A

APPENDIX A

Public Participation Materials

2016 Studies

- Project Overview
  - Existing AIS-Established Population Control grant funds
  - Update certain aspects of studies completed in 2009
- Study Components
  - Water Quality
  - Shoreland Condition
  - Aquatic Plants

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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) **TN:TP = 16:1**
Human development often increases P delivery to lakes

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

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

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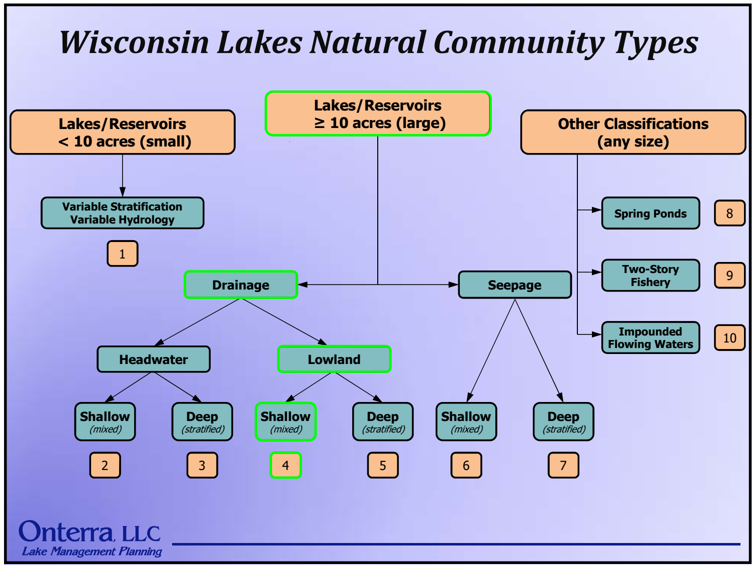
Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Drainage
Seepage
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Headwater
Lowland
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
Shallow (mixed)
Deep (stratified)
2
3
4
5
6
7
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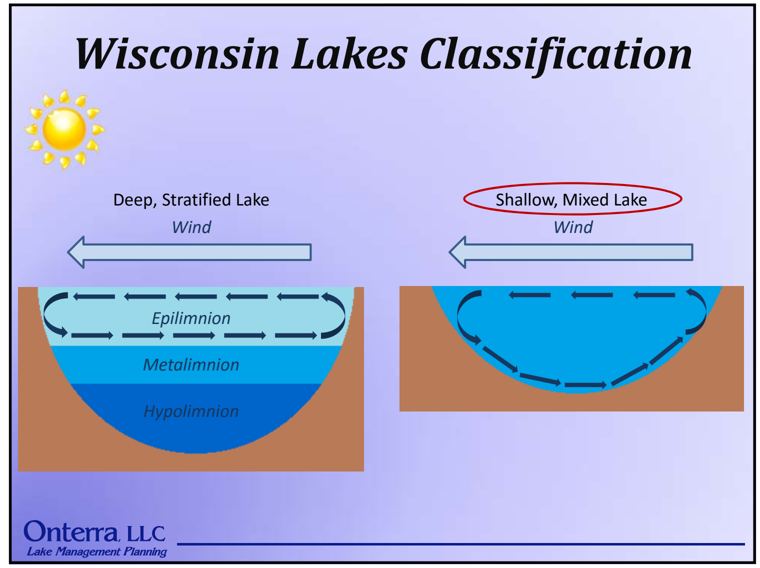
Wisconsin Lakes Classification
Deep, Stratified Lake
Wind
Epilimnion
Metalimnion
Hypolimnion
Shallow, Mixed Lake
Wind
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Water Quality
Wisconsin Ecoregions
Boot Lake
Northern Lakes and Forests
North Central Hardwood Forests
Driftless Area
Southeastern Wisconsin Till Plains
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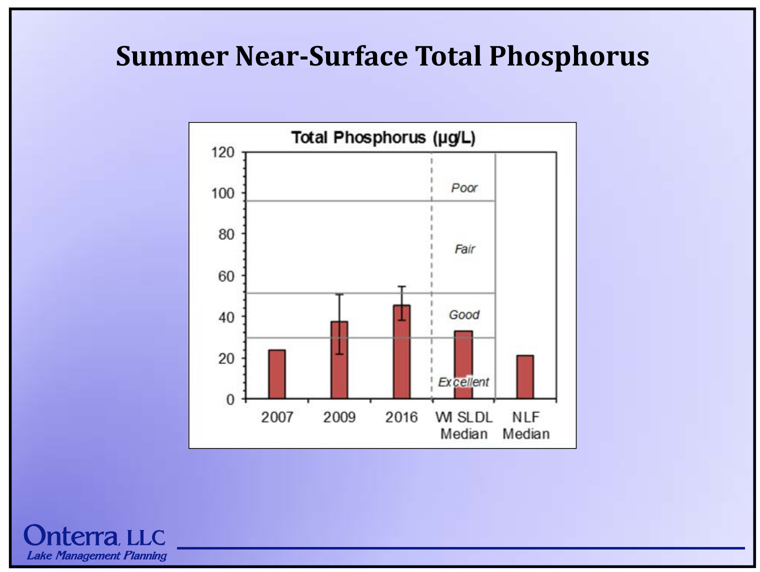
Summer Near-Surface Total Phosphorus
Total Phosphorus (µg/L)
120
100
80
60
40
20
0
Poor
Fair
Good
Excellent
2007
2009
2016
WI SLDL Median
NLF Median
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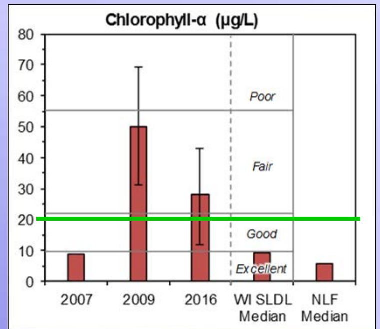
Chlorophyll-α



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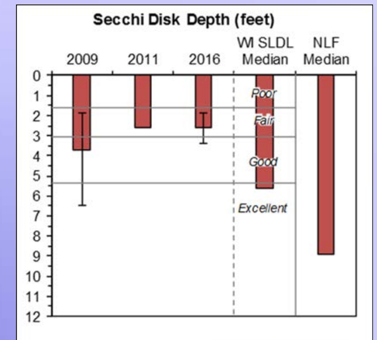
Secchi Disk Depth



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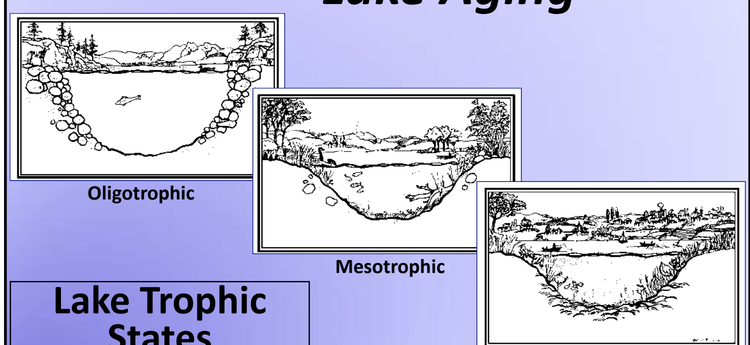
Eutrophication

-Lake Aging



Oligotrophic

Mesotrophic

Eutrophic

Lake Trophic States

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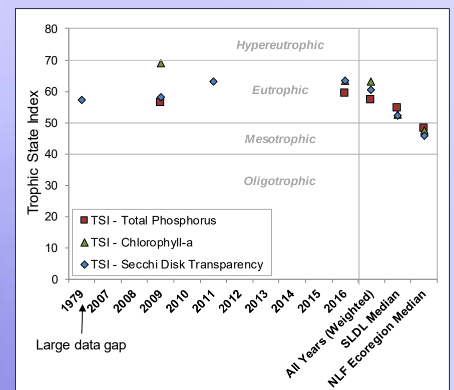
Trophic State Index



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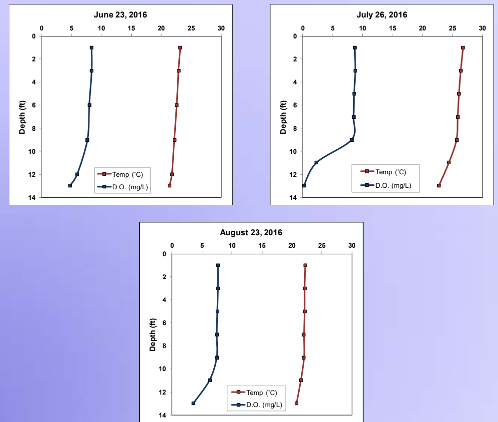
Temperature & Dissolved Oxygen



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Why is phosphorus & algal abundance higher in Boot Lake?

- Cannot say for certain given limited data collected during this project
- First have to look at the watershed, or drainage basin

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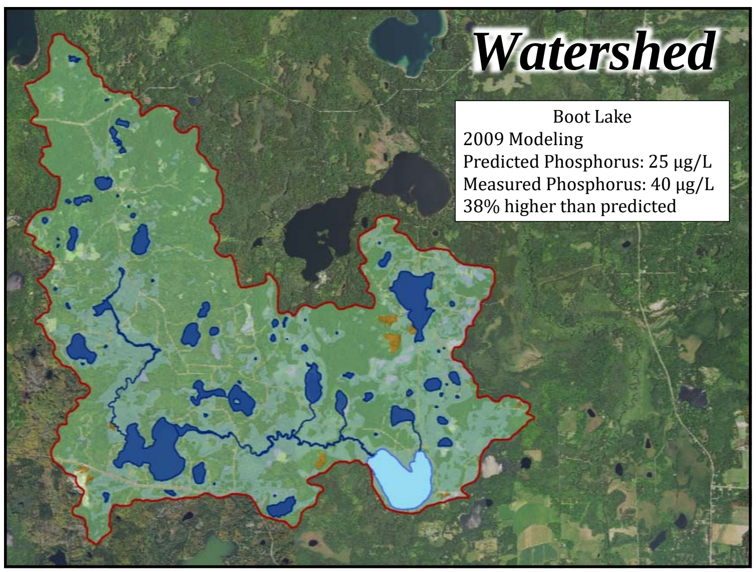

Why is phosphorus & algal abundance higher in Boot Lake?

- Cannot say for certain given limited data collected during this project
- First have to look at the watershed, or drainage basin
- Other potential sources of *unaccounted* phosphorus:
    - Internal nutrient recycling
    - Upstream lakes
    - Groundwater

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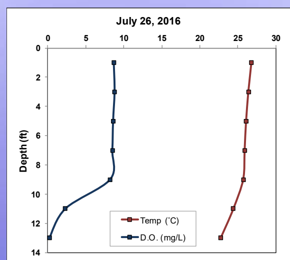
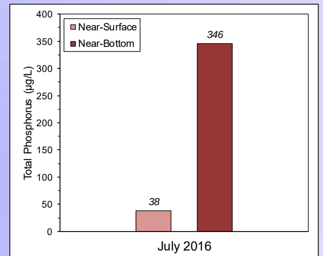
Internal Nutrient Recycling

- Release of phosphorus (and other nutrients) from bottom sediments when overlying water becomes anoxic (devoid of oxygen)
- In shallow lakes, sediment-released phosphorus can get mixed to the surface periodically in the summer





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Upstream Lakes & Groundwater

- Upstream lakes (e.g. Pickerel Lake) are also *polymictic*, and phosphorus from internal nutrient recycling in these lakes may impact Boot Lake
- Nutrient-rich groundwater
    - USGS study on nearby Muskellunge Lake (2010)
    - Found ~60% of annual phosphorus load coming from groundwater
    - Groundwater passing through anoxic wetlands adjacent to the lake

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Why is phosphorus & algal abundance higher in Boot Lake?

- Cannot say for certain given limited data collected during this project
- First have to look at the watershed, or drainage basin
- Other potential sources of *unaccounted* phosphorus:
    - Internal nutrient recycling
    - Upstream lakes
    - Groundwater
- Could be one or a combination of these factors
- More detailed study would need to be completed

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Shoreland Assessment

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

Urbanized

Range

Natural

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Shoreline Assessment Category Descriptions

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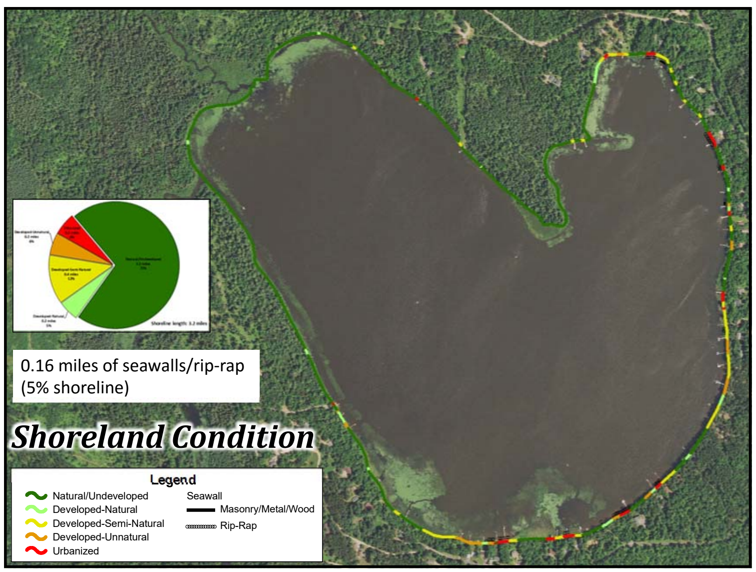
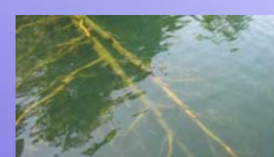


Coarse Woody Habitat

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



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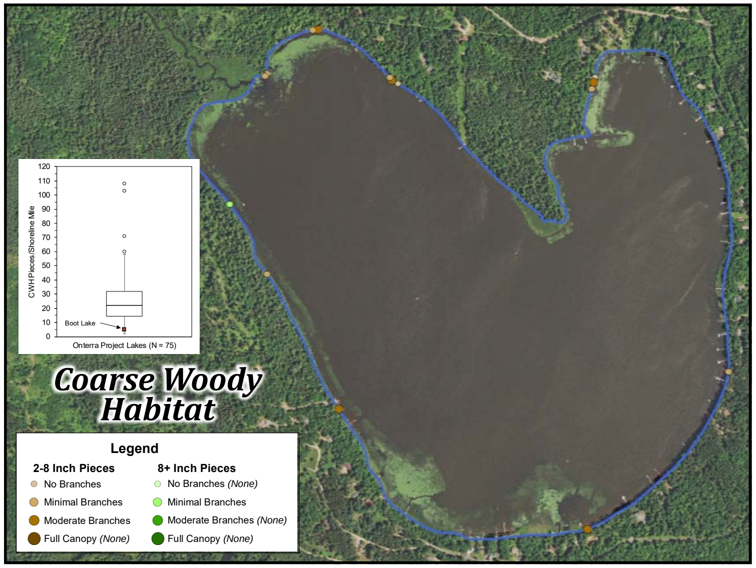

Aquatic Plant Surveys

- Assess both non-native & native species
- Three surveys completed in 2016
  - Whole-lake point-intercept survey
  - Emergent/Floating-leaf plant community mapping survey
  - Eurasian watermilfoil peak-biomass mapping survey

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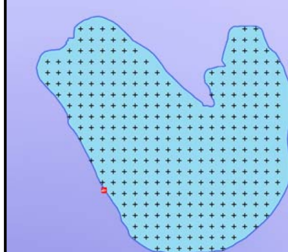
Whole-Lake Point-Intercept Survey



- 315 sampling locations
- 60m resolution
- 10 years of data
  - 2005, 2006, 2007, 2008, 2010, 2011, 2013, 2014, 2015, 2016

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2016 Aquatic Plant Survey Results

- 41 species located
  - 39 native
  - 2 non-native
    - Eurasian watermilfoil
    - Purple loosestrife

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2016 (Onterra)
Emergent	*Carex utriculata*	Common yellow lake sedge	7	I
	Dulichium arundinaceum	Three-way sedge	9	I
	Eleocharis palustris	Creeping spikerush	6	I
	Equisetum fluviatile	Water horsetail	7	X
	Lythrum salicaria	Purple loosestrife	Exotic	I
	Phragmites australis subsp. *americanus*	Common reed	5	I
	Pontederia cordata	Pickerelweed	9	I
	Sagittaria latifolia	Common arrowhead	3	I
	Schoenoplectus acutus	Hardstem bulrush	5	X
	Sparganium eurycarpum	Common bur-reed	5	I
	Typha latifolia	Broad-leaved cattail	1	I
FL	*Brasenia schreberi*	Watershield	7	I
	Nuphar variegata	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
	Sparganium angustifolium	Narrow-leaf bur-reed	9	I
	Sparganium fluctuans	Floating-leaf bur-reed	10	I
FL/E	*Sparganium* sp.	Bur-reed sp.	N/A	I
Submergent	*Ceratophyllum demersum*	Coontail	3	X
	Chara spp.	Muskgrasses	7	X
	Elodea canadensis	Common waterweed	3	X
	Heteranthera dubia	Water stargrass	6	X
	Isoetes spp.	Quillwort spp.	8	X
	Myriophyllum sibiricum	Northern watermilfoil	7	X
	Myriophyllum spicatum	Eurasian watermilfoil	Exotic	X
	Najas flexilis	Slender naiad	6	X
	Nitella spp.	Stoneworts	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton foliosus	Leafy pondweed	6	X
	Potamogeton friesii	Fries' pondweed	8	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X
	Potamogeton praelongus	White-stem pondweed	8	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X
	Potamogeton robbinsii	Fern-leaf pondweed	8	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	Potamogeton strictifolius	Stiff pondweed	8	X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X
	Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	N/A	X
	Utricularia vulgaris	Common bladderwort	7	X
	Vallisneria americana	Wild celery	6	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X
	Sagittaria graminea	Grass-leaved arrowhead	9	I

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

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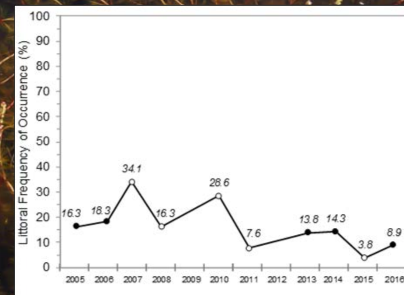
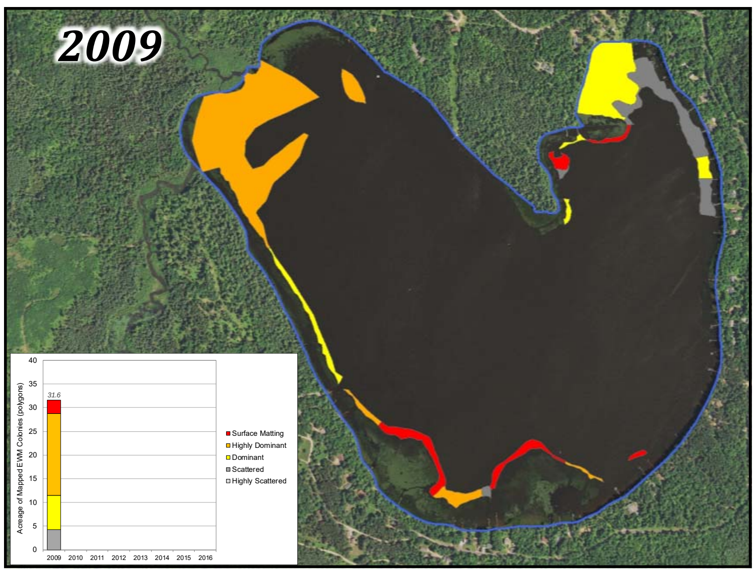
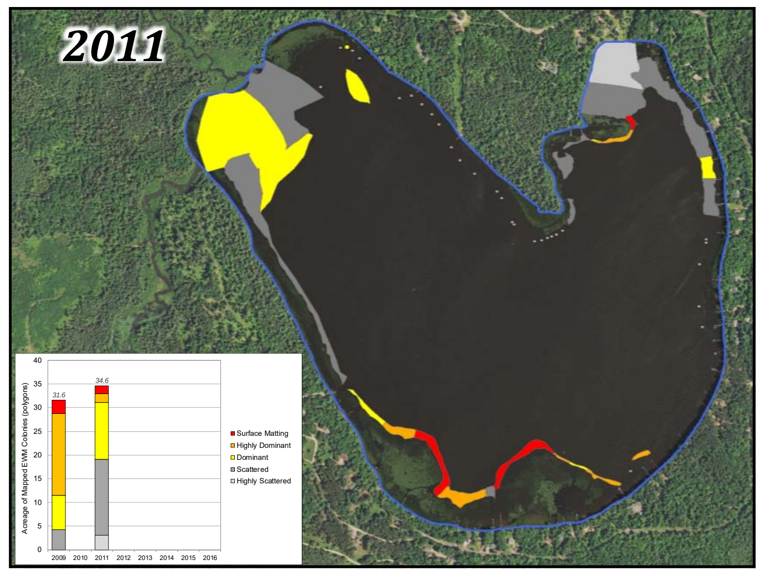
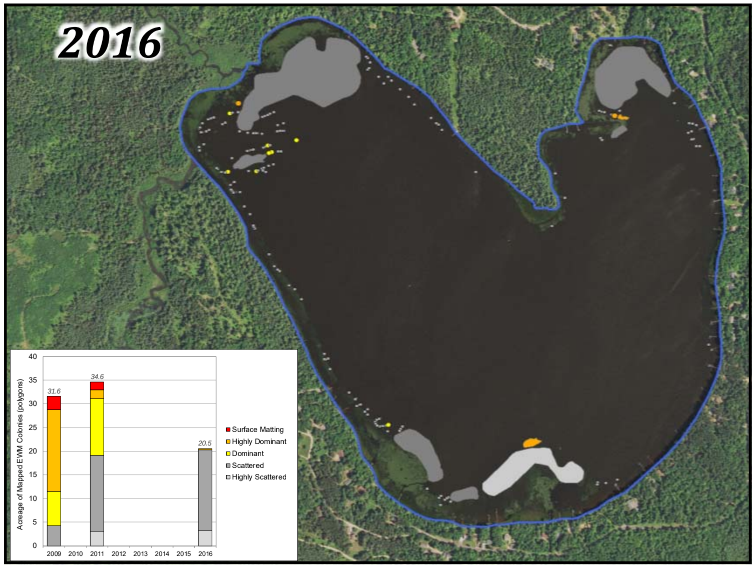
Eurasian watermilfoil

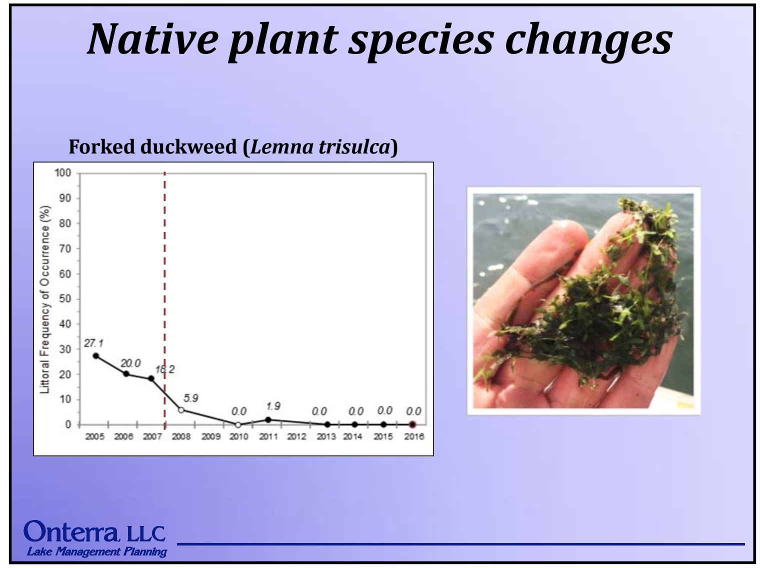
- First discovered in Boot Lake in 2000
- Mapped by Onterra in 2009, 2011, 2016
- No herbicide treatments have occurred








2016
31.6
34.6
20.5
Surface Matting
Highly Dominant
Dominant
Scattered
Highly Scattered
2009 2010 2011 2012 2013 2014 2015 2016


Native plant species changes
Forked duckweed (Lemna trisulca)
Littoral Frequency of Occurrence (%)
27.1
20.0
18.2
5.9
0.0
1.9
0.0
0.0
0.0
0.0
0.0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
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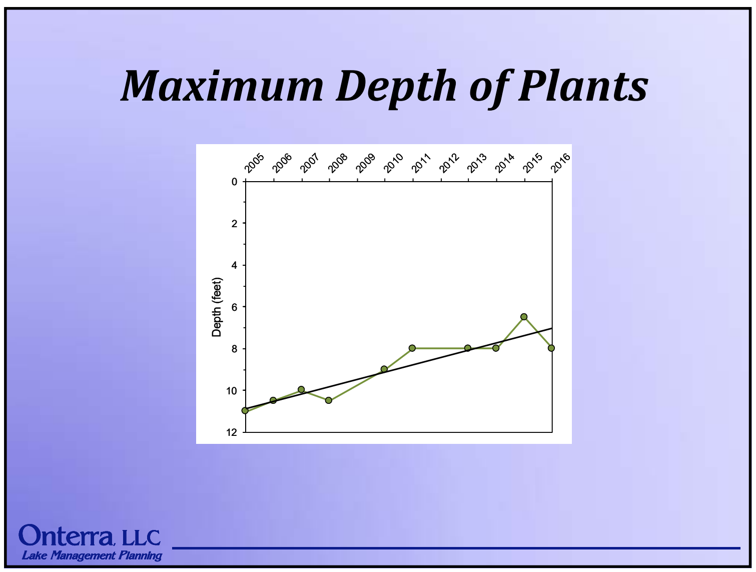
Maximum Depth of Plants
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
Depth (feet)
0
2
4
6
8
10
12
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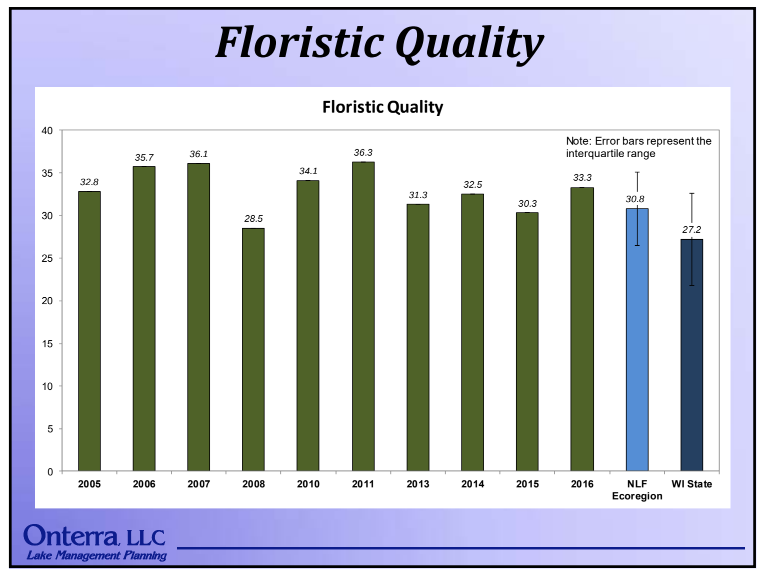
Floristic Quality
Floristic Quality
Note: Error bars represent the interquartile range
32.8
35.7
36.1
28.5
34.1
36.3
31.3
32.5
30.3
33.3
30.8
27.2
2005 2006 2007 2008 2010 2011 2013 2014 2015 2016 NLF Ecoregion WI State
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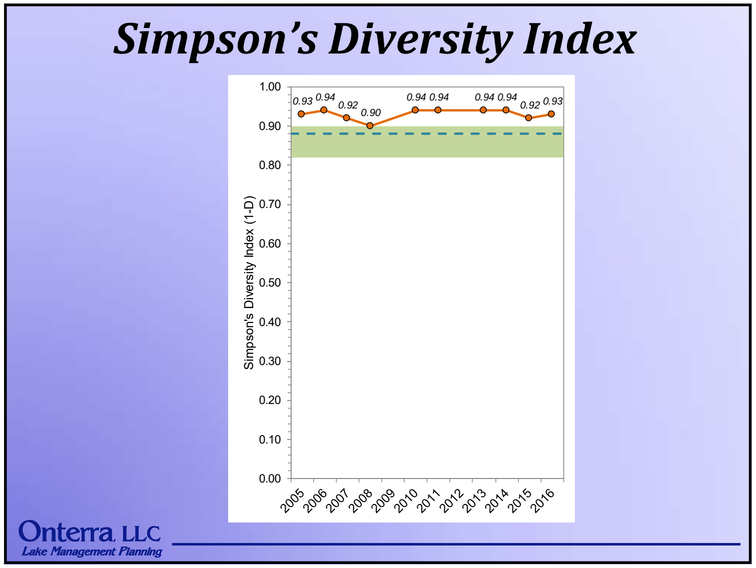
Simpson's Diversity Index
Simpson's Diversity Index (1-D)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.93 0.94 0.92 0.90 0.94 0.94 0.94 0.94 0.92 0.93
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
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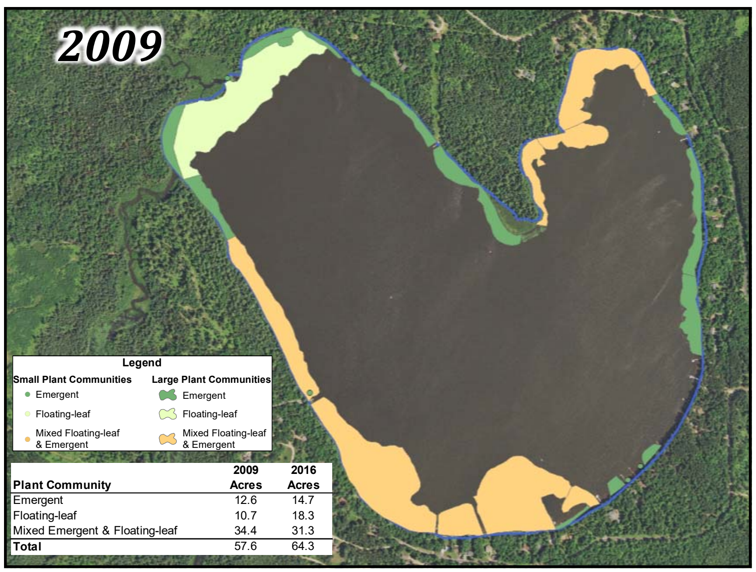
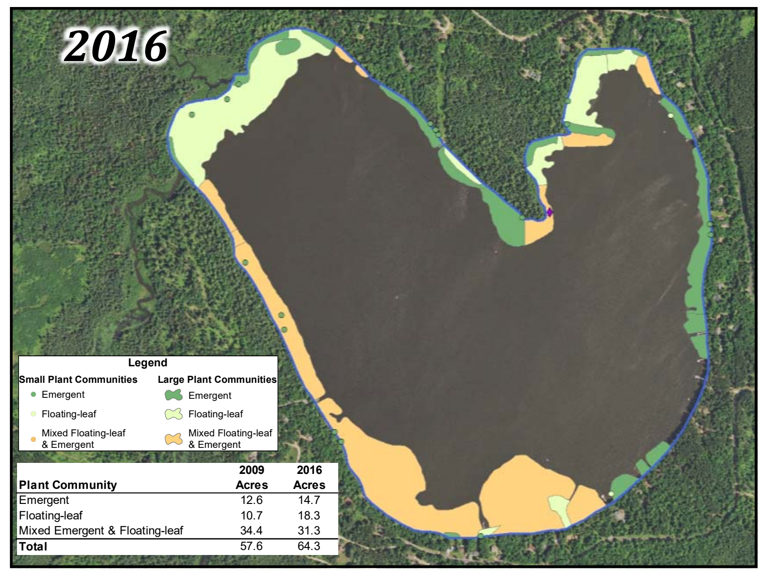
Emergent & Floating-leaf Aquatic Plants


2009
Legend
Small Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Large Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Plant Community 2009 Acres 2016 Acres
Emergent 12.6 14.7
Floating-leaf 10.7 18.3
Mixed Emergent & Floating-leaf 34.4 31.3
Total 57.6 64.3


2016
Legend
Small Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Large Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Plant Community 2009 Acres 2016 Acres
Emergent 12.6 14.7
Floating-leaf 10.7 18.3
Mixed Emergent & Floating-leaf 34.4 31.3
Total 57.6 64.3

Study Conclusions

Water Quality
- Phosphorus is *good* for shallow lowland drainage lake, but higher than expected (possible internal nutrient recycling).
- Chlorophyll-*a* (algae) and Secchi disk depth (water clarity) are *fair* for shallow lowland drainage lakes.
- Plant community indicates possible reduction in clarity around 2007/2008. Cause is unknown.
- Limited data do not allow trends analysis.

Immediate Shoreland Zone
- >70% of shoreline undeveloped
- ~12% with higher degree of development

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Study Conclusions

Aquatic Plants
- Eurasian watermilfoil abundance varies from year to year, but overall declining trend from 2005-2016.
- Native plant community of high quality.
  - Some changes in abundance of native plants from 2005-2016.
  - Most notable is large reduction/loss of forked duckweed between 2007-2008.
- Increase in acreage of floating-leaf & emergent plants between 2009 and 2016 surveys.

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

Onterra, LLC
Lake Management Planning

Managing Our Shorelands to Protect Our Lakes

Cathy Higley
Lake Conservation Specialist
Vilas County Land and Water Conservation Dept.

Program Overview

Shoreland Management

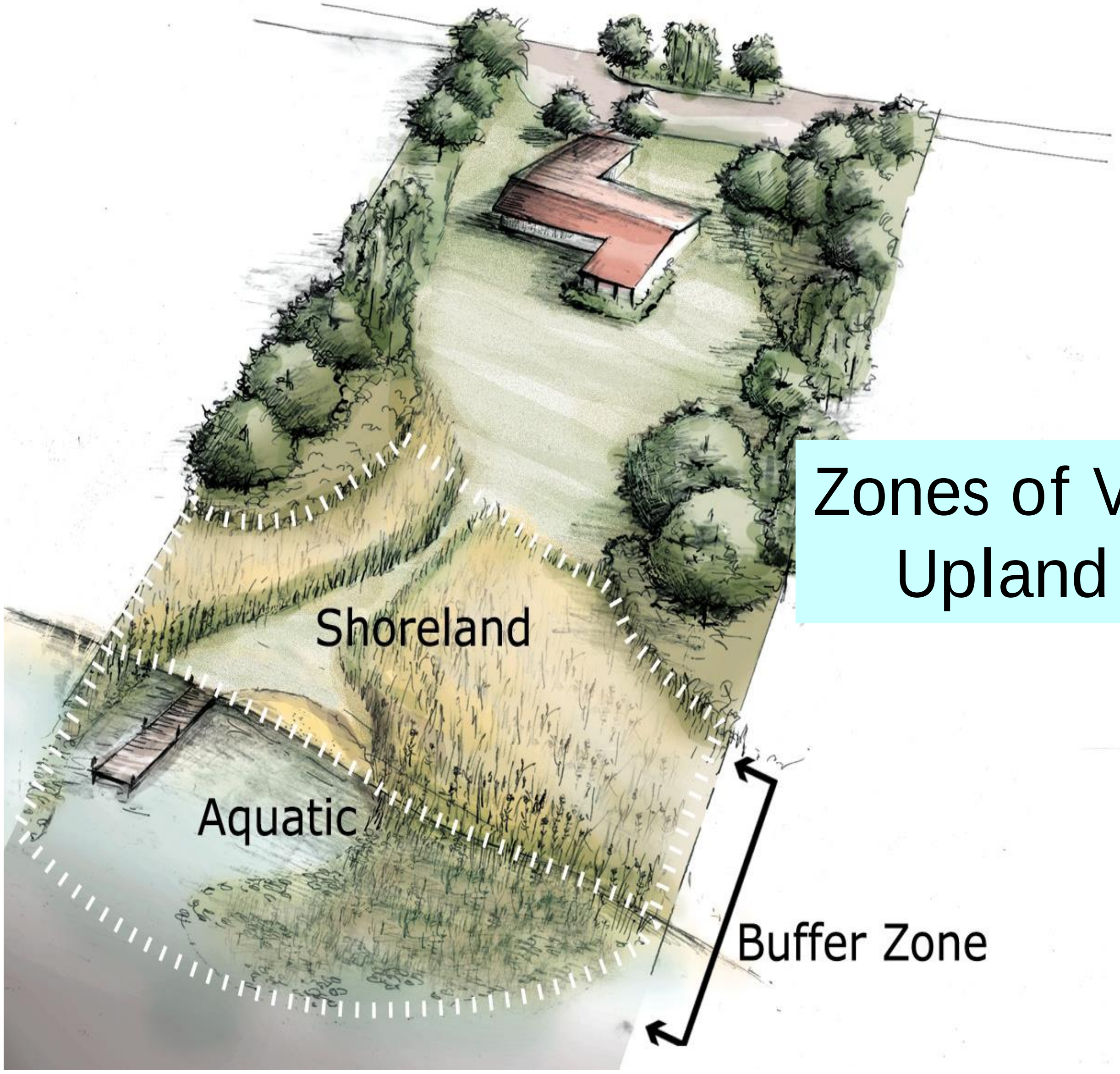
- ❖The Ecology of Shorelands

How to manage Shorelands?

- ❖Surveying
- ❖Restoring

Shoreland Programs

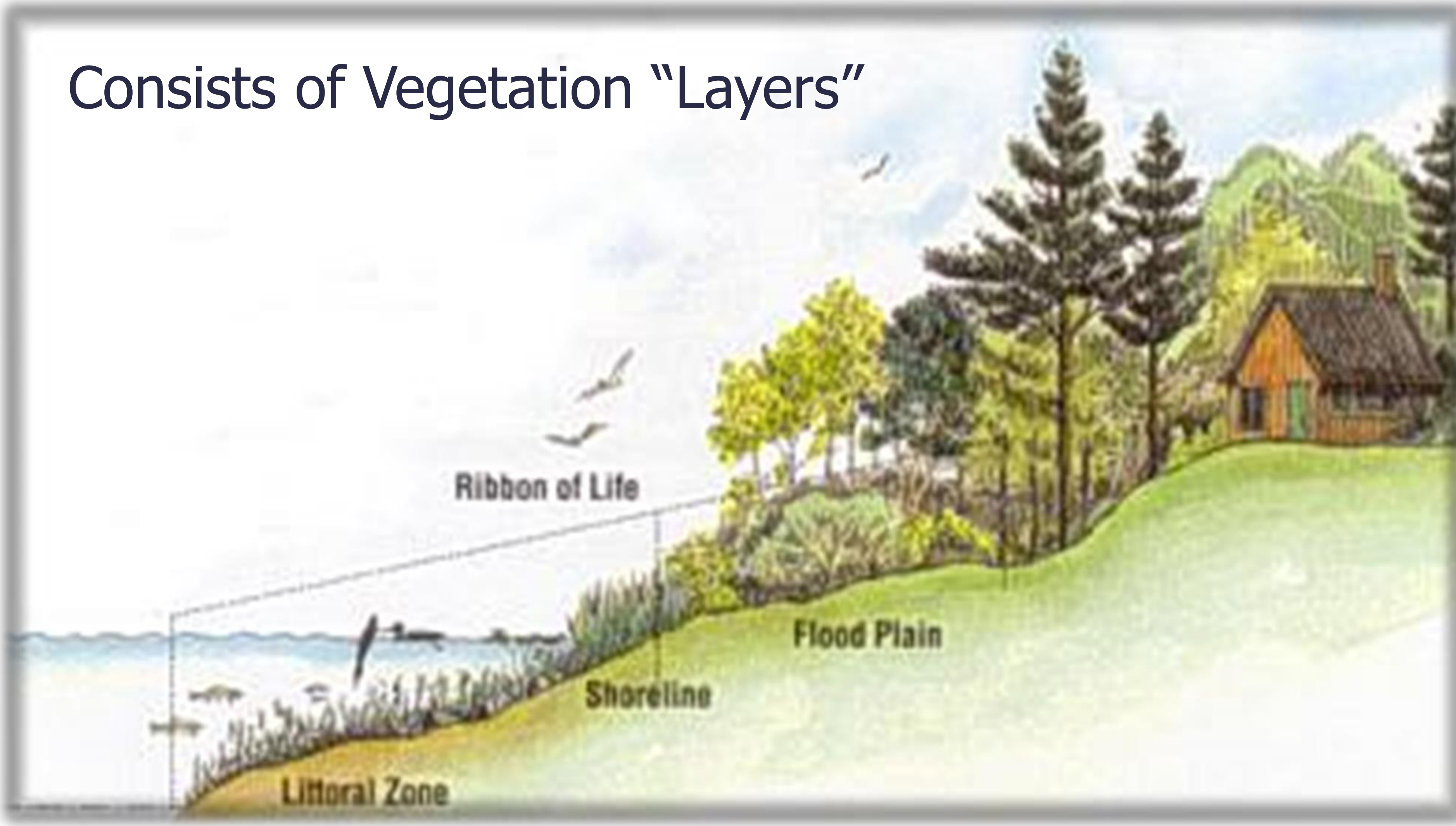
What is the "Shoreland Buffer Zone"?



Zones of Vegetation:
Upland & in Lake

What is the Shoreland Buffer Zone?

Consists of Vegetation “Layers”



Why are Shoreland Buffers Important?

Stabilize Soil

Provide Food & Nesting Habitat

Take Up Nutrients

Shelter for Wildlife

Protection for Fish

90% of all lake life is born, raised, sheltered, and fed or grows in the area where land and water meet:

The Shoreland Buffer Zone

Natural Lake Shorelands

Rich Mosaic of Vegetation

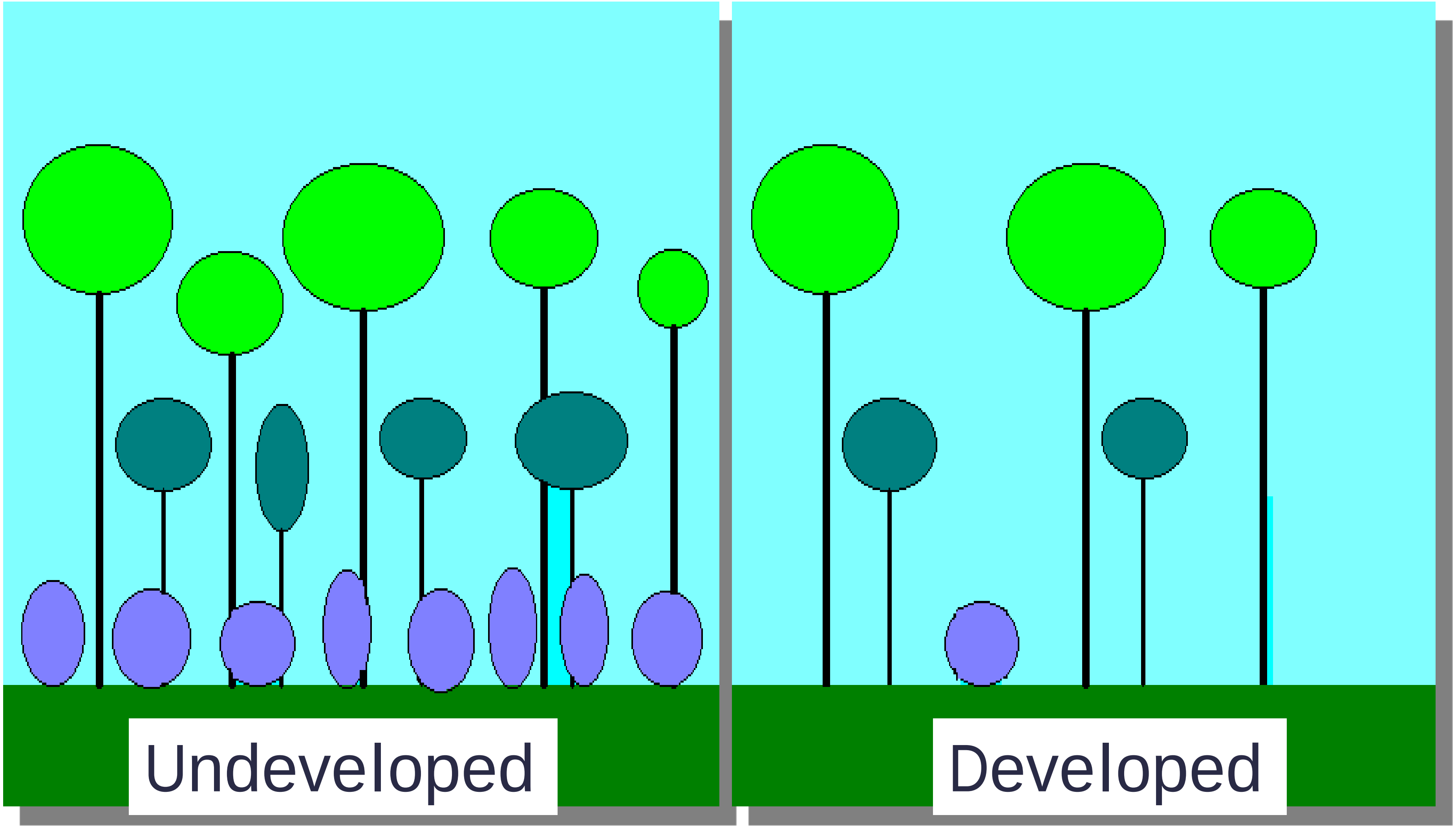
Habitat

Natural Scenic Beauty

Lake Protection

The Very Essence of Being “Up North”

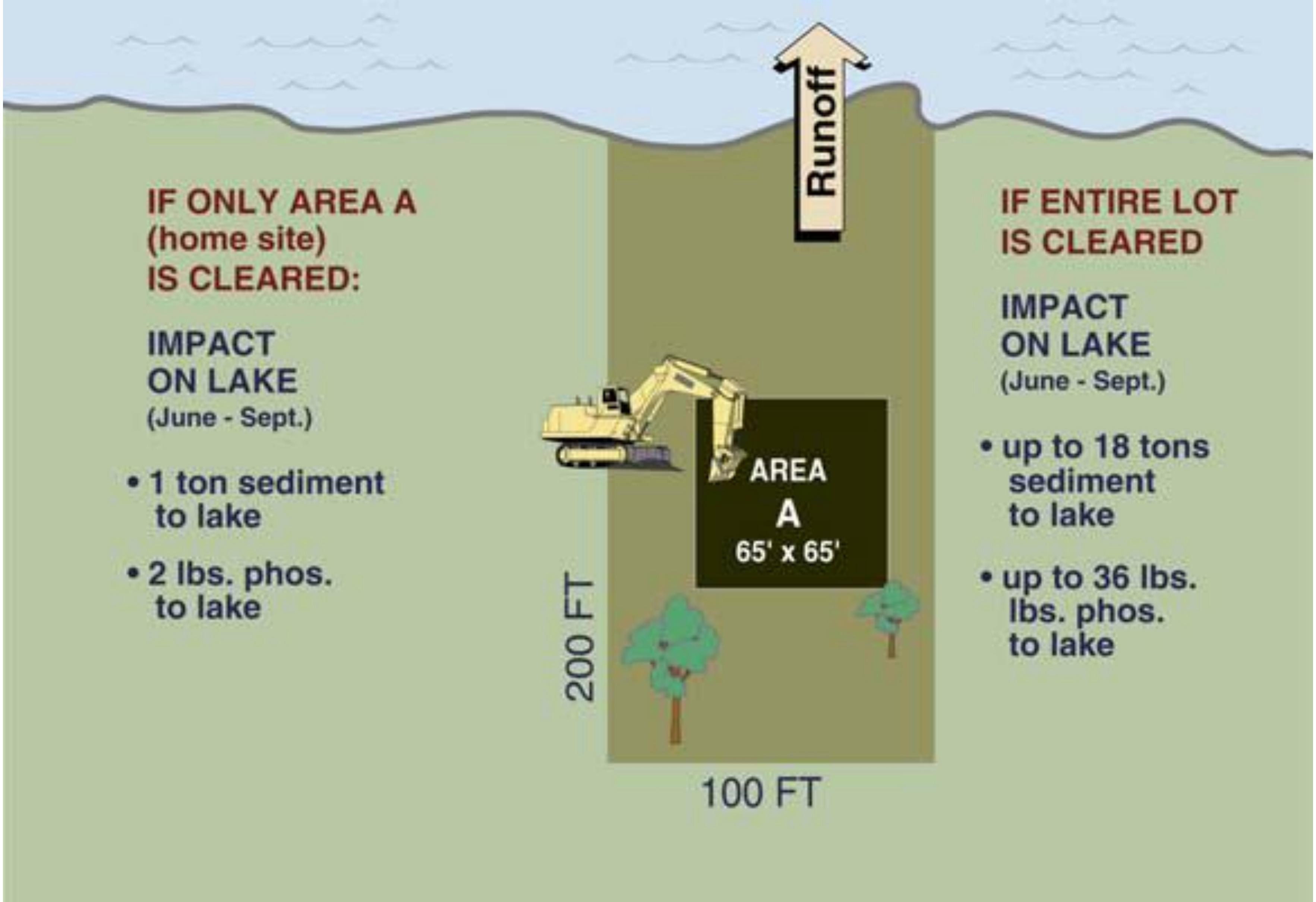
What's Happening to our Shoreland Buffers?



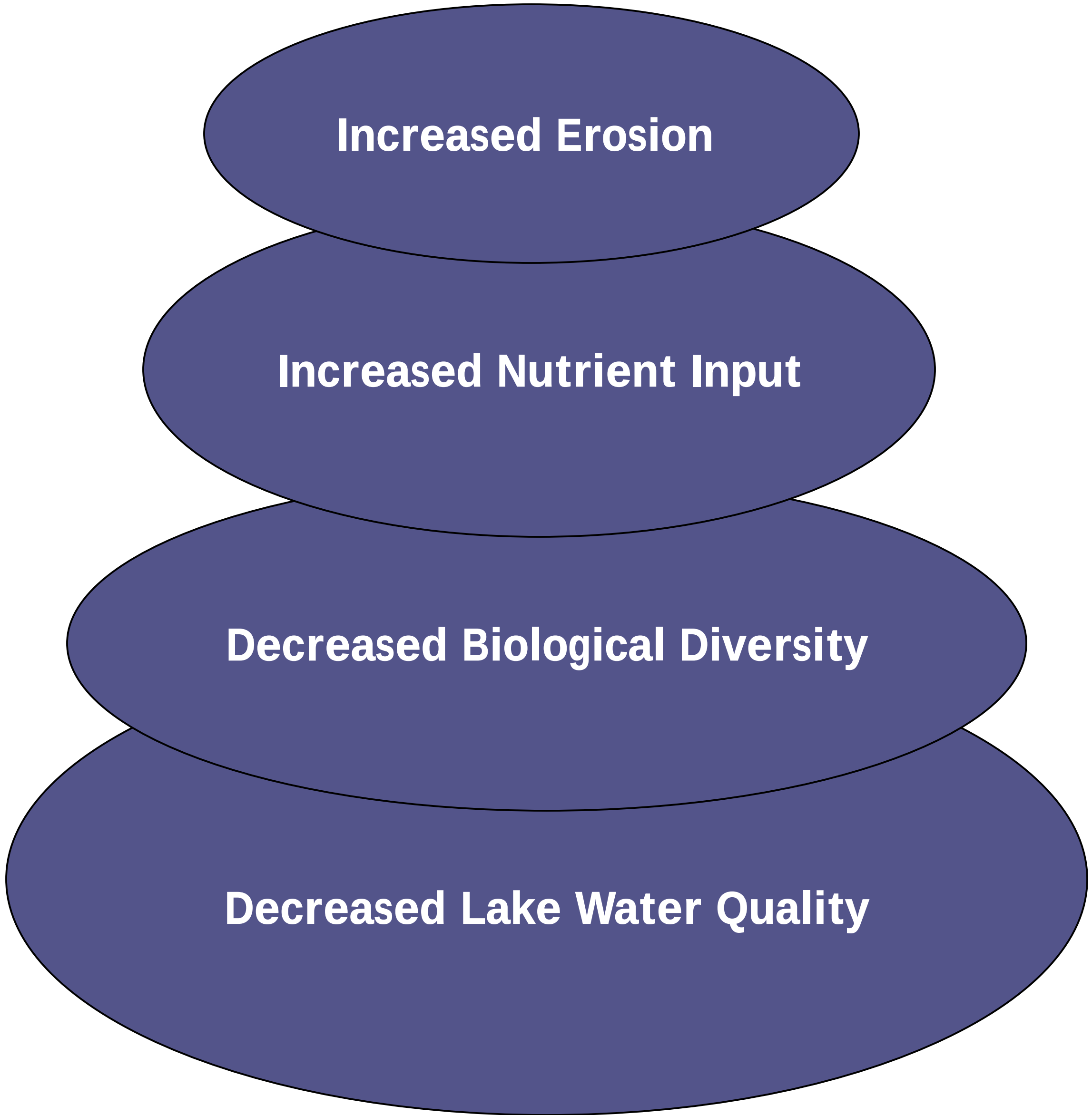
Everyone takes loving care of their own property….

But when everyone does it, the effects add up!

The effect of land disturbance on water quality

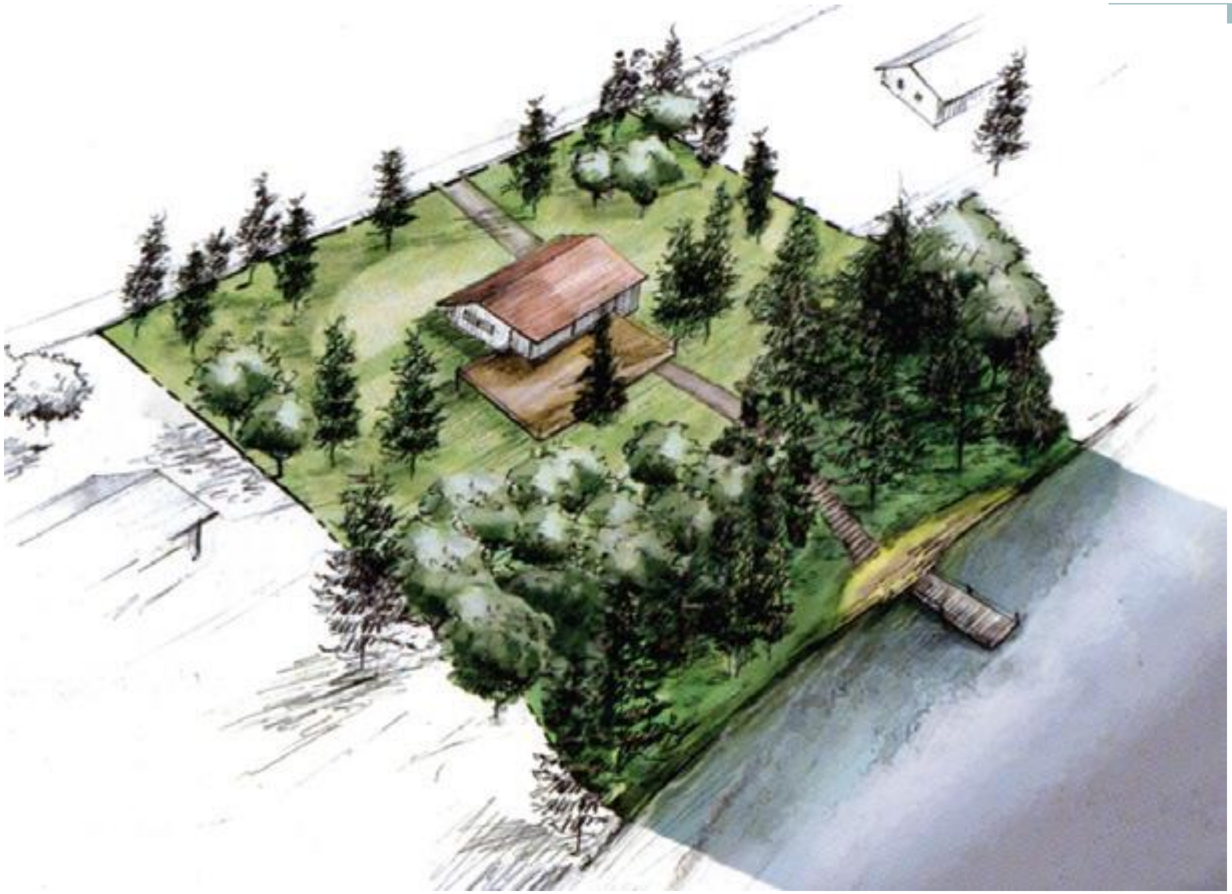


Cumulative Impacts:



How do we know what condition our shoreland is in?

SUREVYS



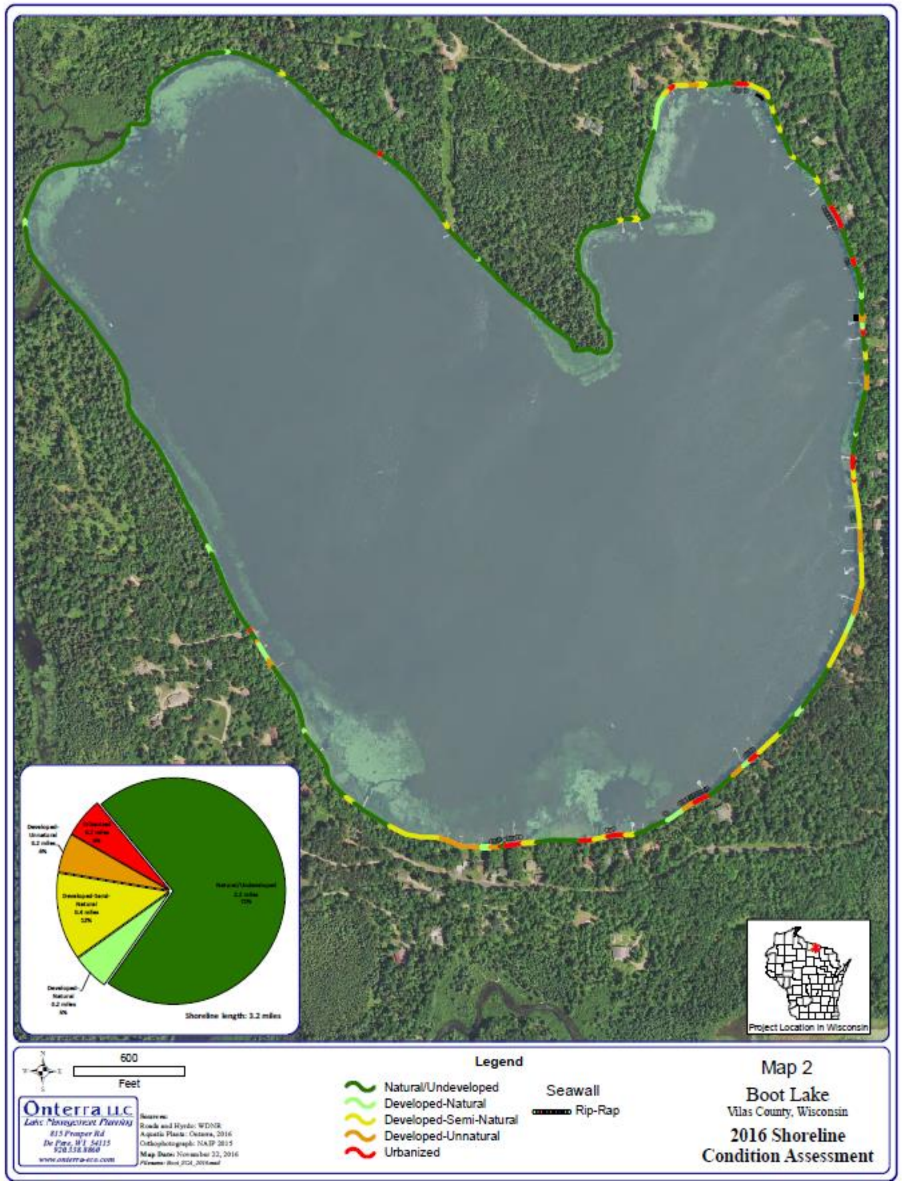
Score your Shoreland

1) Is there natural ground cover? How much?
2) Is there a shrub layer? How much?
3) Is there a tree layer? How much?
4) Is there any soil erosion? How much?

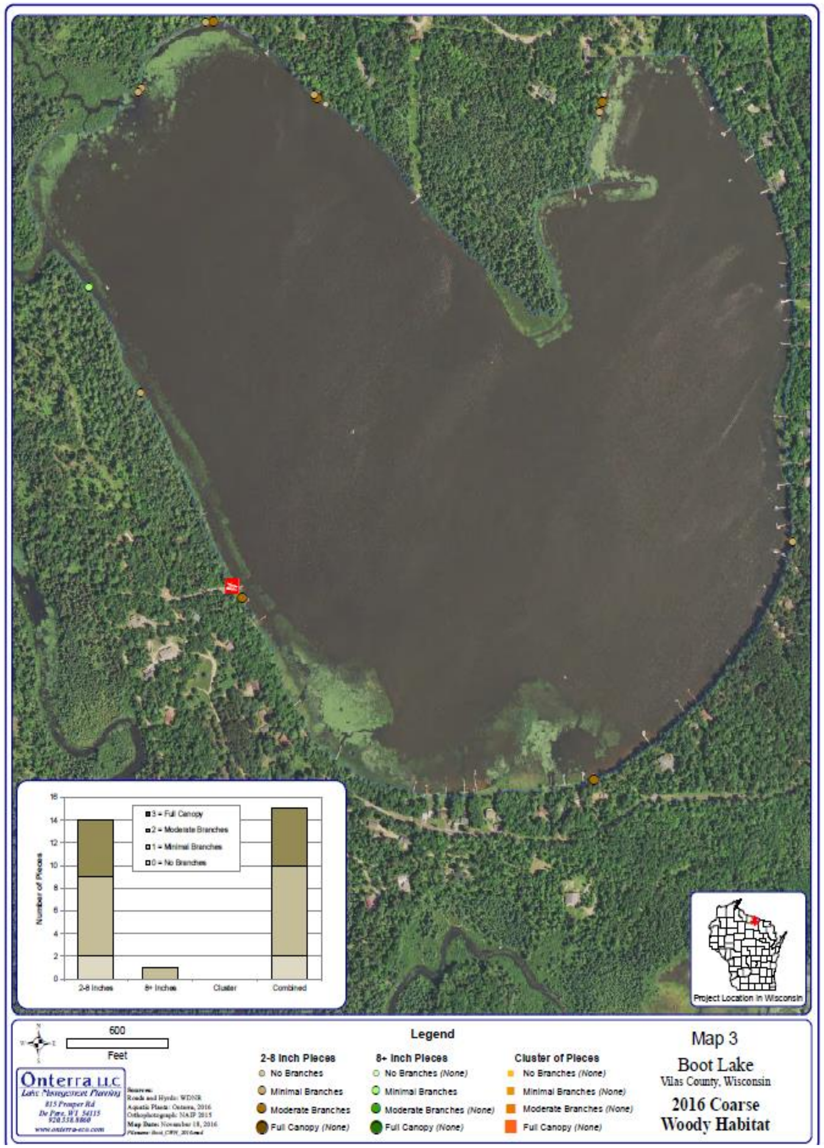
GIS Lake Shoreland Inventory

- Identify areas of shoreland that may need protection or restoration
- Provide a different perspective
- Develop a baseline for future comparison
- Provide specific information to property owners
- Inventory of potential workload for municipal/agency professionals

Shoreland Condition Assessment



Coarse Woody Habitat



Now we know what the condition of our shoreland is -

What can we do?


Restoration Options:
Protection
Natural Recovery
Accelerated Recovery

Protection

- No serious erosion problem
- Native vegetation present
- Diversity of structure

- Shoreland buffer requirement met

Natural Recovery

- Elements of 3 layers present
- Turf grasses not well established
- Leave it be - no mowing or weed whacking
- Discourage disturbance (people and critters)

Accelerated Recovery

- Turf grass well established
- No natives present
- Exposed soil
- Lots of traffic
- Sand beach maintained
- Quick results wanted

Accelerated Recovery Steps

- Site Plan Design
- Find a reference site
- Bioengineering required?
- Permits needed?
- Plant native plant species

“What about the toe erosion of my shoreland?”

Restoration Assistance

- Vilas County Land & Water Conservation Department
  - Technical Assistance
  - Cost Share Program

- WI DNR’s Healthy Lakes Implementation Grant
  - Through Lake Association
  - Shovel Ready Projects

2003

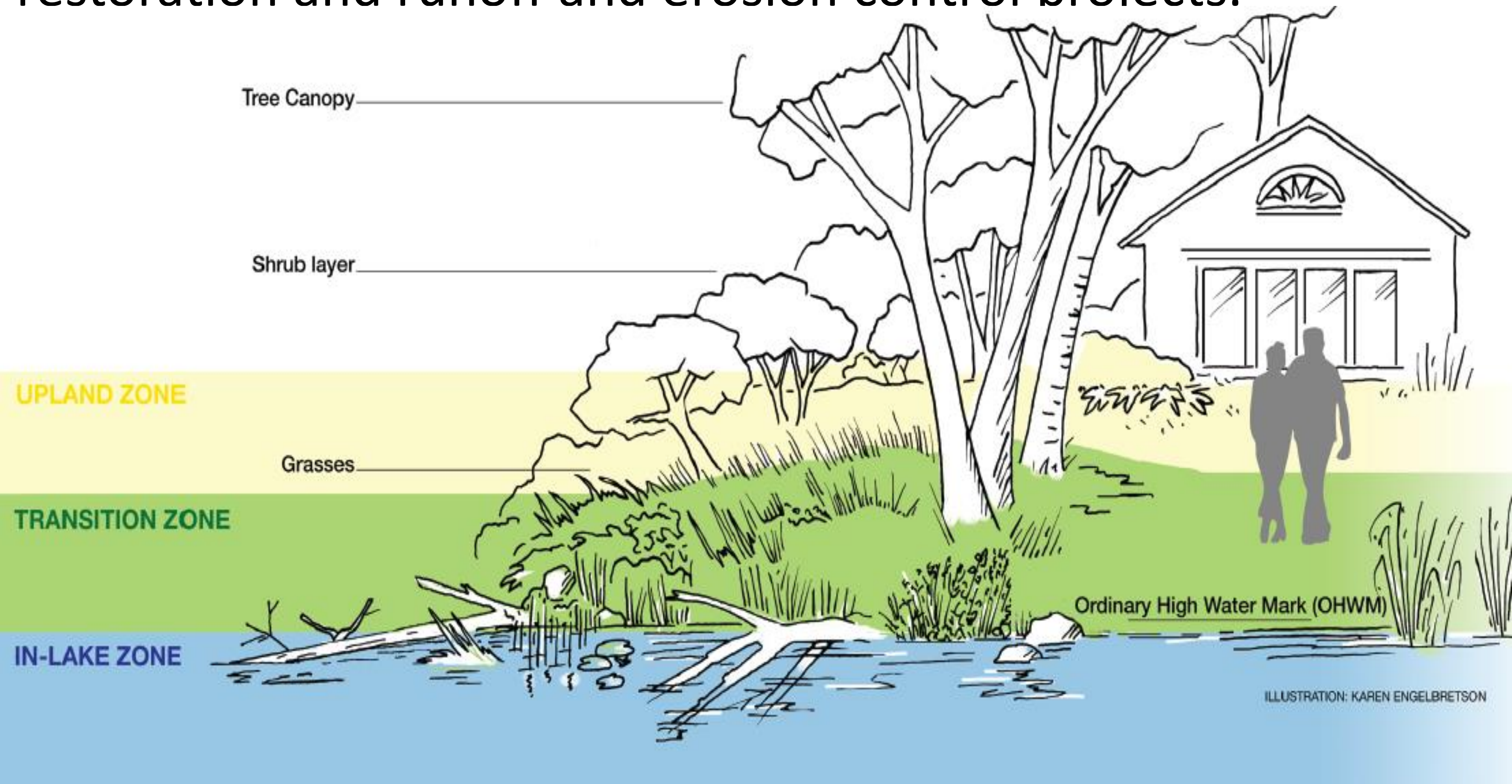
Construction

2005

2011

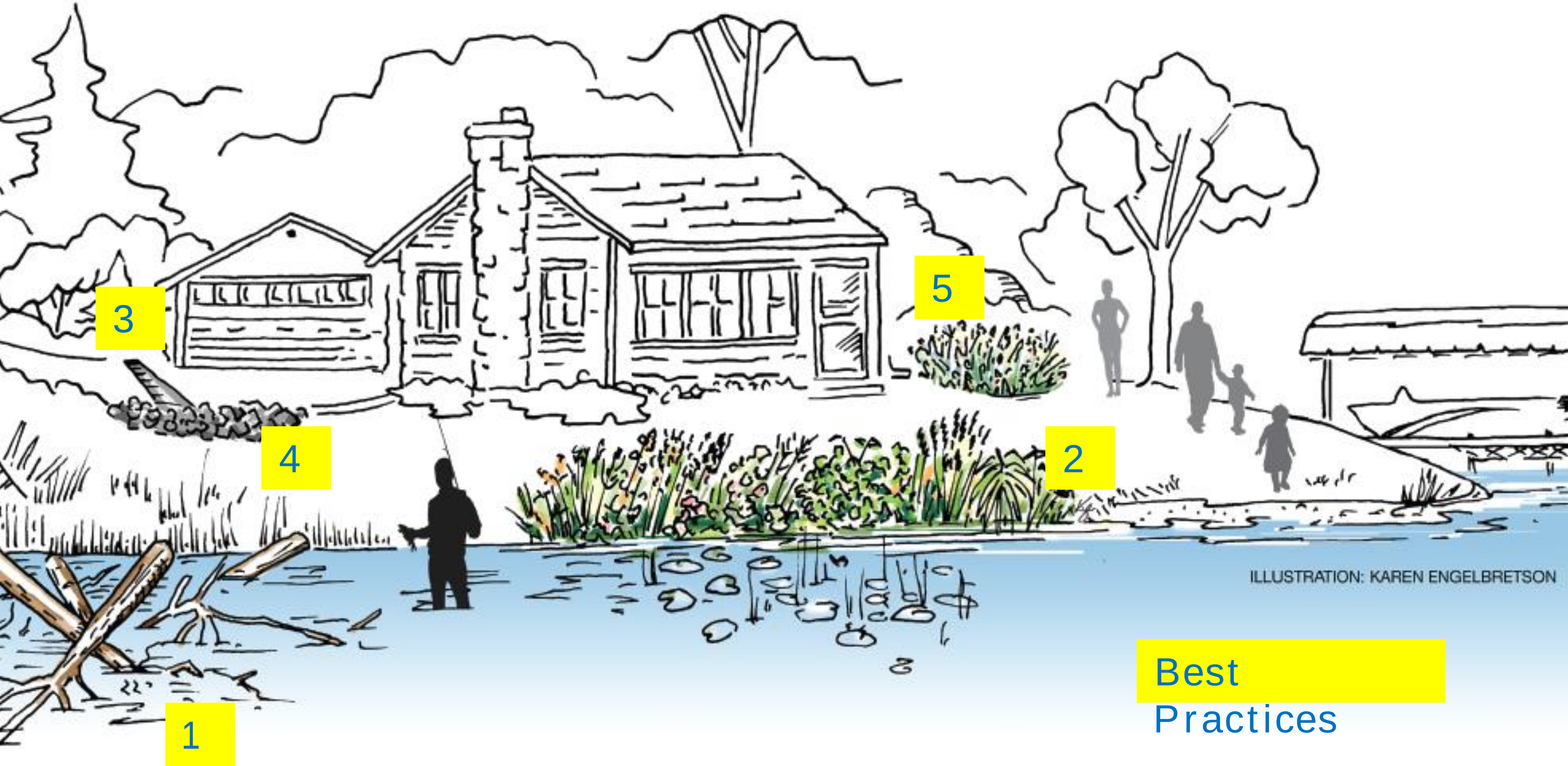
Lean Government Charter

Goal: protect and improve the health of Wisconsin lakes by increasing lakeshore property owner participation in habitat restoration and runoff and erosion control projects.



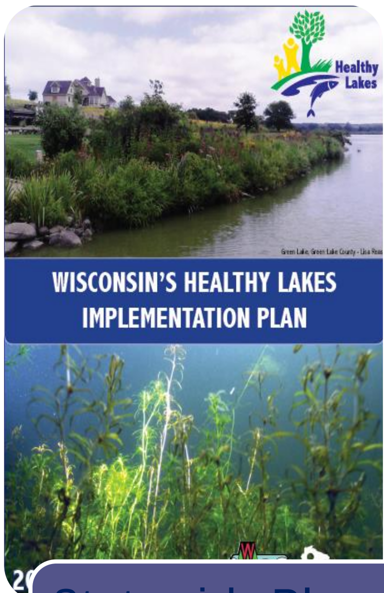
Wisconsin's 2014-2017 Healthy Lakes Implementation Plan

- Apply for Healthy Lakes grant funding, or
- Integrate into local planning efforts, or
- Do it yourself.



Best Practices

Wisconsin's 2014-2017 Healthy Lakes Implementation Plan



FACT SHEET SERIES:

FISH STICKS

MAINTENANCE

COSTS

- Range: $100 – $1000 *(average = $500)*
- Healthy Lakes grant funding available: *$1000 per Fish Sticks Cluster*

MATERIALS

- Whole, live trees from outside shoreland vegetation protection area
- Cables/cabling gear
- Heavy equipment including snowplow and chainsaw
- Safety gear

DNR PERMIT REQUIRED

FISH STICKS, an in-lake best practice, are large woody habitat structures that utilize whole trees grouped together, resulting in the placement of more than 1 tree per 50 feet of shoreline. Fish Sticks are anchored to the shore and are partially or fully submerged. Fish sticks are not tree drops since the trees utilized for the projects come from further than 35 feet from shore, thus they don't "rob from the bank" of trees that may otherwise grow and fall in naturally.

PURPOSE
This fish and wildlife habitat best practice creates food, shelter, and breeding areas for all sorts of creatures from small aquatic insects, to fish, to turtles, ducks, and songbirds. Fish Sticks can also help prevent bank erosion – protecting lakeshore properties and your lake.

HOW TO BUILD
It may be necessary to work with your local DNR fisheries biologist, county land and water conservation department, or landscaper to design and/or construct this practice. Logging companies may assist with tree supply, cutting, and transportation. Check with your local zoning department to determine if any permits are necessary.

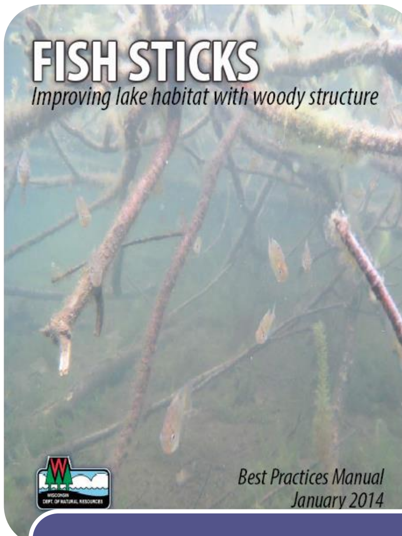
Detailed guidance is found here: http://dnr.wi.gov/topic/fishing/outreach/fishsticks.html

1. Find a location
Ideal Fish Sticks sites have low ice energy – places like protected bays and shorelines leading to and from bays. High ice energy areas on lakes greater than 250 acres require alternate methods that ensure they remain in place.

Typically a single Fish Sticks cluster occupies 50 linear feet of shoreline, so it should be placed on an area of your lakeshore that is not used for pier(s) or swimming. If you have a lot of frontage, you may choose to add more than a single Fish Sticks cluster.

PROJECT TIMELINE

SITE PREP	INSTALLATION	MAINTENANCE	PROJECT END
2 MONTHS winter ice road	< 1 DAY	Spring safety	3 YEARS



Statewide Plan
- Implementation focus

Fact Sheets
- 5 Best Practices
- Funding & Admin FAQs

Technical Guidance
- More project installation detail

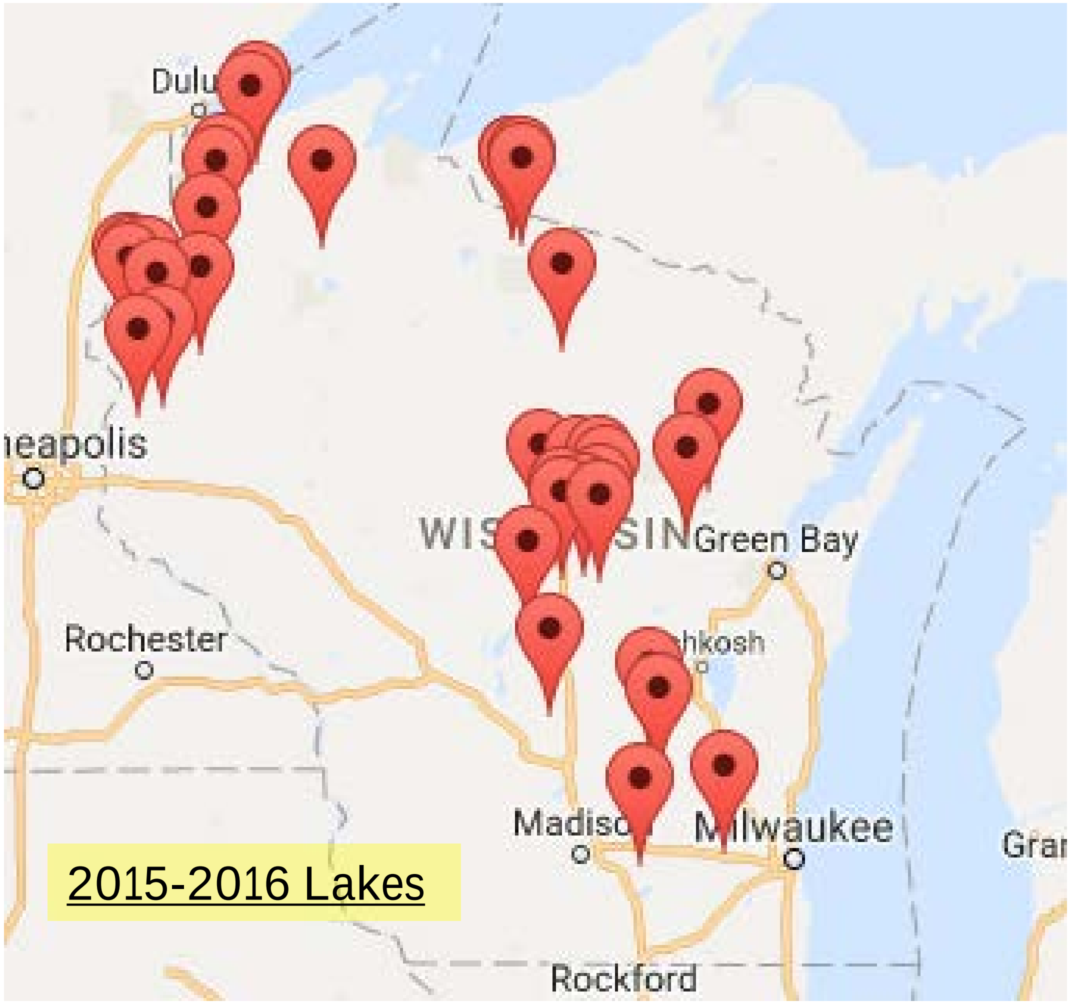
Healthy Lakes Grants

- $1000/best practice funding cap
- Eligible sponsor applies on behalf of landowners with $25,000 grant award cap (multiple best practices)
- 2-year grant agreement and 10-year individual landowner contract with maintenance requirements

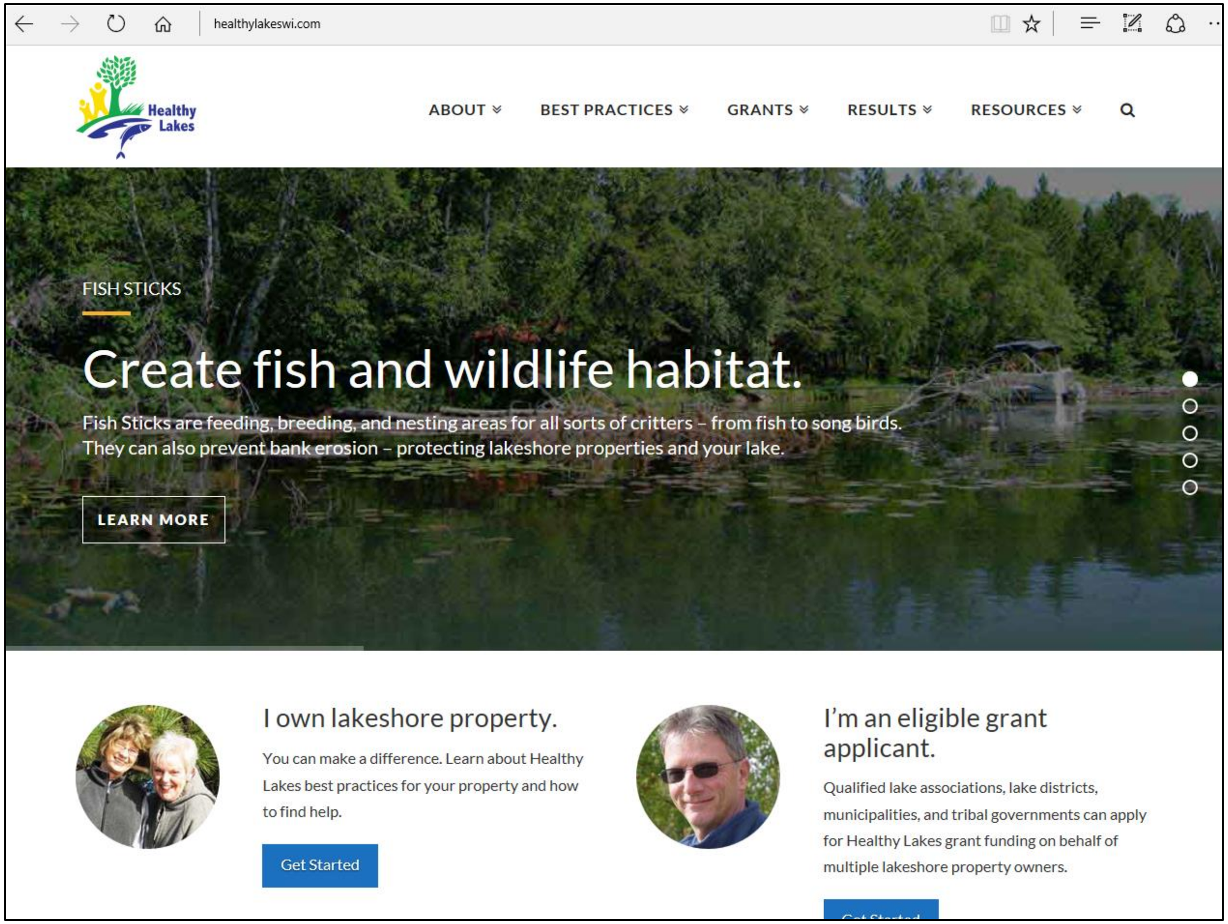
Stan, 2016 Governor's Fishing Opener on Minong Flowage

2015-2017: 407 Best Practices, 267 Properties, 56 Lakes, 21 Counties

$377K state investment



www.healthylakeswi.com



RESOURCES

- www.healthylakeswi.com
- Professional Shoreland Habitat Training (UW-Extension)
- Future workshops – Wisconsin Lake Partnership Convention April 5 -7

DNR's Healthy Lakes Implementation Plan

- Grants available to Lake Associations or other entities
- 5 Best Practices (pick 1 or more)
  - Fish Sticks
  - 10 x 30 ft area of Native Plantings
  - Diversion
  - Infiltrations Pit
  - Rain Garden

Restoration in progress

Rain Gardens

- Increase the amount of water filtering into ground rather than running across the ground and causing soil erosion
- Recharge groundwater
- Provide wildlife habitat
- Enhance beauty of yard and neighborhood
- Protect against flooding and drainage problems
- Protect lakes from damaging flows and reduces erosion
- Reduce the need for costly municipal storm water treatment structures

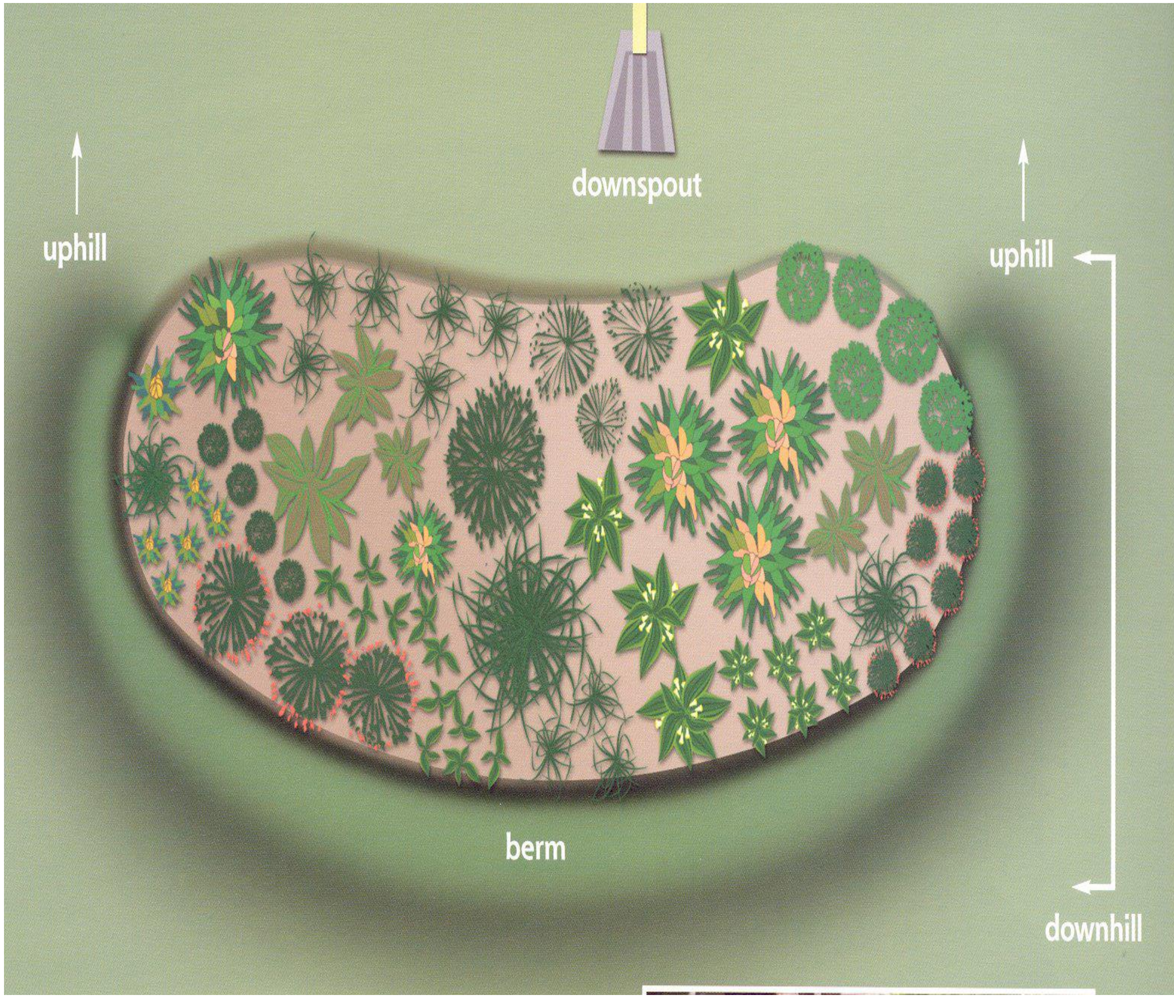
Rain Gardens - Defined

- Shallow depressions planted with native plants usually located near drain spouts of a building or adjacent to pavement areas

- Allows water to infiltrate into the soil

- Reduces soil erosion caused by runoff, to protect the quality of lake water or storm water drainage

- Functional garden



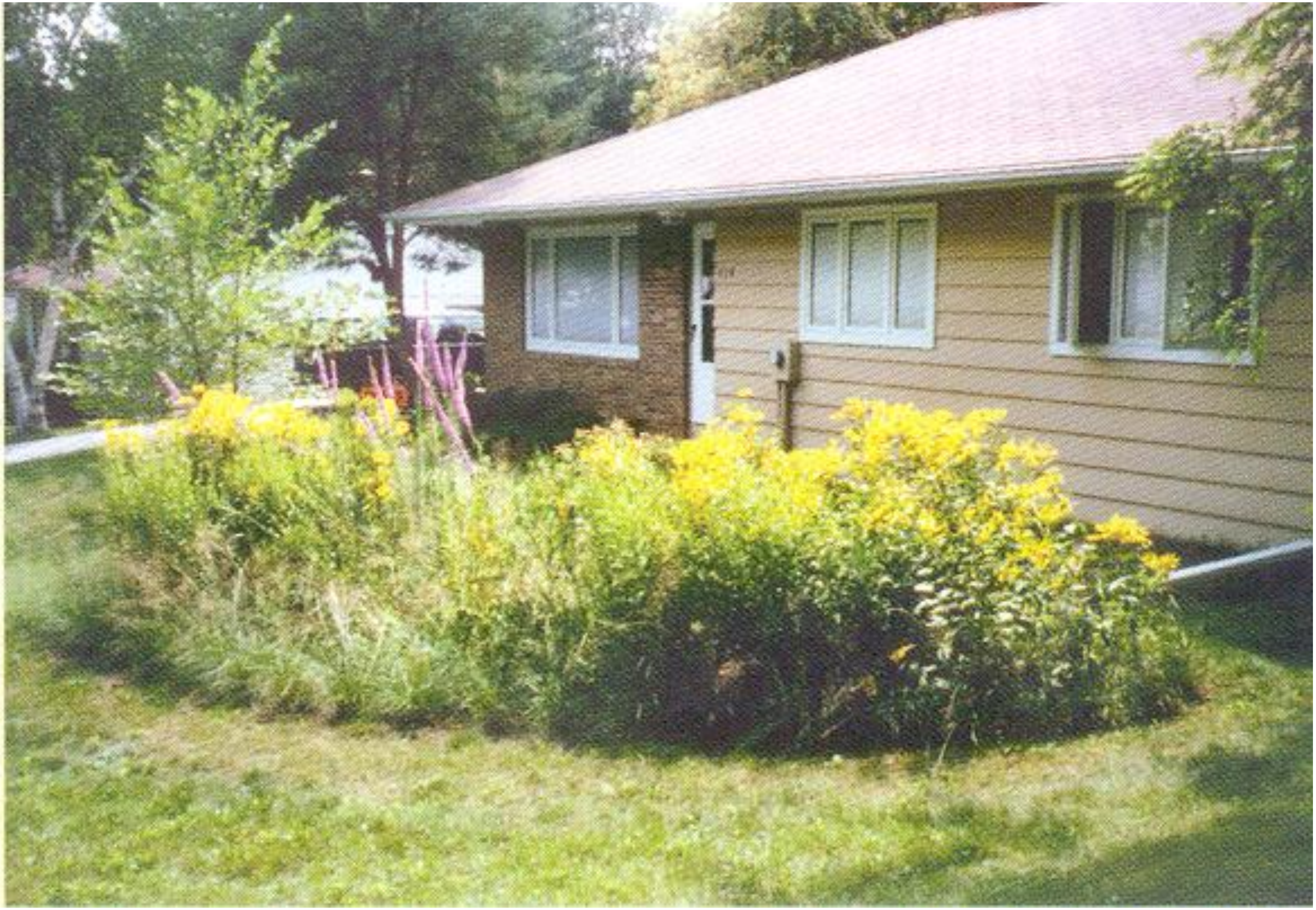
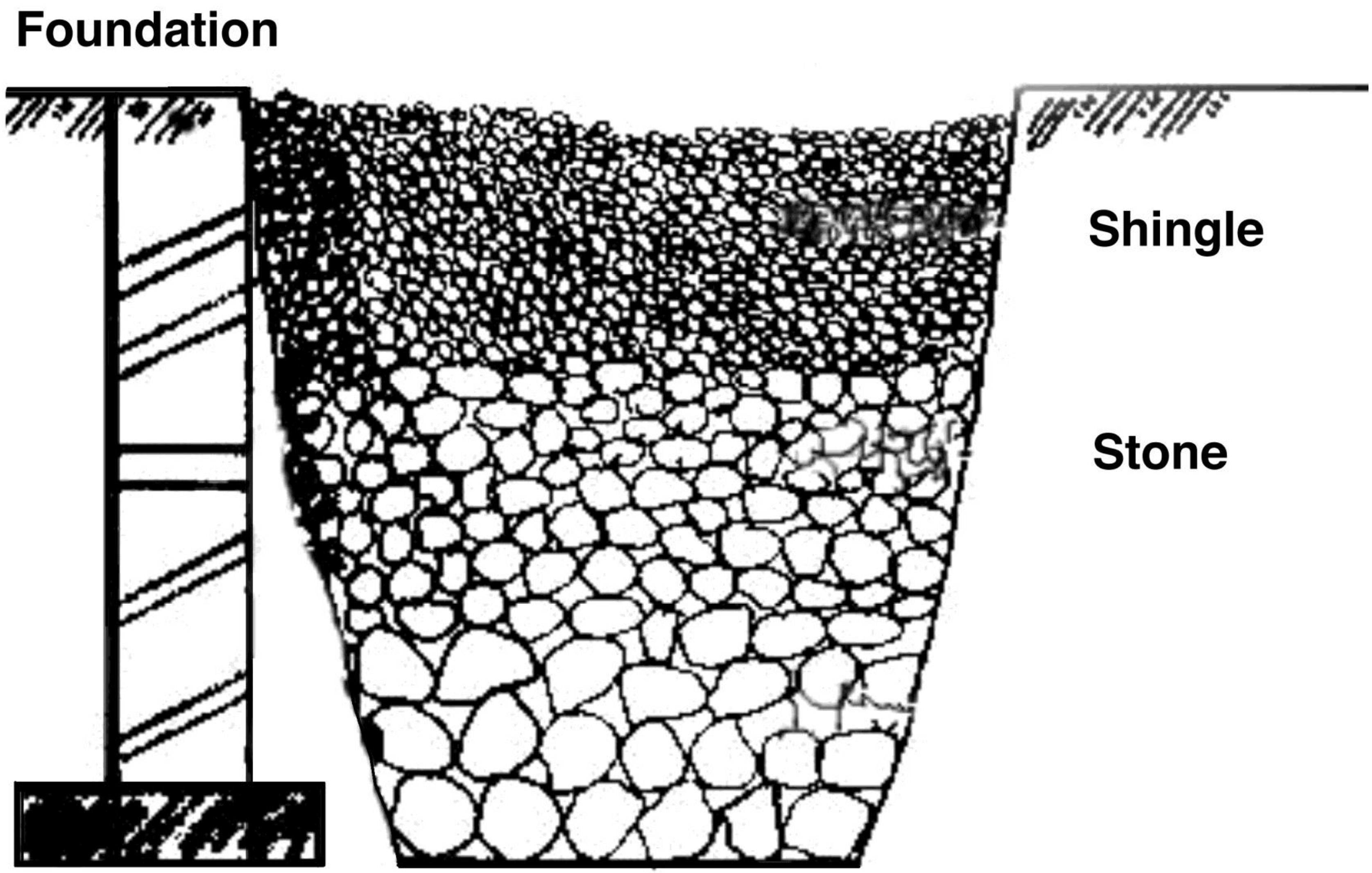


Illustration 1: French Drain



Not to scale

Funding the Projects

Healthy Lakes

- DNR Grant Funded
  - Lake Organizations typically hold grant
  - $1,000 max per practice awards
  - Requires 25% match (cash and/or labor)
  - Lake Organizations often have property owners cover the 25% match on practices implemented
  - Works well for minor erosion problems

Funding the Projects

Cost Share Funding

- DATCP funding managed by Land & Water Conservation Depts.
  - Can provide engineering design
  - Requires match - % varies depending on project
  - Dept. work directly with the land owners
  - Typically for moderate erosion problems
  - Funds more expensive projects (up to $13,999)

Questions?