Herbicide



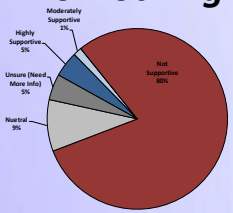
| | |
|---|---|
| Support | 75% |
| Not Support | 13% |
| Unsure/Neutral | 12% |

### HH by Divers



| | |
|---|---|
| Support | 73% |
| Not Support | 6% |
| Unsure/Neutral | 21% |

### Do Nothing



| | |
|---|---|
| Support | 6% |
| Not Support | 80% |
| Unsure/Neutral | 14% |

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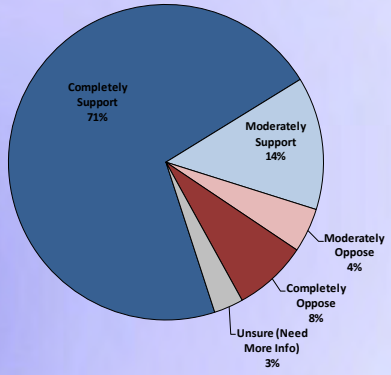
## Stakeholder Survey

- What is your level of support or opposition to aquatic herbicide use to target Eurasian water milfoil in Upper Kaubashine Lake?




| | |
|---|---|
| Support | 85% |
| Not Support | 12% |
| Unsure/Neutral | 3% |

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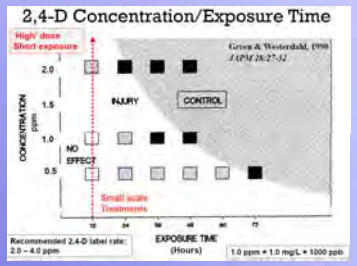
## Herbicide Spot Treatment

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

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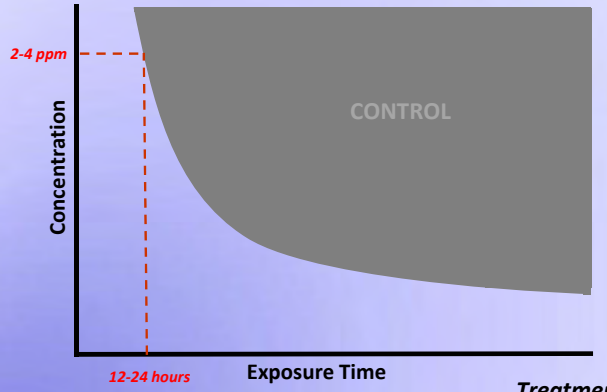
## Herbicide Use Patterns




High Concentration ► Short Exposure Time

***Treatment Type***
***Spot***

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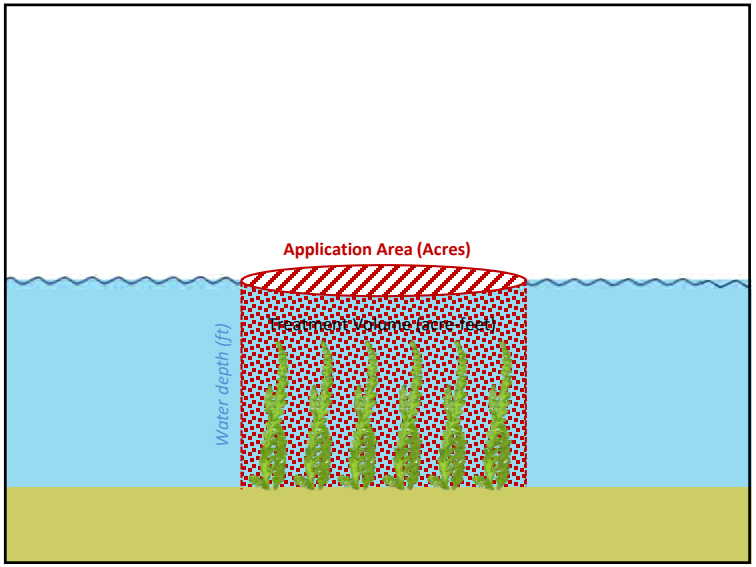
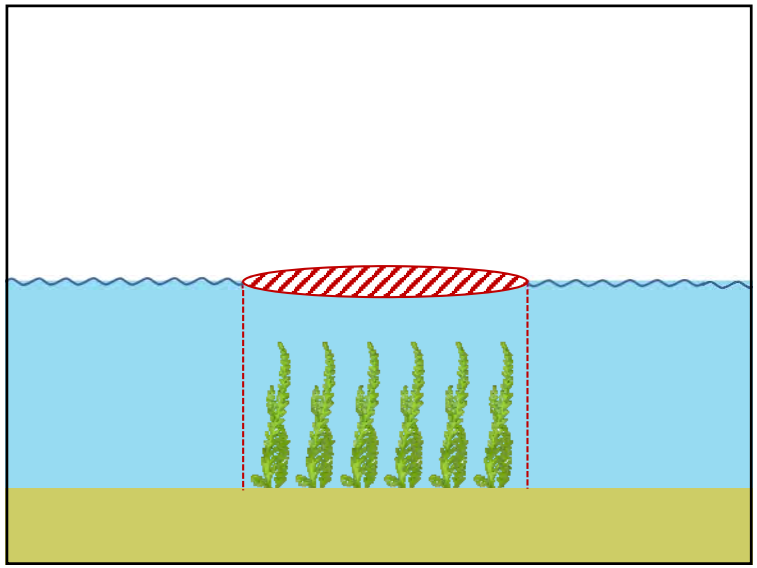
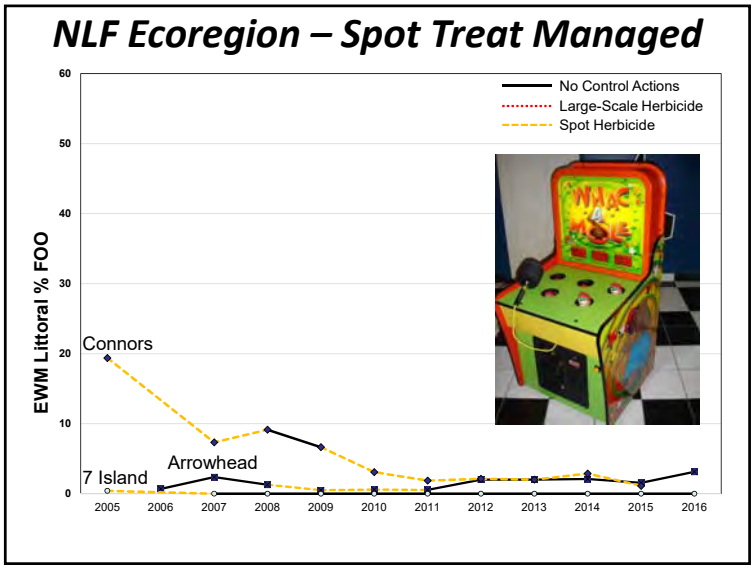
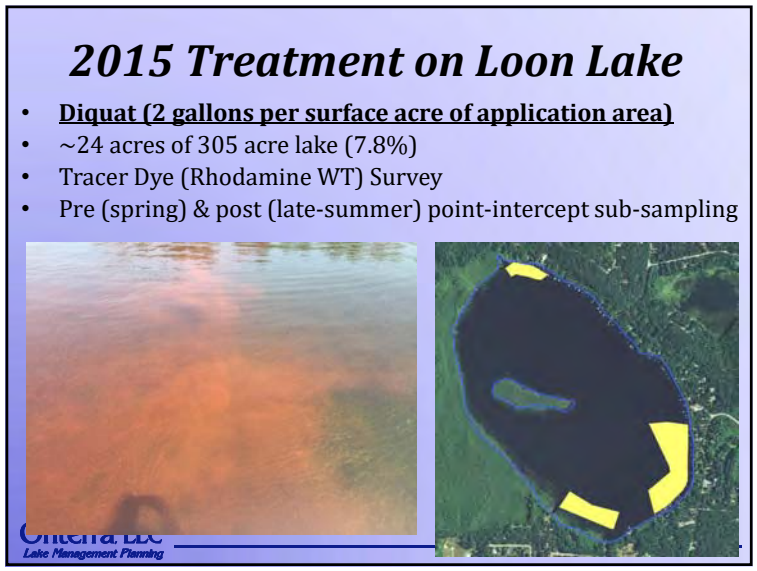





NLF Ecoregion – Spot Treat Managed
No Control Actions
Large-Scale Herbicide
Spot Herbicide
EWM Littoral % FOO
60
50
40
30
20
10
0
Connors
Arrowhead
7 Island
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


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
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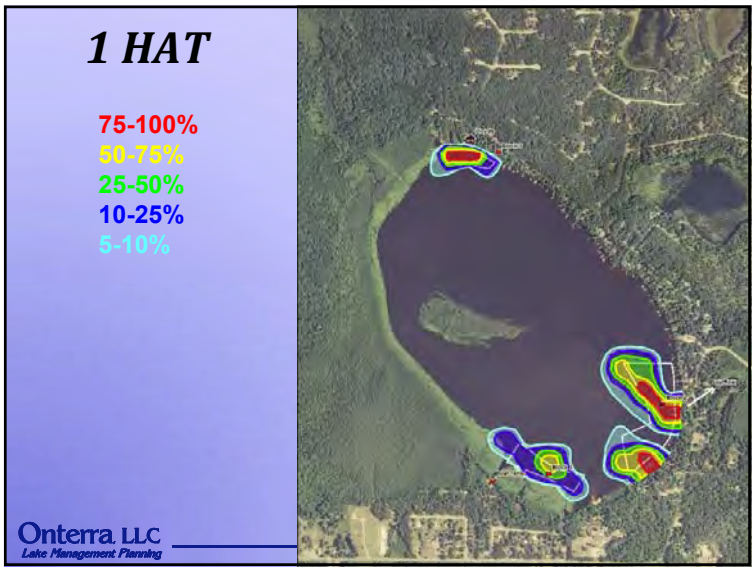
1 HAT
75-100%
50-75%
25-50%
10-25%
5-10%
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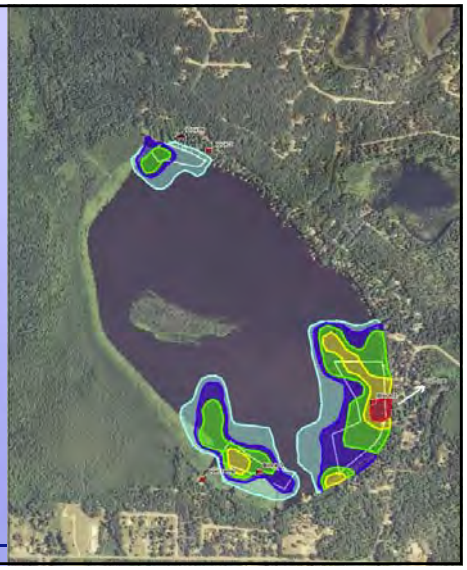
## 2.5 HAT

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



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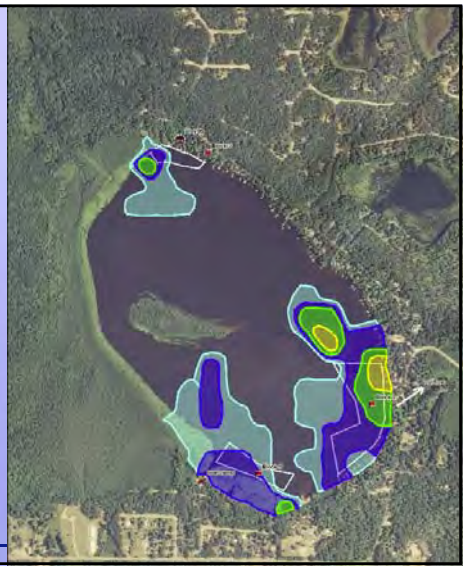
## 4 HAT

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



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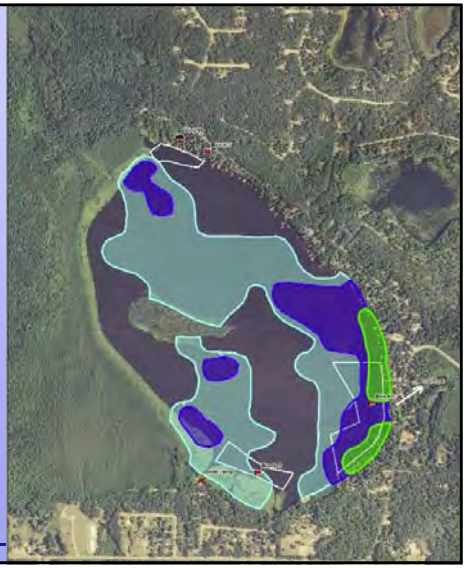
## 6 HAT

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

If apply 2,4-D at 4.0 ppm, 5-10% would be 0.2 - 0.4 ppm



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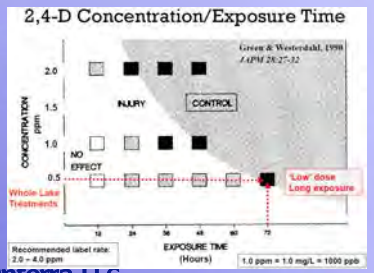
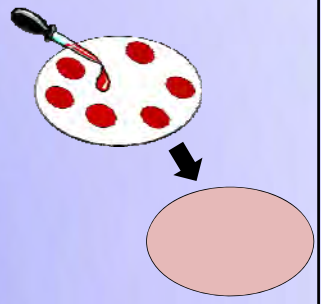
## Large-Scale (Whole-lake) Treatment

- 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*



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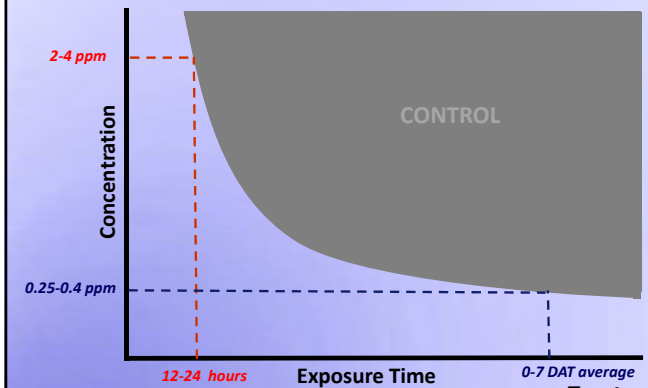
## Herbicide Use Patterns




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

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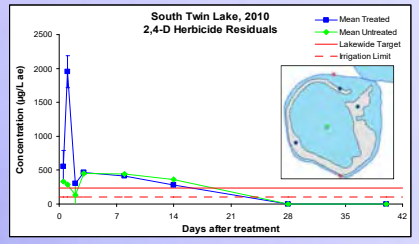
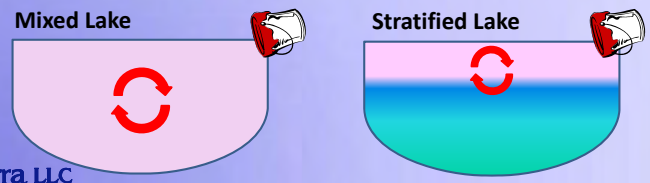
## Large-Scale (Whole-lake) Treatment

- Herbicide Mixing
  - Horizontal
  - Vertical

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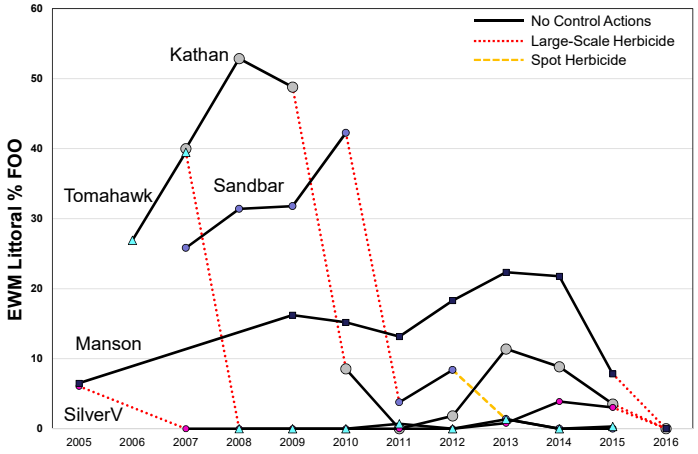
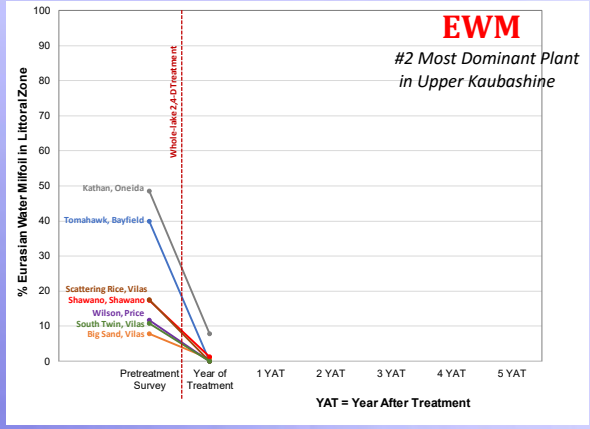
## NLF Ecoregion – Large-Scale Managed




## Results – Long-term Efficacy

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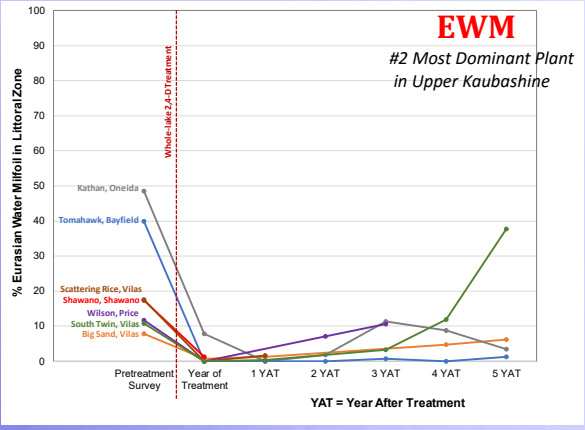
## Results – Long-term Efficacy

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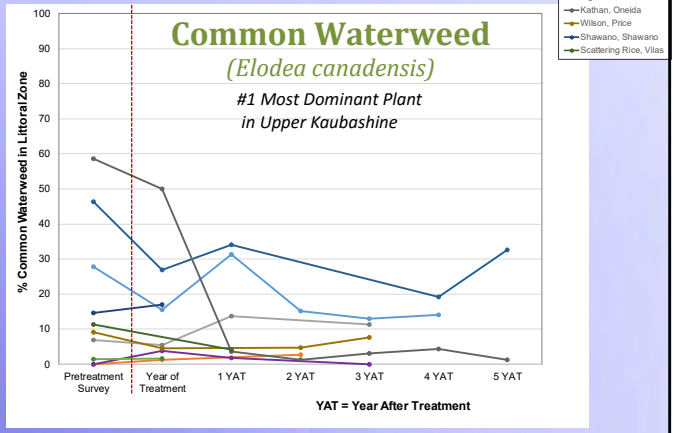
## Results – Selectivity

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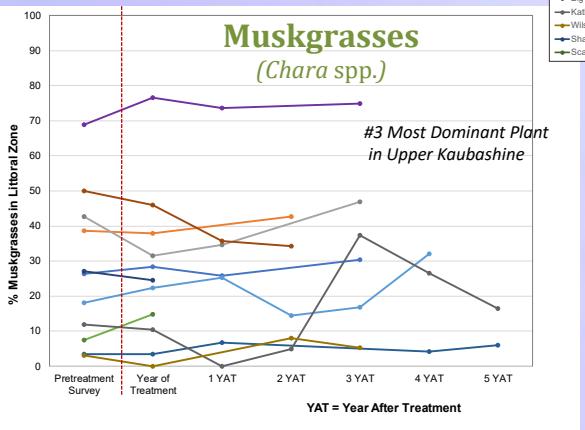
## Results – Selectivity

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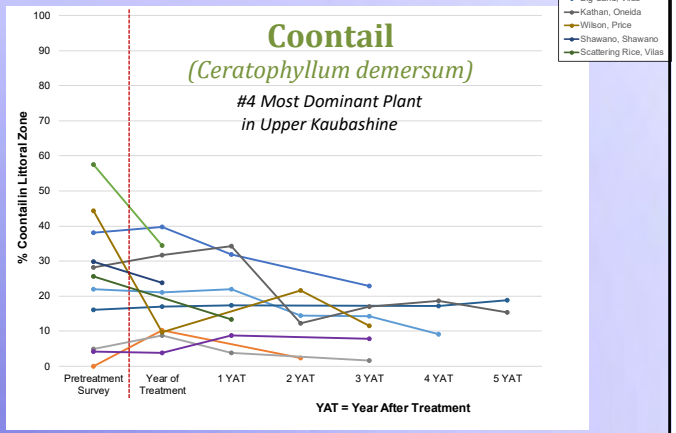
## Results – Selectivity

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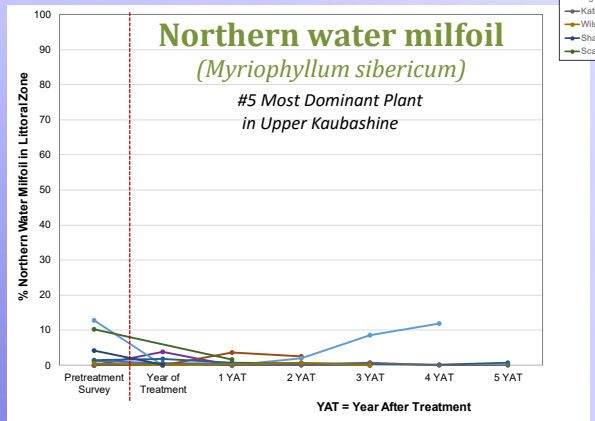
## *Results – Selectivity*

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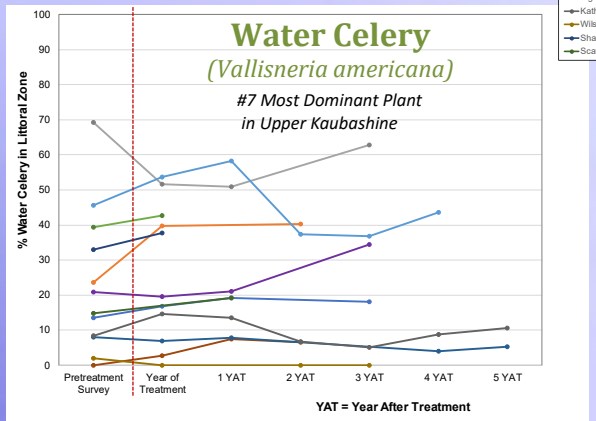
## *Results – Selectivity*

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## *Common Aquatic Herbicides*

- **2,4-D –** absorbed by plant tissue; inhibits plant growth and cell division (auxin hormone mimic) – biological breakdown
- **Triclopyr –** absorbed by plant tissue; inhibits plant growth and cell division(auxin hormone mimic) – breakdown from photolysis
- **Fluridone –** inhibits plant-specific enzyme (carotene) which protects chlorophyll from UV (sun) damage – breakdown from photolysis; requires "bumps" to sustain full growing season
- **Endothall –** commonly referred to as a contact herbicide, inhibits respiration and protein synthesis, disrupts cell membranes – primarily for CLP, used for EWM in combo
- **Diquat –** Inhibits photosynthesis & destroys cell membranes – strictly spot treatments

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## *Conclusions*

### Watershed & Water Quality

- Watershed is small with much forest area, so it currently delivers little phosphorus to the lake
- Changes in watershed can bring about changes in lake water quality (agricultural area east of lake)
- Without current water quality data, we cannot calibrate the watershed model, but it is suspected that in-lake phosphorus values are low

### Shoreland and Coarse Woody Habitat

- Much of the shoreline is undeveloped/natural
- About a quarter of the shoreline is in a condition that could be considered for restoration – not necessarily for water quality, but more for habitat
- With the fishing interest and the high level of undeveloped shoreline, Upper Kaubashine is a good candidate for fish sticks

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## *Conclusions*

**Aquatic Plants**

- Overall plant community is sparse
- Minimal native plant changes between 2013 and 2016
- EWM has become second most abundant plant in the lake
- If decision to control EWM is made, the only way to target the entire population is through a large-scale herbicide treatment
- Continued discussion of herbicide choice based upon water quality samples collected during 2017

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## Presentation Outline

- EWM Timeline
- Parsing of Stakeholder data
- Develop AIS Management Goal
- Develop other Management Goals

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## EWM Timeline

- EWM was first discovered in July 2013
  - WDNR conducted point-intercept survey (0% LFOO)
  - Onterra conducted late-summer mapping survey
  - Pioneering population was recommended for hand-harvesting in 2014
  - AIS-EDR Grant was received
  - Project Kick-off Meeting (July 2014) discussed hand-harvesting and why herbicides were not applicable at that time
- 2014 Control Efforts
  - Approximately 700 gallons of EWM was removed by APM, LLC in 2014 over 4 days (67.1 diver hours)
  - EWM population increase was greater than removal efforts
- 2015 Control Efforts
  - Approximately 600 gallons of EWM was removed by APM, LLC over 5 days (66.9 diver hours)
  - EWM population increase was greater than removal efforts

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## EWM Timeline

- 2016 Planning
  - EWM population control was not being achieved through hand-harvesting
  - Onterra presented to BOD and then at Annual Mtg (July 2015)
  - Recommendation to target the densest area with a spot herbicide treatment with hand-harvesting of other areas
  - Also demonstrated that if used spot treatment strategy to target all EWM, would add up to a large-scale (whole-lake)
  - Second AIS-EDR Grant was pursued
    - WDNR deemed herbicide and hand-harvesting costs ineligible because was not targeting entire EWM population and EWM population was past "pioneer population" threshold
    - WDNR allowed a second AIS-EDR Grant to cover portions of an aquatic plant management plan
- 2016 Monitoring
  - Onterra presented at Annual Mtg (July 2016) about APM Kick-off
  - EWM population continued to increase (22.9% LFOO)

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## AIS Active Management Discussion

| Pros | Cons |
|---|---|
| • Keep AIS population low so native ecosystem can function as it did prior to AIS (***ecosystem restoration***) | • Management action itself may be damaging to the lake, so acknowledging potential known/unknown secondary impacts is important |
| • Keep AIS population low so it does not cause recreation, navigation, or aesthetic issues (***improve cultural ecosystem services***) | • Management action may not be fully supported by public |
| • Keep AIS population low so the lake is not a source population for other nearby lakes (***stewardship***) | • ***Unmanaged*** AIS population may be low enough to not cause measurable ecosystem impacts or reduce cultural ecosystem services |

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## Hand-Harvesting Abilities

- Onterra manages far more hand-harvesting projects than herbicide control projects
- Most hand-harvesting projects target
  - Pioneer populations and may be able to keep population suppressed
  - Follow-up control following large-scale management
- 2 projects Onterra manage contain lake-wide EWM populations
  - Anvil Lake (Vilas County)
    - LFOO 2.1%, but concentrated in one part of lake
    - Fallen short of goals to date, but built a DASH boat and are conducting a 3-year trial of 350 hours per year
  - Squash Lake (Oneida County)
    - LFOO < 1.0 %,
    - 600 SLA divers plus 200 hrs contracted DASH per year
    - Currently meeting management goals

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## AIS Control Goals for Current EWM Population in Upper Kaubashine

1. **No Coordinated Active Management**
   - Onterra recommends periodic monitoring
   - Onterra recommends considering a trigger when goal would be reconsidered
   - Onterra recommends education on manual removal by property owners
2. **Ecosystem Restoration Approach**
   - Onterra recommends a large-scale herbicide treatment (most likely using liquid 2,4-D amine at a target of 0.3 ppm ae) followed by contingency strategy
   - Depending on depth of mixing zone, cost likely $20-25K plus monitoring and contingency management costs
3. **Improve Cultural Ecosystem Services**
   - Onterra recommends professional hand-harvesting of areas or lanes
   - Hand-harvesting may not be able to reach this goal and herbicides or small mechanical harvester may be alternatives worth considering
   - Onterra does not recommend benthic barriers

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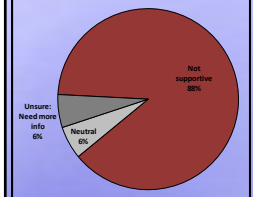
What is your level of support for **do nothing (do not manage plants)?**

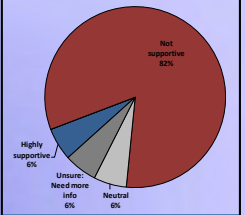
| All Respondents (n=65) | |
|---|---|
| Support | 6% |
| Not Support | 80% |
| Unsure/Neutral | 14% |

**0-10 yrs (n=17)**



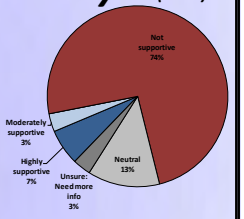

| | |
|---|---|
| Support | 0% |
| Not Support | 88% |
| Unsure/Neutral | 12% |

**10-20 yrs (n=17)**




| | |
|---|---|
| Support | 6% |
| Not Support | 82% |
| Unsure/Neutral | 12% |

**>20 yrs (n=31)**




| | |
|---|---|
| Support | 10% |
| Not Support | 74% |
| Unsure/Neutral | 16% |

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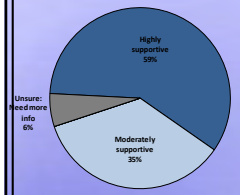
What is your level of support for the responsible use **hand-removal by divers** on Upper Kaubashine Lake?

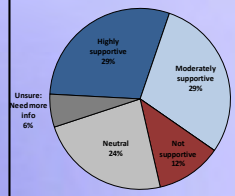
| All Respondents (n=65) | |
|---|---|
| Support | 73% |
| Not Support | 6% |
| Unsure/Neutral | 21% |

**0-10 yrs (n=17)**



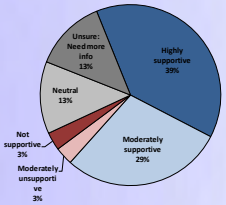

| | |
|---|---|
| Support | 94% |
| Not Support | 0% |
| Unsure/Neutral | 6% |

**10-20 yrs (n=17)**




| | |
|---|---|
| Support | 58% |
| Not Support | 12% |
| Unsure/Neutral | 30% |

**>20 yrs (n=31)**




| | |
|---|---|
| Support | 66% |
| Not Support | 6% |
| Unsure/Neutral | 26% |

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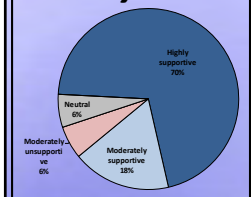
What is your level of support for the responsible use **herbicide (chemical) control** on Upper Kaubashine Lake?

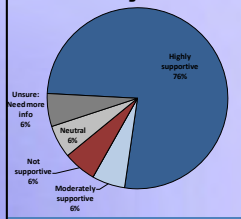
| All Respondents (n=65) | |
|---|---|
| Support | 75% |
| Not Support | 13% |
| Unsure/Neutral | 12% |

**0-10 yrs (n=17)**



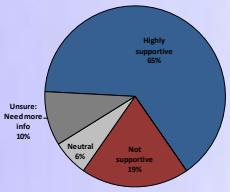

| | |
|---|---|
| Support | 88% |
| Not Support | 6% |
| Unsure/Neutral | 6% |

**10-20 yrs (n=17)**




| | |
|---|---|
| Support | 82% |
| Not Support | 6% |
| Unsure/Neutral | 12% |

**>20 yrs (n=31)**




| | |
|---|---|
| Support | 65% |
| Not Support | 19% |
| Unsure/Neutral | 16% |

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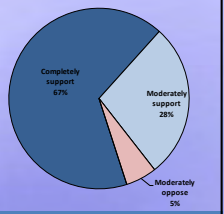
What is your level of support or opposition to aquatic herbicide use to target Eurasian water milfoil in Upper Kaubashine Lake?

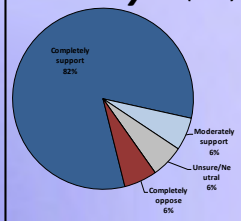
| All Respondents (n=65) | |
|---|---|
| Support | 85% |
| Not Support | 12% |
| Unsure/Neutral | 3% |

**0-10 yrs (n=18)**



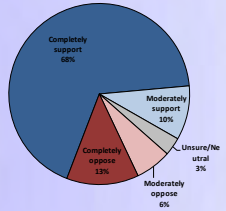

| | |
|---|---|
| Support | 95% |
| Not Support | 5% |
| Unsure/Neutral | 0% |

**10-20 yrs (n=17)**




| | |
|---|---|
| Support | 88% |
| Not Support | 6% |
| Unsure/Neutral | 6% |

**>20 yrs (n=31)**




| | |
|---|---|
| Support | 78% |
| Not Support | 19% |
| Unsure/Neutral | 3% |

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## *Other Potential Goals And Actions*

- **Water quality monitoring**
- **Shoreland restoration and protection**
- **Education initiatives**

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# B

# APPENDIX B

## Stakeholder Survey Response Charts and Comments

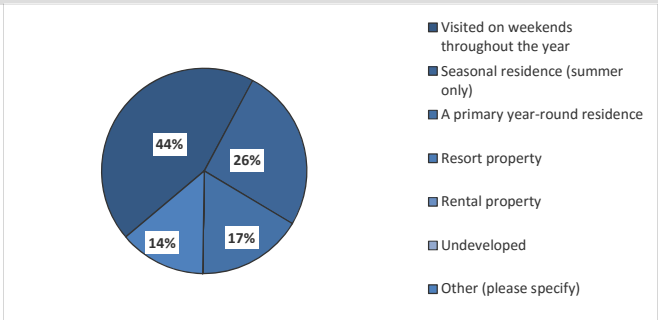
**Upper Kaubashine Lake - Anonymous Stakeholder Survey**

*Surveys Distributed:* 86
*Surveys Returned:* 66
*Response Rate:* 77%

***Upper Kaubashine Lake Property***

**1. How is your property on or near Upper Kaubashine Lake utilized?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Visited on weekends throughout the year | 43.9% | 29 |
| Seasonal residence (summer only) | 25.8% | 17 |
| A primary year-round residence | 16.7% | 11 |
| Resort property | 0.0% | 0 |
| Rental property | 0.0% | 0 |
| Undeveloped | 0.0% | 0 |
| Other (please specify) | 13.6% | 9 |
| *answered question* | | 66 |
| *skipped question* | | 0 |

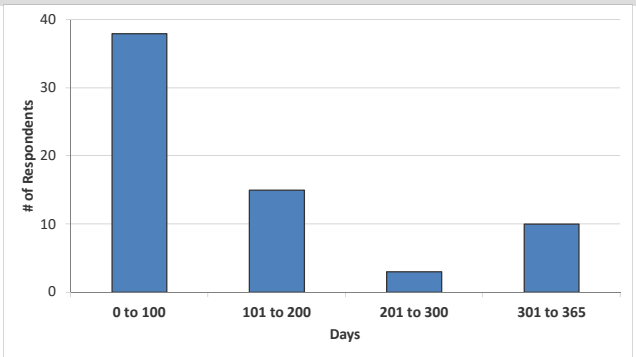



| Number | Other (please specify) |
|---|---|
| 1 | A year-round residence and undeveloped frontage |
| 2 | Visiting on some weeks during summer and fall |
| 3 | Mostly summer but used regularly the rest of the year |
| 4 | visited weekly throughout the summer and early fall |
| 5 | Visited on long weekends and week throughout the year |
| 6 | Currently summer only but plan to expand to 6 months in the next 3-4 years |
| 7 | Year around usage but not primary |
| 8 | four season cottage visited year round |
| 9 | We use our property year round but it is not our primary residence |

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

| Answer Options | Response Count |
|---|---|
| | 66 |
| *answered question* | 66 |
| *skipped question* | 0 |

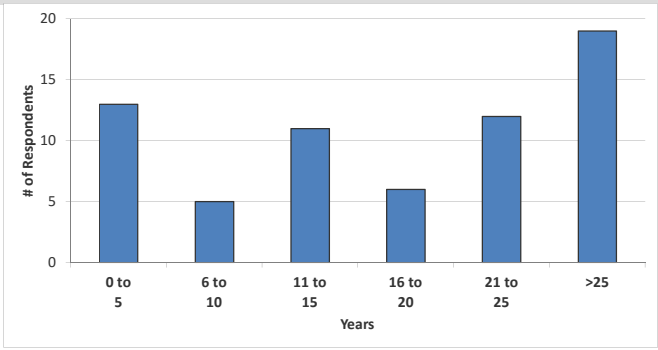
| Category (# of days) | Responses | |
|---|---|---|
| 0 to 100 | 38 | 58% |
| 101 to 200 | 15 | 23% |
| 201 to 300 | 3 | 5% |
| 301 to 365 | 10 | 15% |




**3. How long have you owned or rented your property on Upper Kaubashine Lake?**

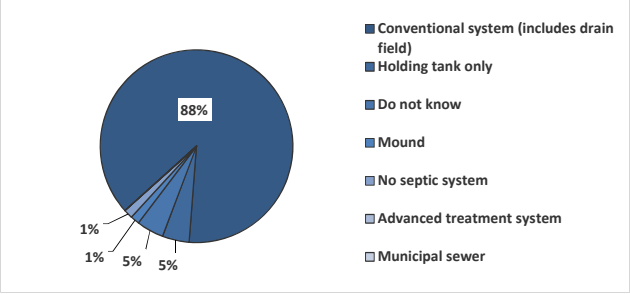
| Answer Options | Response Count |
|---|---|
| | 66 |
| *answered question* | 66 |
| *skipped question* | 0 |

| Category (# of | Responses | % Response |
|---|---|---|
| 0 to 5 | 13 | 20% |
| 6 to 10 | 5 | 8% |
| 11 to 15 | 11 | 17% |
| 16 to 20 | 6 | 9% |
| 21 to 25 | 12 | 18% |
| >25 | 19 | 29% |



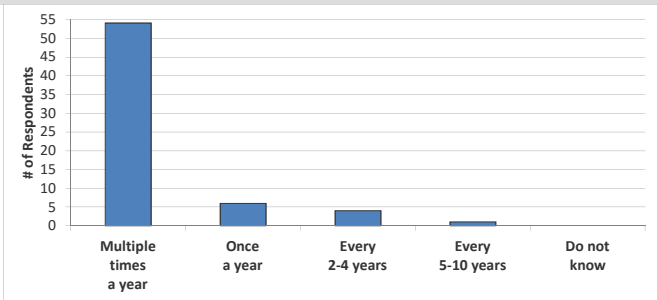
**4. What type of septic system does your property utilize?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Conventional system (includes drain field) | 87.9% | 58 |
| Holding tank only | 4.5% | 3 |
| Do not know | 4.5% | 3 |
| Mound | 1.5% | 1 |
| No septic system | 1.5% | 1 |
| Advanced treatment system | 0.0% | 0 |
| Municipal sewer | 0.0% | 0 |
| *answered question* | | 66 |
| *skipped question* | | 0 |




**5. How often is the septic system on your property pumped?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Every 2-4 years | 83.1% | 54 |
| Every 5-10 years | 9.2% | 6 |
| Once a year | 6.2% | 4 |
| Multiple times a year | 1.5% | 1 |
| Do not know | 0.0% | 0 |
| *answered question* | | 65 |
| *skipped question* | | 1 |

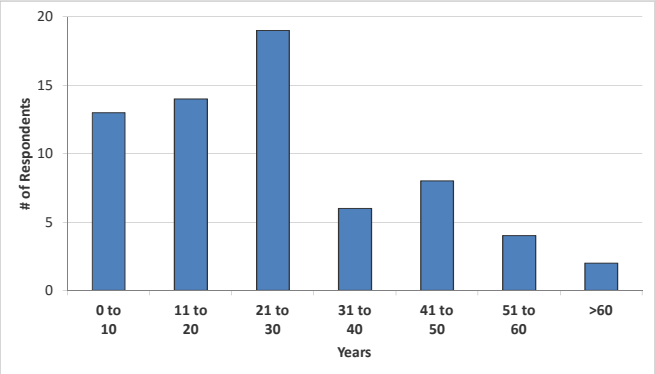



***Recreational Activity on Upper Kaubashine Lake***

**6. How many years ago did you first visit Upper Kaubashine Lake?**

| Answer Options | Response Count |
|---|---|
| | 66 |
| *answered question* | 66 |
| *skipped question* | 0 |

| Category (# of days) | Responses | % Response |
|---|---|---|
| 0 to 10 | 13 | 20% |
| 11 to 20 | 14 | 21% |
| 21 to 30 | 19 | 29% |
| 31 to 40 | 6 | 9% |
| 41 to 50 | 8 | 12% |
| 51 to 60 | 4 | 6% |
| >60 | 2 | 3% |



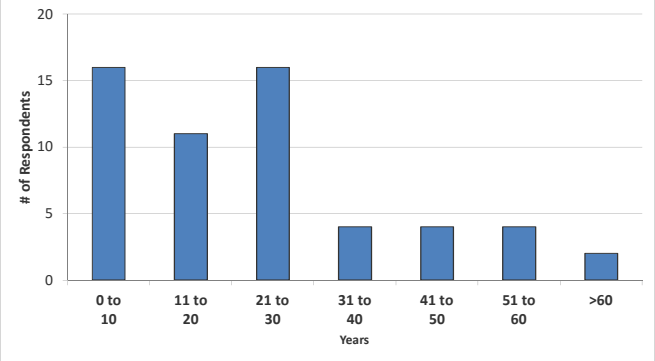

**7. Have you personally fished on Upper Kaubashine Lake in the past three years?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Yes | 89.4% | 59 |
| No | 10.6% | 7 |
| *answered question* | | 66 |
| *skipped question* | | 0 |

## 8. For how many years have you fished Upper Kaubashine Lake?

| Answer Options | Response Count |
|---|---|
| | 57 |
| *answered question* | 57 |
| *skipped question* | 9 |

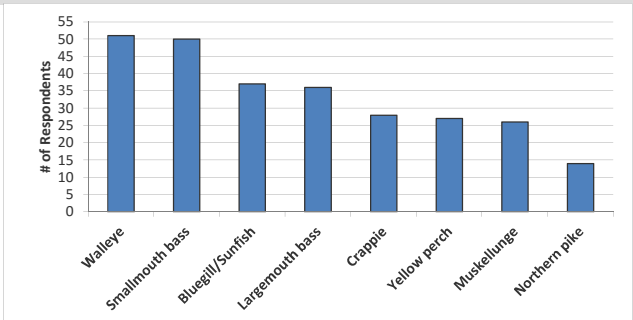
| Category (# of years) | Responses | % Response |
|---|---|---|
| 0 to 10 | 16 | 28% |
| 11 to 20 | 11 | 19% |
| 21 to 30 | 16 | 28% |
| 31 to 40 | 4 | 7% |
| 41 to 50 | 4 | 7% |
| 51 to 60 | 4 | 7% |
| >60 | 2 | 4% |




## 9. What species of fish do you like to catch on Upper Kaubashine Lake?

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Walleye | 86.4% | 51 |
| Smallmouth bass | 84.7% | 50 |
| Bluegill/Sunfish | 62.7% | 37 |
| Largemouth bass | 61.0% | 36 |
| Crappie | 47.5% | 28 |
| Yellow perch | 45.8% | 27 |
| Muskellunge | 44.1% | 26 |
| Northern pike | 23.7% | 14 |
| Other (please specify) | 3.4% | 2 |
| *answered question* | | 59 |
| *skipped question* | | 7 |

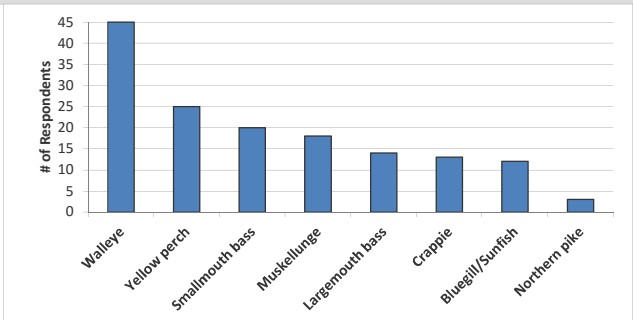
| Number | Other (please specify) |
|---|---|
| 1 | I don't know which kind of bass :( |
| 2 | Would like to catch all but have not caught Muskey yet! |




## 10. Please identify the top three species of fish you would like to catch more of on Upper Kaubashine Lake.

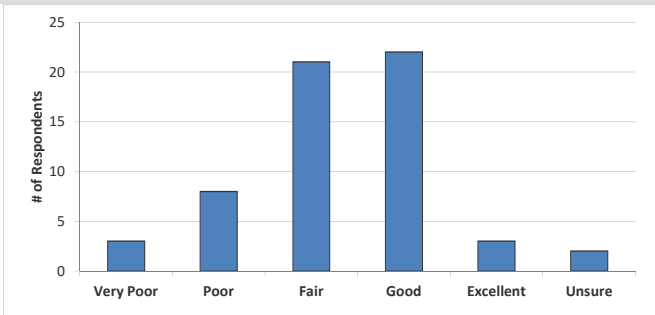
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Walleye | 86.5% | 45 |
| Yellow perch | 48.1% | 25 |
| Smallmouth bass | 38.5% | 20 |
| Muskellunge | 34.6% | 18 |
| Largemouth bass | 26.9% | 14 |
| Crappie | 25.0% | 13 |
| Bluegill/Sunfish | 23.1% | 12 |
| Northern pike | 5.8% | 3 |
| Other (please specify) | 1.9% | 1 |
| *answered question* | | 52 |
| *skipped question* | | 14 |

| Number | Other (please specify) |
|---|---|
| 1 | trout |



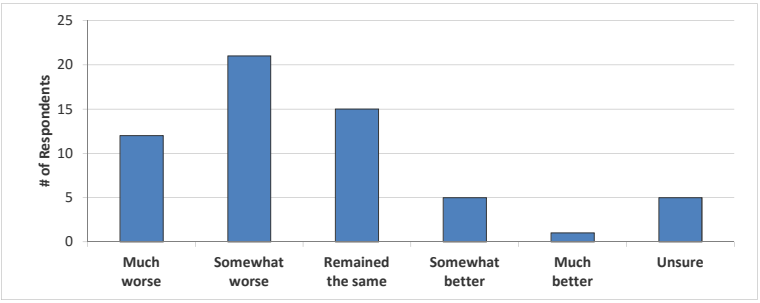
**11. Given your fishing preference, how would you describe the current quality of fishing on Upper Kaubashine Lake?**

| Answer Options | Very Poor | Poor | Fair | Good | Excellent | Unsure | Response Count |
|---|---|---|---|---|---|---|---|
| | 3 | 8 | 21 | 22 | 3 | 2 | 59 |
| | | | | | | *answered question* | 59 |
| | | | | | | *skipped question* | 7 |



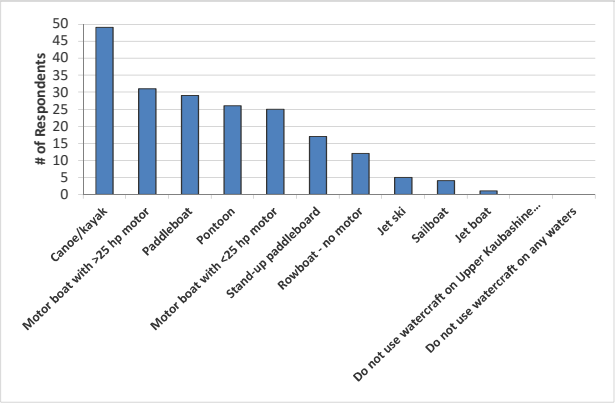

**12. How has the quality of fishing changed on Upper Kaubashine Lake since you have started fishing the lake?**

| Answer Options | Much worse | Somewhat worse | Remained the same | Somewhat better | Much better | Unsure | Response Count |
|---|---|---|---|---|---|---|---|
| | 12 | 21 | 15 | 5 | 1 | 5 | 59 |
| | | | | | | *answered question* | 59 |
| | | | | | | *skipped question* | 7 |




**13. What types of watercraft do you currently use on Upper Kaubashine Lake?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Canoe/kayak | 74.2% | 49 |
| Motor boat with >25 hp motor | 47.0% | 31 |
| Paddleboat | 43.9% | 29 |
| Pontoon | 39.4% | 26 |
| Motor boat with <25 hp motor | 37.9% | 25 |
| Stand-up paddleboard | 25.8% | 17 |
| Rowboat - no motor | 18.2% | 12 |
| Jet ski | 7.6% | 5 |
| Sailboat | 6.1% | 4 |
| Jet boat | 1.5% | 1 |
| Do not use watercraft on Upper Kaubashine Lake | 0.0% | 0 |
| Do not use watercraft on any waters | 0.0% | 0 |
| *answered question* | | 66 |
| *skipped question* | | 0 |



**14. How do you launch your watercraft onto Upper Kaubashine Lake?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Have own launch area/ramp | 45.5% | 30 |
| Use neighbor's launch area/ramp | 54.5% | 36 |
| *answered question* | | 66 |
| *skipped question* | | 0 |

**15. Do you use your watercraft on waters other than Upper Kaubashine Lake? If yes, indicate number of times per open water season.**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Yes | 1.5% | 1 |
| No | 89.4% | 59 |
| Number of times per open water season | 9.1% | 6 |
| *answered question* | | 66 |
| *skipped question* | | 0 |

| Number | Other (please specify) |
|---|---|
| 1 | 2 |
| 2 | 3 |
| 3 | 5/10/2016 |
| 4 | 3 to 4 times per year |
| 5 | 4 |
| 6 | Between labor day and Memorial Day 10-15 times |

**16. What is your typical cleaning routine after using your watercraft on waters other than Upper Kaubashine Lake?**

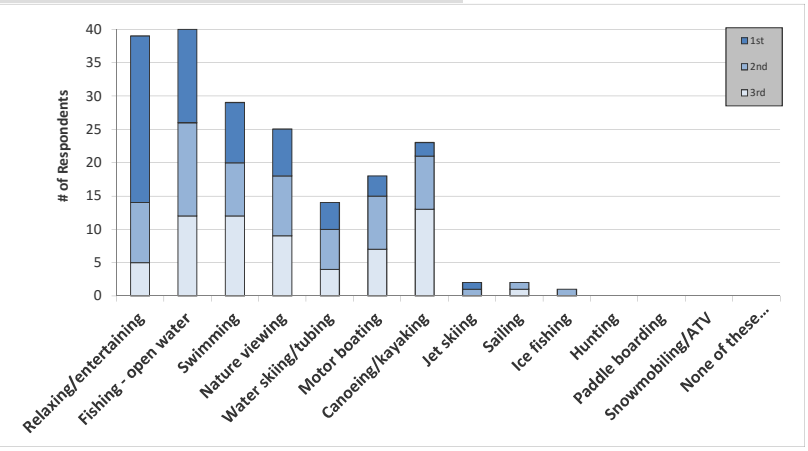
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Remove aquatic hitch-hikers (ex. - plant material, clams, mussels) | 50.0% | 3 |
| Drain bilge | 50.0% | 3 |
| Rinse boat | 66.7% | 4 |
| Power wash boat | 16.7% | 1 |
| Apply bleach | 0.0% | 0 |
| Do not clean boat | 0.0% | 0 |
| Other (please specify) | 33.3% | 2 |
| *answered question* | | 6 |
| *skipped question* | | 60 |

| Number | Other (please specify) |
|---|---|
| 1 | rinse off kayak |
| 2 | Use a different boat for other waters |

**17. For the list below, rank your top three activities that are important reasons for owning or renting your property on or near Upper Kaubashine Lake, with 1 being the most important activity.**

| Answer Options | 1st | 2nd | 3rd | Rating Average | Response Count |
|---|---|---|---|---|---|
| Relaxing/entertaining | 25 | 9 | 5 | 1.49 | 39 |
| Fishing - open water | 14 | 14 | 12 | 1.95 | 40 |
| Swimming | 9 | 8 | 12 | 2.1 | 29 |
| Nature viewing | 7 | 9 | 9 | 2.08 | 25 |
| Water skiing/tubing | 4 | 6 | 4 | 2 | 14 |
| Motor boating | 3 | 8 | 7 | 2.22 | 18 |
| Canoeing/kayaking | 2 | 8 | 13 | 2.48 | 23 |
| Jet skiing | 1 | 1 | 0 | 1.5 | 2 |
| Sailing | 0 | 1 | 1 | 2.5 | 2 |
| Ice fishing | 0 | 1 | 0 | 2 | 1 |
| Hunting | 0 | 0 | 0 | 0 | 0 |
| Paddle boarding | 0 | 0 | 0 | 0 | 0 |
| Snowmobiling/ATV | 0 | 0 | 0 | 0 | 0 |
| None of these activities | 0 | 0 | 0 | 0 | 0 |
| Other (please specify below) | 0 | 0 | 1 | 3 | 1 |
| Please specify "Other" response here | | | | | 3 |
| | | | *answered question* | | 65 |
| | | | *skipped question* | | 1 |

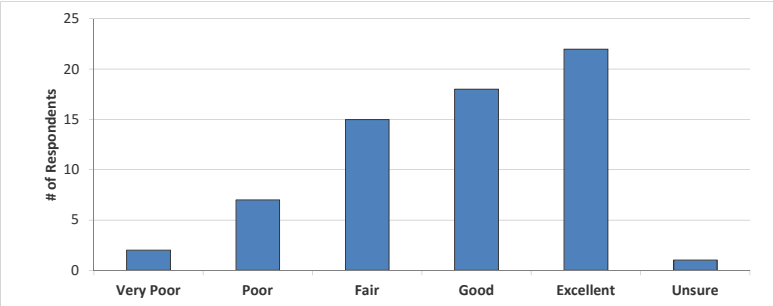
| Number | "Other" responses |
|---|---|
| | no particular order--fishing -- |
| 1 | open water; ice fishing; hunting |
| | 3rd choice is both |
| 2 | swimming and canoeing/kayaking |
| 3 | Snowshoeing, cross-country skiing |




***Upper Kaubashine Lake Current and Historic Condition, Health and Management***

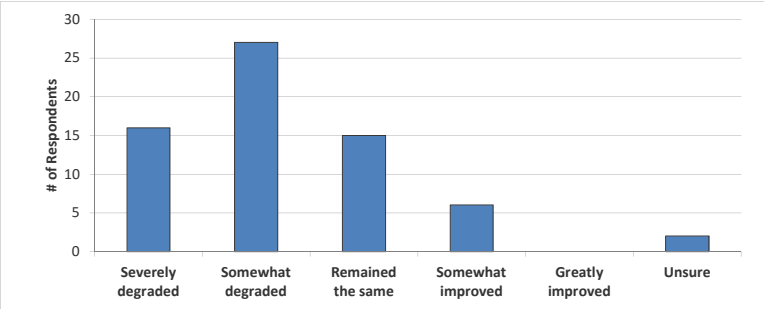
**18. How would you describe the current water quality of Upper Kaubashine Lake?**

| Answer Options | Very Poor | Poor | Fair | Good | Excellent | Unsure | Response Count |
|---|---|---|---|---|---|---|---|
| | 2 | 7 | 15 | 18 | 22 | 1 | 65 |
| | | | | | *answered question* | | 65 |
| | | | | | *skipped question* | | 1 |



**19. How has the current water quality changed in Upper Kaubashine Lake since you first visited the lake?**

| Answer Options | Severely degraded | Somewhat degraded | Remained the same | Somewhat improved | Greatly improved | Unsure | Response Count |
|---|---|---|---|---|---|---|---|
| | 16 | 27 | 15 | 6 | 0 | 2 | 66 |
| | | | | | | *answered question* | 66 |
| | | | | | | *skipped question* | 0 |




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

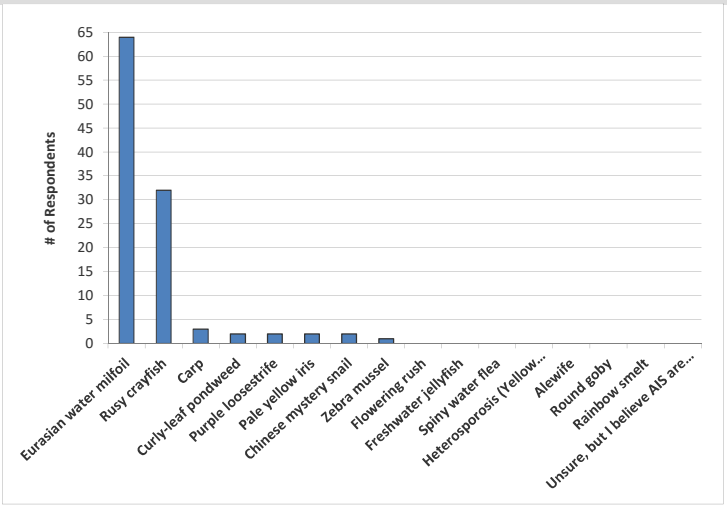
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Yes | 97.0% | 64 |
| No | 3.0% | 2 |
| *answered question* | | 66 |
| *skipped question* | | 0 |

**21. Do you believe aquatic invasive species are present within Upper Kaubashine Lake?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Definitely yes | 96.9% | 62 |
| I think so but am not certain | 3.1% | 2 |
| No | 0.0% | 0 |
| *answered question* | | 64 |
| *skipped question* | | 2 |

**22. Which aquatic invasive species do you believe are in Upper Kaubashine Lake?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Eurasian water milfoil | 100.0% | 64 |
| Rusy crayfish | 50.0% | 32 |
| Carp | 4.7% | 3 |
| Curly-leaf pondweed | 3.1% | 2 |
| Purple loosestrife | 3.1% | 2 |
| Pale yellow iris | 3.1% | 2 |
| Chinese mystery snail | 3.1% | 2 |
| Zebra mussel | 1.6% | 1 |
| Flowering rush | 0.0% | 0 |
| Freshwater jellyfish | 0.0% | 0 |
| Spiny water flea | 0.0% | 0 |
| Heterosporosis (Yellow perch parasite) | 0.0% | 0 |
| Alewife | 0.0% | 0 |
| Round goby | 0.0% | 0 |
| Rainbow smelt | 0.0% | 0 |
| Unsure, but I believe AIS are present | 0.0% | 0 |
| Other (please specify) | 4.7% | 3 |
| *answered question* | | 64 |
| *skipped question* | | 2 |

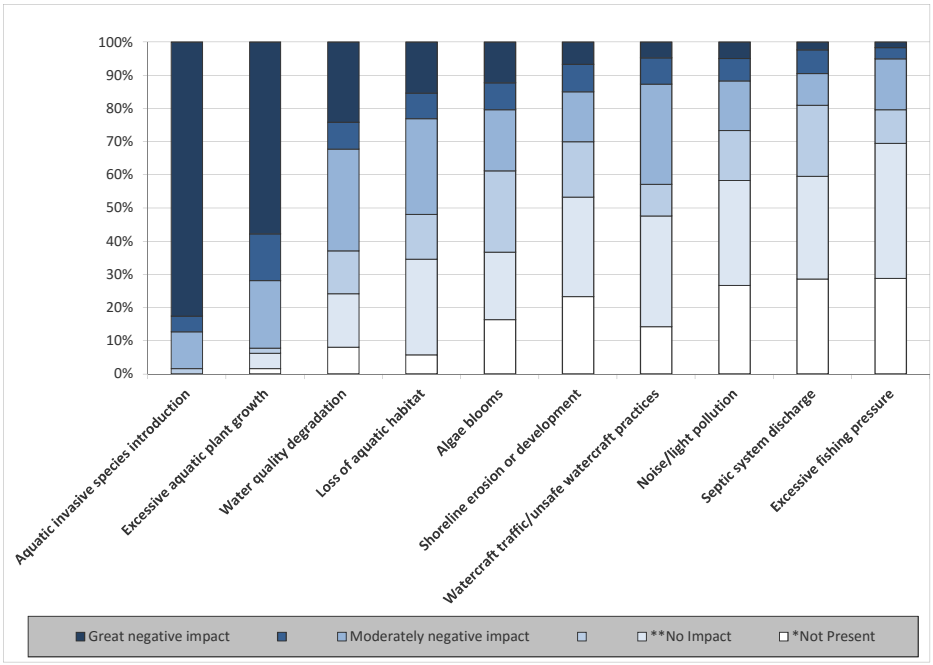



| Number | "Other" responses |
|---|---|
| 1 | Used to be rusty crayfish--not sure if there are any now. |
| 2 | Probably others but I don't know names |
| 3 | Eurasian Milfoil is all i can identify at this time |

**23. To what level do you believe each of the following factors may currently be negatively impacting Upper Kaubashine Lake?**
*** Not Present means that you believe the issue does not exist on Upper Kaubashine Lake.**
**** No Impact means that the issue may exist on Upper Kaubashine Lake but it is not negatively impacting the lake.**

| Answer Options | *Not Present | **No Impact | | Moderately negative impact | | Great negative impact | Unsure: Need more information | Rating Average | Response Count |
|---|---|---|---|---|---|---|---|---|---|
| Aquatic invasive species introduction | 0 | 0 | 1 | 7 | 3 | 52 | 0 | 3.68 | 63 |
| Excessive aquatic plant growth | 1 | 3 | 1 | 13 | 9 | 37 | 1 | 3.11 | 65 |
| Water quality degradation | 5 | 10 | 8 | 19 | 5 | 15 | 3 | 1.86 | 65 |
| Loss of aquatic habitat | 3 | 15 | 7 | 15 | 4 | 8 | 12 | 1.27 | 64 |
| Algae blooms | 8 | 10 | 12 | 9 | 4 | 6 | 13 | 1.06 | 62 |
| Shoreline erosion or development | 14 | 18 | 10 | 9 | 5 | 4 | 5 | 0.91 | 65 |
| Watercraft traffic/unsafe watercraft practices | 9 | 21 | 6 | 19 | 5 | 3 | 1 | 1.11 | 64 |
| Noise/light pollution | 16 | 19 | 9 | 9 | 4 | 3 | 4 | 0.8 | 64 |
| Septic system discharge | 12 | 13 | 9 | 4 | 3 | 1 | 23 | 0.46 | 65 |
| Excessive fishing pressure | 17 | 24 | 6 | 9 | 2 | 1 | 4 | 0.54 | 63 |
| Other (please specify) | | | | | | | | | 5 |
| | | | | | | | | ***answered question*** | **66** |
| | | | | | | | | ***skipped question*** | **0** |

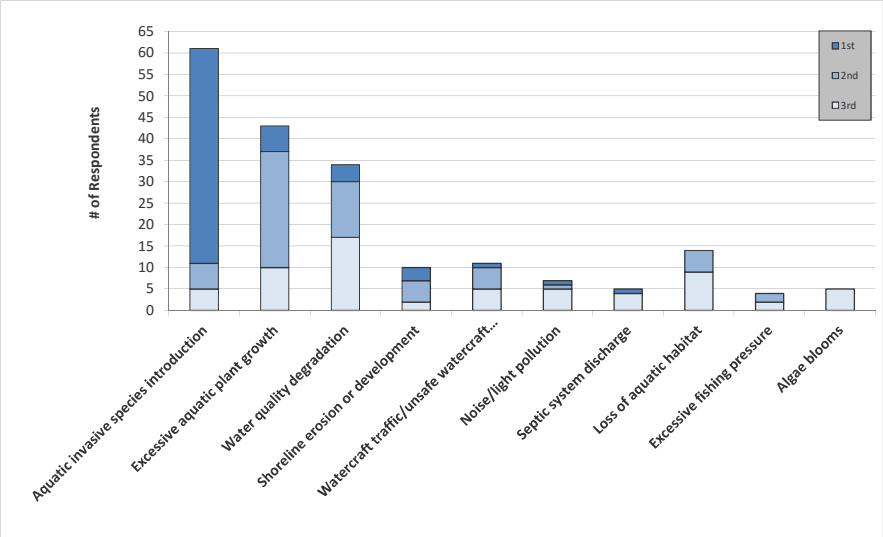
| Number | Other (please specify) |
|---|---|
| 1 | Use of lawn fertilizers & chemicals--has a great negative impact |
| 2 | Certainly hope not for septic system discharge |
| 3 | ice fishing pressure from non-residents negatively impacts fishing. Non-residents do not share the |
| 4 | over development of shoreline and too many speedboats/jet skis/tubers for size of lake |
| 5 | Fireworks pollution (waste in lake and noise) |



**24. From the list below, please rank your top three concerns regarding Upper Kaubashine Lake, with 1 being your greatest concern.**

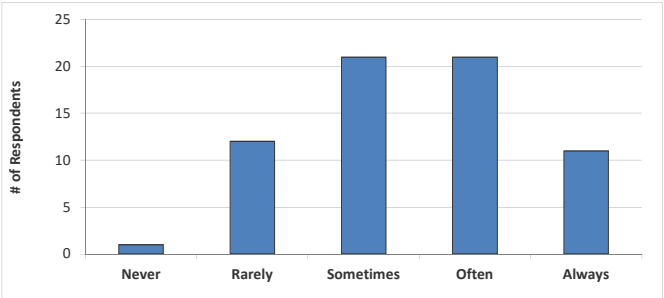
| Answer Options | 1st | 2nd | 3rd | Response Count |
|---|---|---|---|---|
| Aquatic invasive species introduction | 50 | 6 | 5 | 61 |
| Excessive aquatic plant growth | 6 | 27 | 10 | 43 |
| Water quality degradation | 4 | 13 | 17 | 34 |
| Shoreline erosion or development | 3 | 5 | 2 | 10 |
| Watercraft traffic/unsafe watercraft practices | 1 | 5 | 5 | 11 |
| Noise/light pollution | 1 | 1 | 5 | 7 |
| Septic system discharge | 1 | 0 | 4 | 5 |
| Loss of aquatic habitat | 0 | 5 | 9 | 14 |
| Excessive fishing pressure | 0 | 2 | 2 | 4 |
| Algae blooms | 0 | 0 | 5 | 5 |
| Other (please specify) | 0 | 1 | 0 | 1 |
| Please specify "Other" response here | | | | 1 |
| | | | ***answered question*** | **66** |
| | | | ***skipped question*** | **0** |

| Number | "Other" responses |
|---|---|
| 1 | 2. Other--Fireworks disruptive & illegal. Use of herbicides & other chemicals/fertilizers |



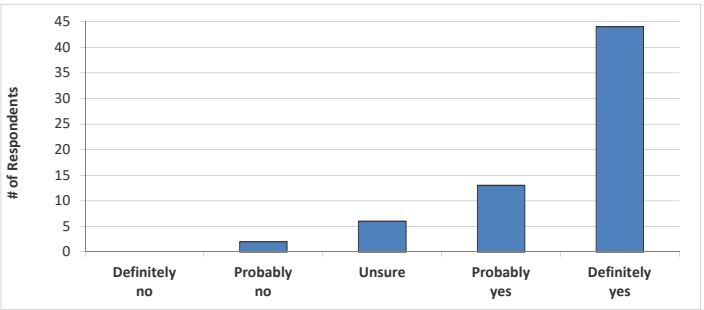

**25. During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of Upper Kaubashine Lake?**

| Answer Options | Answer Options | Never | Rarely | Sometimes | Often | Always | Response Count |
|---|---|---|---|---|---|---|---|
| | | 1 | 12 | 21 | 21 | 11 | 66 |
| | | | | | | ***answered question*** | **66** |
| | | | | | | ***skipped question*** | **0** |



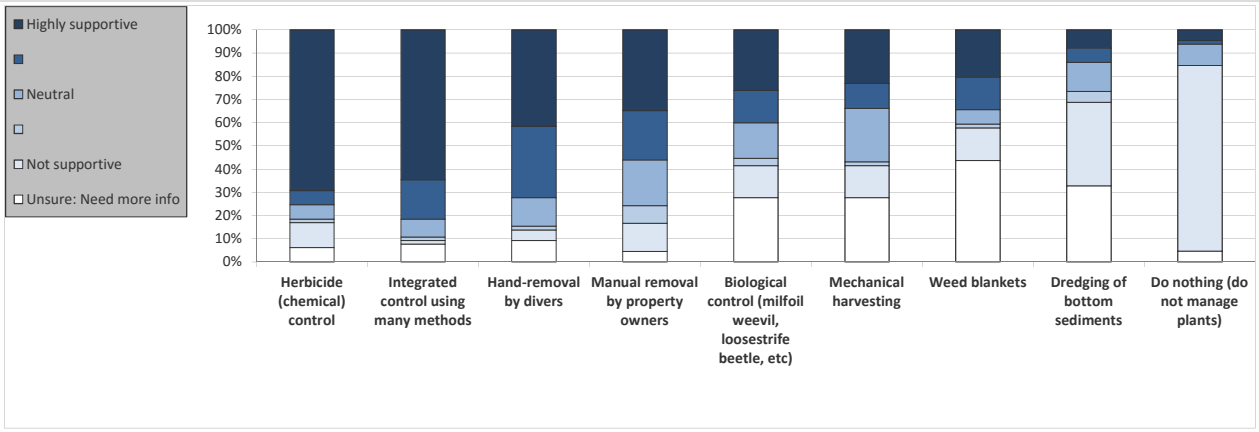
**26. Considering your answer to the question above, do you believe aquatic plant control is needed on Upper Kaubashine Lake?**

| Answer Options | Definitely no | Probably no | Unsure | Probably yes | Definitely yes | Response Count |
|---|---|---|---|---|---|---|
| | 0 | 2 | 6 | 13 | 44 | 65 |
| | | | | | *answered question* | 65 |
| | | | | | *skipped question* | 1 |



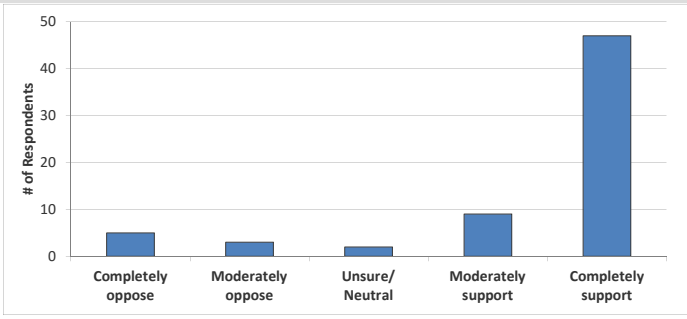

**27. Aquatic plants can be managed using many techniques. What is your level of support for the responsible use of the following techniques on Upper Kaubashine Lake?**

| Answer Options | Not supportive | | Neutral | | Highly supportive | Unsure: Need more info | Rating Average | Response Count |
|---|---|---|---|---|---|---|---|---|
| Herbicide (chemical) control | 7 | 1 | 4 | 4 | 45 | 4 | 3.09 | 65 |
| Integrated control using many methods | 1 | 1 | 5 | 11 | 42 | 5 | 3.14 | 65 |
| Hand-removal by divers | 3 | 1 | 8 | 20 | 27 | 6 | 2.66 | 65 |
| Manual removal by property owners | 8 | 5 | 13 | 14 | 23 | 3 | 2.3 | 66 |
| Biological control (milfoil weevil, loosestrife beetle, etc) | 9 | 2 | 10 | 9 | 17 | 18 | 1.66 | 65 |
| Mechanical harvesting | 9 | 1 | 15 | 7 | 15 | 18 | 1.42 | 65 |
| Weed blankets | 9 | 1 | 4 | 9 | 13 | 28 | 1.41 | 64 |
| Dredging of bottom sediments | 23 | 3 | 8 | 4 | 5 | 21 | 0.95 | 64 |
| Do nothing (do not manage plants) | 52 | 0 | 6 | 1 | 3 | 3 | 1.03 | 65 |
| | | | | | | *answered question* | | 66 |
| | | | | | | *skipped question* | | 0 |



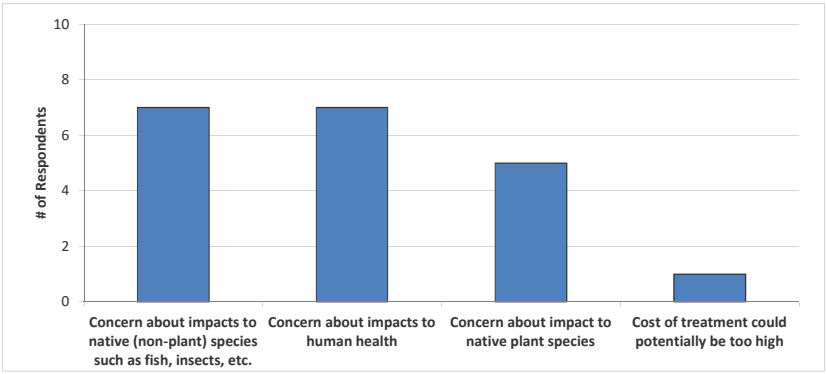
**28. What is your level of support or opposition to aquatic herbicide use to target Eurasian water milfoil in Upper Kaubashine Lake?**

| Answer Options | Completely oppose | Moderately oppose | Unsure/ Neutral | Moderately support | Completely support | Response Count |
|---|---|---|---|---|---|---|
| | 5 | 3 | 2 | 9 | 47 | 66 |
| | | | | | *answered question* | 66 |
| | | | | | *skipped question* | 0 |




**29. What is the reason or reasons you oppose the use of aquatic herbicides to target to target Eurasian water milfoil on Upper Kaubashine Lake?**

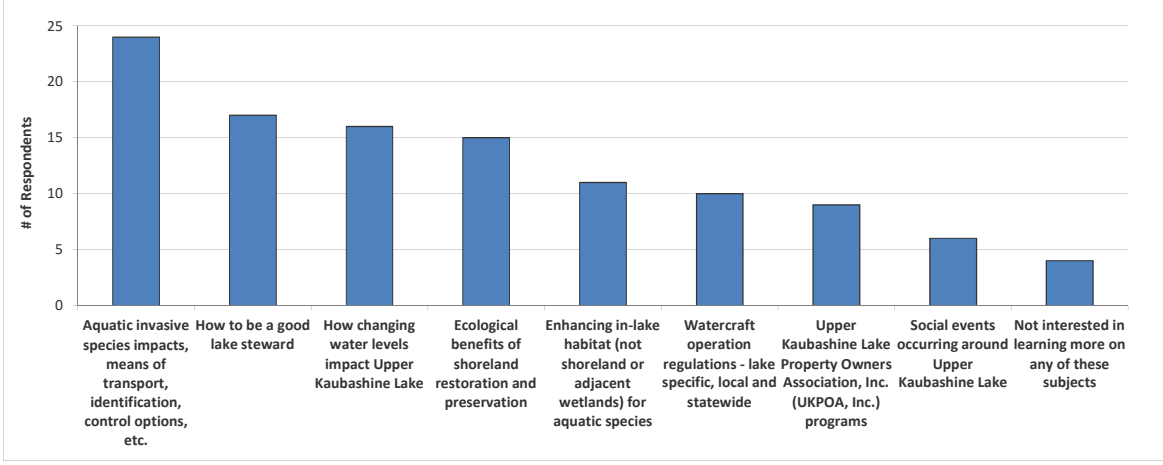
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Concern about impacts to native (non-plant) species such as fish, insects, etc. | 100.0% | 7 |
| Concern about impacts to human health | 100.0% | 7 |
| Concern about impact to native plant species | 71.4% | 5 |
| Cost of treatment could potentially be too high | 14.3% | 1 |
| | *answered question* | 7 |
| | *skipped question* | 59 |



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

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Aquatic invasive species impacts, means of transport, identification, control options, etc. | 42.9% | 24 |
| How to be a good lake steward | 30.4% | 17 |
| How changing water levels impact Upper Kaubashine Lake | 28.6% | 16 |
| Ecological benefits of shoreland restoration and preservation | 26.8% | 15 |
| Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species | 19.6% | 11 |
| Watercraft operation regulations - lake specific, local and statewide | 17.9% | 10 |
| Upper Kaubashine Lake Property Owners Association, Inc. (UKPOA, Inc.) programs | 16.1% | 9 |
| Social events occurring around Upper Kaubashine Lake | 10.7% | 6 |
| Not interested in learning more on any of these subjects | 7.1% | 4 |
| Some other topic (please specify) | 3.6% | 2 |
| ***answered question*** | | **56** |
| ***skipped question*** | | **10** |

| Number | Other (please specify) |
|---|---|
| 1 | The Assn. does a good job of providing info. @ annual mtg. |
| 2 | More info on non-chemical ways to control invasive species, and more info on the data regarding impacts of herbicide treatment on plants, animals, humans, long-term. |




***Upper Kaubashine Property Owners Association, Inc. (UKPOA, Inc.)***

**31. Before receiving this mailing, have you ever heard of the UKPOA, Inc.?**

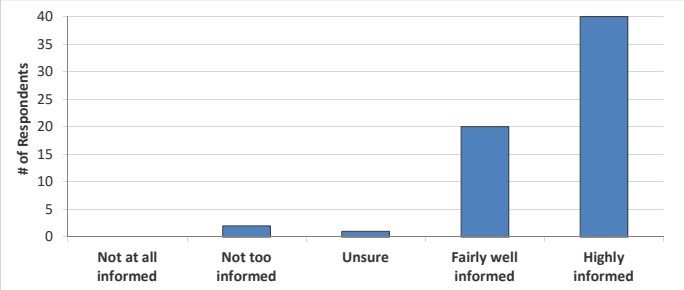
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Yes | 100.0% | 65 |
| No | 0.0% | 0 |
| ***answered question*** | | **65** |
| ***skipped question*** | | **1** |

**32. What is your membership status with the UKPOA, Inc.?**

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Current member | 95.4% | 62 |
| Former member | 1.5% | 1 |
| Never been a member | 3.1% | 2 |
| ***answered question*** | | **65** |
| ***skipped question*** | | **1** |

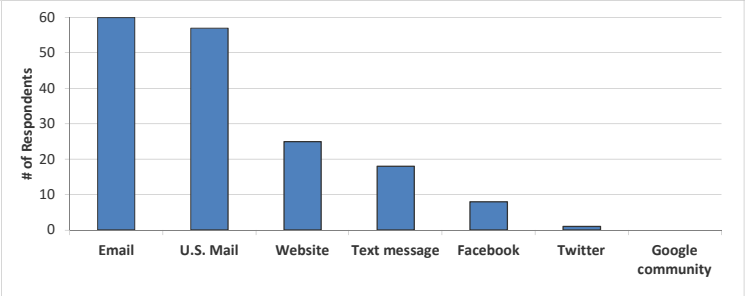
**33. How informed has (or had) the UKPOA, Inc. keeping you regarding issues with Upper Kaubashine Lake and its management?**

| Answer Options | Not at all informed | Not too informed | Unsure | Fairly well informed | Highly informed | Response Count |
|---|---|---|---|---|---|---|
| | 0 | 2 | 1 | 20 | 40 | 63 |
| | | | | | *answered question* | **63** |
| | | | | | *skipped question* | **3** |




**34. Please check all the communication sources you would be willing to use to get updates on the progress of the Aquatic Plant Management Plan Committee, as well as other Upper Kaubashine Lake information**

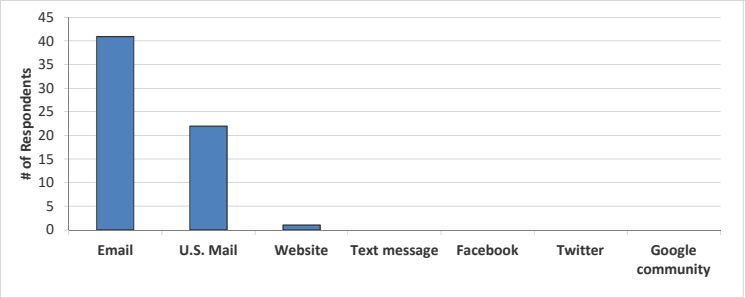
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Email | 92.3% | 60 |
| U.S. Mail | 87.7% | 57 |
| Website | 38.5% | 25 |
| Text message | 27.7% | 18 |
| Facebook | 12.3% | 8 |
| Twitter | 1.5% | 1 |
| Google community | 0.0% | 0 |
| Other (please specify) | | 1 |
| *answered question* | | **65** |
| *skipped question* | | **1** |




| Number | Other (please specify) |
|---|---|
| **1** | Meetings |

**35. What is your preferred method of communication?**

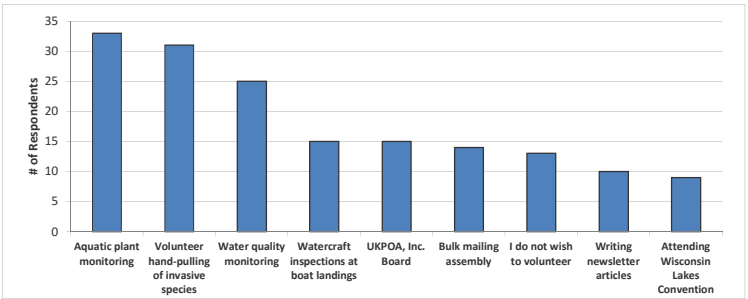
| Answer Options | Response Percent | Response Count |
|---|---|---|
| Email | 63.1% | 41 |
| U.S. Mail | 33.8% | 22 |
| Website | 1.5% | 1 |
| Text message | 0.0% | 0 |
| Facebook | 0.0% | 0 |
| Twitter | 0.0% | 0 |
| Google community | 0.0% | 0 |
| Other (please specify) | 1.5% | 1 |
| *answered question* | | **65** |
| *skipped question* | | **1** |




| Number | Other (please specify) |
|---|---|
| **1** | BOTH U.S. mail and text message |

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

| Answer Options | Response Percent | Response Count |
|---|---|---|
| Aquatic plant monitoring | 51.6% | 33 |
| Volunteer hand-pulling of invasive speci | 48.4% | 31 |
| Water quality monitoring | 39.1% | 25 |
| Watercraft inspections at boat landings | 23.4% | 15 |
| UKPOA, Inc. Board | 23.4% | 15 |
| Bulk mailing assembly | 21.9% | 14 |
| I do not wish to volunteer | 20.3% | 13 |
| Writing newsletter articles | 15.6% | 10 |
| Attending Wisconsin Lakes Convention | 14.1% | 9 |
| ***answered question*** | | **64** |
| ***skipped question*** | | **2** |




**37. Please feel free to provide written comments concerning the Upper Kaubashine Lake, its current and/or historic condition and its management.**

| Answer Options | Response Count |
|---|---|
| | 38 |
| ***answered question*** | **38** |
| ***skipped question*** | **28** |

| Number | Response Text |
|---|---|
| 1 | Looking forward to building an even stronger neighborhood around the lake, so that we can hear every voice, and consider how we balance the needs of individual property owners, long term economic value and the general stewardship of the lake. |

| Number | Response Text |
|---|---|
| 2 | Comment on paragraph after Q. 27: very misleading & makes it sound like herbicides are harmless.<br>Comment on Q. 29, response d--contaminate our well water.<br>Other comments are as follows:<br>1. The paragraph following question 27: "Aquatic herbicides have been used on many lakes throughout Wisconsin. Through proper application and diligent management, they can reduce invasive plants to a manageable level. Aquatic herbicides have been known to impact native vegetation but by applying the herbicide early in the season, before most native vegetation starts growing, that impact can be minimized." is unnecessary, misleading and basically gives 'permission' for people to favor herbicides. Unless statements discussing the harms of herbicides are also included, the discussion is not balanced. This paragraph is an opinion and is biased. It does not belong in this survey. Nor was it approved by people on the committee who reviewed this survey. Who added this paragraph and what is the underlying motivation for adding it?<br>2. EWM is likely here to stay and will likely reach an equilibrium population:<br>a. From Wisconsin article/study "The Science behind the "so-called" super weed" (http://dnr.wi.gov/wnrmag/2016/08/Weed.PDF):<br>-EWM population varies year to year, usually remaining at low levels over the years, or increasing initially and then declining. Other lakes show a stable equilibrium population of EWM over time, usually at about 20%. These lakes were not treated with herbicides.<br>-Few lakes had dense growth. Those that did showed that use of herbicides such as 2,4-D made no difference at reducing EWM populations over the long term. Lower EWM growth occurred on natural lakes and northern lakes.<br>-DNR biologists have concerns over use of 2,4-D, which is why they are conducting more studies on 2,4-D effects on fish larvae.<br>-Recommendation by local DNR biologists is to actively pull out the EWM multiple times each year with divers or DASH (diver assisted suction harvesting) to keep the population under control. Weevils can be helpful. The lakes that have successfully removed or controlled EWM followed an aggressive removal program of pulling the EWM. h<br>b. EWM will NOT be eradicated with the use of 2,4-D and will likely repopulate within a few years. This has been the case in other lakes treated with 2,4-D.<br>3. 2,4-D is not benign and is associated with multiple adverse effects:<br>a. 2,4-D (2,4-Dichlorophenoxyacetic acid), a chlorophenoxy herbicide, comprises 50% of Agent Orange, along with 2,4,5-T. Dioxin has been found in both 2,4-D and 2,4,5-T formulations, and is linked to diabetes, neuropathy, Parkinson's, heart and liver dysfunction, numerous cancers and birth defects, as well as other health concerns. Will dioxin be present in the 2,4-D put in our lake water? 2,4-D and its metabolites can irritate the eyes, skin, respiratory, GI, immune and neurologic systems and exposure can lead to seizures, shock, coma and collapse. Multiple fatalities and poisonings are reported in the medical literature usually related to work-related exposures. Applicators must wear masks, gloves, special clothing when applying the compound. Signs are posted to warn people to keep pets and children away from areas sprayed. Toxicity of 2,4-D depends on its chemical form: salts, esters, or acid. Salts and esters are much more toxic, especially to fish and plants.<br>b. 2,4-D contains many "inert" ingredients that are hazardous themselves and too numerous to mention here (Ref: Journal of Pesticide Reform/Winter 2005, Vol. 25, No. 4-updated 4/2006).<br>c. 2,4-D is degraded into 2,4-dichlorophenol (which inhibits oxidation, disrupts energy production by depleting the body of ATP, is "extremely toxic to earthworms", inhibits normal thyroid function, is "15 times more toxic than 2,4-D itself" Ref. Roberts & Dorough, 1984.), , 2,4-dichloroanisole, 4-chlorophenoxyacetic acid (endocrine disruptor: mimics or inhibits the body's hormones), chlorohydroquinone, 1,2,4-benzenetriol (carcinogenic Ref: Cohen & Tamma-Vithola, 1989), carbon dioxide and other volatile organic compounds. The "toxic properties have not been fully investigated" for these chemicals.<br>d. 2,4-D is an endocrine disruptor with effects on estrogen, androgens and thyroid hormones. It can increase or decrease sex hormones. Its effects on male sexual development include altering levels of testosterone, which may increase prostate tissue or decrease testicular size, and it may lead to abnormally shaped sperm leading to fertility problems.<br>e. There is concern about rising autism rates being related to thyroid disruption (decreasing thyroid hormones) by herbicides, including 2,4-D.<br>f. 2.4-D is linked to asthma and allergies, to neurologic changes that alter behavior, and to Parkinson's disease. (Ref: www.healthyenvironmentgroup.org/2,4-dtoxicity.html).<br>g. Herbicides, particularly Round-up, are now being investigated for a possible role in damaging the gut microbiome because of their antibiotic properties, which can lead to diabetes, obesity, dementia, cancers, etc. (Ref: Our Toxic World; Is Roundup Slowly Killing Us? Medscape. August 02, 2016) h. The WHO/International Agency for Research on Cancer classified 2,4-D as a possible carcinogen, level 3/5, and it is now banned in Quebec, Sweden, Norway, Denmark, Kuwait, and elsewhere. A decline in cancer has been seen in Sweden since phenoxy herbicides were banned. What do these countries know that we do not?<br>i. Wisconsin DNR lists 2,4-D as a possible carcinogen linked to non-Hodgkin's lymphoma, leukemia and sarcomas. It is also linked to cancers in dogs.<br>j. Miscarriage rates were higher in rabbits exposed to 2,4-D. Litter sizes were smaller in animals who drank water with small amounts of 2,4-D. Birth defects in humans were higher in counties with higher usage of 2,4-D. Mothers can transmit 2,4-D to their offspring via breast milk.<br>k. 2,4-D affects serotonin and dopamine neurotransmitters (which impact mood and behavior), decreases brain size, affects brain development leading to apathy, decreased social interactions, repetitive movements and tremor, and may impair myelin deposition in the brain.<br>l. Genetic chromosomal damage to human cells, lab animals and exposed people has been shown at low levels of 2,4-D, along with immune system dysfunction.<br>m. Minnesota study showed estrogenic effects from 2,4-D on breast cancer cells.<br>n. Netherlands study shows that it can displace sex hormones from carrier proteins.<br>o. Birds, beneficial insects and invertebrates, other mammals, frogs, fish are affected depending on the form of 2,4-D used, including by the loss of habitat and food supply.<br>p. The EPA "believes no significant risks will occur to recreational users of water treated with 2,4-D" only because they have not fully tested for risks and/or they have chosen to ignore the research that does show harm. There has been little to no research done on the interactions of 2,4-D with other chemical compounds. The EPA typically doesn't fully test or regulate most chemicals in use today, instead relying on the companies who manufacture the chemicals to prove their safety. When problems crop up down the line, the EPA may or may not step in to ban the chemical. Many examples of why this is important include lead (banned in other countries in the 1920's and 1930's, but not in the US until the 1970-1980's), DDT (sprayed extensively in neighborhoods to eradicate mosquitoes until the harms were well-documented), glyphosate (Round-up: now banned in some countries and thought to be of major concern world-wide). Another example is found at https://hcn.org/issues/131/4189 regarding "How California Poisoned A Small Town" with Rotenone, which was used in a lake to kill Northern Pike. The fallout from this chemical poisoning led to many more problems than just wiping out the pike, who returned to the lake in two years. Rotenone is linked to Parkinson's disease.<br><br>There is a substantial amount of fraudulent research and fraudulent reporting of research that occurs in the US, especially in regards to chemicals. There is also substantial pressure placed on the EPA and FDA by manufacturers to approve their chemicals.<br>4. 2,4-D can contaminate our groundwater and well water:<br>a. The half-life of 2,4-D is 20-40 days under ideal conditions when there is adequate oxygen, nutrients, warmer temperatures, microbes present, sun exposure, etc. This means that about half the chemical will be metabolized into multiple other chemicals (whose effects are of concern as previously noted) possibly within 40 days, but it could take as long as 312-355 days depending on the bacteria involved. It may continue to degrade by half of a half of a half etc. as time goes on. It will not just disappear in 40 days. Nor will its metabolites just disappear. Since our lake is clear and deep, it will not degrade as fast and will be more likely to leach into groundwater, per local DNR biologists and public health physician. 2,4-D is now being found in U.S. surface water, groundwater and in drinking water, which indicates either that it is not degrading as expected, or the amount exceeds the ability to be degraded. This is an issue of grave concern.<br>b. If the chemical(s) seeps into the groundwater, it will degrade more slowly or possibly not at all, because the groundwater is much colder, has few bacteria, less oxygen, and less organic matter for nutrients. Once it gets into the groundwater, it will enter our well water and we, and our pets, will end up drinking it and using it to water our plants.<br><br>5. Our lake feeds into Lower Kaubashine Lake and affects their water quality as well. They should have input into the decision about management of EWM. Off-lake property owners also could be affected if herbicides are used, which would impact their well water quality.<br>6. Use of lawn fertilizers and pesticides/herbicides/fungicides by property owners is likely already negatively impacting the water quality. People need to educate themselves and stop using harmful chemicals. Wisconsin Public Service needs to stop spraying herbicides under electrical lines.<br>7. Though it is unfortunate that EWM was introduced into our lake by someone extremely careless (our family had nothing to do with this travesty), we may have to learn to coexist with it in our ecosystem. It will take a concerted multi-pronged effort to manually remove it and control it. It may also diminish over time. The use of toxic herbicides is not the answer. Why should we take the risk of polluting our lake and ourselves with a chemical(s) whose long-term adverse health effects are unknown and potentially hazardous, especially when it will not alter the course of the EWM in the long run? We have some of the best drinking water on the planet. Wars will likely be fought over clean pure water. What water will we drink when all of it is contaminated? Many of us purchased land and built houses on the lake because we wanted to live where the air and water is clean and pure.<br>8. Who will be responsible for any adverse consequences resulting from the use of 2,4-D or other herbicides? |
| 3 | When we bought our property in 1984 the lake water was extremely clear--you could see the bottom from many feet. In the last 5 or so years, this has not been the case. We have seen algae blooms which we never had before and the Eurasian Milfoil has consumed our bay. You cannot swim, nor can you take a boat out without getting weeds all over your propellers.<br>This situation, I fear, will cause people not to want to buy property on our lake, and, I wonder if it is not addressed--will the bays turn into swamps?<br>The rusty crayfish were trapped out--but they certainly kept the water clean when they were in the lake. |

| Number | Response Text |
|---|---|
| 4 | Need to Kill OWM NOW! |
| 5 | Association has been wonderful in keeping us informed and in taking action. |
| 6 | As a family we highly value Upper Kaubashine. We have been blessed with a beautiful serene setting with tenants who collectively respect the beauty and serenity of nature. As a lake community, historically lake members have respected each other and most importantly have valued the many amenities the lake provides. Fishermen have been respected in the past by boating enthusiasts by giving them space and by acknowledging fishing times. At the same time boating enthusiasts have been given the opportunity to enjoy the lake without a need to impose rigid restrictions. That harmonious relationship has allowed us to optimize our enjoyment of this beautiful lake. My hope is that this mutual respect continues. In order for us to protect our lake however we need to be selfish. Although we like to share its beauty with others, allowing other boating vessels on our lake has threatened its health through the introduction of invasive species. To reduce future risk, I ask that we minimize or restrict guests from introducing other boats on our lake and collectively we work together to eradicate the invasive species present.<br>At the same time we need to do our best to confine fishing opportunities to lake tenants. |
| 7 | I don't think that the consultant has been very effective in helping our membership understand the extent of the EWM problem and the many options that we have for controlling it. The consultant has provided long powerpoints at the annual meetings, but these should have been available to the members beforehand, online, and as handouts. And the information provided should have covered more extensively the options for non-chemical controls of the milfoil. The consultant has given mixed information from year to year and it appears that the milfoil is rapidly expanding its growth areas. All the information from the consultant should be/should have been available online in reports, updates, links to more information, etc., as has been done in the case of other lake associations in the region. I do not trust our consultant at this point to do what is best for our lake. |
| 8 | Historically for the most part the Lake Association has done a remarkable job managing and promoting water quality and protecting the Lake for years . How ever of the last 5 years we have a lot of new people on the lake. When you look at where the Eurasian Milfoil is currently located in the lake you will see that is very close associated with Boat landings on Private property. While it is always possible that this Eurasian Milfoil came into our lake on Loon of Duck bodies, it is much more likely and reasonable to assume in came in from boats that had been on other lake with Milfoil. I believe we should use the Chemical option to eradicate the Milfoil and then undertake a active social campaign to enhance the understanding of those property owners who have boat landing on the lakes of the importance of not launching contained boats into the lake. |
| 9 | This is a lovely lake. We've been coming here for many years. The number of big water crafts and jet skis have increased. Not a good thing! |
| 10 | it is good that we are in communication as often we are on issues that effect our lake. We MUST be aggressive in attacking the milfoil issue |
| 11 | The rapid growth of milfoil this summer in front of our dock has seriously impacted our ability to use our pontoon boat and swim in the lake. Steps need to be taken soon to control and/or eliminate milfoil in the lake |
| 12 | fishing use to be a lot better with plenty of perch and walleye made it fun. seems more busy and less fish |
| 13 | Keep up the good work. We all care about our lake! |
| 14 | Thank you for this opportunity. |
| 15 | The milfoil in the lake has gotten out of control and really needs to be treated. I am very supportive of the treatment of the entire lake. While my area of shoreline is currently not effected, it is clear that the entire lake is being changed by this weed and something must be done. |
| 16 | The only significant change to the lake over the past 20+ years has been a dramatic increase of aquatic plants (invasive and native) without any noticeable improvement in fishing, habitat or water quality. Aquatic plants need to be significantly reduced or we'll risk losing Upper Kaubashine's 'sought after' lake status. |
| 17 | as of September 30,2016, we sold our property on Upper Kaubashine and downsized to a condo on lake Minocaqua so this survey was filled out to reflect our feelings at the time of our sale |
| 18 | Over the the years we have seen many changes to the lake. This is another challenge with help and support we will manage and continue to provide a wonderful body of water for what ever your passion is. This is a class A lake we must continue to do what is necessary to keep it that way for the future lake lovers. |
| 19 | Over a long period of time, shoreline deterioration is most notable! |
| 20 | I am really concerned about the huge increase in aquatic plants that showed up just last summer in the lake. I am also concerned about the almost total lack of fishing success the last two summers. |
| 21 | Lake Association Board is performing and communicating at a high level. We fully support the board and their current efforts (including |
| 22 | The progression of UKPOA from an informal organization to UKPOA, INC. has been a necessary transition to address the issues that face the lake |
| 23 | the fishing has changed greatly since 1993 and getting rid of the crayfish as brought the weeds back |
| 24 | We love everything about the lake and the area however we are very concerned about how unpleasant it is on our shoreline now because of the excessive weed growth. We are on the west end and the weeds get cut by boats and the weeds then gather along the shore. It is very sad. |
| 25 | Upper Kaubashine is a great lake and we want to keep it that way. Our biggest concern is the Eurasian Milfoil explosion that occurred this summer. We sincerely hope that aggressive action can be taken in 2017, particularly for the homeowners in that choked off bay. More people need to manage the areas in front of their homes to better control the growth but that needs to be conveyed more directly to them. That means we need MUCH better information on EWM control from independent experts, beyond Onterra. Sharing information or articles on best practices or success stories with lake residents would be helpful so people truly understand the dynamics of this plant. Onterra came across as quite dismissive of people's concerns at the last meeting which was concerning. Plus, they seem to have been providing conflicting information on EWM propagation. A year ago it was any little piece forms a plant and this year it was fragments don't matter. That is an issue if we don't get consistent information on how to combat EWM. Also, Onterra seems biased toward a chemical solution rather than giving us a broader overview of our options and their efficacy in other lakes across the Midwest. Our lake would be better served if leadership didn't rely solely on Onterra's opinion and used this study to more broadly reflect what lake residents desire. In addition, we believe it is VERY important for there to be more communication throughout the year. Two newsletters and one meeting a year don't seem to be enough, particularly when dealing with an invasive species. There is no such thing as over communication for our lake considering the investment people have made to purchase and maintain their properties. Given all the technology available today, it seems we could do a better job of keeping people informed about the lake overall and what it is happening. Building a greater sense of community on the lake is a good thing and could go a long way to helping lake owners pull together to manage our EWM issue appropriately. Thank you for doing this survey and getting input from everyone on how best to care for this treasure of a lake. |

| Number | Response Text |
|---|---|
| 26 | The water quality and clarity of UKL has diminished over the 30 years that my family has been on the lake. Invasive weeds seem to be the biggest problem along with eliminating the rusty crayfish. I know the crayfish is an invasive species but water quality and excessive weed growth seem to be linked to the lowering of the crayfish population. |
| 27 | Thank you to the board for working hard to make sure that Upper Kaubashine is a clean and beautiful lake for generations to come. |
| 28 | Love the lake...that is why we bought there. Hurts to see the milfoil taking over. UKPOA has been fabulous in keeping us informed. We must take positive steps to reclaim our lake! |
| 29 | No concerns..our lake association keeps us very well informed. |
| 30 | I strongly believe the invasive species needs to be mitigated before it becomes unmanageable. We purchased this property in the last year because of the beautiful lake and its quality and really want it to stay that way. |
| 31 | We bought our property three years ago and felt so blessed to find a place on Upper Kaubashine due to its incredible beauty. At that time, we had not even heard of EWM. In just three short years, the growth of EWM near our property has nearly sealed off our little bay. I can't imagine the impact that has on aquatic life. We're not sure if we will be able to boat this next summer considering how far it has spread. We have attended the annual meetings and truly appreciate what the Board and the consultant have done to-date. We are very willing to volunteer and contribute funds to do what is necessary to control EWM. |
| 32 | What attracted us to purchasing a place on Upper Kaubashine was the quality of the water. We fear this is not longer present on the lake. |
| 33 | Board is too small and needs participation of all members. too few do all the work. EWM is serious and getting worse fast. Time to stop planning and ACT. |
| 34 | Fourth of July celebrations on the lake with the illegal fireworks display is disturbing from the standpoint that this is an organization that purports it's desire to protect and preserve the land, water, and animals as it's goal. Disturbing the environment of property owners, their pets, and the wildlife in the area for a human desire to party seems quite selfish to me |
| 35 | Very concerned about the milfoil invading our beautiful lake. |
| 36 | We love the lake and all of our fabulous neighbors. And we are thankful the board, with Mary's leadership, is taking these steps to keep our lake quality high. |
| 37 | Upper Kaubashine is a beautiful lake and controlling the invasive weeds should be top priority , this needs to happen as soon as possible! |
| 38 | EWM is destroying our beautiful lake. Given the small size of the lake a full lake herbicide treatment seems the only viable solution. |

# C

# APPENDIX C

## Watershed Analysis WiLMS Results

**Date: 5/26/2017 Scenario: Upper Kaubashine Lake Current**

Lake Id: Upper Kaubashine Lake
Watershed Id: 0

**Hydrologic and Morphometric Data**

Tributary Drainage Area: 500.0 acre
Total Unit Runoff: 12.2 in.
Annual Runoff Volume: 508.3 acre-ft
Lake Surface Area <As>: 185 acre
Lake Volume <V>: 4741 acre-ft
Lake Mean Depth <z>: 25.6 ft
Precipitation - Evaporation: 5.8 in.
Hydraulic Loading: 597.8 acre-ft/year
Areal Water Load <qs>: 3.2 ft/year
Lake Flushing Rate <p>: 0.13 1/year
Water Residence Time: 7.93 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

**NON-POINT SOURCE DATA**

| Land Use | Acre | Low | Most Likely | High | Loading % | Low | Most Likely | High |
|---|---|---|---|---|---|---|---|---|
| | (ac) | Loading (kg/ha-year) | | | | Loading (kg/year) | | |
| Row Crop AG | 0.0 | 0.50 | 1.00 | 3.00 | 0.0 | 0 | 0 | 0 |
| Mixed AG | 0.0 | 0.30 | 0.80 | 1.40 | 0.0 | 0 | 0 | 0 |
| Pasture/Grass | 151 | 0.10 | 0.30 | 0.50 | 32.6 | 6 | 18 | 31 |
| HD Urban (1/8 Ac) | 0.0 | 1.00 | 1.50 | 2.00 | 0.0 | 0 | 0 | 0 |
| MD Urban (1/4 Ac) | 0.0 | 0.30 | 0.50 | 0.80 | 0.0 | 0 | 0 | 0 |
| Rural Res (>1 Ac) | 1 | 0.05 | 0.10 | 0.25 | 0.1 | 0 | 0 | 0 |
| Wetlands | 33 | 0.10 | 0.10 | 0.10 | 2.4 | 1 | 1 | 1 |
| Forest | 315 | 0.05 | 0.09 | 0.18 | 20.4 | 6 | 11 | 23 |
| Lake Surface | 185.0 | 0.10 | 0.30 | 1.00 | 39.9 | 7 | 22 | 75 |

**POINT SOURCE DATA**

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

**SEPTIC TANK DATA**

| Description | | Low | Most Likely | High | Loading % |
|---|---|---|---|---|---|
| Septic Tank Output (kg/capita-year) | | 0.3 | 0.5 | 0.8 | |
| # capita-years | 53 | | | | |
| % Phosphorus Retained by Soil | | 98 | 90 | 80 | |
| Septic Tank Loading (kg/year) | | 0.32 | 2.65 | 8.48 | 4.7 |

**TOTALS DATA**

| Description | Low | Most Likely | High | Loading % |
|---|---|---|---|---|
| Total Loading (lb) | 47.7 | 124.1 | 304.9 | 100.0 |
| Total Loading (kg) | 21.6 | 56.3 | 138.3 | 100.0 |
| Areal Loading (lb/ac-year) | 0.26 | 0.67 | 1.65 | 0.0 |
| Areal Loading (mg/m^2-year) | 28.91 | 75.19 | 184.71 | 0.0 |
| Total PS Loading (lb) | 0.0 | 0.0 | 0.0 | 0.0 |
| Total PS Loading (kg) | 0.0 | 0.0 | 0.0 | 0.0 |
| Total NPS Loading (lb) | 30.5 | 68.7 | 121.1 | 95.3 |
| Total NPS Loading (kg) | 13.8 | 31.2 | 54.9 | 95.3 |

# D

# APPENDIX D

## Ten Eurasian Watermilfoil Myths & Facts

# 10 EURASIAN WATER MILFOIL
# MYTHS & FACTS

**MYTH #1: If we are aggressive, we can get rid of Eurasian Water Milfoil (EWM) for good.**
**FACT:** EWM is tenacious, adaptable and unpredictable. No lake has been able to completely eradicate EWM long-term. Neither will we. The bottom line? We need to learn to live with some percentage of it in our lake.

**MYTH #2: We must do something right now or our whole lake will be overrun by EWM.**
**FACT:** Highly unlikely given Upper Kaubashine's 56 foot depth. EWM usually grows in depths up to 20 feet, so it likes the shoreline and shallow bays. We could follow other lake associations by letting nature take its course and do nothing. A small number of lake groups have taken this path. They found EWM hit a plateau of between 20-55% of the littoral zone (the area where aquatic plants grow) and then periodically died back on its own to less than 10%.

**MYTH #3: One whole lake herbicide treatment will kill it once and for all.**
**FACT:** Herbicides can effectively knock back EWM but it is ***not*** a permanent fix. EWM can return to pre-management levels within 5-7 years after treatment but sometimes, even sooner. Solid lake management plans call for on-going monitoring, a contingency strategy of spot pulling whether or not herbicides are used, and setting a regrowth tolerance threshold that then would trigger discussion about what further action steps to consider.

**MYTH #4: If we use the right dose, the herbicide will kill only the EWM.**
**FACT:** Unfortunately, there is no silver bullet for EWM. Our native plants may be negatively impacted for a few years but should rebound based on studies of other lakes. Lab studies indicate fish larvae populations also could be reduced. Toxicology tests show that fish will have some level of the herbicide in their bodies that mimic the herbicide concentration in the lake, though it is not believed to be lethal and does not persist or accumulate. Human exposure to herbicides can have ill effects as well. A proposed dosing would be to achieve a lake-wide concentration of 0.3 ppm, which is **above** the 0.07 ppm the Environmental Protection Agency (EPA) Maximum Contaminant Level for public drinking water. (There is controversy about overall aquatic herbicide safety, with some advocating that no level is safe in drinking water.) The 0.3 ppm target level would be **below** the swimming standards for adults of 9.8 ppm and for children of 3.6 ppm. It is estimated the herbicide residue would be non-detectable in our lake approximately 35 days after treatment, but that is dependent on many factors such as temperature, water clarity and weather. In other lakes, residual amounts of herbicide have been long lasting, including up to four months in some cases.

**MYTH #5: Pulling the EWM does no harm to the lake.**
**FACT:** Every action we take on our lake has an impact, including pulling EWM. For example, sediments are stirred and redistributed, native plants are inadvertently pulled, fragments break free and some of the roots may remain. While effective, pulling is not completely benign.

**MYTH #6: There has to be a proven way to get rid of EWM on Upper Kaubashine.**
**FACT:** Like snowflakes, no two lakes are alike nor can success be predicted. Factors such as water quality, depth, shoreline degradation, drainage, boat traffic and other recreational use, lake type, weather conditions, surrounding land uses, and density of native plants all play a role. Working with the DNR and scientific experts to fully understand a lake's unique ecosystem helps identify suitable options for us to consider.

**MYTH #7: We waited too long to get started. That was a mistake.**
**FACT:** Actually, our Board was on it from Day One. They have followed the DNR's best practices, secured critical state grants for outside assistance and monitoring, and organized homeowners to hand-pull plants. The Board arranged for nearly 200 hours of professional hand-harvesting over two years. Before we could implement a more intense response, the DNR requested we further study our lake's ecology and use, solicit homeowner input via the survey, and put together a long-term Aquatic Plant Management Plan. That's where we are today.

**MYTH #8: My area is sandy or rocky. EWM won't grow here.**
**FACT:** That may be true, for now. EWM grows in sand, silt or rock, which explains the growth from 0% in 2013 to nearly 23% of our littoral zone in 2016. It is an opportunistic plant and will grow anywhere conditions are favorable.

**MYTH #9: We can't swim off of our dock because of EWM, but I need a permit to pull it.**
**FACT:** Actually, homeowners can hand-pull EWM in front of their properties without a permit. Owners also may contract with professional divers to hand-pull in that same area. Mechanical harvesting, including suction, needs a permit from the DNR. Whenever possible, leave the native plants. They are our best defense against EWM. UPKOA, Inc. has several resources available to help you identify our 27 native plants.

**MYTH #10: We're just one household. There's nothing we can do to battle EWM.**
**FACT:** The good news is everyone can do a little something to fight EWM. Here are a few ideas: Learn to identify EWM and educate your guests about what it looks like and where it is on our lake. If pulling, wrap the strands around your hand first to get the root crown. EWM self-fragments, so regularly remove floating strands/pieces by your shoreline – it makes great compost. Keep a small net on your boats/kayaks to remove floating pieces; the ones with visible white roots are the ones to really try to catch and remove ASAP. Consult the lake map that plots the EWM colonies and avoid the large masses with your pontoons, jet skis or water skiing/tubing activities. If you must go through, tilt your motor up to avoid cutting the weeds. When fishing in weeds, remove any EWM fragments before recasting. Avoid pulling our 27 native plants: they are a perfect, natural defense to reduce the spaces where EWM can grow. Keep your shoreline as natural and woody as possible. Avoid using fertilizers with phosphorus.

E

# APPENDIX E

**Herbicide Toxicology Materials**

- WDNR Aquatic Herbicide FAQ
- WDNR Chemical Fact Sheet
- Summary: Effects of 2, 4-D Herbicide Treatments Used to Control Eurasian Watermilfoil on Fish and Zooplankton in Northern Wisconsin Lakes (UWSP & WDNR, March 2018)

# Frequently Asked Questions about Aquatic Herbicide Use in Wisconsin

**Prepared by Wisconsin Dept. of Natural Resources, Dept. of Health Services and Dept. of Agriculture, Trade, and Consumer Protection**

**June 23, 2011**

## Why are herbicides used in Wisconsin lakes and rivers?

Aquatic herbicides are used to reduce the abundance of invasive species to reduce spread to new water bodies, to help maintain a healthy native plant community that is beneficial for fish and other aquatic organisms, to improve navigational access to lakes and rivers and make boat navigation safer, and to control nuisance plant and algae growth that can pose a hazard to swimmers.

## How is aquatic herbicide use regulated in Wisconsin?

In order to be used in Wisconsin, an aquatic herbicide must be all of the following:

1) Labeled and registered with U.S. EPA's office of Pesticide Programs;
2) Registered for sale and use by the Department of Agriculture, Trade, and Consumer Protection (DATCP);
3) Permitted by the Department of Natural Resources (DNR); and
4) Applied by a DATCP-certified and licensed applicator, with few exceptions.

Step 1) U.S. EPA's office of Pesticide Programs reviews the chemical and label.

Federal law requires herbicides to be registered with the Environmental Protection Agency (EPA) before they can be sold or used. The registration process determines potential risk to human health and the environment. The human health assessment includes sensitive groups such as infants, and risk is evaluated for both short-term and chronic effects. Ultimately, the EPA registers the herbicide if it determines that use of the pesticide will result in "no unreasonable adverse effects" as defined in federal law. This means that the benefits of using the pesticide according to the label outweigh the risks. Once an herbicide is registered, it is re-assessed by EPA every fifteen years.

Step 2) Herbicides must be registered by DATCP prior to sale or use in Wisconsin.

Most EPA-registered herbicide products are eligible to be registered for sale and use in Wisconsin by DATCP-licensed manufacturers and labelers. DATCP will not register an herbicide for use if it is prohibited for sale, use or distribution in Wisconsin, even if it is registered by EPA.

Step 3) DNR evaluates requests for use of chemicals in public waters when a permit application is submitted.

> When making a decision whether or not to issue a permit, the Department considers the appropriateness of the herbicide selected at the site, the likely non-target organism effects, the potential for adverse effects on the water body, as well as the potential hazard to humans. DNR may then issue the permit, issue the permit with conditions, or deny the permit. Permit conditions are frequently used to make sure that the herbicide is used responsibly and in accordance with best management practices for the plant being managed.

Step 4) Applied by a certified applicator.

> Most herbicide applications to water bodies in Wisconsin must be done by certified applicators. To become certified, an individual must complete a training course and pass a written exam. Businesses that provide herbicide application services must also be licensed by DATCP. A certified applicator is not needed only if the treatment area is less than ¼ acre in size and the product being applied is a granular herbicide.

## Are herbicides safe?

The distinction between "EPA registered" and the terms "approved" or "safe" is important. Registration by the EPA does not mean that the use of the herbicide poses no risk to humans or the environment, only that for use in the U.S., the benefits have been determined to outweigh the risks. Because product use is not without risk, the EPA does not define any herbicide as "safe". It is prudent to minimize herbicide exposure whenever possible.

When an herbicide is registered, the EPA sets use requirements to minimize risk that are given on the herbicide label. When using herbicides it is important to follow the label instructions exactly, and never use an herbicide for a use not specified on the label.

## What does the DNR do to minimize herbicide use and ensure that herbicides are used responsibly?

The Department of Natural Resources evaluates the benefits of using a particular chemical at a specific site vs. the risk to non-target organisms, including threatened or endangered species, and may stop or limit treatments to protect them. The Department frequently places conditions on a permit to require that a minimal amount of herbicide is needed and to reduce potential non-target effects, in accordance with best management practices for the species being controlled. For example, certain herbicide treatments are required by permit conditions to be in spring because they are more effective, require less herbicide and reduce harm to native plant species. Spring treatments also means that, in most cases, the herbicide will be degraded by the time peak recreation on the water starts.

The DNR encourages minimal herbicide use by requiring a strategic Aquatic Plant Management (APM) Plan for management projects over 10 acres or 10% of the water body or any projects

receiving state grants. DNR also requires consideration of alternative management strategies and integrated management strategies on permit applications and in developing an APM plan, when funding invasive species prevention efforts, and by encouraging the use of best management practices when issuing a permit.

The Department also supervises treatments, requires that adjacent landowners are notified of a treatment and have an opportunity to request a public meeting, requires that the water body is posted to notify the public of treatment and usage restrictions, and requires reporting after treatment occurs.

## How long do the chemicals stay in the water?

The amount of time an herbicide will stay in the water varies greatly based on a number of different factors, including the type of herbicide used. Residues may only be present in the water for a few hours, or for as long as a few months. Each herbicide has different characteristics that affect where the chemical moves (e.g. if it stays in the water column or settles into the sediment), how it is broken down, and how long it can be detected in water, sediments, and aquatic organisms. For more information on the environmental fate of a particular herbicide, please see the individual chemical fact sheets, available by request from your local lake coordinator (http://dnr.wi.gov/lakes/contacts/Contacts.aspx?role=LAKE_COORDINATOR). These are currently being updated and will be available online soon, as well.

## Should I let my kids swim in the water?

None of the aquatic herbicides licensed for use in Wisconsin have swimming restrictions. Dilute amounts of herbicide may be present in the water, but EPA has determined that minimal exposure would result from adults or children swimming in treated waters.

Use restrictions for treated water vary by herbicide, but will always be listed on the herbicide label. To find out how to read an herbicide label, see http://www.epa.gov/pesticides/label/. Restrictions must be posted at public access points to the water body for at least one day near an herbicide treatment and sent to shoreline landowners in advance of the treatment. To minimize your risk of direct exposure, it is wise to stay a safe distance from the area being treated while herbicide applications are being made.

## What if I accidently ingest some of the water while swimming or my pet drinks the water?

When assessing the risk posed by swimming in treated water, the EPA considers exposure from accidental swallowing of water, as well as from other routes such as through the skin. Any exposure to herbicide in the water while swimming or through accidental ingestion would be small and would not have toxic effects. Similarly, your pet should not have any side effects from swimming in or drinking treated water, so long as any applicable use restriction period is over.

## Are there risks to drinking water?

In Wisconsin, most drinking water supplies come from groundwater, not surface water. For water bodies that are used for drinking water, treatments are required to be a minimum distance from any existing intakes (usually ¼ of a mile). Wells are not considered to be intakes, and therefore the setback distance does not apply. Some aquatic herbicides can move through the sediment into the groundwater, but even those that do move through soil have not been detected above drinking water thresholds in wells.

Campers that are treating surface water for drinking should obtain water from an alternate location until after any posted drinking water restrictions have passed.

## Can I eat the fish?

There are no restrictions on eating fish for any currently registered aquatic herbicides following application to water. That does not mean you would not be exposed to the herbicide, just that the amount of herbicide that you might be exposed to is not toxic. A common concern with eating fish from treated water is that the herbicide concentration may be higher in fish tissues than in the water, and therefore exposure may be greater from fish than from exposure to lake water. The potential for bioaccumulation in fish varies by herbicide, and is evaluated by the EPA during the registration process.

## Can I water my lawn/garden with lake water?

Many of the herbicides used in lakes and ponds are broadleaf herbicides which will damage garden plants including fruits and vegetables. Some aquatic herbicides will also affect grass. Whether you are watering your lawn or your garden, follow water usage restrictions to avoid any unintended damage. These restrictions on watering will be listed on the herbicide label and posted at boat landings and beaches. The limits vary widely, from no restriction to 120 days. If you are unsure about the herbicide used on the lake near your home, the safest option is to use water from your municipal supply or private well to water plants.

## How can I find out if an aquatic herbicide treatment is scheduled for my lake, or has occurred recently?

Notices of herbicide applications and the use restrictions of the herbicides used are required to be posted along shore adjacent to a treatment area, as well as at public access points for the day of treatment through the end of the restricted use period. Additionally, landowners adjacent to a treatment area should be sent advance notification of the treatment by mail, email or newsletter. For a large-scale treatment (over 10 acres or over 10% of the area of the lake) all landowners around the lake would receive advance notification.

## How can I be notified in advance of when and where an application will occur, even if I am not adjacent to the treatment area?

The DNR will notify any interested person of upcoming applications if they request to be notified in writing each year. To request notification, contact your local DNR aquatic plant management coordinator (http://dnr.wi.gov/lakes/contacts/Contacts.aspx?role=AP_MNGT).

## Why can one person or group of people receive a permit to treat my lake if I don't want the treatment?

Any individual or group can request a permit from the DNR for a treatment since water bodies in the state are public property. The DNR is charged with evaluating any proposed treatments to consider the impact on the environment, and permits can be denied.

The permitting process requires that all landowners adjacent to the treated area be notified of the treatment. If you receive the notice and don't want the treatment to occur, you can send a written request to the applicant and the DNR requesting a public informational meeting on topics of concern to you regarding the treatment and alternatives. If 5 or more such requests are received within 5 days of the notice, the applicant is required to conduct such a meeting in a location near the water body.

## What can I do to reduce the need for aquatic herbicide use?

Individuals can help reduce requests for herbicide use to control aquatic plants and algae by implementing best management practices on their property to prevent nutrients from running into the water and by preventing the spread of invasive species. To reduce runoff eliminate the use of fertilizers adjacent to a water body, rake leaves out of the street and off the lawn, plant a buffer strip of native vegetation on shore to reduce erosion and filter water coming off lawns, create a rain garden to filter and slow down water from driveways or rooftops, use a rain barrel to collect water from rooftops to use to water plants, or use a pervious option to pave driveways and sidewalks. To prevent the introduction of new invasive species and stop the spread of existing invasives, when boating remove plants, animals, and mud from your boat when leaving a boat launch, drain all water from your boat, and rinse your boat and equipment with hot or high pressure water or allow to dry for at least five days before moving to another water body.

## Where can I find more information about a specific herbicide?

The DNR keeps a fact sheet on file for each herbicide used in aquatic systems. These fact sheets can be requested from your local DNR lake coordinator (http://dnr.wi.gov/lakes/contacts/Contacts.aspx?role=LAKE_COORDINATOR), and will be updated and available online soon, as well.

The EPA's risk assessments are available at http://www.epa.gov/pesticides/reregistration/status.htm.

Additional information can be found with these resources:

http://www.co.thurston.wa.us/health/ehipm/ehipm_aquaticreview.html
Health assessment of aquatic herbicides by Thurston County, Washington, Public Health and Social Services

http://extoxnet.orst.edu/pips/ghindex.html
Specific information on pesticides as well as toxicology

http://npic.orst.edu/
Information about pesticides, supported by EPA and Oregon State University

http://www.datcp.wi.gov/Plants/Pesticides/
WI Department of Agriculture, Trade, and Consumer Protection

# 2,4-D Chemical Fact Sheet

## Formulations

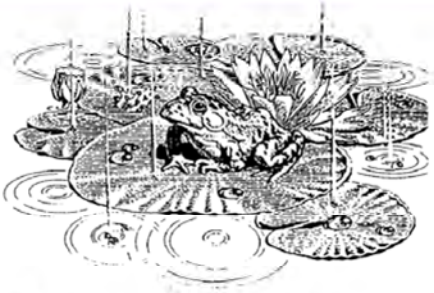
2,4-D is an herbicide that is widely used as a household weed-killer, agricultural herbicide, and aquatic herbicide. It has been in use since 1946, and was registered with the EPA in 1986 and re-reviewed in 2005. The active ingredient is 2,4-dichloro-phenoxyacetic acid. There are two types of 2,4-D used as aquatic herbicides: dimethyl amine salt and butoxyethyl ester. Both liquid and slow-release granular formulations are available. 2,4-D is sold under the trade names Aqua-Kleen, Weedar 64 and Navigate (product names are provided solely for your reference and should not be considered endorsements nor exhaustive).

## Aquatic Use and Considerations

2,4-D is a widely-used herbicide that affects plant cell growth and division. It affects primarily broad-leaf plants. When the treatment occurs, the 2,4-D is absorbed into the plant and moved to the roots, stems, and leaves. Plants begin to die in a few days to a week following treatment, but can take several weeks to decompose. Treatments should be made when plants are growing.

For many years, 2,4-D has been used primarily in small-scale spot treatments. Recently, some studies have found that 2,4-D moves quickly through the water and mixes throughout the waterbody, regardless of where it is applied. Accordingly, 2,4-D has been used in Wisconsin experimentally for whole-lake treatments.

2,4-D is effective at treating the invasive Eurasian watermilfoil (*Myriophyllum spicatum*). Desirable native species that may be affected include native milfoils, coontail (*Ceratophyllum demersum*), naiads (*Najas* spp.), elodea (*Elodea canadensis*) and duckweeds (*Lemna* spp.). Lilies (*Nymphaea* spp. and *Nuphar* spp.) and bladderworts (Utricularia spp.) also can be affected.



## Post-Treatment Water Use Restrictions

There are no restrictions on eating fish from treated water bodies, human drinking water or pet/livestock drinking water. Following the last registration review in 2005, the ester products require a 24-hour waiting period for swimming. Depending on the type of waterbody treated and the type of plant being watered, irrigation restrictions may apply for up to 30 days. Certain plants, such as tomatoes and peppers and newly seeded lawn, should not be watered with treated water until the concentration is less than 5 parts per billion (ppb).

## Herbicide Degradation, Persistence and Trace Contaminants

The half-life of 2,4-D (the time it takes for half of the active ingredient to degrade) ranges from 12.9 to 40 days depending on water conditions. In anaerobic lab conditions, the half-life has been measured up to 333 days. After treatment, the 2,4-D concentration in the water is reduced primarily through microbial activity, off-site movement by water, or adsorption to small particles in silty water. It is slower to degrade in cold or acidic water, and appears to be slower to degrade in lakes that have not been treated with 2,4-D previously.

There are several degradation products from 2,4-D: 1,2,4-benzenetriol, 2,4-dichlorophenol, 2,4-dichloroanisole, chlorohydroquinone (CHQ), 4-chlorophenol and volatile organics.

## Impacts on Fish and Other Aquatic Organisms

Toxicity of aquatic 2,4-D products vary depending on whether the formulation is an amine or an ester 2,4-D. The ester formulations are toxic to fish and some important invertebrates such as water fleas (*Daphnia*) and midges at application rates; the amine formulations are not toxic to fish or invertebrates at application rates. Loss of habitat following treatment may cause reductions in populations of invertebrates with either formulation, as with any herbicide treatment. These organisms only recolonize the treated areas as vegetation becomes re-established.

Available data indicate 2,4-D does not accumulate at significant levels in the bodies of fish that have been tested. Although fish that are exposed to 2,4-D will take up some of the chemical, the small amounts that accumulate are eliminated after exposure to 2,4-D ceases.

On an acute basis, 2,4-D is considered moderately to practically nontoxic to birds. 2,4-D is not toxic to amphibians at application rates; effects on reptiles are unknown. Studies have shown some endocrine disruption in amphibians at rates used in lake applications, and DNR is currently funding a study to investigate endocrine disruption in fish at application rates.

As with all chemical herbicide applications it is very important to read and follow all label instructions to prevent adverse environmental impacts.

## Human Health

Adverse health effects can be produced by acute and chronic exposure to 2,4-D. Those who mix or apply 2,4-D need to protect their skin and eyes from contact with 2,4-D products to minimize irritation, and avoid inhaling the spray. In its consideration of exposure risks, the EPA believes no significant risks will occur to recreational users of water treated with 2,4-D.

Concerns have been raised about exposure to 2,4-D and elevated cancer risk. Some (but not all) epidemiological studies have found 2,4-D associated with a slight increase in risk of non-Hodgkin's lymphoma in high exposure populations (farmers and herbicide applicators). The studies show only a possible association that may be caused by other factors, and do not show that 2,4-D causes cancer. The EPA determined in 2005 that there is not sufficient evidence to classify 2,4-D as a human carcinogen.

The other chronic health concern with 2,4-D is the potential for endocrine disruption. There is some evidence that 2,4-D may have estrogenic activities, and that two of the break-down products of 2,4-D (4-chlorophenol and 2,4-dichloroanisole) may affect male reproductive development. The extent and implications of this are not clear and it is an area of ongoing research.

## For Additional Information

Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides

Wisconsin Department of Agriculture, Trade, and Consumer Protection
http://datcp.wi.gov/Plants/Pesticides/

Wisconsin Department of Natural Resources
608-266-2621
http://dnr.wi.gov/lakes/plants/

Wisconsin Department of Health Services
http://www.dhs.wisconsin.gov/

National Pesticide Information Center
1-800-858-7378
http://npic.orst.edu/

# Effects of 2, 4-D Herbicide Treatments Used to Control Eurasian Watermilfoil on Fish and Zooplankton in Northern Wisconsin Lakes

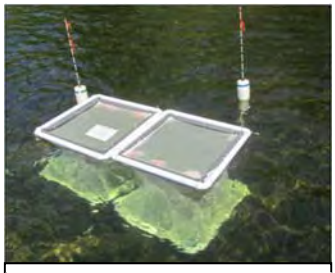
Larval Black Crappie

Eurasian Watermilfoil (EWM; *Myriophyllum spicatum*) is one of the most prolific aquatic invasive plants in North America. Since the 1950s, the herbicide 2, 4-dichlorophenoxyacetic acid (2, 4-D) has been used to control EWM. Little was known regarding the effect of 2, 4-D treatments on young fish and zooplankton outside of a few laboratory studies. Increasing demand for whole-lake 2, 4-D treatments to control EWM in Midwest lakes warranted additional examination of fish and zooplankton responses to these treatments. Our sampling occurred over 3 years (2015-2017) on 6 lakes in northern Wisconsin. No treatment occurred on any lake in 2015 (pre-treatment) or 2017 (post-treatment). In 2016, whole lake treatments using 2, 4-D were conducted on 3 lakes between May 24th and June 7th; the remaining 3 lakes served as reference systems.

## Zooplankton and Larval Fish

Zooplankton are the first prey item for all larval fish. Zooplankton were sampled from May through August. Larval fish were collected each year from May through July using ichthyoplankton nets and quatrefoil light traps. Otoliths (a bone from the inner ear) develop rings similar to trees, and were removed from larval black crappie to determine hatch dates and daily growth rates. Larval crappie diets were examined to determine any changes in feeding success.

Ichthyoplankton tow nets (left) and light traps (right) were set overnight to catch larval fish.



Net pens used to hold juvenile fish during 2,4-D treatments.

## Juvenile and Adult Fish

Juvenile and adult fish were sampled from May to August of each year using seines and electrofishing. Net pen trials with juvenile yellow perch or bluegill (< 5 inches) were conducted before, during, and after herbicide applications to assess mortality.

## Aquatic Plants and 2, 4-D Concentrations

Aquatic plants were sampled once in late summer of each year to monitor changes in abundance of both native plants and EWM. Water samples were collected to determine concentration of 2, 4-D up to 62 days post-treatment.

Larval fish otolith magnified to show daily rings.

## Results

Peak concentrations of 2, 4-D were lower than expected (0.152 to 0.257 ppm), but no EWM was detected after herbicide treatments in 2016. In 2017, EWM was sampled in Kathan Lake (4% vegetative coverage) and Manson Lake (9.4% vegetative coverage), but was not detected in Silver Lake. Zooplankton densities were similar within lakes in 2015 and 2016, but different trends were observed for some zooplankton in treatment lakes in 2017. Peak abundance of larval yellow perch was visually (but not statistically) lower in the year after herbicide was applied (2017) and this was not observed in reference lakes. No significant effect was observed on peak abundance of larval largemouth bass, minnows, black crappie or bluegill. Larval black crappie showed no detectable response in growth or feeding success. There was no difference between treatments in juvenile yellow perch abundance from August seines. Net pen trials for juvenile bluegill indicated no significant difference in survival between treatment and reference trials, indicating that no direct mortality was associated with the herbicide treatments. The lack of statistically significant responses to 2, 4-D herbicide treatments observed in our evaluation does not mean that herbicide application has no effects. However, potential effects may not be detectable in a lake setting given the inherent variation in many of the metrics we measured. Observed declines in larval yellow perch abundance and changes in zooplankton trends for treatment lakes in the year after herbicide treatments occurred, may be a result of changes in aquatic plant communities and not a direct effect of treatment. These observations warrant further investigation.

**For additional information contact:** Nick Rydell, Nick.Rydell@uwsp.edu

F

# APPENDIX F

## Official Comments on Draft Documents

# Comments to Upper Kaubashine Lake Draft Comprehensive Management Plan – February 2018 (comments received on March 27, 2018)

Response Comments by Eddie Heath

## **Overview Comments from Carol Warden (**UW Trout Lake Station Center for Limnology Aquatic Invasive Species Specialist)

We have reviewed the Upper Kaubshine Lake Management Plan. We offer these comments from our review.

1) Page 4: you say two exotic species of plants were found in Upper Kaubashine. Can you name them here? It feels like I'm left hanging right away. Change made.

2) Page 25: shoreline research, this section outlines the topic nicely. No Action taken

3) Page 55: says genetic analysis showed that all samples from Upper Kaubashine were confirmed to be pure-strain EWM, not hybrid. Then on map 7 says "2018 Preliminary HWM treatment strategy." This needs to be corrected on the top of the map. Change made

4) Page 49-89: see Nault and Knight comments below. I echo their sentiment on the use of your term "ecosystem restoration" and that it may not be appropriate to use here and may be misleading. Statement regarding this perspective was added to the first paragraph of the "Ecosystem Restoration Approach" discussion.

5) Page 67, Figure 3.4.16: Define in the text around this graph what "responsible use" of these following techniques are. As you know, that can mean a lot of different things to different people. This is the terminology approved by the WDNR social scientist. Consideration for using a less-subjective phrase in the future.

6) Page 81, second paragraph should read "CLMN program with ENSURE…" not insure. Change has been made.

7) Page 89: simple typo, you named this as mgmt. goal #3 but it's #4. Change has been made

8) One management goal for water quality should be an action step/recommendation looking at possibly 24D well water contamination or similar studies. Or information on this could also simply be added to this plan. As you know, this is clearly a concern for some on the lake. Aspect was addressed in two locations.

## **Comments from Michelle Nault** (WDNR scientist)

A few comments below. I just skimmed through the aquatic plant survey results section and conclusion/implementation section.

- **Pg. 49 in PDF (last sentence) and Pg. 64 in PDF (last paragraph)**: "*The densest areas of aquatic plant biovolume correspond with the EWM population*." I believe the figure that illustrates this concept is Figure 3.4-12 (pg. 65 in PDF) where the biovolume data is overlaid with the EWM bed mapping data. While I agree that there appears to be a high degree of overlap, I

would be interested in seeing how the 2017 PI data for several of the dominant taller growth form native plants (i.e. Elodea, Coontail, Pondweeds, etc.) overlap with this biovolume data. Coontail and common waterweed are not tall in the water column unless they are entangled on other vegetation like pondweeds. The question I have is whether or not these areas of dense plant biovolume may just be 'good habitat' for taller plant growth in general (both native and invasive), or if it really is primarily the presence of dense EWM in these areas (versus, or in addition to, dense elodea or coontail) that's contributing to the majority of this biovolume. There is some associated text that indicates that Elodea is most abundant between 9-15 ft, and Coontail is most abundant between 11-15 ft, so perhaps these species are not really found in the more nearshore areas where EWM has been mapped. Figure 3.4-12 was added and addresses this comment

- **Pg. 53-54 in PDF, Figure 3.4-6**: Note that figure legend has "2003" instead of "2013". Change has been made

- **Figure 3.4-6 (Pg. 53-54 in PDF) & Figure 3.4-11 (Pg. 63 in PDF)**: I think it could be beneficial to create a single combined figure that looks at the trend of EWM over time overlaid with the trend of several dominant native species. It is clear that EWM has increased in frequency over the past few years. However, from looking at the native plant frequency data, it also seems clear that the vast majority of native plants have remained very consistent and steady in their frequency over time. This seems to suggest that EWM is not actually outcompeting or pushing out native plants (at least based upon the data we have collected to date), but rather is more than likely just filling in an open niche in the ecosystem that's currently unoccupied. I would like to see a more detailed discussion of this observation included in the plan, and how that observation is related to discussions on whether or not to manage for 'ecological restoration'. I realize that ecological impacts are only one of the criteria to consider when deciding the best mgmt. approach, and that recreational/economic impacts are also important to consider. However, if this large-scale treatment approach is being called 'ecosystem restoration', then I would anticipate that the current impacts of EWM on the ecosystem are clearly evident, which I'm not sure they necessarily are (at least based upon the native plant & WQ data presented). If this mgmt. approach is being considered primarily to alleviate social concerns and recreational/aesthetic impacts (which seems to be the case based upon the social survey data), that's certainty a valid concern to consider, but then I would not call it 'ecosystem restoration'; maybe 'cultural ecosystem service restoration' would be a better term? These concepts are addressed in the sub-sections on *Impact Riparian Use* and *Impact Historic Ecosystem Function*. Also see response comment to Carol Warden's 4th comment.

- **Pg. 58 in PDF, Figure 3.4-8**: Note that figure legend has "2013-2016" instead of "2013-2017". Change has been made

- **Pg. 60 in PDF, Figure 3.4-9**: I believe that some of the data being presented in the LTT EWM figure is slightly incorrect (admittedly, it's probably been wrong in all the recent plans I've reviewed, but I just noticed it now!). The Weber Lake dated is slightly 'shifted' over time – the EWM data point in this figure for 2009 is actually the data from 2006. There was then a gap of no surveys for several years, and then annual surveys from 2010-2017. So in the bottom panel, the Weber data should start at year 0 (since EWM was first detected in 2006) and not at year 3. Hancock Lake also has PI data from 2006 (collected by Susan K.) which is not currently included in this figure (EWM litt FOO = 0.65%). So if this data is included, in the bottom panel the Hancock data should start at year 0 (since EWM was first detected in 2006) and not at year 2. Changes have been made I would also consider adding in the Manson Lake PI data (from 2005-2015, prior to mgmt.) to this figure. EWM was first reported from this lake in 1989, which is 16 years prior to our first PI survey in 2005. It's my understanding that Manson did not

actively manage EWM during this time, and so I think this adds a unique 'long-term' perspective (although the x-axis would need to be extended out towards 26 years after detection in order to show all the Manson data on the bottom panel). No action taken

- **Pg. 61 in PDF, Figure 3.4-10**: The Sandbar Lake treatment in 2013 was a large-scale 2,4-D treatment (same exact approach as 2011, definitely not a spot treatment). The line in the figure for Sandbar Lake should be changed from yellow or red. It should also be noted in the text that both Tomahawk and Sandbar Lakes had whole lake 2,4-D treatments again in 2017 (3rd WL treatment for Sandbar, 2nd WL treatment for Tomahawk). Change has been made

- **Pg. 63 in PDF, Figure 3.4-11**: Note that figure legend has "2003" instead of "2013". Change has been made

- **Pg. 70 in PDF, Efficacy section**: I believe this sentence should read: "*Also included on this figure are two lakes that received large-scale 2,4-D treatment that were monitored by ~~Onterra~~ WDNR as part of the EWM Long-Term Trends project discussed above*." (I think this statement is referring to the Tomahawk/Sandbar PI data). Change has been made. In general this dataset is a mix of Onterra collected PI data and WDNR collected PI data, as WDNR staff collected the PI data on several of these projects during the years that Onterra was the primary consultant, as a few of their projects overlapped with the lakes originally included in the WDNR long-term EWM study (and Onterra was OK with DNR continuing to collect the PI data on these systems in order to avoid unnecessary duplication). Note in Figure caption was added.

- **Pg. 70, Figure 3.4-17:** Add to legend that Sandbar Lake also had another WL treatment at 6 YAT (in addition to 2 YAT). Also add that Tomahawk Lake had another WL treatment at 9 YAT [they also had diquat spot treatments, 2,4-D spot treatments, and hand removal during the years since the initial large-scale 2,4-D treatment]. Addition was made.

- **Pg. 71 in PDF, Selectivity section**: I would like to see this section expanded upon based upon the native impacts documented in Nault et al 2018. Perhaps include a table of the native species currently present in Upper Kaubashine Lake, and how these specific species may likely be impacted based upon the findings presented in Nault et al 2018 (Table 5). An analysis of the anticipated native plant impacts of a large-scale 2,4-D treatment in Upper Kaubashine Lake was presented at Planning Meeting I and is contained within Appendix A (PDF pg 16-17). A short paragraph referencing this discussion was added.

- **Pg. 73 in PDF, Purple Loosestrife**: Our SWIMS database has an 'observed' (non-verified) purple loosestrife record for Upper Kaubashine. If this species has been verified by WDNR or the Herbarium, the status should be changed to 'verified'. Map 5 shows the 2 locations where Onterra located PL in 2017.

- **Pg. 84 in PDF, last paragraph**: I believe that the statement that "*The reduction of EWM would set the aquatic vegetation community (lakescape) back to what it looked like in 2013*" is overly generalized and very likely unrealistic. Based upon what we know about native plant community impacts following large-scale 2,4-D treatments, I would not expect that the current plant community would simply 'go back' to the same community that was present prior to invasion. It's very likely that this proposed treatment will have some lakewide native plant impacts similar to other large-scale treatments we've monitored to date, but the longevity of those impacts is not as certain. I think that they can state that the mgmt. *goal* is to try and get the native community as close to pre-invasion as possible, but the statement that by reducing EWM (via a large-scale herbicide treatment) that the native plant community will quickly rebound back to

'normal' is very unlikely. In fact, based upon the data presented, the current 2017 native plant community is already basically the same as the native community documented in 2013. In addition, recent research (unpublished, but submitted to peer-review) indicates that the impacts to the native plant community following large-scale chemical management are oftentimes observed at a much greater magnitude than the direct impacts of EWM competition on native plants (i.e. cure vs. disease analysis). This statement has been qualified per the reviewer's comment. This sentiment is now also addressed in the Summary & Conclusions Section (4.0).

- **Pg. 89 in PDF:** I'm not sure that I would consider a lakewide epilimnetic rate of 0.3 ppm (300 ppb) 2,4-D to be on the 'lower range' of current dosing strategies. Rather, a lakewide rate of 0.3 ppm has been the recommended target rate suggested across many recently implemented large-scale treatments, in order to try and see if we can find a 'middle ground' that maximizes EWM control while simultaneously minimizing native plant impacts. The Nault et al. 2018 paper had lakewide targets that ranged from 73-500 ppb, with an average mean rate of 310 ppb, and a median rate of 339 ppb. So in my opinion I would consider a lakewide rate of 300 ppb to be right in the 'middle range' of recently implemented large-scale dosing strategies, not the 'lower range'. Onterra does not/has not recommend large-scale 2,4-D targets below 0.3 ppm ae. This statement has been modified and clarified.

**Comments from Susan Knight(**UW Trout Lake Station Center for Limnology Scientist)

Overall, I think Onterra created a very good and balanced plan laying out the results, and pros and cons of using herbicides and other options.

- I think figure 3.4-12 was useful for showing the overlap of EWM and biovolume. I don't know if there is a map of biovolume before EWM was high, but my guess is there has always been a high biovolume where there is now EWM, i.e., the biovolume isn't high only because of EWM. The EWM has clearly added to the plant biovolume, but likely it moved into areas already rich with plants. I don't have a map of pre-EWM vegetation, but possibly the EWM has already spread to its full distribution, and while it might get denser, its footprint may already be evident. Topic is addressed in Figure 3.4-12 and associated text.

- Nault: …Figure 3.4-6 (Pg. 53-54 in PDF) & Figure 3.4-11 (Pg. 63 in PDF): "…This seems to suggest that EWM is not actually outcompeting or pushing out native plants (at least based upon the data we have collected to date), but rather is more than likely just filling in an open niche in the ecosystem that's currently unoccupied."

  a. I agree and see from Figure 3.4-4 that % rake fullness of 3 has increased over years. It seems likely that EWM has added to the frequency with which there is a 3 on the rake.
  b. Figure 3.4-13 indicates EWM has increased, and some native species are somewhat diminished, but the most common species are still the most common species.
  c. And Onterra (p. 81) agrees: "Many of the native aquatic plant species have not shown practically significant changes (some statistically valid changes noted) in their population during the 5 years since EWM has been detected from Upper Kaubashine Lake."
  d. Nault:"…I would like to see a more detailed discussion of this observation included in the plan, and how that observation is related to discussions on whether or not to manage for 'ecological restoration'…"
     i. I agree here, too. I don't see managing EWM as ecological restoration, though maybe management could lead to recreational restoration.

These concepts are addressed in the sub-sections on *Impact Riparian Use* and *Impact Historic Ecosystem Function*. Also see response comment to Carol Warden's 4th comment.

- 4. I agree with Michelle there should be a table of the native plant species likely affected by 2,4-D based on her 2018 paper. See response comment to Michelle Nault's 10th comment.

5. Onterra, p.65: "Ecosystem Restoration Approach: Some believe that there is an intrinsic responsibility to correct for changes in the environment that are caused by humans. For lakes with EWM populations, that may be to manage the EWM population at a reduced level to allow the lake to function as it had prior to EWM establishment." I am not convinced the lake is functioning differently with EWM (though I recognize the recreational value has changed). Qualifying statements were added. This sentiment is now also addressed in the Summary & Conclusions Section (4.0).

6. Goals:

a. See Michelle's comment on "lower range of current dosing strategies". Qualifying statements were added.

b. There are two Goal 3s: the first is to reduce EWM and the second is for restoring shorelands (maybe they were parts of the same goal). Change has been made

i. I heartily agree with restoring shorelands; Map 3 indicates there is a great deal of room for improvement, though the CWH survey indicates this feature is in good shape. No action taken.

ii. Pre-treatment year should be 2018 at the earliest. I suggest waiting a few years longer to see the full extent of EWM distribution and density. No action taken.

I feel that the lake association should wait until the full extent of EWM levels is evident, or it becomes intolerable. 2,4-D will likely be effective, but it will only be effective for a few years. I recommend at least delaying, and possibly not using plant herbicides. There is value in having the lake group see if they can adjust to this new normal situation (their lake with a sizable EWM population), and consider what it means to start down the path of using high quantities of herbicides into the future. No action taken.

**Comments from Scott Van Egeren:** (WDNR statewide limnologist)

I think this is a very well done plan overall, but I have provided a few edits and comments below.

- Pg. 53 – According to Figure 3.4-6 Elodea was significantly more abundant in 2016 and 2017 than in 2013. It wasn't significantly more abundant in 2016 than 2017. Change has been made.

- Pg. 63 and pg. 81 – The Simpson diversity metric was 0.88 in 2013, 0.88 in 2016, and 0.87 in 2017. While the relative frequency of the "other species" did decline slightly in 2017, the species richness and diversity haven't changed in a significant way. I don't see a strong argument that the increase in EWM has had an effect on the plant diversity measurement within the lake. It could be possible that native plants have decreased at the points which EWM occupies, but this isn't illustrated in the report. Change has been made.

- Pg. 70 – At a static exposure of 0.05 ppm ae for 58 days (**adult** fish exposed for 28 days then **larval fish from** eggs they laid were continued to be exposed for 30 more days post **hatching**) uncovered a reduction in larval fathead survival from 97% to 83% at the lowest dose of **the 2,4-d (amine salt) formulation** that was tested (no reduction at higher doses). The

added bold words in the sentence above make this an accurate representation of the research (DeQuattro and Karasov 2015) that was conducted. Change has been made.

- Pg. 72 – It seems somewhat inaccurate and/or premature to state that the UWSP study found no measurable impacts on zooplankton and fisheries. The different groups of zooplankton showed different trends in the treated vs reference lakes and larval perch abundance the year after treatment declined in treatment lakes, but not the reference lakes (although not quite significant to p=0.05). A one-page summary of the study written by the authors is included in the Appendices.

- 2,4-d toxicity studies – Both the recent UW-Madison laboratory and UWSP 2,4-d toxicity field studies have not yet been published and no large claims should be made about them at this point. This plan portrays the risk of herbicide use well throughout the document, but it won't help to discuss unpublished results at this point. Updated reference to these studies, as they are now all published

- Pg. 73 – The title for figure 3.5-2 seems to be wrong Change has been made

- General comment – There should be a discussion on likely susceptibility to 2,4-d herbicide for the plant species found in Upper Kaubashine Lake. See response comment to Michelle Nault's 10th comment.

**Comments from John Kubisiak** (WDNR Fisheries Biologist)

- Page 85, contacts. I am no longer the Fisheries Biologist, this is not the Three Lakes Chain and Pat Novesky is not the warden. Change has been made

- Upper Kaubashine does not have adequate public access, so DNR does not perform Natural Resource Enhancement Services like fish stocking. Clarification was made.

# G

# APPENDIX G

## Upper Kaubashine 2018 EWM Control & Monitoring Report

# 1.0 INTRODUCTION

Upper Kaubashine Lake is a 190-acre spring lake in Oneida County. Eurasian watermilfoil (EWM) was first discovered in the lake in July of 2013 along the lake's northwest side. Genetic analysis has indicated that of the few samples tested to date, all are were confirmed as pure-strain EWM rather than a hybrid variety.

**Photo 1. Upper Kaubashine Lake, Oneida County.** Photo by Onterra, August 22, 2018.

The Upper Kaubashine Property Owners Association (UKPOA) partnered with the Town of Hazelhurst and were awarded a three-year Aquatic Invasive Species (AIS) Early Detection & Response (EDR) in February 2014 (AIRR-169-14) to initiate monitoring and hand-removal actions in 2014-2016. In 2014-2015, the UKPOA contracted with a professional hand-harvesting firm that removed approximately 1,300 gallons of EWM from the lake. These efforts provided some seasonal reductions in the EWM population in the areas where removal actions took place, but ultimately were shown to be insufficient to maintain or reduce the EWM population in the lake.

During a July 2015 UKPOA annual meeting, Onterra and UKPOA representatives discussed the increasing concerns regarding the EWM population in the lake. Control strategies were discussed including addition of a Diver Assisted Suction Harvest (DASH) component to the hand-harvesting. The use of spot and large-scale herbicide treatments was also discussed. The AIS-EDR grant category is intended to provide funding to lake groups to "*provide early identification and control of pioneer populations of AIS*". In the WDNR's review, it was stated that actions such as the use of DASH or herbicide spot treatment would not be in line with the AIS-EDR's intended goal as the population progressed past a pioneer phase and therefore were disallowed from the project.

The WDNR also voiced concerns about the lack of an approved lake management plan for Upper Kaubashine Lake. A lake management plan would document the current state of the lake in terms of various biologic factors (e.g. water quality, watershed, aquatic plants, fisheries) in addition to drawing off historical information on these parameters. A lake management plan would also create an implementation plan which would help guide management and monitoring actions in the future, which on Upper Kaubashine Lake would include the development of a management strategy for EWM. To aid in the planning process, a stakeholder survey is often sent to lake riparians to understand riparian sentiments on the direction of management and their level of support for various management strategies (e.g. herbicide treatment). The WDNR granted a second AIS-EDR Grant (AIRR-208-16) in February 2016 to offset the costs of continued EWM monitoring as well a portion of the tasks required to create an Aquatic Plant Management Plan.

The EWM population was monitored in 2016 and 2017 during which the population continued to expand in the lake (Map 1). A late-summer 2016 EWM mapping survey indicated that the population expanded to include approximately 26.5 acres of colonized plants in addition to numerous smaller sized occurrences mapped with point-based methodologies. By the late-summer of 2017, the population was found to cover approximately the same footprint, however an increase in density was evident in many

colonies as more colonies were described as either *dominant*, *highly dominant,* and *surface matting* in densities. Quantitative monitoring in the form of whole-lake point-intercept surveys showed an increasing littoral frequency of occurrence of the EWM population from 0% in 2013 to over 35% in 2017.

The expanding EWM population in Upper Kaubashine Lake led to the UKPOA to consider various management strategies for Upper Kaubashine Lake during the creation of the lake management plan. The *Upper Kaubashine Lake Comprehensive Management Plan* was finalized and approved by the WDNR in December 2018. This document contains 21 pages (pg 51-72) of expanded discussion specific to EWM management within Upper Kaubashine Lake. The Implementation Plan Section (5.0) of the Comprehensive Management Plan contains management goals and associated management actions, including those the association constructed to manage and monitor the EWM population of Upper Kaubashine Lake. Reference to the *Upper Kaubashine Lake Comprehensive Management Plan* (Dec2018) will improve understanding of this document.

On June 28, 2017 the UKPOA Planning Committee voted 4 (in favor) to 2 (against) pursuing large-scale herbicide treatment strategy to present to the membership for consideration. Prior to the 2017 UKPOA annual meeting, the Planning Committee with review from Onterra and the WDNR, distributed a *10 Eurasian Watermilfoil Myths and Facts* factsheet. At the meeting, both dissenting Planning Committee members were given an opportunity to explain to the attendees why they were not in favor of a large-scale herbicide control strategy. Some other UKPOA members then voiced their opinion, either for or against herbicide use. The UKPOA membership voted 72 *for* and 18 *against* to give the Board of Directors permission to make the decision on how to proceed. The board voted to move forward with a whole-lake 2,4-D treatment during the spring of 2018.

The UKPOA and the third-party applicator selected by the association, Clean Lakes, started the WDNR permit application process during mid-March 2018. A component of the permit application includes publishing a notice of the permit request in the local newspaper, including acknowledgement that the applicant would hold a public information meeting if requested by five or more individuals or entities. Fifteen individuals, largely from Lower Kaubashine Lake, submitted letters to the WDNR during the five days following the notice requesting a public informational meeting. According to WDNR administrative code, the individuals requesting the public information meeting set the agenda, so a representative of the Lower Kaubashine Lake Association provided that agenda in the form of a series of questions. The meeting was held on April 17, 2018 at the Hazelhurst Town Hall, with representatives from WDNR and Onterra addressing the questions posted as the agenda, as well as follow-up questions from the approximately 80 attendees. The meeting was facilitated by an impartial moderator.

The WDNR approved the UKPOA's permit application on May 10, 2018. No individuals or entities challenged the permit issuance. This report discusses the planning, monitoring, and implementation of the 2018 whole-lake 2,4-D treatment on Upper Kaubashine Lake during the *year of treatment* (2018).

## 1.1 Whole-Lake 2,4-D Treatment Strategy

From an ecological perspective, large-scale treatments are those where the herbicide may be applied to specific sites, but when the herbicide dissipates from where it was applied and reaches equilibrium within the entire mixing volume of water (within the epilimnion of the lake); it is at a concentration that is sufficient to cause mortality to the target plant within that entire volume. An article by Nault et al. 2018 investigated 28 large-scale herbicide treatments in Wisconsin and found that "herbicide dissipation from

the treatment sites into surrounding untreated waters was rapid (within 1 day) and lake-wide low-concentration equilibriums were reached within the first few days after application." In other words, the herbicide dissipates out of the application area and reaches a lake-wide equilibrium concentration within a few days after the treatment occurs. Further, the subsequent herbicide concentration in the lake is largely driven by the rate of microbial degradation. In some lakes that have an outlet, herbicide dissipation out of the lake can also influence in-lake herbicide concentrations.

The control strategy developed for Upper Kaubashine Lake included the application of liquid 2,4-D amine over approximately 34 acres of high-density EWM in order to achieve a target lake-wide epilimnetic concentration of 0.300 ppm acid equivalent (ae). Onterra typically recommends a target lake-wide 2,4-D concentration between 0.300 ppm ae and 0.375 ppm ae for pure-strain EWM large-scale 2,4-D treatments. The target concentration prescribed for Upper Kaubashine is toward the lower range of Onterra's current dosing strategies to account for a potentially slower degradation pattern due to the moderate productivity (mesotrophic biological parameters) of the system. While Upper Kaubashine has an outlet, the herbicide loss from this source was hypothesized to have minimal impact on the in-lake concentrations. The strategy also accounts for the western basin being targeted in a manner that would aid in even herbicide concentration in this protected part of the lake that might not experience the water exchange patterns as the main body of the lake

In the summer of 2017, Onterra ecologists conducted an acoustic survey of Upper Kaubashine Lake to obtain accurate bathymetric data for the proposed 2018 treatment to ensure accurate herbicide dosing (Figure 1). This ensures that the dosing strategy is appropriate to impact the target plant and to minimize collateral effects on the native plant community. These data are particularly important for Upper Kaubashine Lake as small changes in anticipated herbicide mixing depth can have large differences in water volumes. Volume calculations utilizing the data obtained from the acoustic data indicate the entire water volume of Upper Kaubashine Lake to be approximately 5,092 acre-feet.

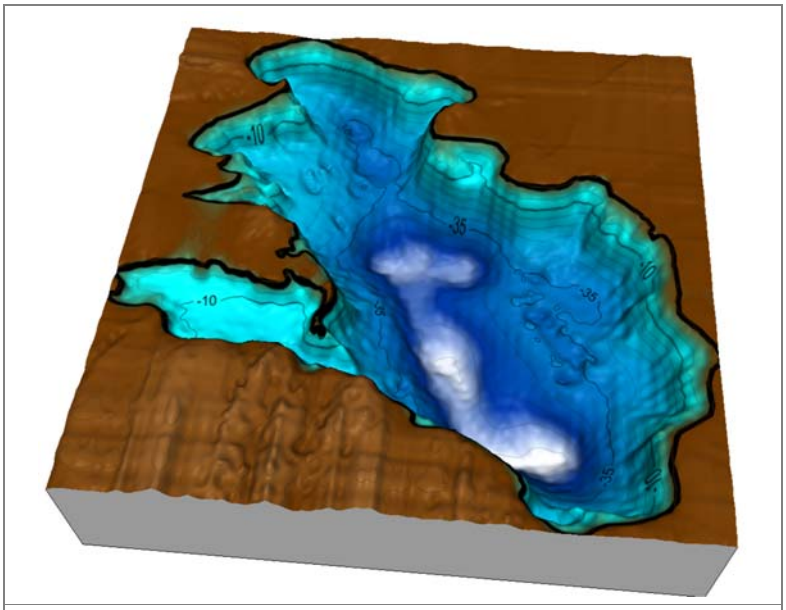



**Figure 1. 3-D model of Upper Kaubashine Lake's Bathymetry.** Bathymetry model based on 2017 acoustic survey. Model not applied to surrounding shorelands.

The objective of an herbicide treatment strategy is to maximize target species (EWM) mortality while minimizing impacts to valuable native aquatic plant species. Monitoring herbicide treatments and defining their success incorporates both quantitative and qualitative methods. As the name suggests, quantitative monitoring involves comparing number data (or quantities) such as plant frequency of occurrence before and after the control strategy is implemented. Qualitative monitoring is completed by comparing visual data such as AIS colony density ratings before and after the treatments.

Because the 2018 treatment on Upper Kaubashine Lake was anticipated to have whole-lake affects, the whole-lake point-intercept method as described by the WDNR Bureau of Science Services (PUB-SS-

1068 2010) will be used to complete a quantitative evaluation of the occurrences of non-native and native aquatic plant species. To monitor the treatment's efficacy, a whole-lake point-intercept survey was conducted in 2017 (*year prior to treatment*), 2018 (*year of treatment*), and planned for 2019 (*year following treatment*).

As outlined within the *Upper Kaubashine Lake Comprehensive Management Plan* (Dec2018), the success criteria of a whole-lake 2,4-D treatment on Upper Kaubashine Lake would be a 70% reduction in EWM littoral frequency of occurrence comparing point-intercept surveys from the *year prior to the treatment* (2017) to the *year after the treatment* (2019). Understanding the EWM population in 2018 (*year of treatment*) is important, but an insufficient time has passed to make official judgements if EWM control occurred or if the plants were simply injured for that season and can quickly rebound.

Qualitative monitoring will be conducted annually through EWM mapping surveys on Upper Kaubashine Lake using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and were qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques are applied to locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.

In-lake herbicide concentrations are also monitored as a part of some treatment strategies, especially those involving anticipated whole-lake impacts. In association with the 2018 treatment in Upper Kaubashine Lake, 2,4-D concentrations were monitored to determine if the target concentrations had been met as well as to evaluate concentrations in the downstream waterbodies including Kaubashine Creek and Lower Kaubashine Lake. With this type of monitoring, water samples are collected by trained volunteers from multiple locations over the course of numerous days following treatment.

Water samples were to be collected at eight sites (Figure 2) at time intervals of approximately 1, 3, 5, 7, 14, 21, 35, 49,70, and 100 days after treatment (DAT) using an integrated sampler or Van Dorn sampler. The samples were preserved with acid and shipped to the Wisconsin State Lab of Hygiene (SLOH) where the herbicide analysis is completed. A volunteer from Lower Kaubashine Lake assisted with the collection of water samples at LK1, LK2, and LK3. A volunteer from Upper Kaubashine Lake collected the water samples in Upper Kaubashine Lake and in the outlet beaver pond (KC).

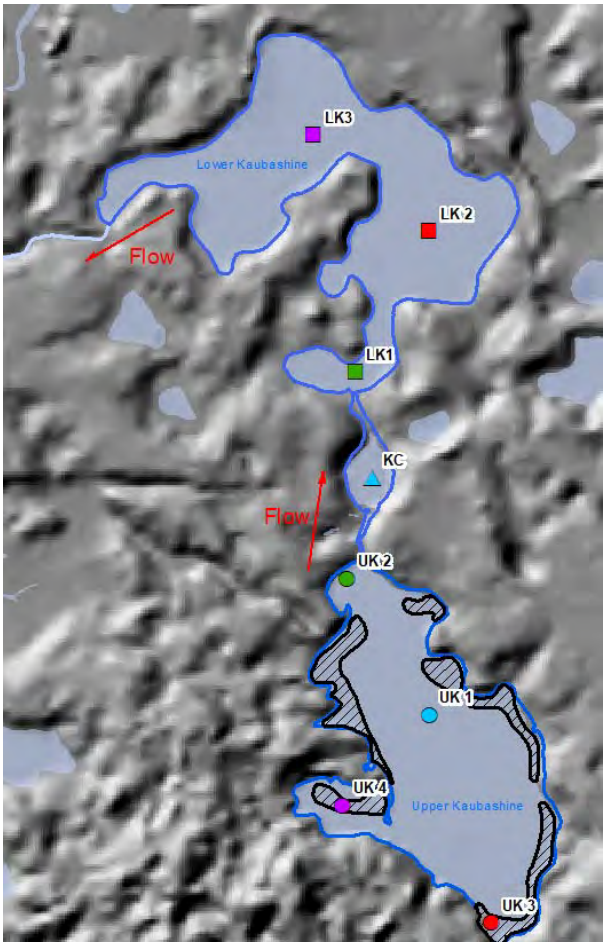



**Figure 2. Herbicide concentration monitoring plan.**

# 2.0 PRETREATMENT SURVEY AND FINAL DOSING

In order to finalize the dosing volume for the 2018 treatment, it was necessary to understand the volume of water in which the herbicide is expected to mix. As the water warms, a thermal barrier develops in many lakes essentially separating the lake into an upper epilimnion with warmer water temperatures and a lower hypolimnion with cooler water temperatures (Figure 3). The transitional area separating the upper and lower portions of the water column or metalimnion, is used to calculate the dosing volume for the herbicide treatment. Volunteers from the UKPOA provided numerous temperature profiles in the days and weeks leading up to the whole-lake herbicide treatment on Upper Kaubashine Lake (Figure 4).

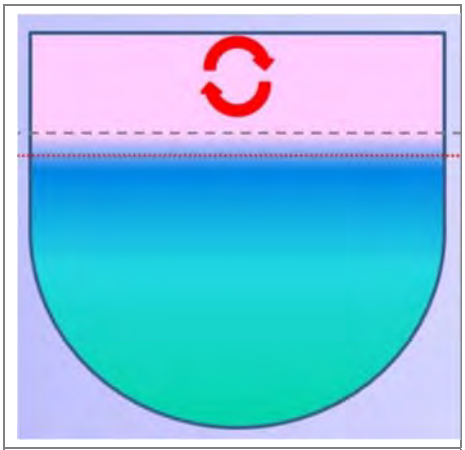


**Figure 3. Mixing zone of a stratified lake.** Grey dashed line indicates start of metalimnion. Red dashed line indicates mixing volume used in dosing calculations.

On May 24, 2018, Onterra ecologists conducted the Spring Pre-treatment Confirmation and Refinement Survey on Upper Kaubashine Lake. During this survey, the presence of actively growing EWM was confirmed within the proposed treatment sites. A temperature profile indicated the near-surface water temperature in the lake was 66°F and the lake was weakly stratified between approximately 9 and 15 feet (Figure 4). No alterations were made to the herbicide application areas following the pre-treatment survey, however continued monitoring of the thermal stratification parameters was required.

Based upon profiles collected in June 2017, Upper Kaubashine Lake's top water layer (epilimnion) mixed down to 15 feet. For planning purposes during the winter of 2017-2018, discussions were based off stratification down to 18 feet to ensure the lake group was financially prepared if it stratified a little deeper in 2018 compared to 2017. Early projections in mid-May 2018 indicated that Upper Kaubashine Lake was starting to stratify at a depth of approximately 15 feet. However, the cool spring followed by a late-May heat wave resulted in a different stratification pattern emerging. The late-May 2018 temperature profiles suggested the epilimnion only extended down about 6 feet. Acknowledging that some herbicide will undoubtedly mix into the middle water layer (metalimnion), Onterra typically predicts the herbicide mixing depth a few feet below the bottom of the epilimnion.

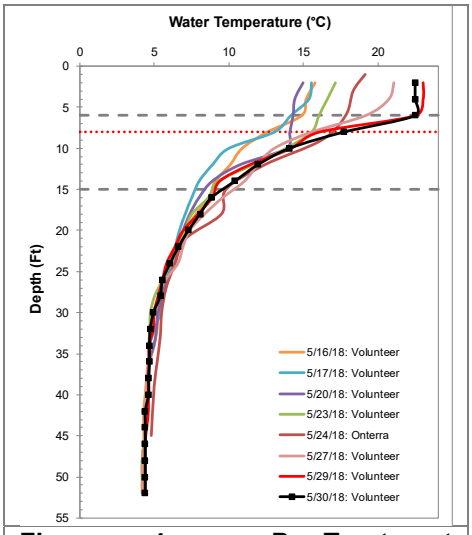



**Figure 4. Pre-Treatment Temperature Profiles on Upper Kaubashine Lake.** Red dotted line indicates dosing depth used for 2018 treatment (8ft).

For Upper Kaubashine Lake in 2018, Onterra recommended a mixing volume that extends down 8 feet (Figure 4). Onterra indicated that it was likely that surface waters of Upper Kaubashine Lake would cool and the epilimnion may extend a little deeper. This would result in the potential for a slightly lower herbicide concentration. With the potential for a slower 2,4-D degradation pattern on Upper Kaubashine Lake, Onterra's position was that it would be better to be slightly below targets than risk having too high of concentrations that could have greater impacts to the native plant

community of the lake. Onterra was averse to postponing the treatment any longer for concerns of increased potential impact to native plant communities as the season progressed.

Map 2 displays the final whole-lake 2,4-D treatment designed for Upper Kaubashine Lake in 2018. The treatment included application of liquid 2,4-D at between 0.9-2.1 ppm acid equivalent (ae) over 34.3 acres of the lake. It was expected that the herbicide would mix throughout the entire epilimnion of the lake (8 feet) following the application, resulting in a target whole-lake epilimnetic 2,4-D concentration of 0.300 ppm ae.

Due to the later than usual ice-off in spring 2018, the WDNR wanted to evaluate whether the EWM population may be suppressed in 2018 if left untreated. To accomplish this task, WDNR staff completed a pretreatment whole-lake point-intercept survey on May 24, 2018. This survey would allow for a quantitative assessment of the EWM population as well as provide insight as to which native aquatic plant species were present prior to the herbicide treatment. If the data showed a minimal EWM population, consideration for postponing the herbicide treatment strategy would be made.

The results of the survey found EWM to be present on 72 of the 231 sampling sites that were within the littoral area of the lake resulting in a littoral frequency of occurrence of 31.2%. At 31.2%, the EWM population documented during this survey was similar to the 35.2% occurrence that was observed during the summer 2017 point-intercept survey and suggested that the EWM population was likely to be of a similar footprint in 2018 as was observed in 2017. Native aquatic plants were also recorded during the survey and found that the most common species at the time of the survey included common waterweed (23.8% occurrence), muskgrasses (19.5% occurrence), and coontail (17.3% occurrence).

The herbicide treatment was conducted by Clean Lakes, Inc on May 31, 2018 using a liquid formulation of 2,4-D amine (DMA 4 IVM). The herbicide was applied to the upper half of the water column through sub-surface injection using weighted hoses. The applicator reported a near-surface water temperature of approximately 73-74°F and westerly winds (1-12 mph) at the time of application.

# 3.0 2018 MONITORING RESULTS

## 3.1 Herbicide Concentration Monitoring in Surface Waters

Figure 5 shows the results of the volunteer-based 2,4-D monitoring that occurred in association with the 2018 large-scale treatment on Upper Kaubashine Lake. Herbicide concentrations were near the application target in three of the four surface samples during the 1 DAT interval. Concentrations were fairly uniform by about 3 DAT indicating that mixing had occurred within the lake-wide (or basin-wide) epilimnion. Herbicide monitoring following the treatment found that the mean 1-14 DAT concentration was 0.180 ppm ae (Figure 4).

Herbicide persistence was similar to predicted, with concentrations exceeding the irrigation threshold (0.1 ppm ae) for at least 21 days (model suggest 25 DAT). Through a log-linear regression analysis ($r^2$=0.93), the 2,4-D half-life for the 2018 treatment in Upper Kaubashine Lake was found to be 22.5 days, meaning that every 22.5 days, the herbicide degraded into half of its original concentration. Nault et al. 2018 indicated the 2,4-D half-life was shown to range from 4-76 days within the 28 lakes studies, with the "rate of herbicide degradation to be slower in lower-nutrient seepage lakes." Adding 18 additional Onterra-monitored projects to this dataset yields a median 2,4-D half-life of approximately

22.75 days. The 22.5-day half-life from Upper Kaubashine Lake in 2018 falls within the 48th percentile of this dataset (i.e. similar to the median).

Herbicide concentrations exceeded the irrigation threshold (0.1 ppm ae) through approximately 21 DAT. Concentrations degraded to approximately 0.05 ppm ae by 35 DAT and were sustained at approximately that level through 70 DAT. The black square symbols on Figure 4 represent the samples that were collected from the UK 1 deep hole site from a depth of 30 feet. The herbicide concentrations from each of the deep samples confirm that minimal 2,4-D migrated below the thermal temperature gradient separating the epilimnion from the hypolimnion between the time of application and at least 21 DAT.

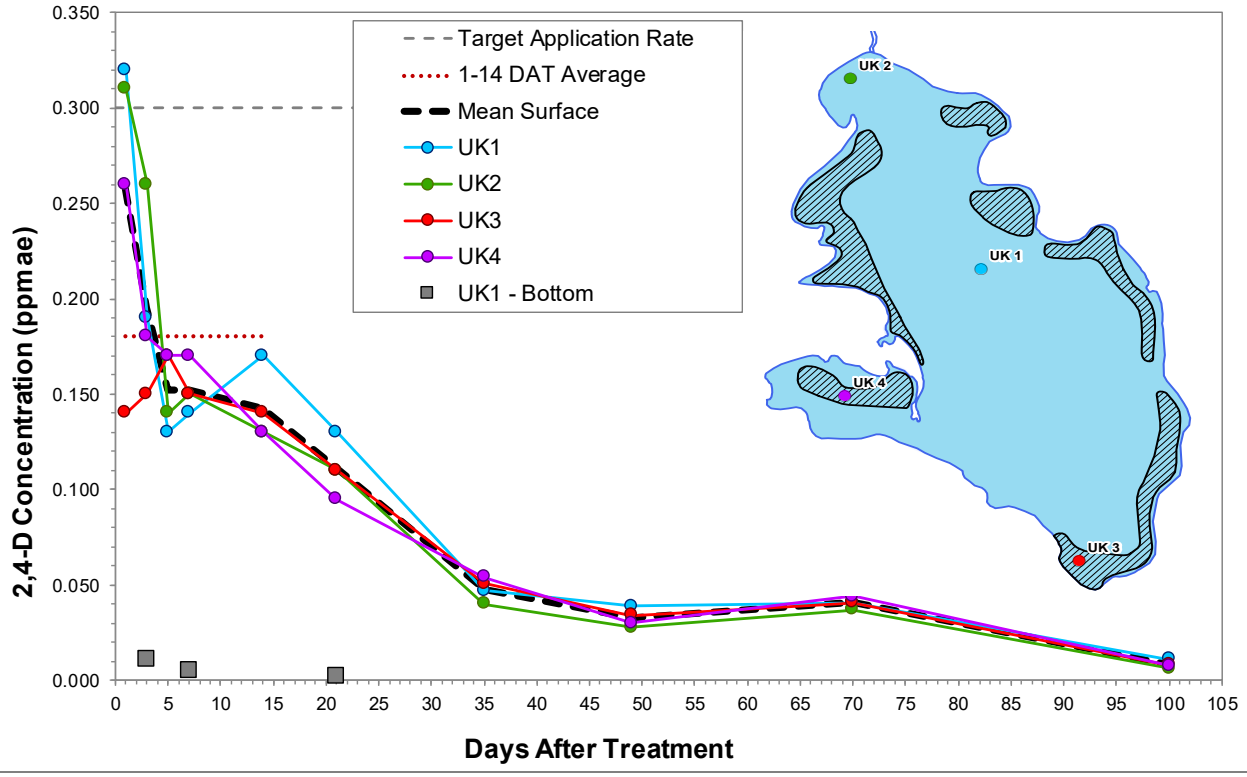



**Figure 5. Upper Kaubashine Lake 2018 Herbicide Concentration Monitoring Results from five monitoring locations.**

Water samples in the downstream Kaubashine Creek beaver pond (KC) and Lower Kaubashine Lake (LK1-LK3) were also collected to determine 2,4-D concentrations (Figure 6). Herbicide concentrations in the beaver pond were 0.13-0.14 ppm ae during the 3 DAT and 7 DAT sampling events, respectively. By 21 DAT, the concentrations were at 0.023 ppm ae and below detection at 49 DAT. Onterra believes the concentrations observed in the beaver pond may have been sufficient to have impacts (likely sub-lethal impacts) to some sensitive native plants if present, but do not anticipate impacts to floating-leaf (i.e. water lilies) or nearshore emergent plants at these concentrations.

Herbicide concentrations within the upstream part of Lower Kaubashine peaked at 0.71 ppm ae at 7 DAT and were found at below 0.005 ppm ae at all subsequent sampling events. Herbicide concentrations in LKI2 and LK3 were not observed above 0.005 ppm ae in any of the samples.

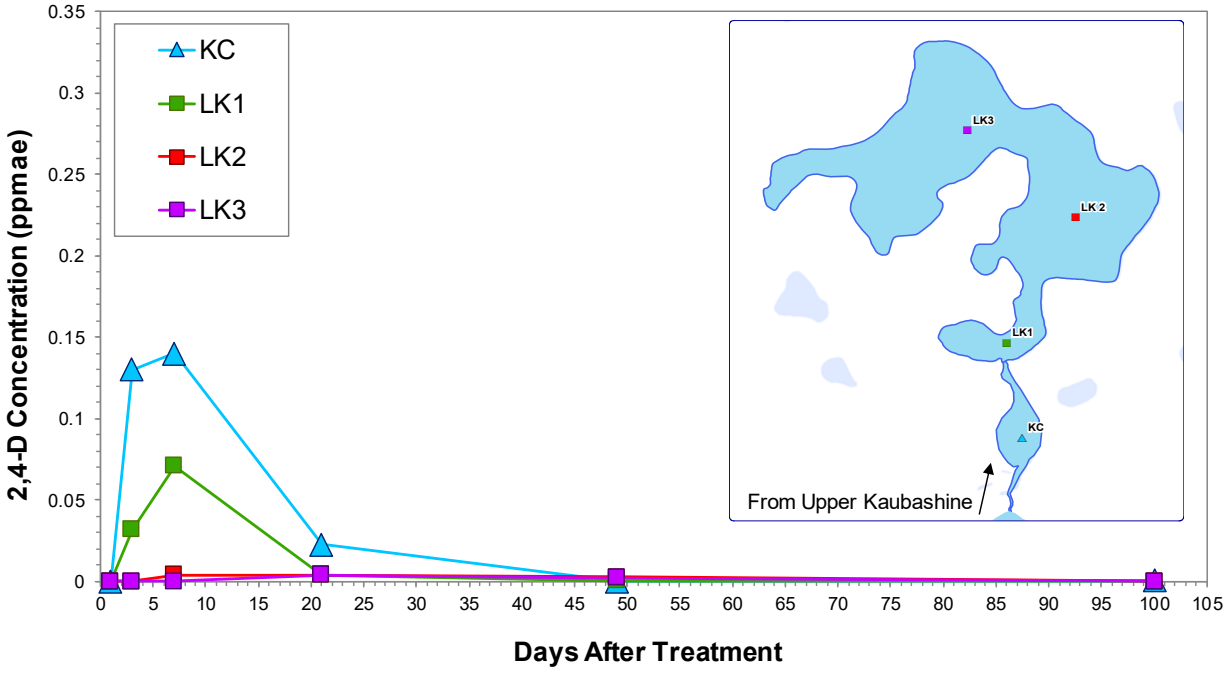



**Figure 6. Kaubashine Creek and Lower Kaubashine Lake 2018 Herbicide Concentration Monitoring Results from four monitoring locations.** Whole-lake 2,4-D treatment occurred on upstream waterbody (Upper Kaubashine Lake).

Temperature profiles collected before the treatment and at each herbicide concentration sampling interval indicate that the lake was stratified to approximately eight feet in the profiles collected up to 8 days after treatment. Limnologists understand thermal stratification as occurring when there is a change of 1°C within 1 meter of water depth. As is displayed on the isotherm on Figure 7(left frame), the thermal stratification that was in place around the time of the herbicide treatment appeared to have shifted somewhat deeper over the duration of the post-treatment sampling into September. The deeper shift in stratification resulted in a larger water volume for the herbicide to mix within resulting in a dilution of the herbicide and ultimately the lower concentrations observed.

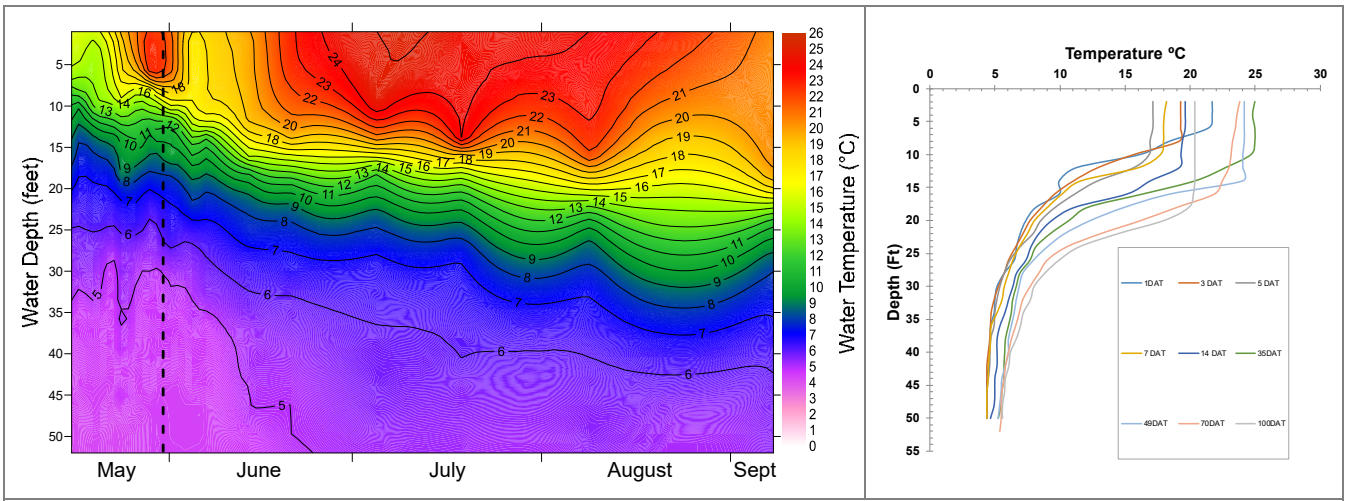



**Figure 7. Temperature Isotherm (left) and Profiles (right) Collected from Upper Kaubashine Lake after the 2018 Herbicide Treatment.** Dashed line on isotherm represents treatment date.

## 3.2 Herbicide Concentration Monitoring in Ground Waters

***Authored by WDNR Staff***

Some landowners expressed concern about herbicide from the proposed whole-lake treatment moving into the groundwater adjacent to the lake and being found in well water. WDNR Groundwater program staff helped to provide feedback on the shoreline areas surrounding the lake which would be most likely to receive groundwater moving from the lake. They used information on topography, lake elevation, and glacial geology from the area to describe the most likely flow direction of water from the lake to the groundwater.

Information from the DNR and Wisconsin Geological and Natural History Survey (WGNHS) well construction databases were used to examine the depths of wells constructed near the lake. In addition, nitrate data from wells near the lake were used to show that nitrate (originating from surface water) concentrations decreased substantially around 40 feet depth. Therefore, shallow wells (near or less than 40 feet in depth) were also prioritized for monitoring.

Finally, an estimation of groundwater specific capacity and soil hydraulic conductivity was made using well pump test data from the well databases. This data was combined with an estimate of groundwater velocity to estimate how long it would take for water moving from the lake to reach the wells at a certain distance and depth. This information allowed us to set well monitoring dates that should capture the timeframe of herbicide that would be moving from the lake to the groundwater near the selected wells.

WDNR and the UKPOA asked for landowners that wanted their well water tested. Homes/cabins along the western/northwestern shoreline that were fairly close to the lake and/or were shallow were included. Ultimately five wells were monitored along the west shore of the lake on four dates between August 9 and October 4, 2018 (Figure 8). Samples were sent to Davy Laboratories in La Crosse, WI to be analyzed for 2,4-D using EPA drinking water analysis method 515.3. The detection limit of the analysis was 0.000093 ppm (0.093 ug/L) and the maximum contaminant level allowed for 2,4-D in drinking water 0.07 ppm (70 ug/L). No 2,4-D was detected in any of the wells over this time period.

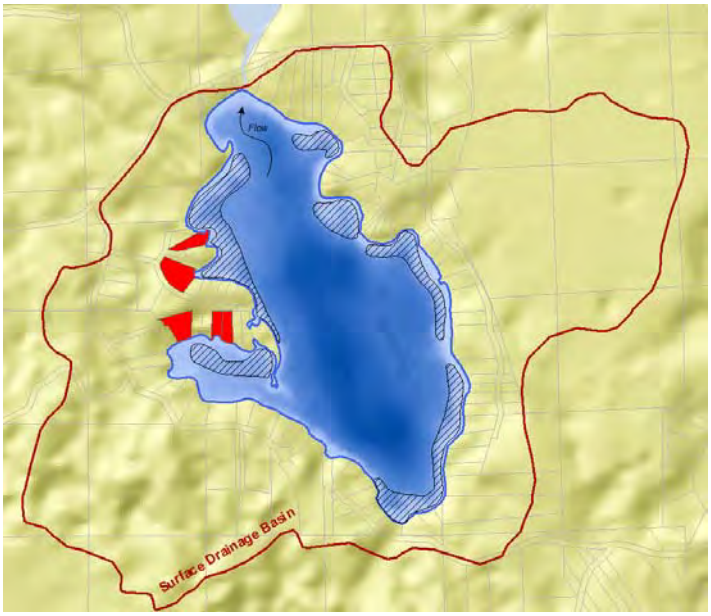



**Figure 8. Well testing locations.** Properties with wells tested highlighted in red.

## 3.3 Point-Intercept Survey

A point-intercept aquatic plant survey was first conducted on Upper Kaubashine Lake in 2013 by the WDNR. Although EWM was present in the lake during the 2013 point-intercept survey, no occurrences were physically sampled on the rake. Only plants that are sampled on the survey rake are used for analysis purposes and thus the littoral frequency of occurrence (LFOO) of EWM in 2013 was 0%. Additional point-intercept surveys were completed in 2016, 2017, and 2018 by Onterra as a part of the current WDNR grant-funded project. The LFOO of EWM was found to have increased to 22.9% by 2016 and to 35.2% in 2017 (Figure 9). Following the spring 2018 large-scale 2,4-D treatment, the EWM LFOO was reduced to 0% in the August 2018 point-intercept survey representing a 100% decrease since 2017. Understanding the EWM occurrence in 2018 is important, however, the 2019 littoral frequency of occurrence will be used to determine if the large-scale treatment meets the quantitative success criterion of a 70% decline from the *year before treatment* (2017) to the *year after treatment* (2019).

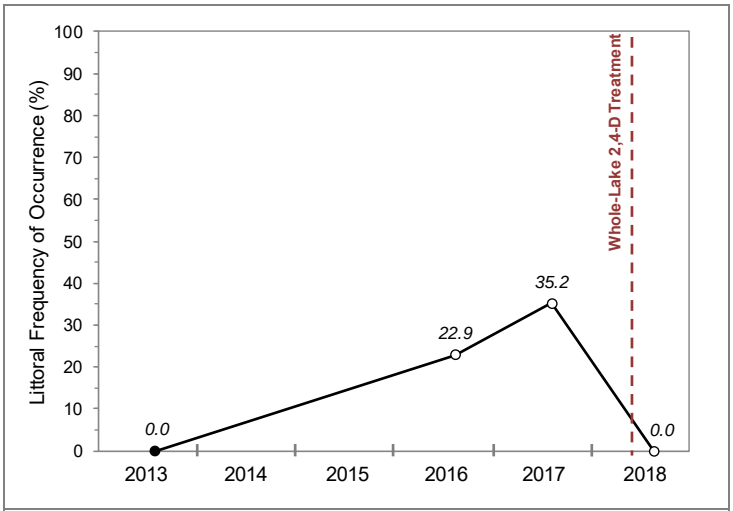



**Figure 9. Upper Kaubashine Lake EWM littoral frequency of occurrence from 2013-2018.** Open circles on represent a statistically valid change from previous survey.

Figure 10 investigates the average number of native plant species at each point-intercept sampling location. These data show a downward trend in native plant population from 2013 to 2017 when no chemical treatments occurred. Aquatic plant populations are known to fluctuate over time and continued monitoring would be needed to understand if these changes are in response to the increased EWM population or if they are related to other environmental factors. Following the whole-lake herbicide treatment, the average number of native species per sampling site decreased further from 1.27 in 2017 to 0.92 in 2018.

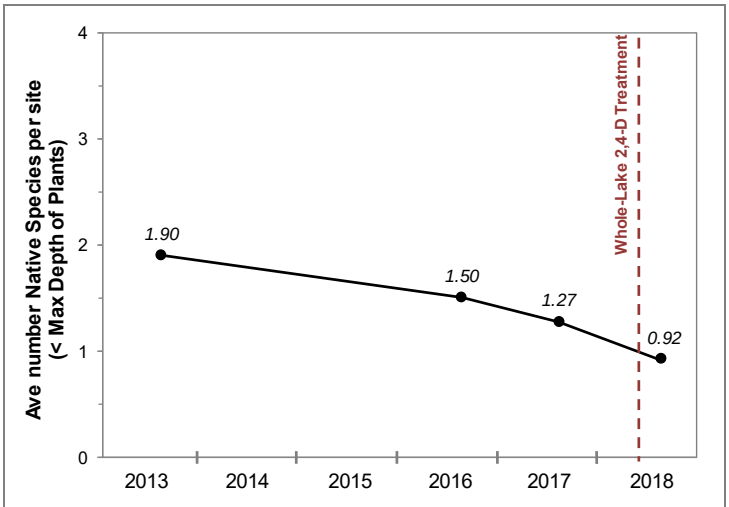



**Figure 10. Average number of native aquatic plant species per littoral sampling site (2013-2018) in Upper Kaubashine Lake.**

Figure 11 displays the number of point-intercept survey sampling locations that contained either native plants only, EWM plants only, or native plants and EWM plants from surveys completed in 2013-2018 in Upper Kaubashine Lake. An increase in sampling points that contained vegetation, both native and EWM, is evident between the 2013 and 2016 surveys. After the whole-lake treatment, the number of sampling points with native plants decreased slightly from 134 points in 2017 to 126 points in 2018, whereas the number of sampling points with EWM decreased from 76 in 2017, to zero sampling points in 2018.

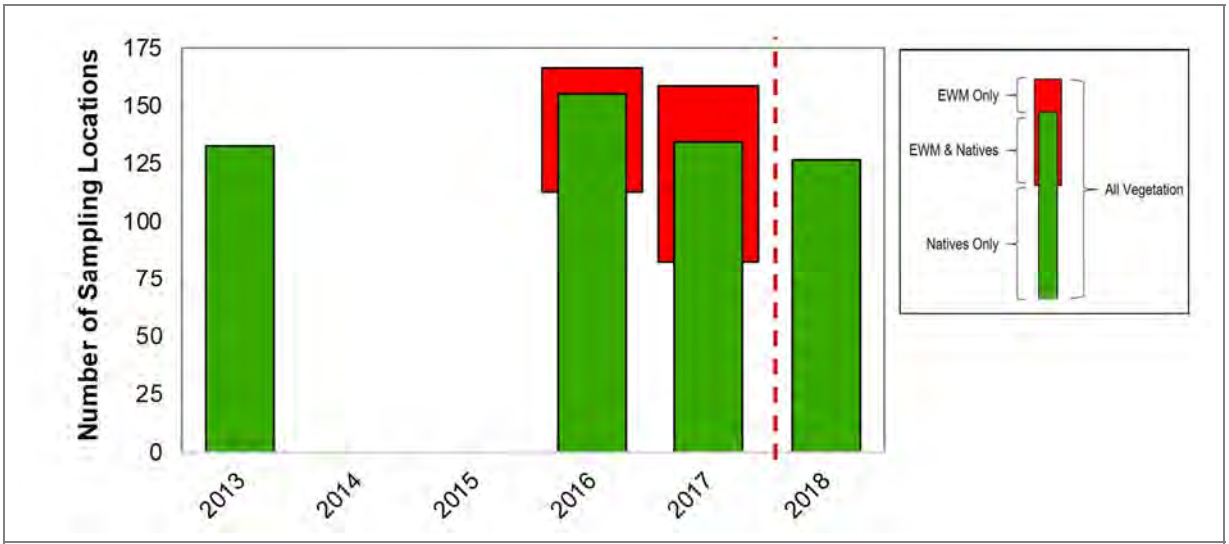



**Figure 11. Number of point-intercept sampling locations that contained native plants, EWM, or native plants and EWM during surveys completed from 2013-2018 in Upper Kaubashine Lake.** Red-dashed line indicates whole-lake herbicide treatment.

Based upon the point-intercept surveys conducted between 2013-2018, Figure 12 shows mean littoral frequency of occurrence of each aquatic plant species (square black symbol), the population range (extent bars), and the 2018 littoral frequency of occurrence (red circle). These data indicate the northern watermilfoil, common waterweed, muskgrasses, and wild stargrass had 2018 populations near the lower end of their population range of this period. The 2018 population of other species are near the average of this time period.

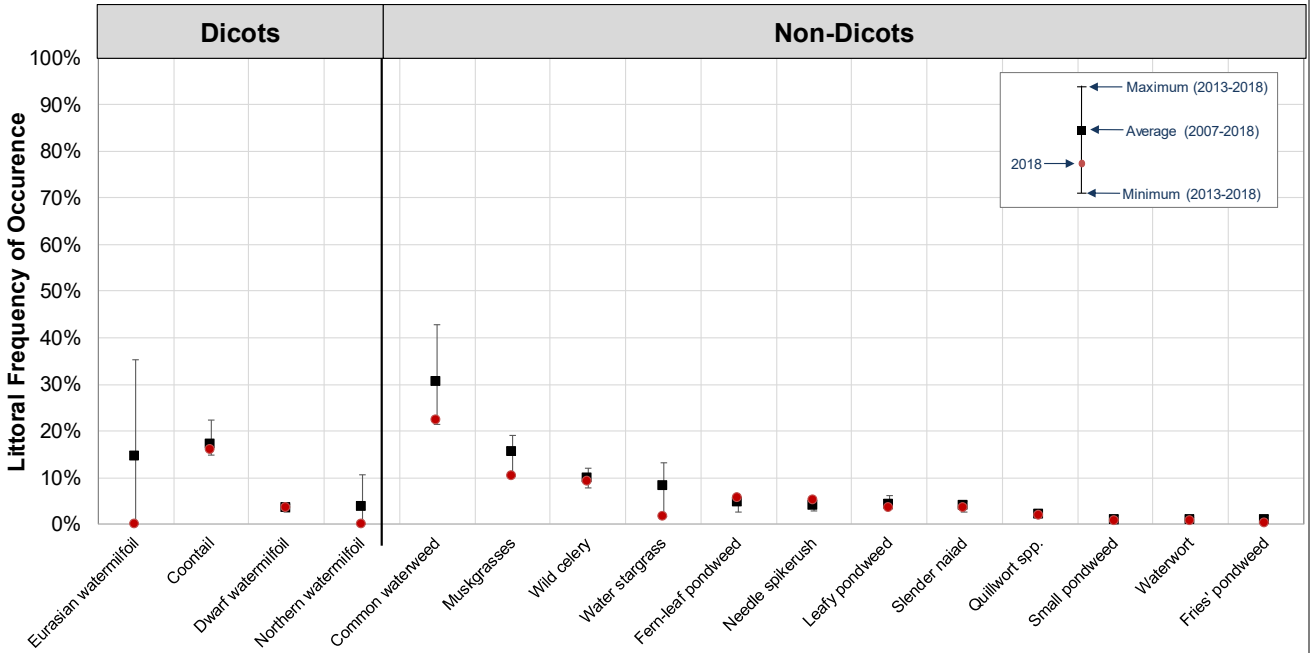



**Figure 12. Historic average aquatic plant frequencies (2013-2018) in Upper Kaubashine Lake.** Only species with a mean frequency of occurrence ≥2% are shown.

Figures 13-15 provide a population trend analysis from 2013-2018 of the native species in Upper Kaubashine Lake. Figure 12 displays the littoral frequency of occurrence (LFOO) of native species that exhibited a statistically valid decrease in occurrence between the 2017 and 2018 surveys in Upper Kaubashine Lake and Figures 14-15 display the remainder of the species that did not show a statistically valid decline in population. A full matrix of all species is included as an appendix.

Northern water milfoil (*Myriophyllum sibiricum*) and water stargrass (*Heteranthera dubia*) exhibited statistically valid decreases in littoral frequency between the 2017 and 2018 surveys (Figure 13). Northern water milfoil has been known to be extremely susceptible to early-season 2,4-D use patterns. No occurrences of northern water milfoil were recorded during the 2018 point-intercept survey. Water stargrass exhibited an 85.4% decrease in occurrence between 2017 and 2018. Continued monitoring of these important native species will serve to evaluate any potential longer-term impacts of the 2018 treatment strategy.

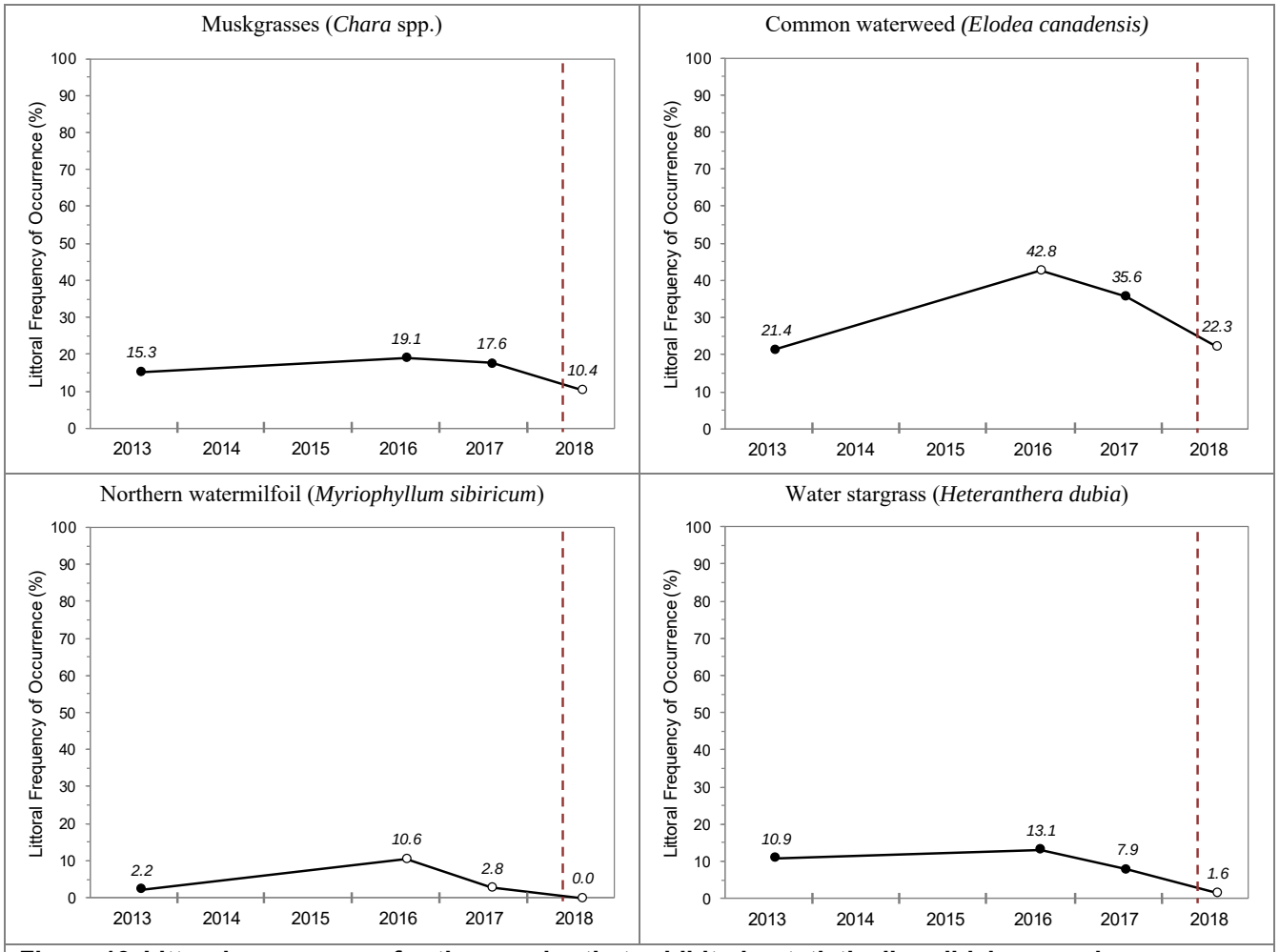



**Figure 13. Littoral occurrence of native species that exhibited a statistically valid decrease in occurrence between 2017-2018.** Open circle represents a statistically valid change in occurrence from previous survey (Chi-square α = 0.05). Dashed line indicates whole-lake herbicide treatment.

Muskgrasses (*Chara* spp.) are actually macroalgae and due to their lack of vascular tissue are unable to translocate herbicides; therefore, they are typically unaffected by their use. These macroalgae require

lakes with good water clarity, and their large beds stabilize bottom sediments. Muskgrasses exhibited a statistically valid decrease in population between 2017 and 2018 (Figure 13).

Common waterweed (*Elodea canadensis*) is arguably one of the most common species in Wisconsin's inland lakes, and has been one of the most commonly encountered species on point-intercept surveys in Upper Kaubashine Lake with littoral frequencies ranging from approximately 21-43%. (Figure 13) Common waterweed exhibited a statistically valid 37.4% decrease in occurrence between the 2017 and 2018 surveys. Common waterweed is a free-floating or loosely rooted plant species that can utilize the biomass of other plant species as a "substrate" in which they become entangled and grow. It is suspected that with the loss of structural habitat previously being supplied by the robust EWM population, may have compounded the direct impacts from the herbicide treatment strategy. The WDNR spring 2018 point-intercept survey (pre-treatment) indicated common waterweed had a 23.8% littoral frequency. Common waterweed had the highest LFOO (22.3%) of any species in the 2018 survey and the population remains relatively robust. The 2018 LFOO was similar to the 2013 point-intercept survey (Figure 12).

Figure 14 shows three species that are often impacted by whole-lake 2,4-D treatment, but did not have statistically valid declines in 2018 on Upper Kaubashine Lake.

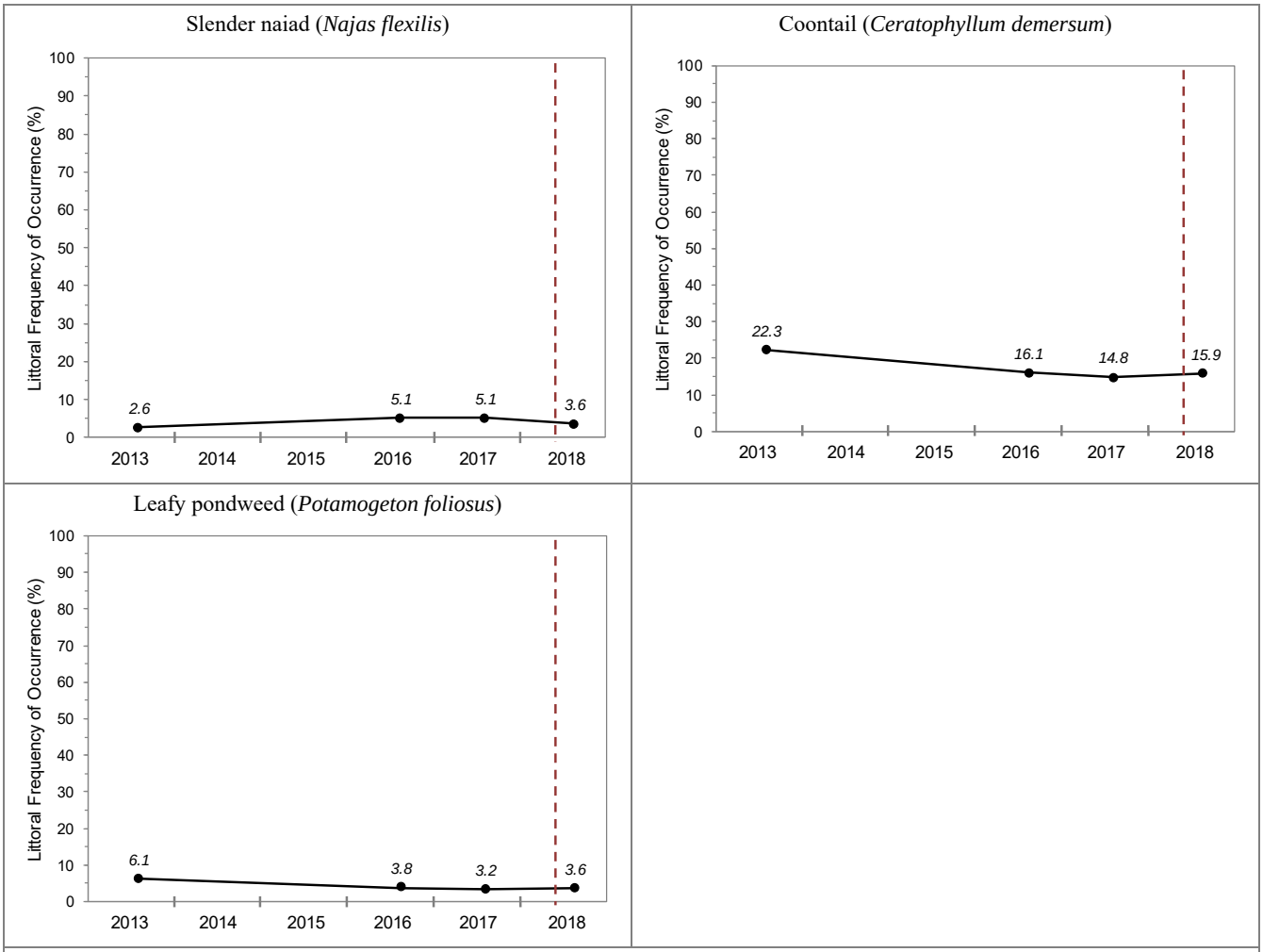



**Figure 14. Littoral occurrence of native species that did not have a statistically valid change in occurrence between 2017-2018.** Open circle represents a statistically valid change in occurrence from previous survey (Chi-square α = 0.05). Dashed line indicates whole-lake herbicide treatment.

The LFOO of coontail has been relatively stable in recent years at around 15-16% (Figure 14). Like common waterweed, coontail is a largely unrooted plant that can be directly impacted by 2,4-D treatments and indirectly impacted as the EWM "substrate" is removed. Coontail (*Ceratophyllum demersum*) was the second-most frequently encountered species in the 2018 survey with a LFOO of 15.9%.

Slender naiad is an annual that relies on seed production and has been shown to be particularly susceptible to whole-lake auxin herbicide treatments (e.g. 2,4-D, triclopyr). During the *year of treatment*, slender naiad populations off decline substantially with quick rebound the following year, sometimes above pretreatment levels. On Upper Kaubashine Lake, slender naiad populations remained relatively unchanged from 2017-2018 (Figure 14).

Thin-leaved pondweeds, like leafy-pondweed, are also often impacted by whole-lake 2,4-D treatments. Population recovery of these morphologically similar species often takes a number of years. On Upper Kaubashine Lake, leafy pondweed population remained relatively stable from 2017-2018 (Figure 14).

Onterra's experience is that wild celery (Photo 2) emerges a little later than many native plant species and perhaps is dormant during the highest concentrations of an early-season whole-lake treatment and thus less susceptible to its impacts. Wild celery is relatively tolerant of low-light conditions and is able to grow in deeper water. Its long leaves provide excellent structural habitat for numerous aquatic organisms while its extensive root systems stabilize bottom sediments. Towards the late-summer when water celery is at its peak growth stage, it is easily uprooted by wind and wave activity. The wild celery can then pile up on shorelines depending on the predominant wind direction. The leaves, fruits, and winter buds of wild celery are food sources for numerous species of waterfowl and other wildlife and are an important component of the Upper Kaubashine Lake ecosystem. Wild celery populations were statistically unchanged over the period of study (Figure 15).

**Photo 2. Wild celery.** Photo credit Gary Fewless.

The term isoetid encompasses a number of unrelated aquatic plant species which share similar morphological features and adaptations to their environment and superficially resemble the quillworts (*Isoetes* spp.). Plants of the isoetid growth form are small, inconspicuous, and slow-growing with succulent-like leaves (Photo 3). These diminutive plants are typically found growing in shallower water over areas of sand and rock. Needle spikerush, dwarf watermilfoil, and quillworts are the more common isoetid species in Upper Kaubashine Lake. These species remained statistically unchanged over the period of study (Figure 15).

**Photo 3. Quillwort.** Photo credit Onterra

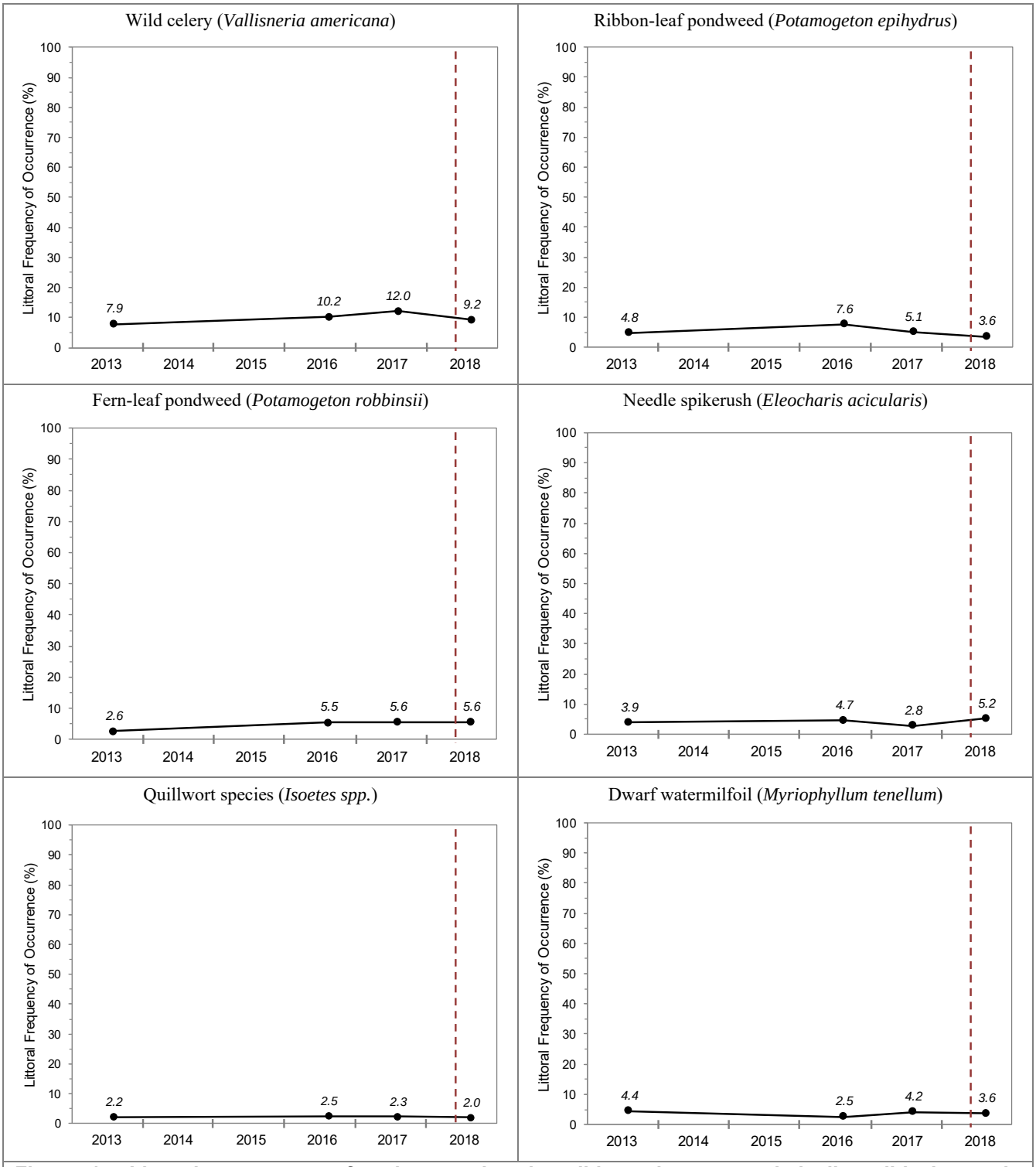



**Figure 15. Littoral occurrence of native species that did not have a statistically valid change in occurrence between 2017-2018.** Open circle represents a statistically valid change in occurrence from previous survey (Chi-square α = 0.05). Red-dashed line indicates whole-lake herbicide treatment.

Another way to look at the aquatic plant community composition is through the relative frequency of occurrence analysis. Because each sampling location may contain numerous plant species, relative frequency of occurrence is a tool to evaluate how often each plant species is found in relation to all other species found (composition of the population). Explained another way, if 100 plants were sampled from Upper Kaubashine Lake in 2017, 20 would be EWM (Figure 16). This means that prior to the treatment, one out of every five plants was EWM and four out of five were native plants. Even though the littoral frequency of occurrence of common waterweed declined in 2018, it proportionally contributes a slightly higher relative frequency of occurrence in 2017 due to the reduction of the EWM population.

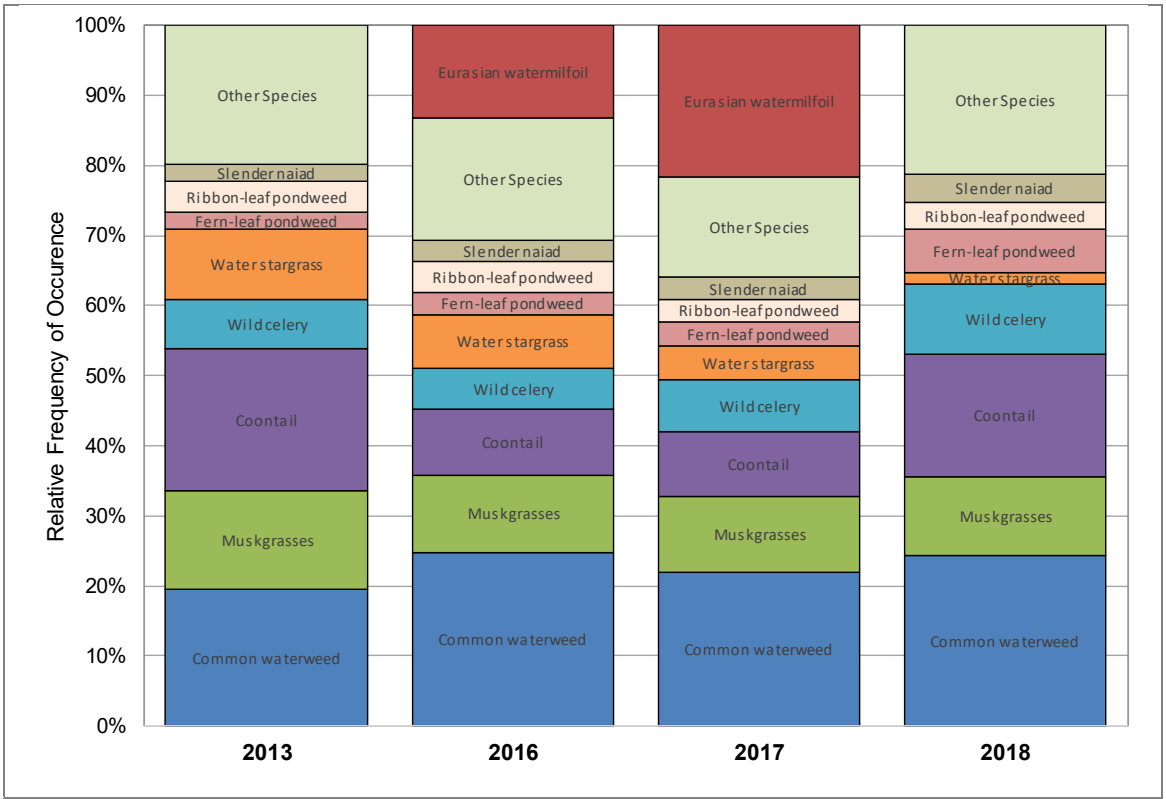



**Figure 16. Relative frequency of occurrence analysis of aquatic plants in Upper Kaubashine Lake from 2013, 2016-2018.**

## 3.4 Late-Summer EWM Peak-biomass Survey

While the point-intercept survey is a valuable tool to understand the overall plant population of a lake, it does not offer a full account (census) of where a particular species exists in the lake. As the name implies, the Late-Summer EWM Peak-Biomass survey is a meander-based survey conducted when the plant is at its peak growth stage, allowing for a true assessment of the amount of this exotic within the lake.

Onterra ecologists visited Upper Kaubashine Lake on August 22, 2018 to conduct the Late-Summer EWM Peak-Biomass Survey to map the EWM population at its peak growth stage and to qualitatively assess the large-scale treatment. The crews noted favorable conditions during the survey with sunny skies. During the survey, no EWM was visible from the surface in the lake. The field crew deployed submersible cameras in all areas that previously were known to harbor EWM and observed some native vegetation. No EWM was observed anywhere in the lake during 2018 post treatment surveys. Areas of dense EWM prior to the treatment were noted as having filamentous algae (spirogyra). It is hypothesized

that the decreases in EWM populations in these areas allowed increased light penetration to the sediment which spurred the increase of these populations.

## 3.5 Acoustic Surveys

Onterra ecologists have also conducted acoustic-based surveys to measure the bio-volume of aquatic plants throughout the lake. While the map output does not differentiate between aquatic plant species, it indicates where high bio-volumes of vegetation exist in the lake. Conducting bio-volume surveys before and after herbicide treatments can allow an understanding of how the macrophyte structure was influenced by the treatment, a set of data that have particular interest to some fisheries manager

As illustrated on Figure 17, areas where aquatic plants occupy most or the entire water column are indicated in red, while areas of little to no aquatic plant growth are displayed in blue. The bio-volume data indicate that much of the aquatic plant growth in Upper Kaubashine Lake is present near the shore. Fewer areas were comprised of the highest bio-volume percentages in 2018 as compared to 2017, likely explained by the 100% decline in EWM between the two surveys. A decline in some native aquatic plants also contribute to the lower bio-volume present in 2018. The 2018 survey shows that native vegetation is still contained in most of these areas, but of more moderated density (orange and green) than pretreatment.

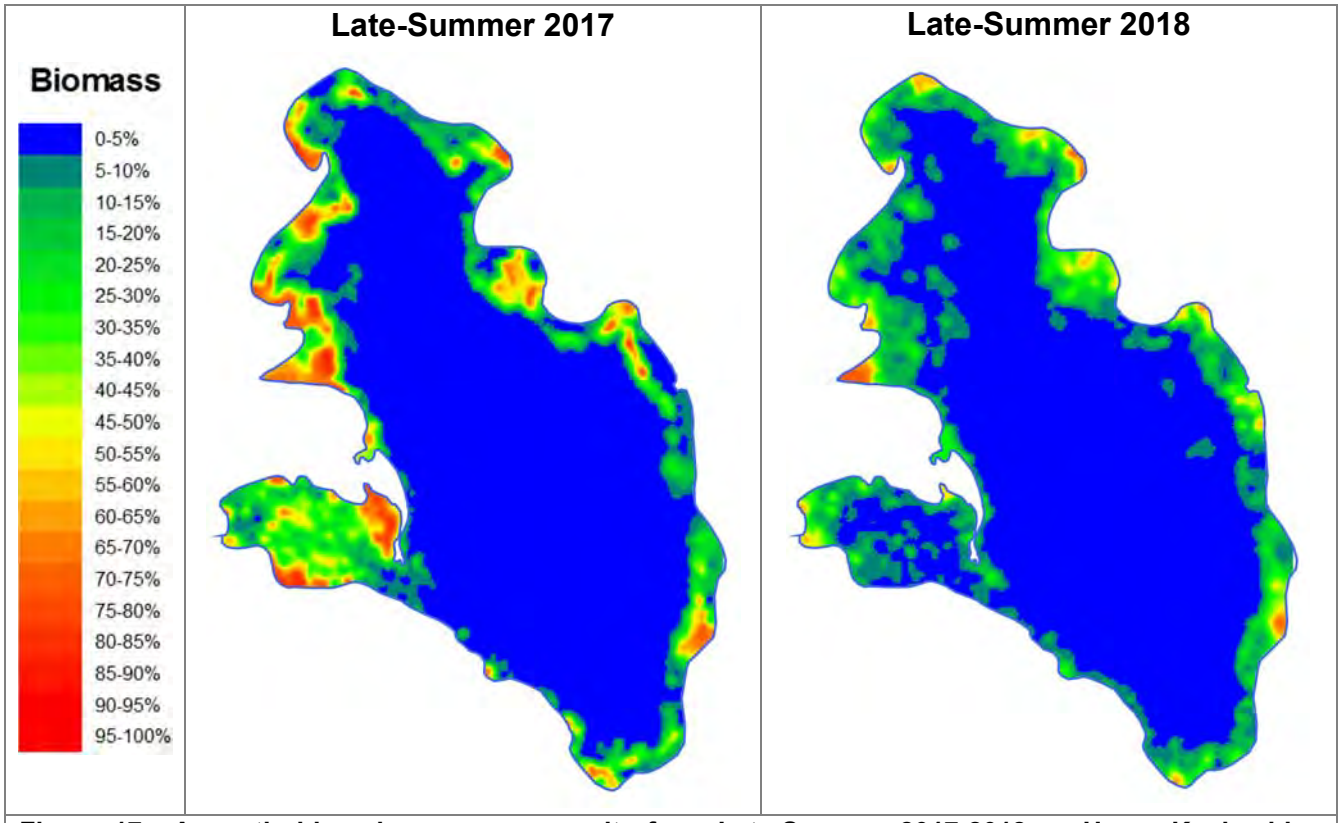



**Figure 17. Acoustic bio-volume survey results from Late-Summer 2017-2018 on Upper Kaubashine Lake.**

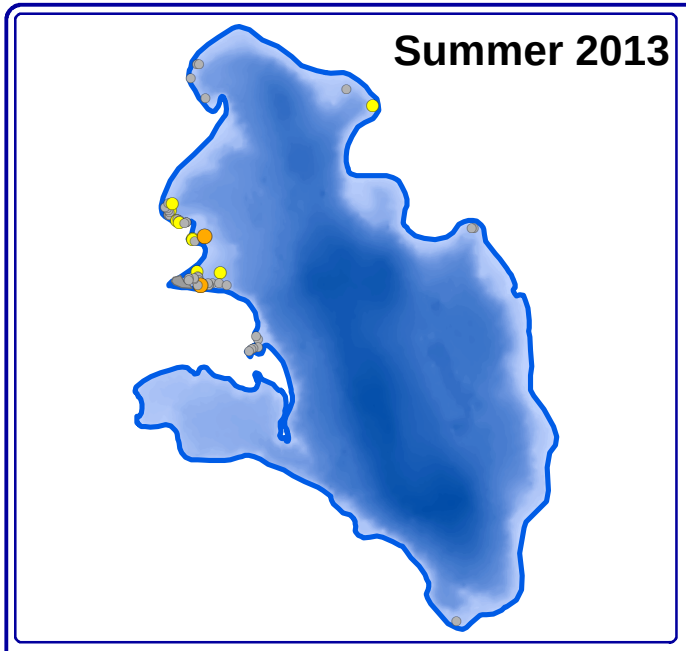
# 4.0 CONCLUSIONS & DISCUSSION

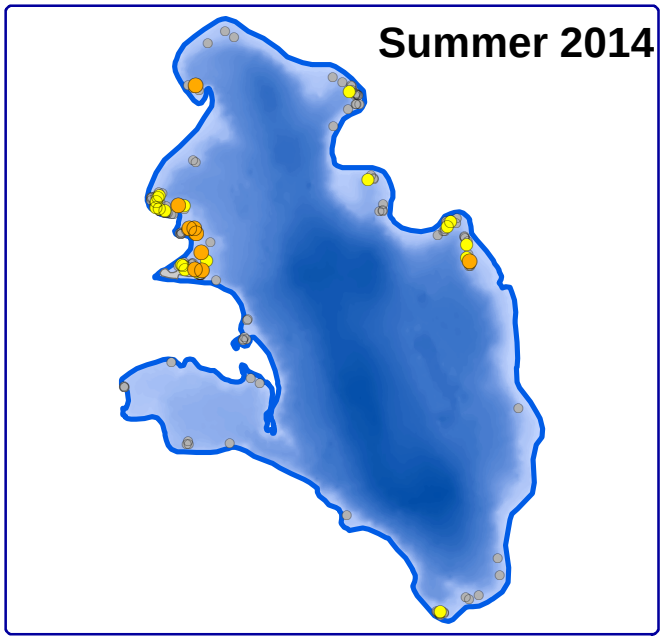
Aquatic plant monitoring surveys conducted in 2018 indicate that the large-scale 2,4-D treatment led to a high level of EWM population reduction. Understanding the EWM population in the *year-of-treatment* (2018) is important, however surveys completed in the *year-after-treatment* (2019) will determine whether the herbicide treatment met the pre-determined criteria for a success. Herbicide concentration monitoring showed 2,4-D concentrations remained above approximately 0.1ppm ae for at least 21 days after treatment. Low levels of 2,4-D were detected in the downstream sampling locations between Upper Kaubashine Lake and Lower Kaubashine Lake. Herbicide concentrations in Kaubashine Creek, nearest to Upper Kaubashine Lake, were found to be above 0.1ppm ae for a period of at least several days during which some impacts to less tolerant native aquatic plant species cannot be ruled out. The minimal levels of herbicide that were detected in Lower Kaubashine Lake are not believed to be high enough to cause impacts to aquatic plants.

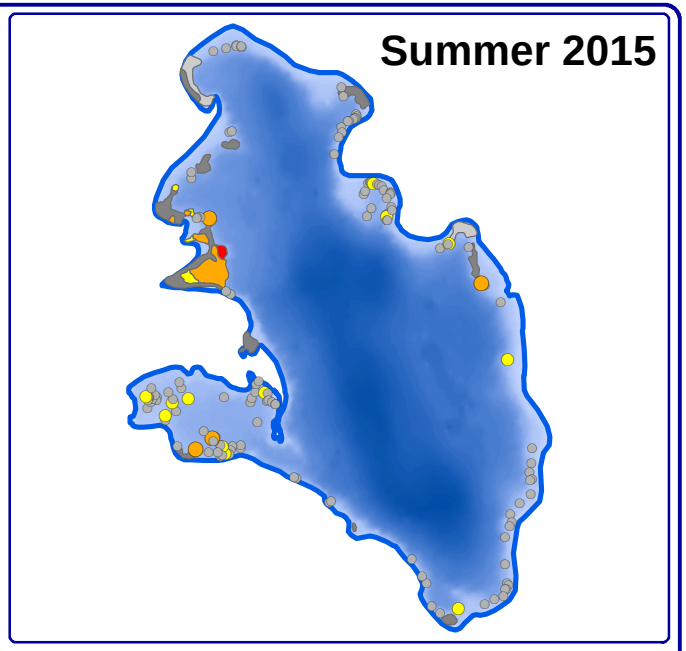
Four native species were shown to decrease from 2017 to 2018, with northern watermilfoil not being located during the post treatment assessments. Some species recover faster than others following large-scale treatments. Continued aquatic plant monitoring through the point-intercept survey in 2019 will be valuable in documenting the populations recovery or lack-thereof following the herbicide treatment as well as document inter-annual population dynamics.

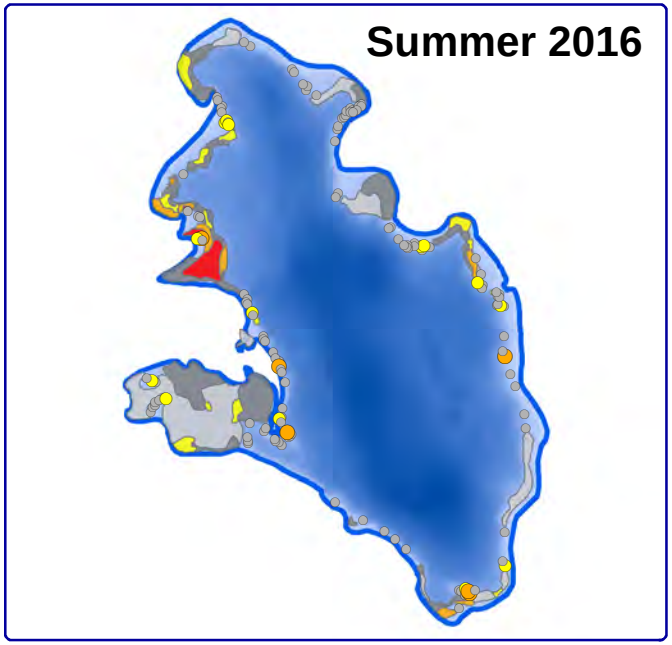
Many lake groups initiate a whole-lake herbicide strategy with the intention of implementing smaller-scale control measures (e.g. herbicide spot treatments, hand-removal) when EWM begins rebounding. This is referred to as Integrated Pest Management (IPM). This approach has shown promise on some lakes. However, the EWM population rebounds on some lakes in a lake-wide fashion that does not lend well to these methods. The UKPOA would give preference to non-herbicide control measures following the whole-lake 2,4-D treatment to preserve the gains as long as possible. This would likely include hand-harvesting with Diver-Assisted Suction Harvesting

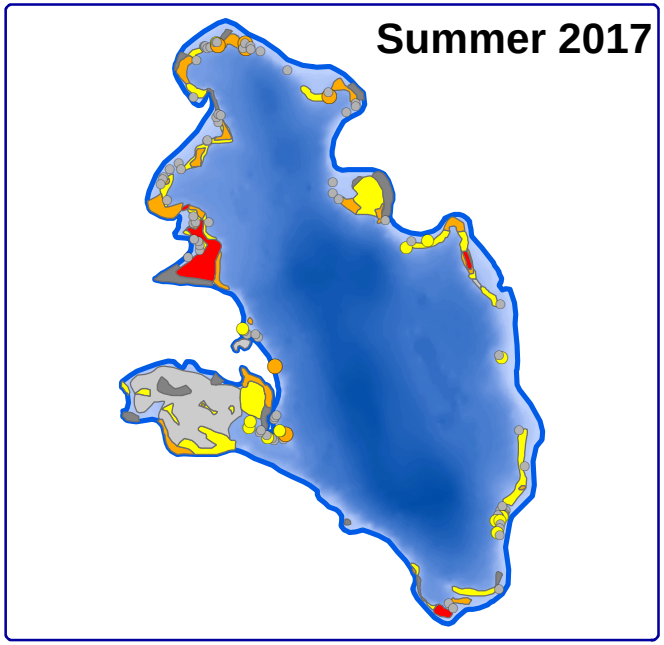
The UKPOA intends to continue to monitor Upper Kaubashine Lake in 2019 to search for rebounding EWM to initiate an IPM program in an effort to preserve the gains made from the whole-lake treatment. A 2019 late-Summer EWM Mapping Survey (August-September) is currently scheduled, as this survey would be the best chance for detecting EWM and setting up an IPM strategy for 2020. Consideration should also be given to conducting an Early-Season AIS Survey in June 2019, as this survey would be conducted early enough to initiate IPM activities in 2019 if appropriate. This survey could be triggered if UKPOA volunteers locate rebounding invasive milfoil during volunteer-based reconnaissance monitoring.

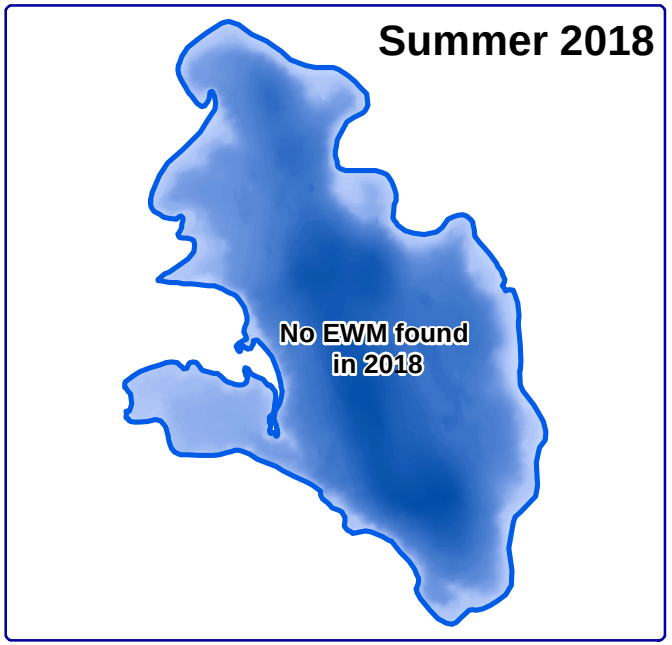
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Feet

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Lake Management Planning
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De Pere, WI 54115
920.338.8860
www.onterra-eco.com

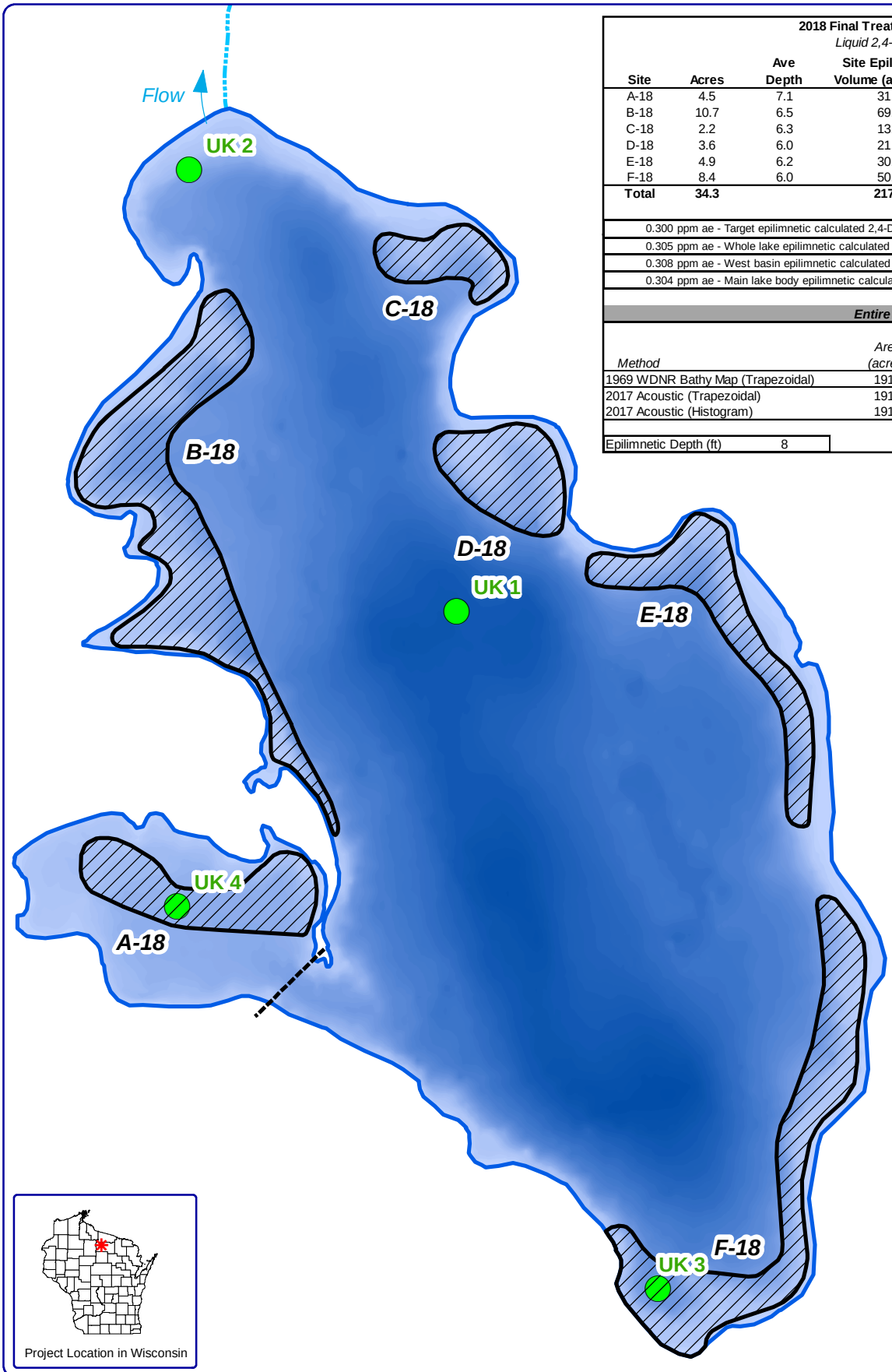
**Sources:**
Roads Hydro: WDNR
Bathymetry: Onterra, 2017
Plant Survey: Onterra, 2013-2018
**Map Date:** February 6, 2019 TWH
*Filename:UpKaub_EWMPB_2013-2018.mxd*


Project Location in Wisconsin

## Legend

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

Map 1
# Upper Kaubashine Lake
Oneida County, Wisconsin
## 2013-2018 EWM Survey Results




**2018 Final Treatment Strategy**

*Liquid 2,4-D amine*

| Site | Acres | Ave Depth | Site Epilimnetic Volume (acre-feet) | 2,4-D PPM ae | 2,4-D amine (gallons) |
|---|---|---|---|---|---|
| A-18 | 4.5 | 7.1 | 31.9 | 0.9 | 21.0 |
| B-18 | 10.7 | 6.5 | 69.4 | 2.1 | 104.0 |
| C-18 | 2.2 | 6.3 | 13.8 | 2.1 | 21.0 |
| D-18 | 3.6 | 6.0 | 21.8 | 2.1 | 33.0 |
| E-18 | 4.9 | 6.2 | 30.4 | 2.1 | 46.0 |
| F-18 | 8.4 | 6.0 | 50.2 | 2.1 | 75.0 |
| **Total** | **34.3** | | **217.6** | | **300.0** |

0.300 ppm ae - Target epilimnetic calculated 2,4-D concentration

0.305 ppm ae - Whole lake epilimnetic calculated 2,4-D concentration

0.308 ppm ae - West basin epilimnetic calculated 2,4-D concentration

0.304 ppm ae - Main lake body epilimnetic calculated 2,4-D concentration

***Entire Lake***

| *Method* | *Area (acres)* | *Epilimnetic Volume* | *Epilimnetic 2,4-D ppm ae* |
|---|---|---|---|
| 1969 WDNR Bathy Map (Trapezoidal) | 191.3 | 1319.9 | 0.318 |
| 2017 Acoustic (Trapezoidal) | 191.3 | 1370.5 | 0.306 |
| 2017 Acoustic (Histogram) | 191.3 | 1376.9 | 0.305 |

| | | | |
|---|---|---|---|
| Epilimnetic Depth (ft) | 8 | *Target:* | 0.300 |



Project Location in Wisconsin

N W E S

550

Feet

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Lake Management Planning
815 Prosper Road
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www.onterra-eco.com

**Sources:**
Hydro and Roads: WDNR
Bathymetry: Onterra, 2017
Aquatic Plant Survey: Onterra, 2017
**Map Date:** May 30, 2018 EJH
*Filename: UpKaub_Oneida_T2018_Perm1.mxd*

## Legend

2018 Herbicide Application Area

Herbicide Concentration Monitoring Location

Map 2

# Upper Kaubashine Lake

Oneida County, Wisconsin

# 2018 Final EWM Treatment Strategy

# APPENDIX

| | Scientific Name | Common Name | LFOO (%) | | | |
|---|---|---|---|---|---|---|
| | | | 2013 | 2016 | 2017 | 2018 |
| Dicots | *Myriophyllum spicatum* | Eurasian watermilfoil | 0.0 | 22.9 | 35.2 | 0.0 |
| | *Ceratophyllum demersum* | Coontail | 22.3 | 16.1 | 14.8 | 15.9 |
| | *Myriophyllum tenellum* | Dwarf watermilfoil | 4.4 | 2.5 | 4.2 | 3.6 |
| | *Myriophyllum sibiricum* | Northern watermilfoil | 2.2 | 10.6 | 2.8 | 0.0 |
| | *Nuphar variegata* | Spatterdock | 0.4 | 0.4 | 0.5 | 0.8 |
| | *Nymphaea odorata* | White water lily | 0.4 | 0.0 | 0.0 | 0.0 |
| Non-dicots | *Potamogeton crispus* | Curly-leaf pondweed | 0.0 | 0.0 | 0.0 | 0.0 |
| | *Elodea canadensis* | Common waterweed | 21.4 | 42.8 | 35.6 | 22.3 |
| | *Chara spp.* | Muskgrasses | 15.3 | 19.1 | 17.6 | 10.4 |
| | *Filamentous algae* | Filamentous algae | 10.5 | 9.3 | 0.9 | 13.5 |
| | *Vallisneria americana* | Wild celery | 7.9 | 10.2 | 12.0 | 9.2 |
| | *Heteranthera dubia* | Water stargrass | 10.9 | 13.1 | 7.9 | 1.6 |
| | *Potamogeton robbinsii* | Fern-leaf pondweed | 2.6 | 5.5 | 5.6 | 5.6 |
| | *Potamogeton epihydrus* | Ribbon-leaf pondweed | 4.8 | 7.6 | 5.1 | 3.6 |
| | *Eleocharis acicularis* | Needle spikerush | 3.9 | 4.7 | 2.8 | 5.2 |
| | *Potamogeton foliosus* | Leafy pondweed | 6.1 | 3.8 | 3.2 | 3.6 |
| | *Najas flexilis* | Slender naiad | 2.6 | 5.1 | 5.1 | 3.6 |
| | *Isoetes spp.* | Quillwort spp. | 2.2 | 2.5 | 2.3 | 2.0 |
| | *Potamogeton pusillus* | Small pondweed | 0.0 | 1.7 | 1.9 | 0.8 |
| | *Elatine minima* | Waterwort | 0.4 | 1.3 | 1.4 | 0.8 |
| | *Potamogeton friesii* | Fries' pondweed | 0.9 | 0.8 | 1.9 | 0.4 |
| | *Potamogeton gramineus* | Variable-leaf pondweed | 0.4 | 0.4 | 0.9 | 0.4 |
| | *Potamogeton amplifolius* | Large-leaf pondweed | 0.0 | 0.8 | 0.0 | 0.8 |
| | *Nitella spp.* | Stoneworts | 0.0 | 0.4 | 1.4 | 0.4 |
| | *Juncus pelocarpus* | Brown-fruited rush | 0.0 | 0.0 | 0.0 | 0.8 |
| | *Fissidens spp. & Fontinalis spp.* | Aquatic Moss | 0.0 | 0.0 | 0.9 | 0.4 |
| | *Persicaria amphibia* | Water smartweed | 0.4 | 0.0 | 0.0 | 0.0 |