



# Exploring the water's edge: shoreland habitat, biodiversity, and restoration opportunities

Lakeshore habitat restoration training – Moon Beach Camp  
- July 16-17<sup>th</sup>, 2014



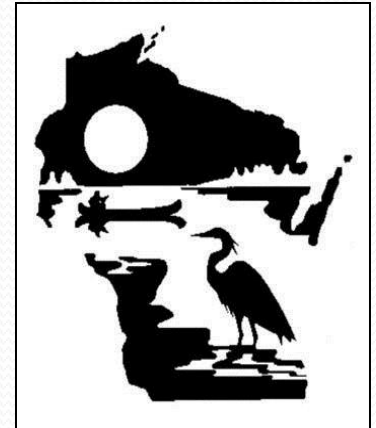
Patrick Goggin  
– *Lakes Specialist*  
UW Extension Lakes /  
Wisconsin Lakes Partnership

**The Wisconsin Lakes Partnership**



College  
of Natural Resources

# The Wisconsin Lakes Partnership



- **Google** UWEX lakes
- <http://www.uwsp.edu/cnr/uwexplakes/>
- <http://www.wisconsinlakes.org/>
- <http://www.dnr.state.wi.us/>
  
- **Lake Tides... The Lake Connection**
- **Lake List**
- **CBCW**
- **CLMN**



# Talk outline



## Shoreline habitat

What/where is it?

Why does it matter?

Who does it support?

## Shoreland biodiversity

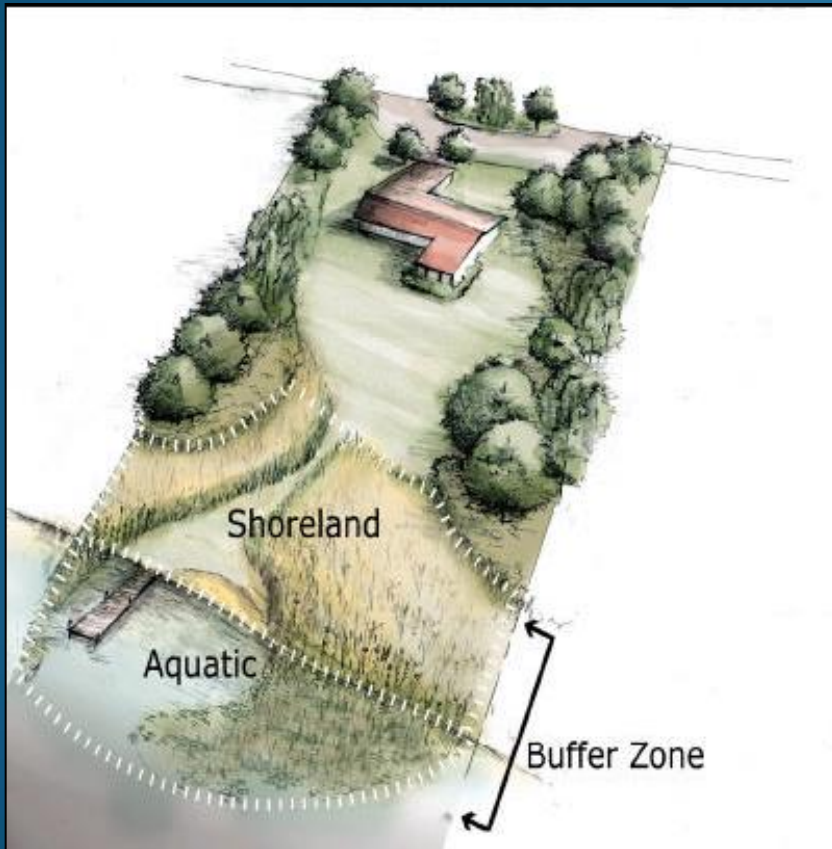
## Restoration opportunities

## Q & A



# It's all about HABITAT!

- Interface between land and water --area adjacent to lakes/streams.
- Links together the world of water with the terrestrial uplands.
- Essential habitat plants and animals—corridor between uplands and lowlands as well as between habitats along the shore.
- Important for water quality protection and other functions.



# Importance/functions of the land-water interface—the water's edge habitat zones



- Help clarity by holding sediment in place.
- Take up nutrients that would be used by algae.
- Shelter for wildlife.
- Wildlife food and nesting areas.
- Can help reduce erosion and runoff.
- Spawning beds in sedges /emergent plants for fish.

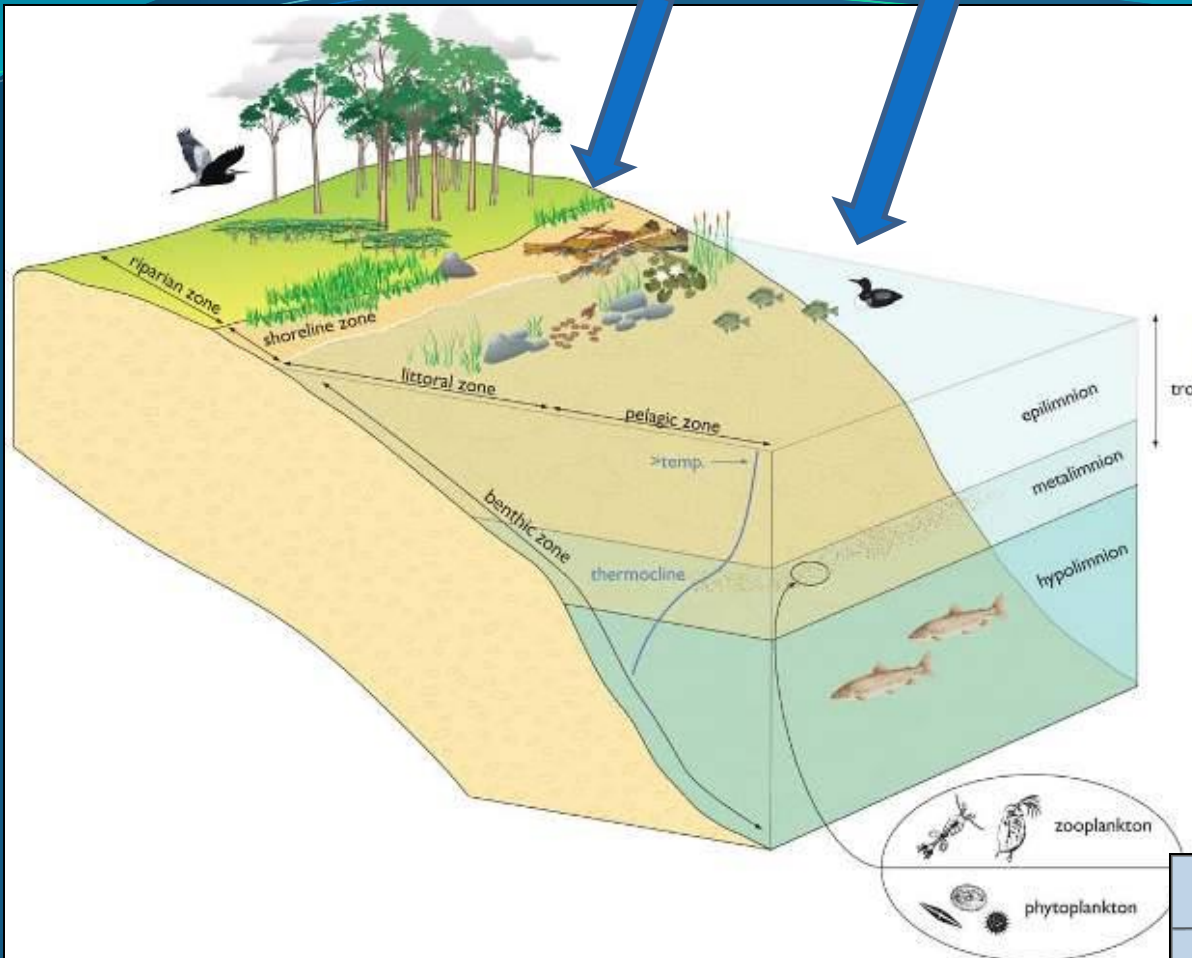


**90% of all lake life is born, raised and fed in the area where land and water meet.**

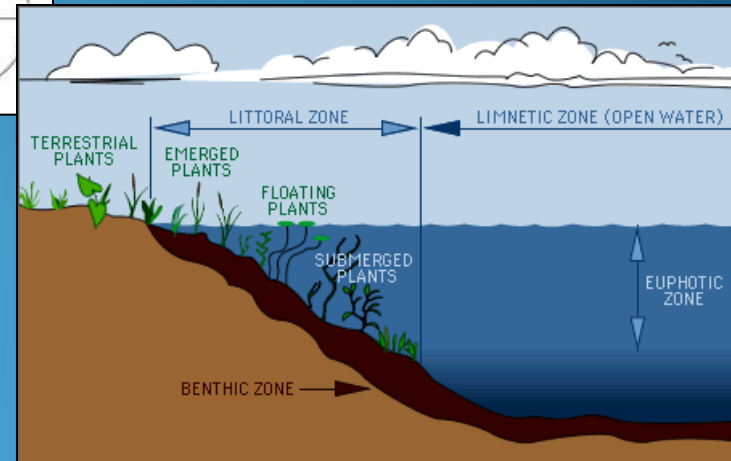


## Lakeshore zone

## Shallow zone / littoral zone

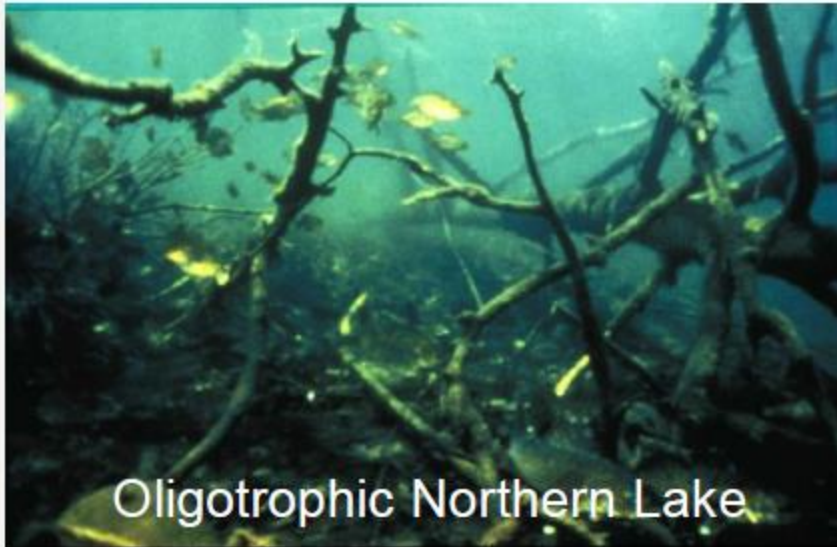
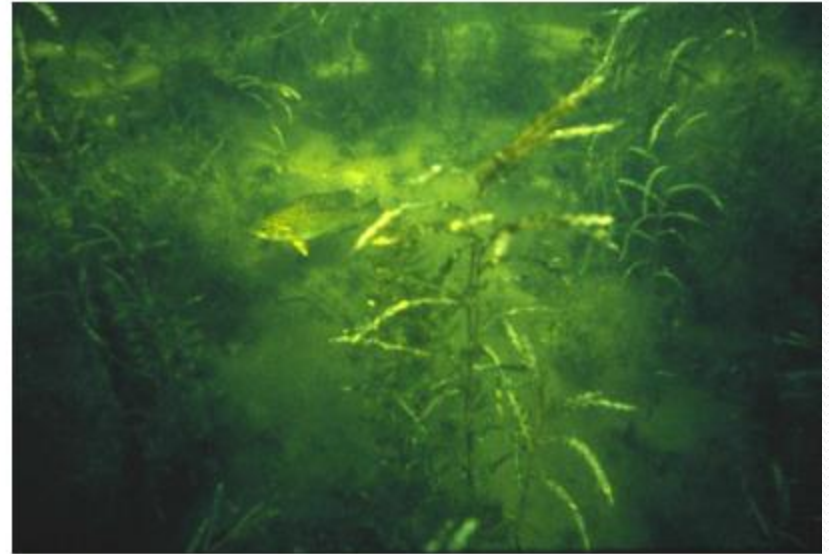


- The land and water ecotone facilitates movement of food into and out of lakes.
- Shoreland and littoral zone habitats act as the “skin” of a lake, nurturing biodiversity of all kinds.
- The littoral zone is the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants (macrophytes) to grow.



# LAKE LITTORAL ZONE

- Functions
  - Intercepts Nutrients
  - Refuge from Predators
  - Nursery for Fish



Oligotrophic Northern Lake



Eutrophic Southern Lake

# AQUATIC PLANTS

- Habitat
- Energy Dissipation
- O<sub>2</sub> Producers

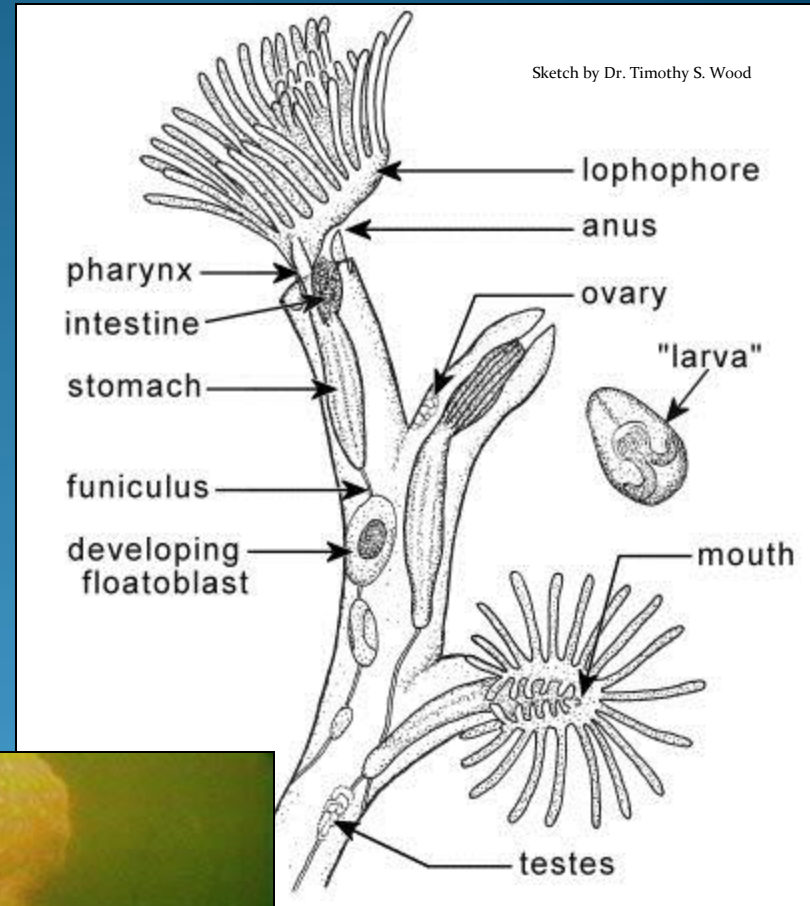
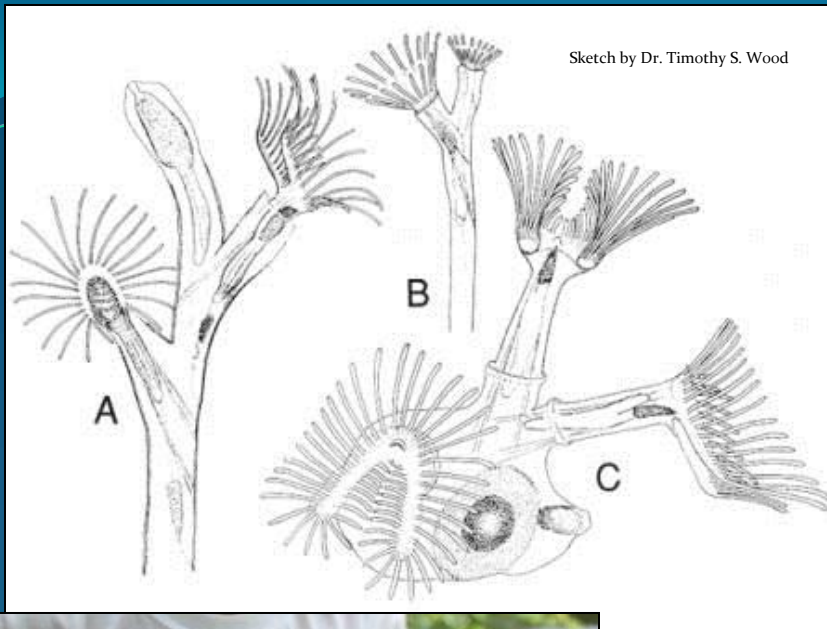




Let's walk down to the dock and see  
what's along the water's edge...



# Bryozoans



# Jellyfish (*Craspedacusta sowerbyi*)

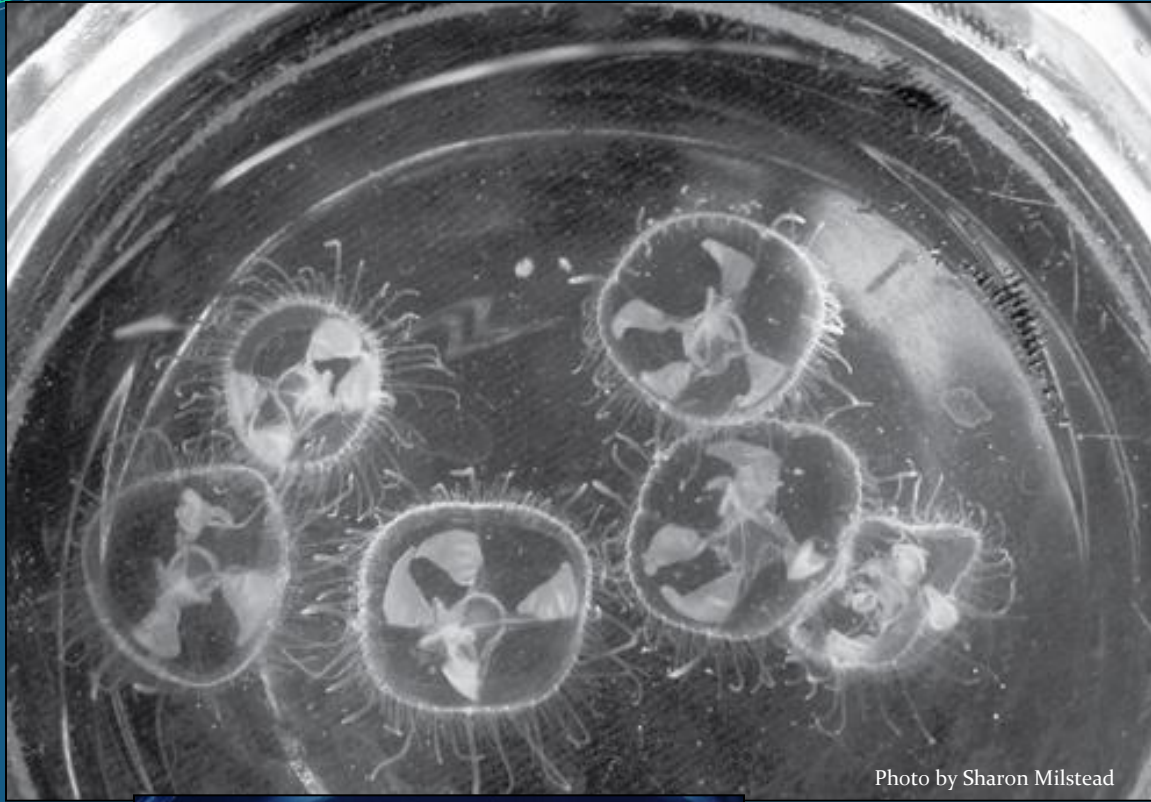
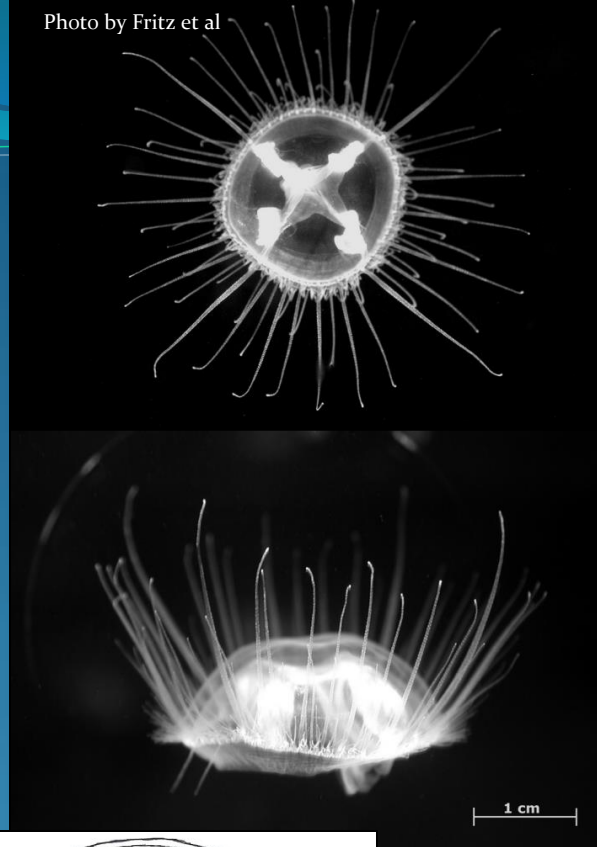
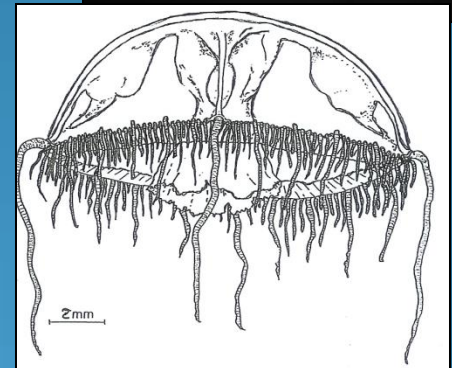


Photo by Sharon Milstead

Photo by Fritz et al



1 cm



2mm

Sketch by R. W. Pennak



Photo by USGS

# Freshwater opossum shrimp (*Mysis relicta*)

Photo by NOAA



Photo by Central Michigan University

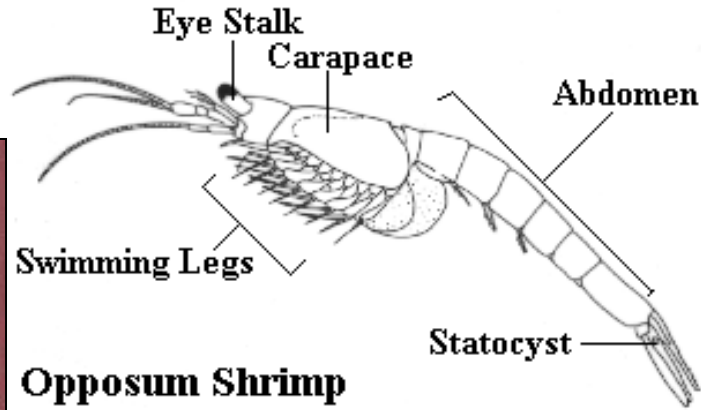


Photo by Central Michigan University



Photo by Andrew Muir



Photo from Super Stock



Treefrogs – live in forests around lakes/ponds

# Frogs, treefrogs and toads



Photo by Robert Hay, WDNR



Photo by Rori Paloski, WDNR

Northern Cricket Frog (*Acris crepitans*)  
METALLIC 'GICK-GICK-GICK' NOISES (mid-May)



Photo by Rori Paloski, WDNR

Spring Peeper (*Pseudacris crucifer*)  
RISING PEEP (late-March)



Photo by Robert Hay, WDNR

Cope's Gray Treefrog (*Hyla chrysoscelis*)  
FAST, HARSH, BUZZING TRILL (early May)

Toads – live in forests around lakes/ponds



Photo by staff, WDNR

Eastern American Toad (*Bufo americanus*)  
TRILLING (April)



Photo © A.B. Sheldon

Eastern Gray Treefrog (*Hyla versicolor*)  
BLAAT



Photo © A.B. Sheldon

Boreal Chorus Frog (*Pseudacris maculata*)  
RISING "CREE-EE-EEK"/COMB (mid-March)

# Frogs, treefrogs and toads [continued]

True frogs – live in forests around lakes/ponds



Photo by Drew Feldkirchner, WDNR



Photo by Drew Feldkirchner, WDNR

Green Frog (*Lithobates clamitans*)  
"CLUNG-CLUNG-CLUNG"/BANJO TWANG (mid-May)



Photo © Bob Howe

Pickerel Frog (*Lithobates palustris*)  
LOW-PITCHED, SNORE-LIKE CROAK (April)

American Bullfrog (*Lithobates catesbeianus*)  
DEEP "BUR-RUM"/FOG HORN - GUIN (mid-May)



Photo © A.B. Sheldon

Northern Leopard Frog (*Lithobates pipiens*)  
LOUD, BROKEN SNORE/BALLOON RUB (late March)



Photo by Robert Hay, WDNR

Mink Frog (*Lithobates septentrionalis*)  
LOW-PITCHED CROAKS/DISTANT HAMMERING-  
"TOK"- "TOK"- "TOK"- "TOK"



Photo © Dan Nedrelo

Wood Frog (*Lithobates sylvaticus*)  
CLUCKING CROAKS/QUACKING DUCK (late-March)

# Salamanders



Photo © A.B. Sheldon

Redback Salamander (*Plethodon cinereus*)



Photo © Ohio DNR

Four-toed salamanders (*Hemidactylum scutatum*)



Photo © A.B. Sheldon

Tiger Salamander (*Ambystoma tigrinum*)



Photo © Dan Nedrelo

Spotted Salamander (*Ambystoma maculatum*)



Photo © Bob Howe

Central Newt (*Notophthalmus viridescens*)



Mudpuppy (*Necturus maculosus*)

# Common mussels and clams

© Illinois Natural History Survey



Floater (*Pyganodon grandis*)

© Illinois Natural History Survey



Fatmucket (*Lampsilis siliquoidea*)

© Illinois Natural History Survey



Fingernailclams and Peaclams  
(*Musculium*, *Pisidium*, and *Sphaerium*-Family *Sphaeriidae*)

© Illinois Natural History Survey



Threeedge (*Amblema plicata*)

© Illinois Natural History Survey



Threehorn wartyback (*Obliquaria reflexa*)



# Dragonflies



Photo © June Tveckrem

Lake emerald (*Somatochlora cingulata*)



Photo © R. DuBois

Lake darner (*Aeshna eremita*)



© 2006  
Ann Johnson

Twelve-spotted Skimmer (*Libellula pulchella*)



© Stephen Cresswell

Widow skimmer  
(*Libellula luctuosa*)



Copyright © 2006 Bill Meier

Common whitetail (*Plathemis lydia*)



© 2007  
Ann Johnson

Common green darner  
(*Anax junius*)



Copyright © 2005 Tom Murray

Common pondhawk (*Erythemis simplicicollis*) eating a pearl crescent



© 2003  
Ann Johnson

Common baskettail (*Epiheca cynosura*)

# Damselflies



Powdered dancer (*Argia moesta*)



Violet dancer (*Argia fumipennis violacea*)



Alkali bluet (*Enallagma clausum*)



Amber-winged spreadwing (*Lestes eurinus*)



Boreal bluet (*Enallagma boreale*)



Marsh bluet (*Enallagma ebrium*)

# Turtles



Photo by Scott Crave, UWEX

Eastern Spiny Soft shell (*Apalone spinifera*)



Photo by Bob Korth, UWEX

Painted Turtle (*Chrysemys picta*)



Photo © A.B. Sheldon

Common Snapping Turtle (*Chelydra serpentina*)





Common garter snake (*Thamnophis sirtalis*)



Photo © A.B. Sheldon

Smooth greensnake (*Opheodrys vernalis*)



Photo © A.B. Sheldon

Western foxsnake (*Elaphe vulpina*)



copyright © 2010 Tom Murray

Red-bellied snake (*Storeria occipitomaculata*)



Photo © A.B. Sheldon

Northern watersnake (*Nerodia sipedon*)

# Snakes

# Butterflies



White admiral (*Limenitis arthemis*)



Canadian tiger swallowtail (*Papilio canadensis*)



Bronze copper (*Lycaena hyllus*)



Viceroy (*Limenitis archippus*)



Mourning cloak (*Nymphalis antiopa*)



Dorcas copper (*Lycaena dorcas*)

# Aquatic plants-very soft water

Brown-fruited rush  
(*Juncus pelocarpus*)



Least waterwort (*Elatine minima*)

Photo by Susan Knight, WDNR



Pipewort (*Eriocaulon aquaticum*)



Ribbon-leaved pondweed (*Potamogeton epihydrus*)

# Aquatic plants-soft water



Photo by Susan Knight, WDNR

Fern pondweed (*Potamogeton robbinsii*)



Photo by Susan Knight, WDNR

Large-leaved pondweed (*Potamogeton amplifolius*)



Photo by Susan Knight, WDNR

Quillwort (*Isoetes* sp.)



Photo by Susan Knight, WDNR

Water lobelia (*Lobelia dortmanna*)



(C) Paul Skawinski, 2009

White-stemmed pondweed (*Potamogeton praelongus*)

# Aquatic plants-hard water



Slender pondweed (*Potamogeton pusillus*)

Photographer: Robert W. Freckmann



Waterweed (*Elodea canadensis*)



Northern water-nymph (*Najas flexilis*)



Water beggar's-tick (*Megalodonta beckii*)



American eel grass (*Vallisneria americana*)



(C) Paul Skawinski, 2009

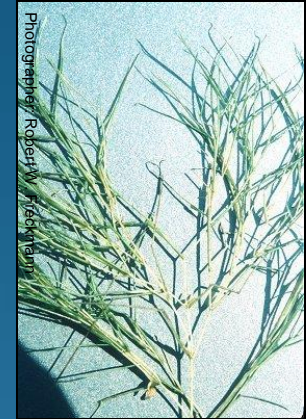


Coontail (*Ceratophyllum demersum*)

# Aquatic plants-very hard water



Flat-stemmed pondweed (*Potamogeton zosteriformis*)



Comb pondweed (*Stuckenia pectinata*)



White water crowfoot (*Ranunculus aquatilis*)



Illinois pondweed (*Apalone spinifera*)



Fries' pondweed (*Potamogeton friesii*)

# Upland plants-trees



*Amelanchier arborea* – downy Juneberry



*Prunus serotina* - wild cherry



*Abies balsamea* – balsam fir



*Acer rubrum* - red maple



*Tilia americana* - basswood)



*Betula alleghaniensis* – yellow birch



*Quercus rubra* – red oak

# Upland plants-shrubs



*Aronia melanocarpa* – black chokeberry



*Diervilla lonicera* – northern bush honeysuckle



*Vaccinium angustifolium* – early low blueberry



Photographer: Kitty Kohout

Sweet fern (*Comptonia peregrina*)



Photographer: Steve C. Garske

Hazelnuts (*Corylus* sp.)



*Prunus virginiana* –chokeberry

# Aquatic insects



Giant water bug (*Lethocerus americanus*)



Water boatman (*Sigara* sp.)



Water strider (*Aquarius remigis*)



Water scorpion (*Ranatra fusca*)



Northern casemaker caddisfly (*Nemotaulis hostilis*)



Backswimmer (*Notonecta* sp.)

# Beetles

Photo by Tom Murray



Giant water scavenger beetle (*Hydrophilus triangularis*)



Predaceous diving beetle (*Dytiscus* sp.)



Water lily beetle (*Galerucella nymphaeae*)



Photo by © David Liebman

Large whirligig (*Dineutus* sp.)

# Water birds



Photo by Scott Crave, UWEX

Common loon (*Gavia immer*)



Photo by Scott Crave, UWEX

Osprey (*Pandion haliaetus*)

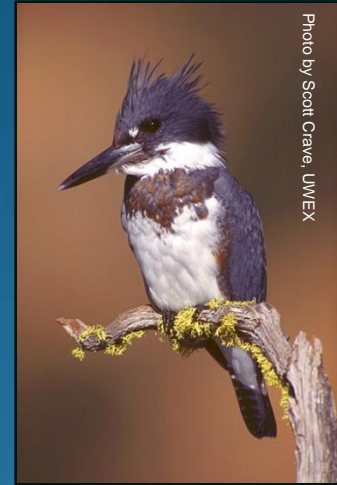


Photo by Scott Crave, UWEX

Belted kingfisher (*Ceryle alcyon*)



Photo by Scott Crave, UWEX

Wood duck (*Aix sponsa*)



Photo by Scott Crave, UWEX

Great blue heron (*Ardea herodias*)



Photo by Scott Crave, UWEX

Bald eagle (*Haliaeetus leucocephalus*)

Pumpkinseed sunfish (*Lepomis gibbosus*)



Bluegill (*Lepomis macrochirus*)



# Fishes-small

Fathead minnows (*Pimephales promelas*)



Common shiner (*Luxilus cornutus*)



Green sunfish (*Lepomis cyanellus*)



Burbot (*Lota lota*)



Iowa darter (*Etheostoma exile*)



Rock bass (*Ambloplites rupestris*)



# Fishes-large



Northern pike (*Esox lucius*)



Muskellunge (*Esox masquinongy*)



Large mouth bass (*Micropterus salmoides*)



Common carp (*Cyprinus carpio*)



Black bullhead (*Ameiurus melas*)



Lake sturgeon (*Acipenser fulvescens*)



Small mouth bass (*Micropterus dolomieu*)



Walleye (*Sander vitreus*)



Big-mouth buffalo (*Ictiobus cyprinellus*)





Photo by Scott Crave, UWEX

# Small mammals

North American river otter (*Lontra canadensis*)



Photo by Wikimedia Commons



Photo courtesy of Kenneth C. Catania

Star-nosed mole (*Condylura cristata*)



Long-tailed weasel (*Mustela frenata*)

Short-tailed weasel (*Mustela erminea*)



Snowshoe hare (*Lepus americanus*)



Photo by Scott Crave, UWEX



Eastern Cottontail (*Sylvilagus floridanus*)



Photo by Scott Crave, UWEX

Fisher (*Martes pennanti*)

Muskrat (*Ondatra zibethicus*)

# Large mammals



©E.J. Peiker

White-tailed deer (*Odocoileus virginianus*)



Bobcat (*Lynx rufus*)



Photo by Scott Crave, LWEX

Moose (*Alces alces*)



Black bear (*Ursus americanus*)

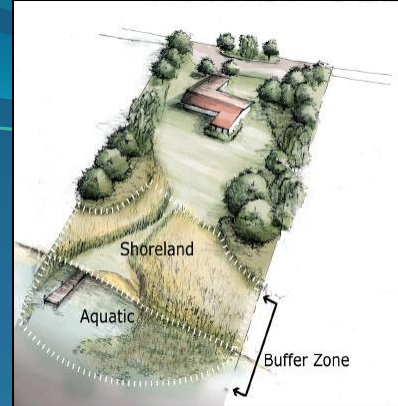


Grey fox (*Urocyon cinereoargenteus*)



Red fox (*Vulpes vulpes*)

# One other critter— People!



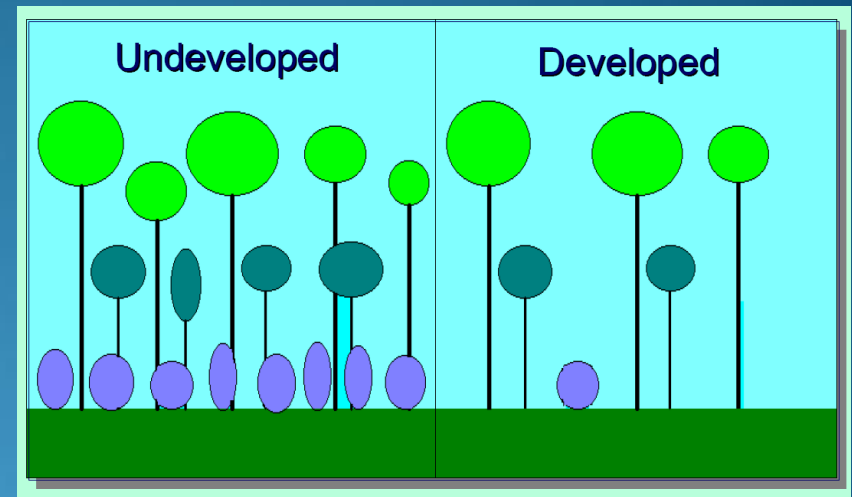
- In many places, people were loving their lakes to death with development—*“death by a thousand cuts”*
- Research findings got people and lake groups around Wisconsin rethinking what is best for lakes?
- Lake residents and organizations, natural resource agencies, tribal entities, energy companies, and businesses like resorts and restaurants all have embraced the idea of restoring shoreland buffers
- Large investments by DATCP and WDNR grants have gone toward shoreline and littoral zone habitat protection and conservation



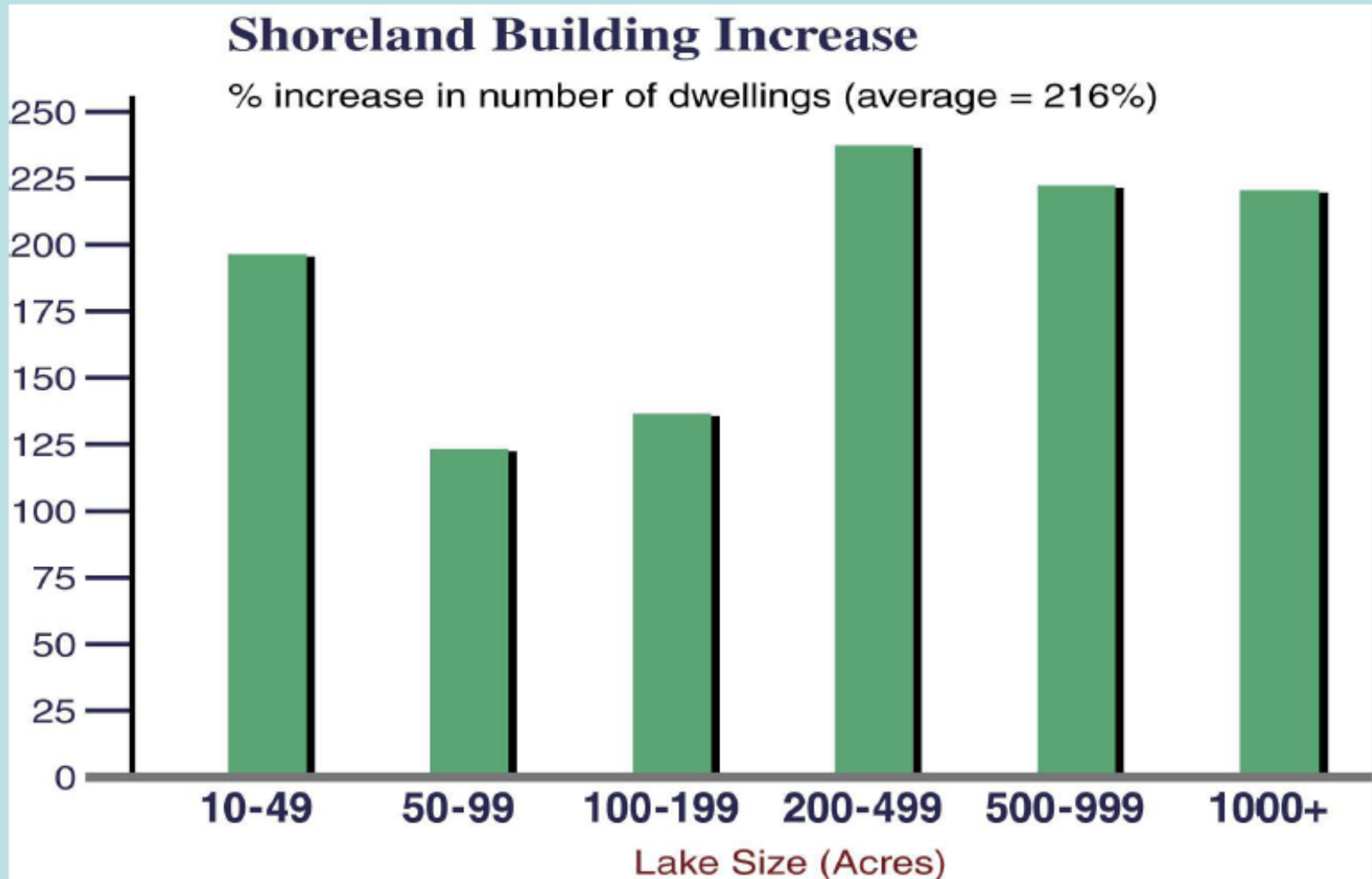
# Development pressures have changed our lakes

## Affects include:

- wildlife diversity decline;
- water quality degradation;
- less vegetation—especially less shrub and ground layers & woody habitat along shore;
- more lake users on the water;
- ‘*death by a thousand cuts*’ w/ population growth and housing density rise
- more impervious surfaces on the average lot
- erosion control challenges

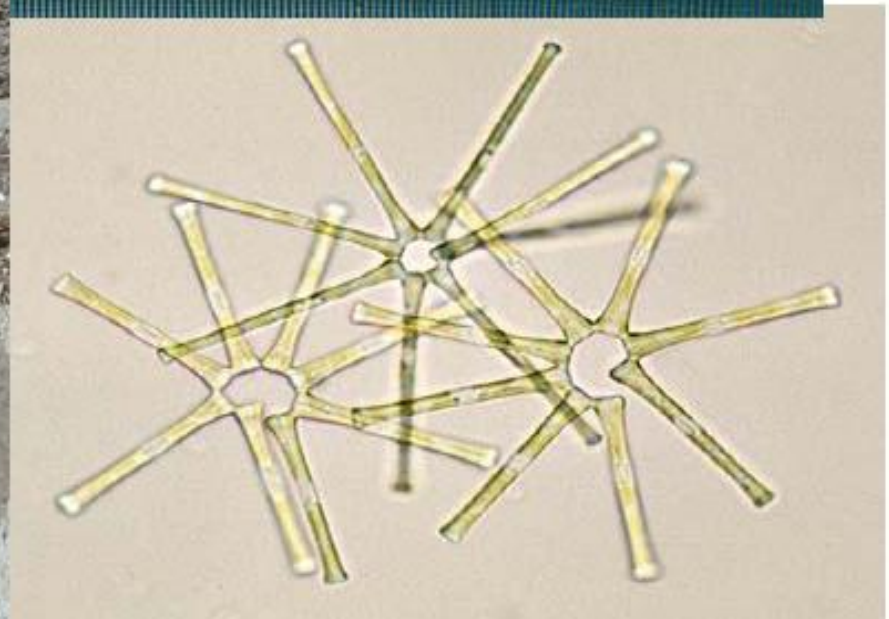
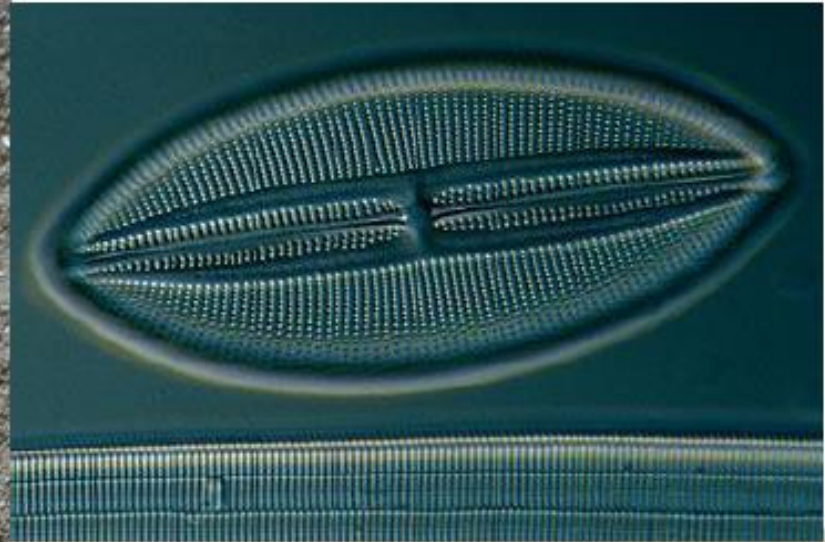


# Housing Development Since 1965



Source WDNR

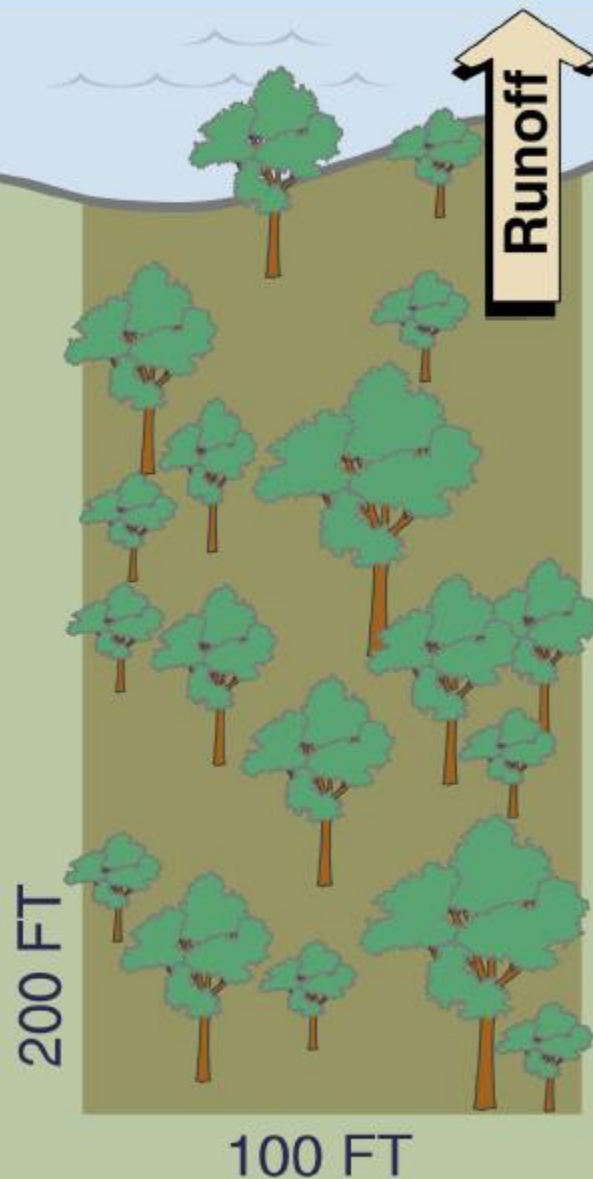
# ***PALEOLIMNOLOGY***





# Undeveloped – Apr.-Oct. phosphorus/sediment runoff model

- maple-beech forest
- 6% slope to lake
- sandy loam soil



## IMPACT ON LAKE (April - Oct.)

- 1,000 ft<sup>3</sup> runoff to lake
- 0.03 lbs. phos. to lake
- 5 lbs. sediment to lake

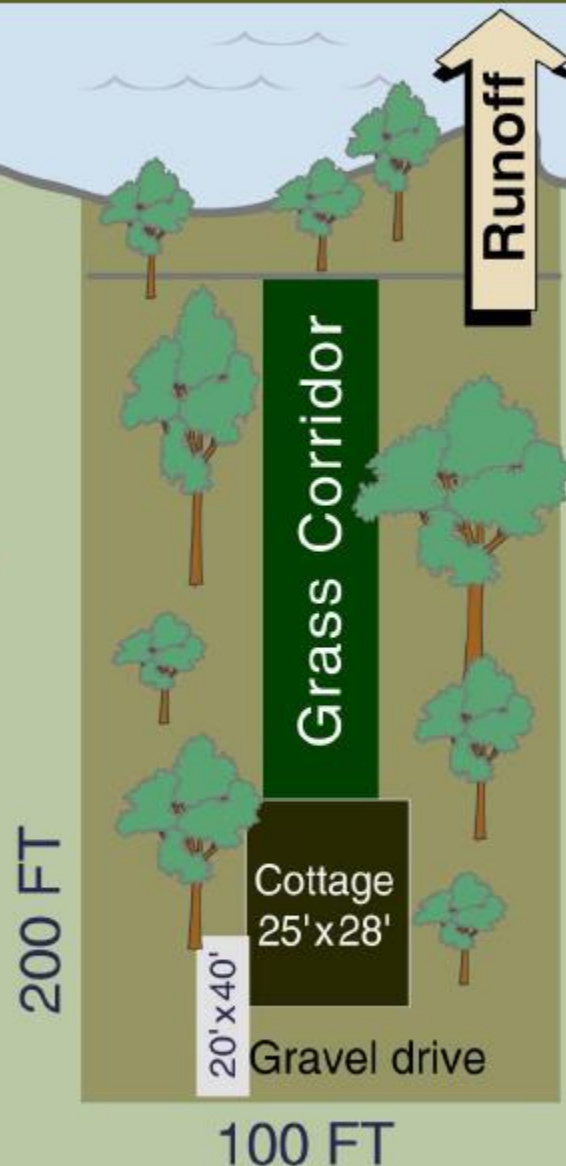




***Laine Cabin, Long Lake Chippewa County***

# 1940s development – Apr.-Oct. phosphorus/sediment runoff model

- maple-beech forest
- 6% slope to lake
- grass corridor 20'-wide
- cottage 700 ft<sup>2</sup> perimeter
- gravel drive 800 ft<sup>2</sup>
- 35'-wide buffer strip



## IMPACT ON LAKE (April - Oct.)

- 1,000 ft<sup>3</sup> runoff to lake
- 0.03 lbs. phos. to lake
- 20 lbs. sediment to lake



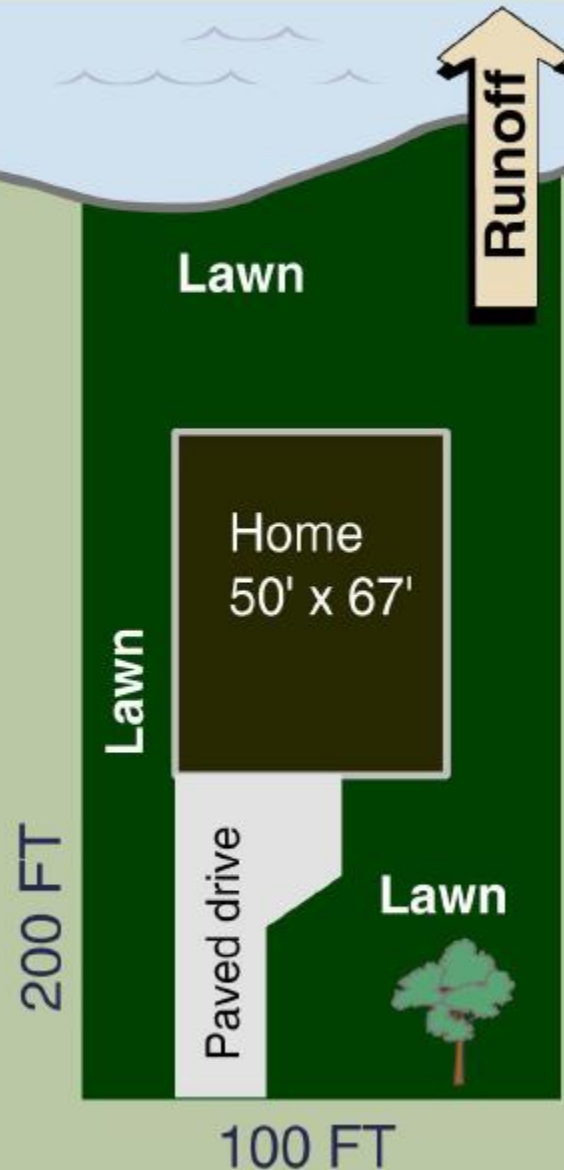


*Redevelopment Long Lake Chippewa County*

4 26 '94

# 1990s development – Apr.-Oct. phosphorus/sediment runoff model

- maintained lawn, soil graded
- 6% slope to lake
- home 3,350 ft<sup>2</sup> perimeter
- paved drive 770 ft<sup>2</sup>



## IMPACT ON LAKE (April - Oct.)

- 5,000 ft<sup>3</sup> runoff to lake
- 0.20 lbs. phos. to lake
- 90 lbs. sediment to lake



# ***LOSS OF WATER CLARITY***



# ***NUISANCE ALGAE BLOOMS***



# ***FISHERIES DEGRADATION***



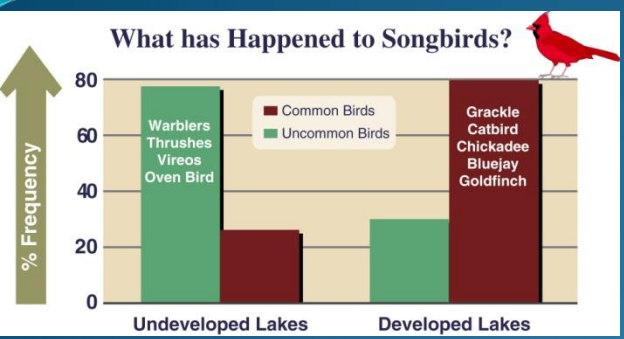


# ***Aquatic Invasive Species***

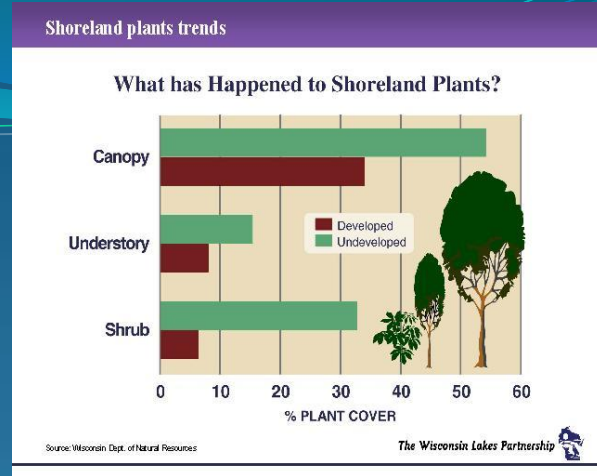
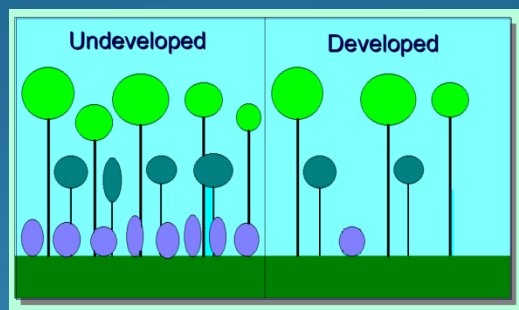




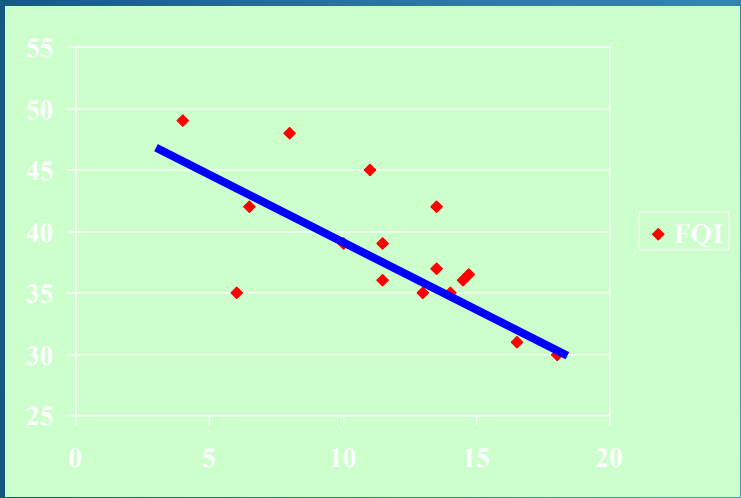
# Various research over the last decade has helped illuminate the affects of development



(Lindsay et al. 2003)

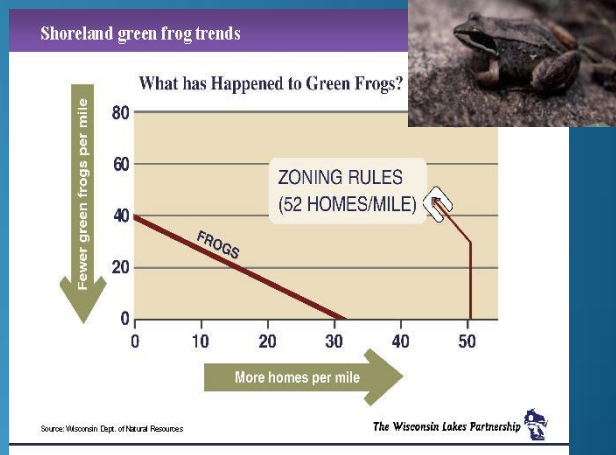
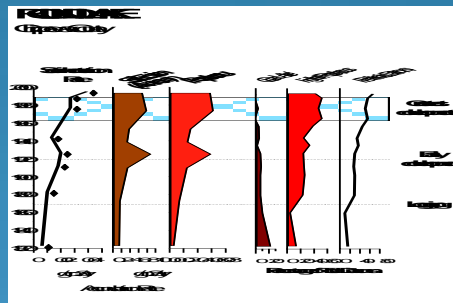


(Elias et al. 2003)



Dwellings/km shoreline

Hatzenbeler et al.(2004)



(Woodford et al. 2002)



# Lake shore erosion

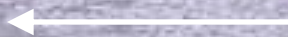
- Slumped banks
- Root wads exposed
- Rilling
- Receding shoreline







Soil loss from mowing  
to water's edge

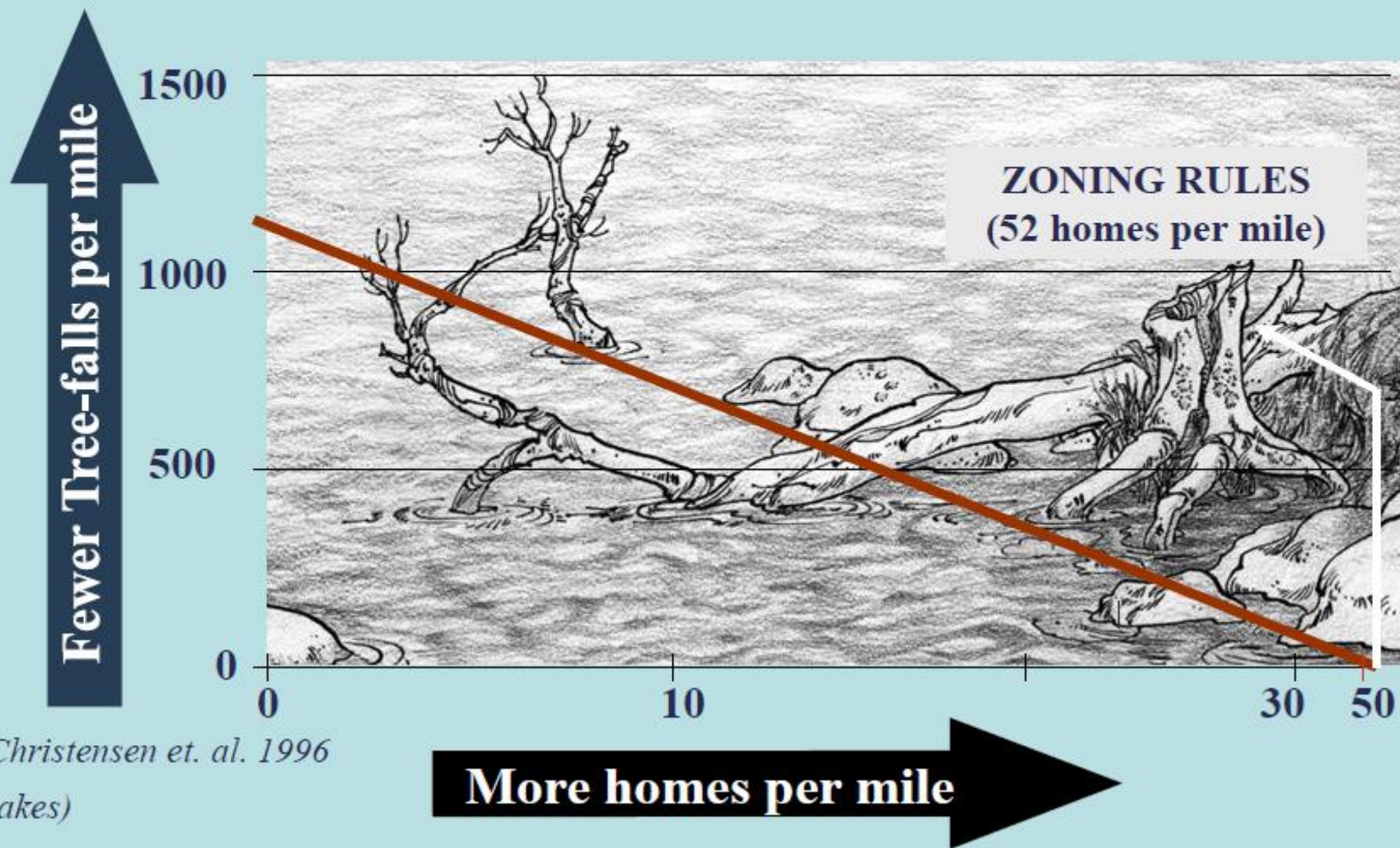


Coon Lake

# Altered Watershed Effects

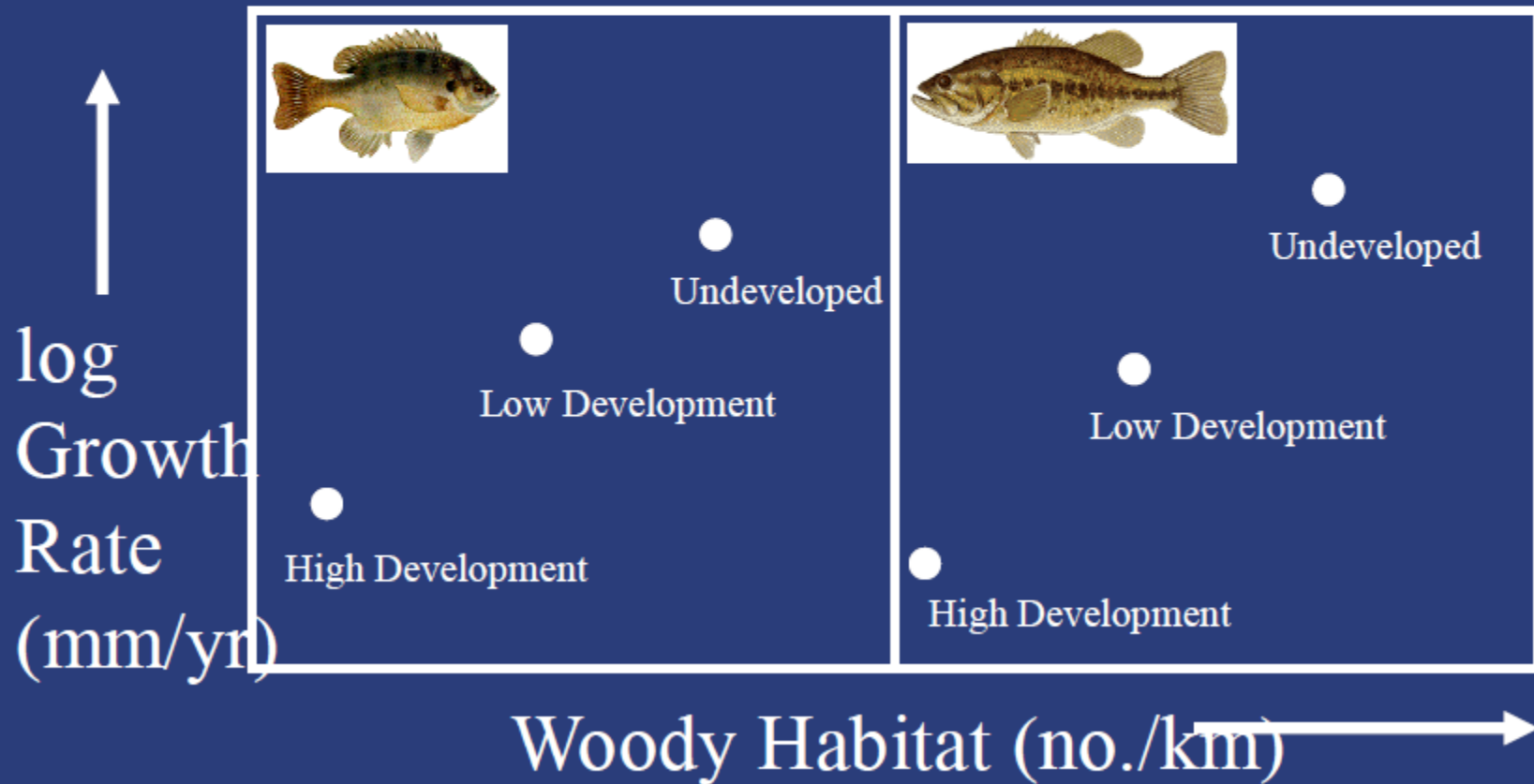


# Woody Habitat in Littoral Zone



Source Christensen et. al. 1996  
(16 N. Lakes)

# Fish grow ~3X faster in lakes with lots of woody habitat



From Schindler et al. 2000

# Value / Function of Stable & Vegetated Shoreland Zone

## Shoreland Vegetation

(erosion-control, water quality, wildlife habitat, high plant diversity = high wildlife diversity)

## Emergent Vegetation

(water quality, erosion-control & wildlife habitat)

## Tree Stumps

(wildlife habitat & water quality)

## Drifted-in Logs & Snags

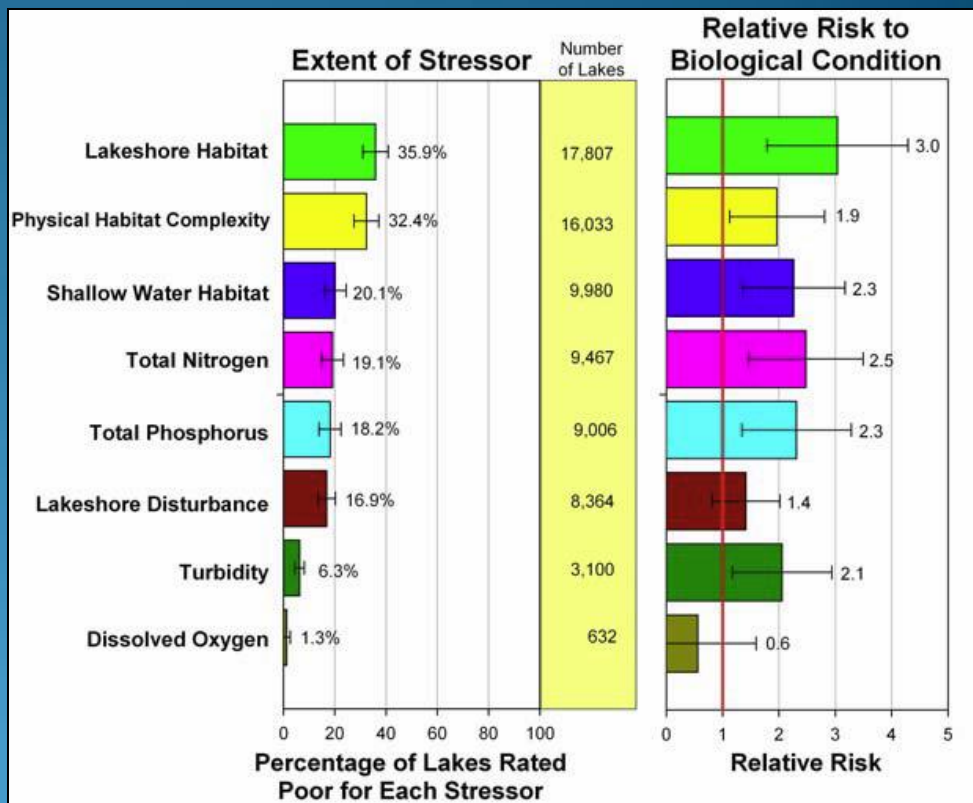
(wildlife habitat, erosion control & water quality)





# National Lakes Assessment (NLA)

- First-ever baseline study of the condition of the nation's lakes.
- The latest in a series of surveys of the nation's aquatic resources.
- Unbiased estimates of the condition of natural and man-made freshwater lakes, ponds, and reservoirs greater than 10 acres and at least one meter deep.
- A total of 1,028 lakes were sampled for the NLA during summer 2007, representing the condition of about 50,000 lakes nationwide.



# *“Neatniks” to Ecologically Sound Landscapes*



*A neat and tidy landscape reflects well on a property owner, while native landscapes are often perceived as messy.*

*Using conventional design elements and ecological knowledge property owners can take pride in creating healthy, ecologically diverse habitats that conserve water, save energy and sequester carbon.*

*“our tools... do not suffice for the oldest task in human history – to live on a piece of land (water) without spoiling it” ..... Aldo Leopold*

# Types of revegetation

## 1. Protection of intact buffers

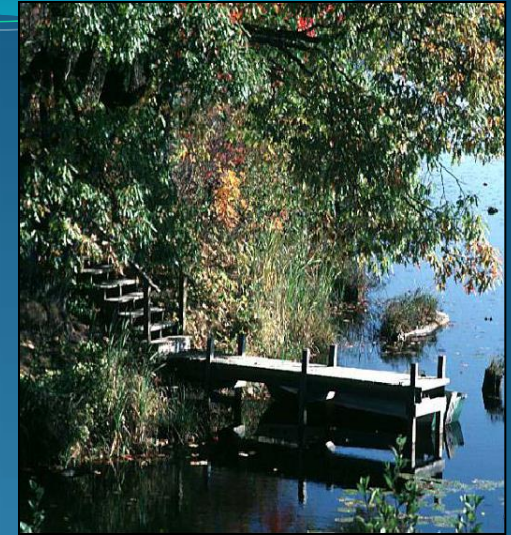
- No serious erosion problem
- Native vegetation present
- Diversity of structure
- Shoreland buffer requirement met

## 2. 'No mow' > natural colonization / recovery

- Native elements present including seed bank
- Turf grasses not well established
- Areas screened from view
- Discourage trampling
- Look for opportunities to see results and promote

## 3. Accelerated Recovery

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



# Defining shoreland buffer restoration

*Practice that uses native trees, shrubs, and groundcover, along with natural and biodegradable materials (biologs, delta-lock bags, sediment logs, soil lifts, woody material, etc.), to reduce lakeshore erosion and improve aquatic and wildlife habitat quality.*



# Shoreland buffer restorations can be considered a successful management practice if they:

- Reduce surface water and nutrient run-off
- Reduce shoreline bank erosion
- Increase native plant abundance and diversity
- Improve wildlife habitat quality
- Increase wildlife abundance and diversity



# Types of revegetation

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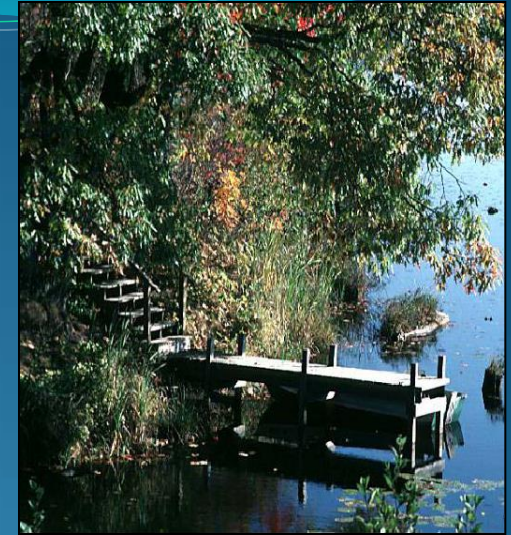
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- Shoreland buffer requirement met

## 2. 'No mow' > natural colonization / recovery

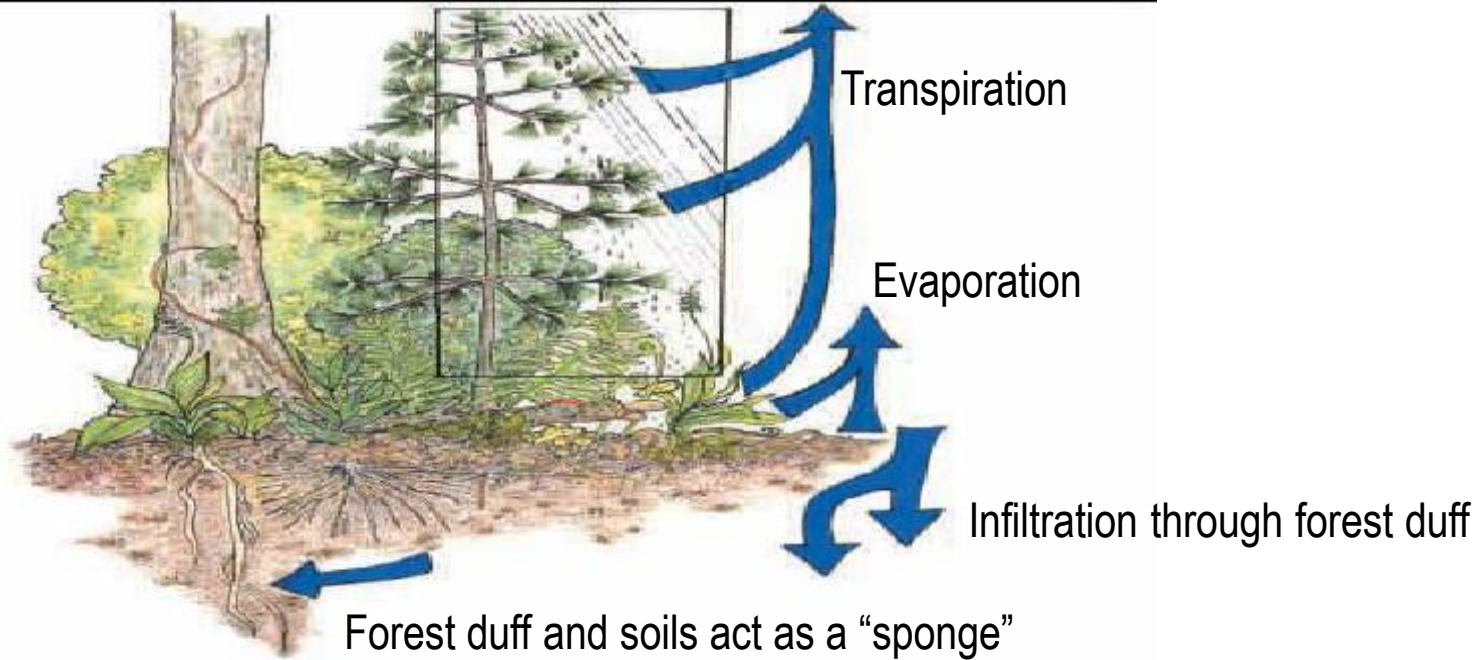
- Native elements present including seed bank
- Turf grasses not well established
- Areas screened from view
- Discourage trampling
- Look for opportunities to see results and promote

## 3. Accelerated Recovery

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



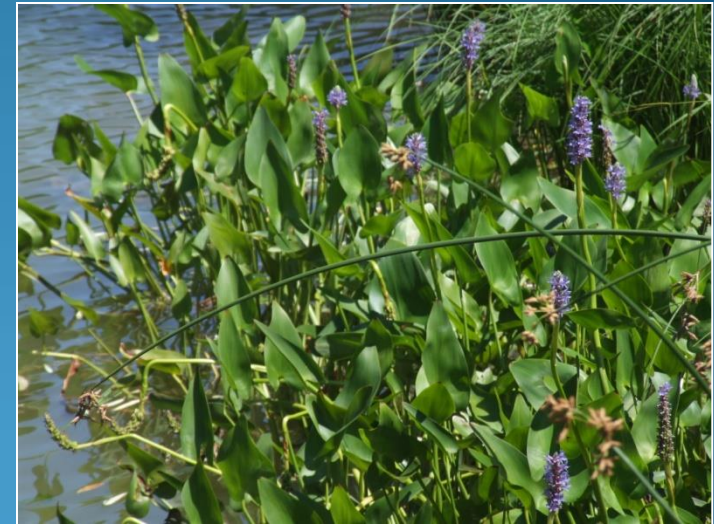
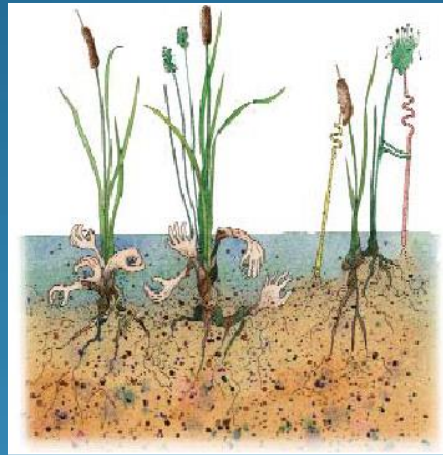
# Importance of layered vegetation



Roots stabilize soils preventing erosion and allow plants to pump up water back into the atmosphere (transpiration)

# Vegetation—the roots to the solution

The riparian areas of shorelines are glued together by a diversity of plants with strong, deep root systems, especially those of woody plants.





# Value / Function of Stable & Vegetated Shoreland Zone

## Shoreland Vegetation

(erosion-control, water quality, wildlife habitat, high plant diversity = high wildlife diversity)

## Emergent Vegetation

(water quality, erosion-control & wildlife habitat)

## Tree Stumps

(wildlife habitat & water quality)

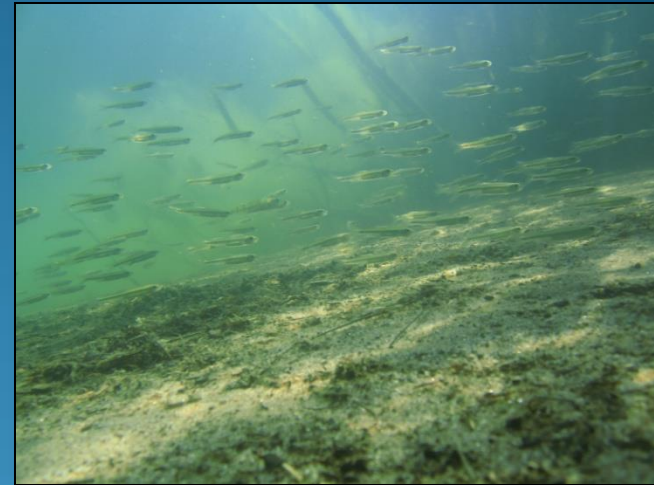
## Drifted-in Logs & Snags

(wildlife habitat, erosion control & water quality)



# Steps in the process > identify and discuss the goals and objectives for the site

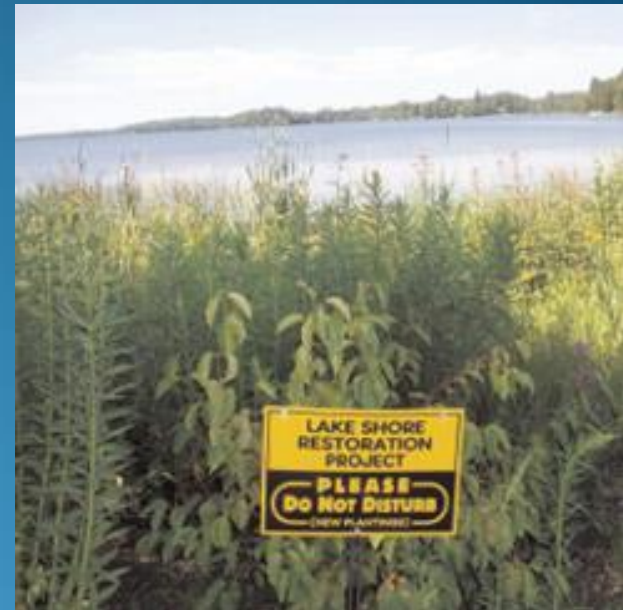
- View corridor (30 ft. viewshed), recreational uses, wildlife support
- Access points along shoreline including docks, walkways, beach area, storage, etc.
- Wildlife impacts (muskrats; deer; etc.)
- Enhance existing native plants at the site / no mow areas vs. accelerated recovery
- Aesthetics: natural, wild (“untidy”) look versus a more landscaped feel (“tidy”)
- What the neighbors will think? Talk w/ them @ the project
- Exotic species control
- Attaining proper WDNR / county zoning permits



# Steps in site plan design

The first step in designing a site plan is to inventory and map existing:

- Trees and shrubs
- Areas of native forbs, sedges and grasses
- Structures
- Relevant landscape features



# Work to address landowner concerns

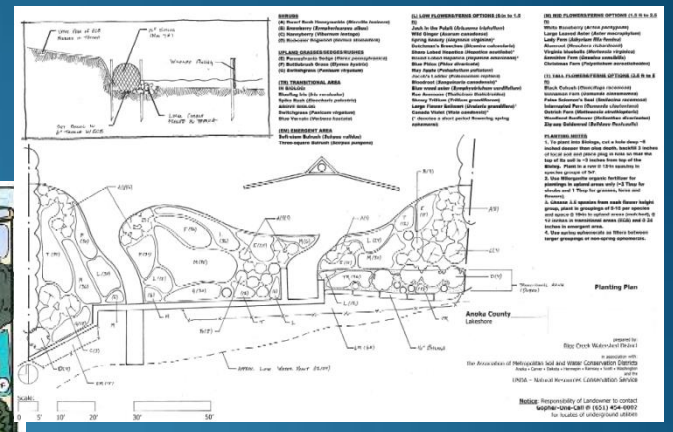
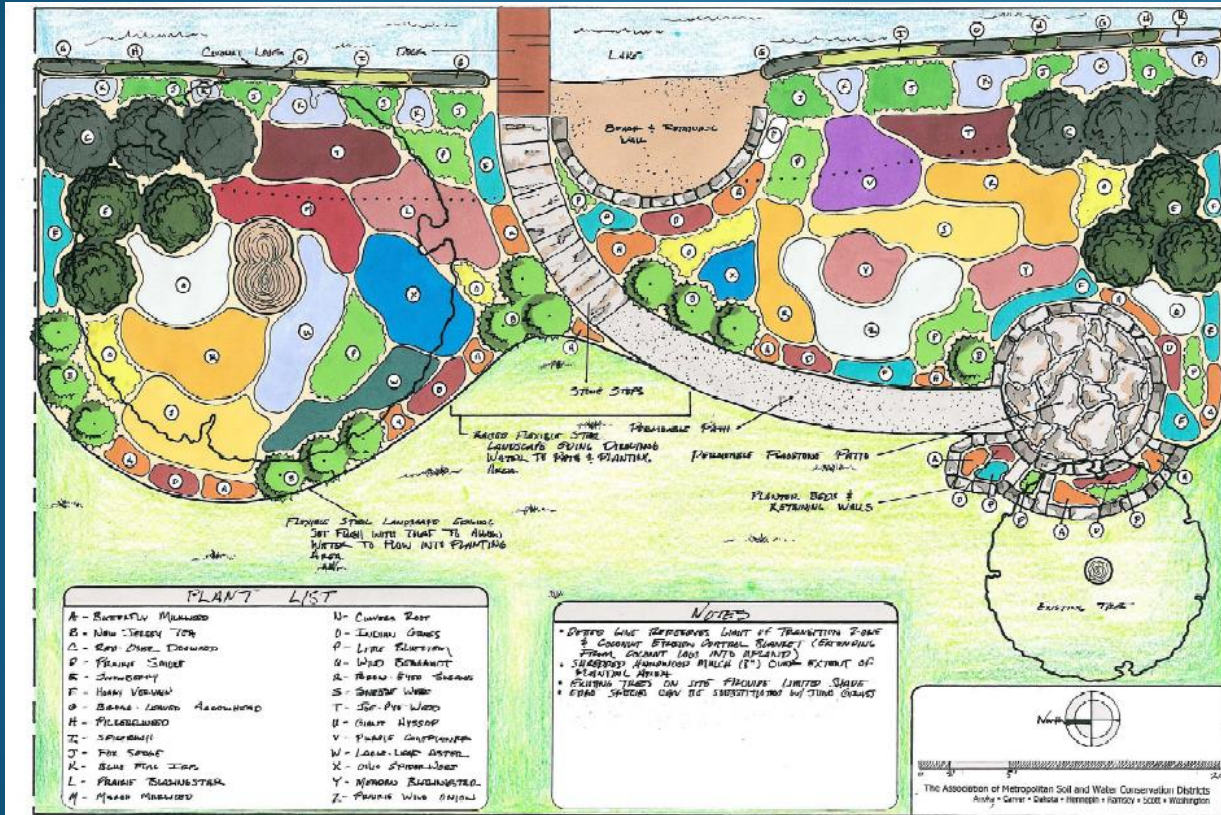
- View corridor (30 ft. viewshed)
- Access points along shoreline including docks, walkways, beach area, storage, etc.
- Wildlife impacts (muskrats; deer; etc.)
- Enhance existing native plants at the site / no mow areas
- Aesthetics
- What the neighbors will think? Talk w/ them @ the project
- Exotic species control
- Attaining proper WDNR / county zoning permits

## Typical questions to ask:

1. What end product does each family
2. member envision for the shoreline?
3. What is the property's drainage pattern?
4. Where are the areas of heaviest use
5. Recreation (types; # of people) etc.
6. Pet and children areas?
7. Where is the viewing corridor?
8. Structures near the water?

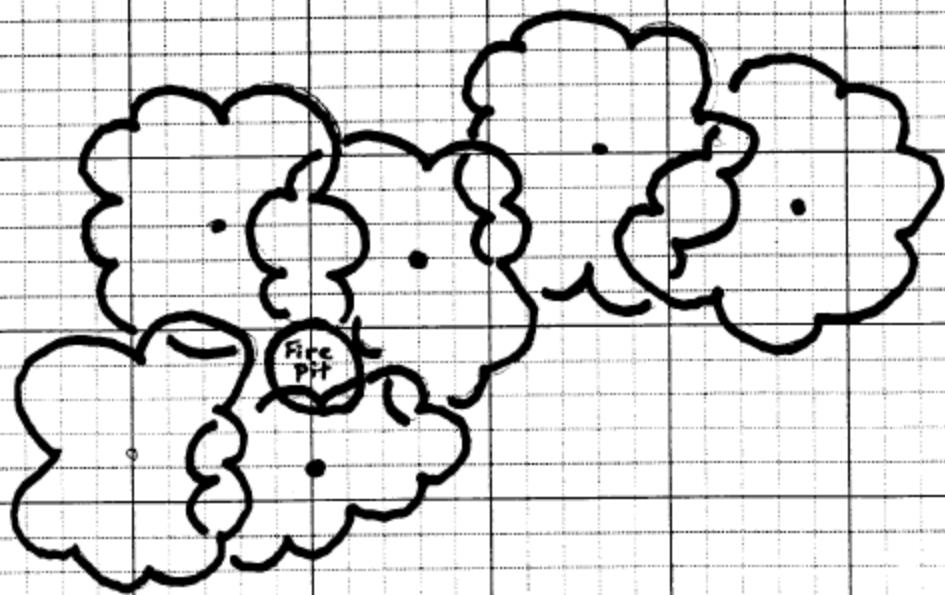
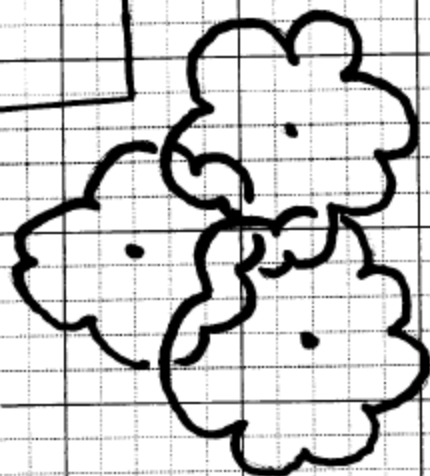
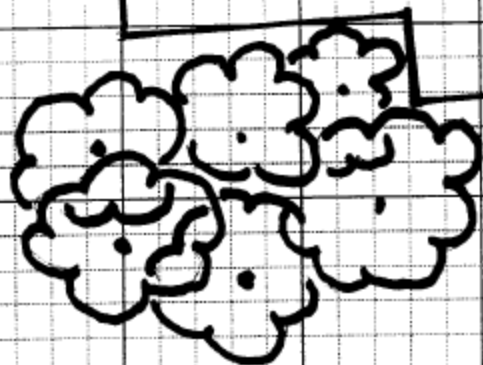


# Plan



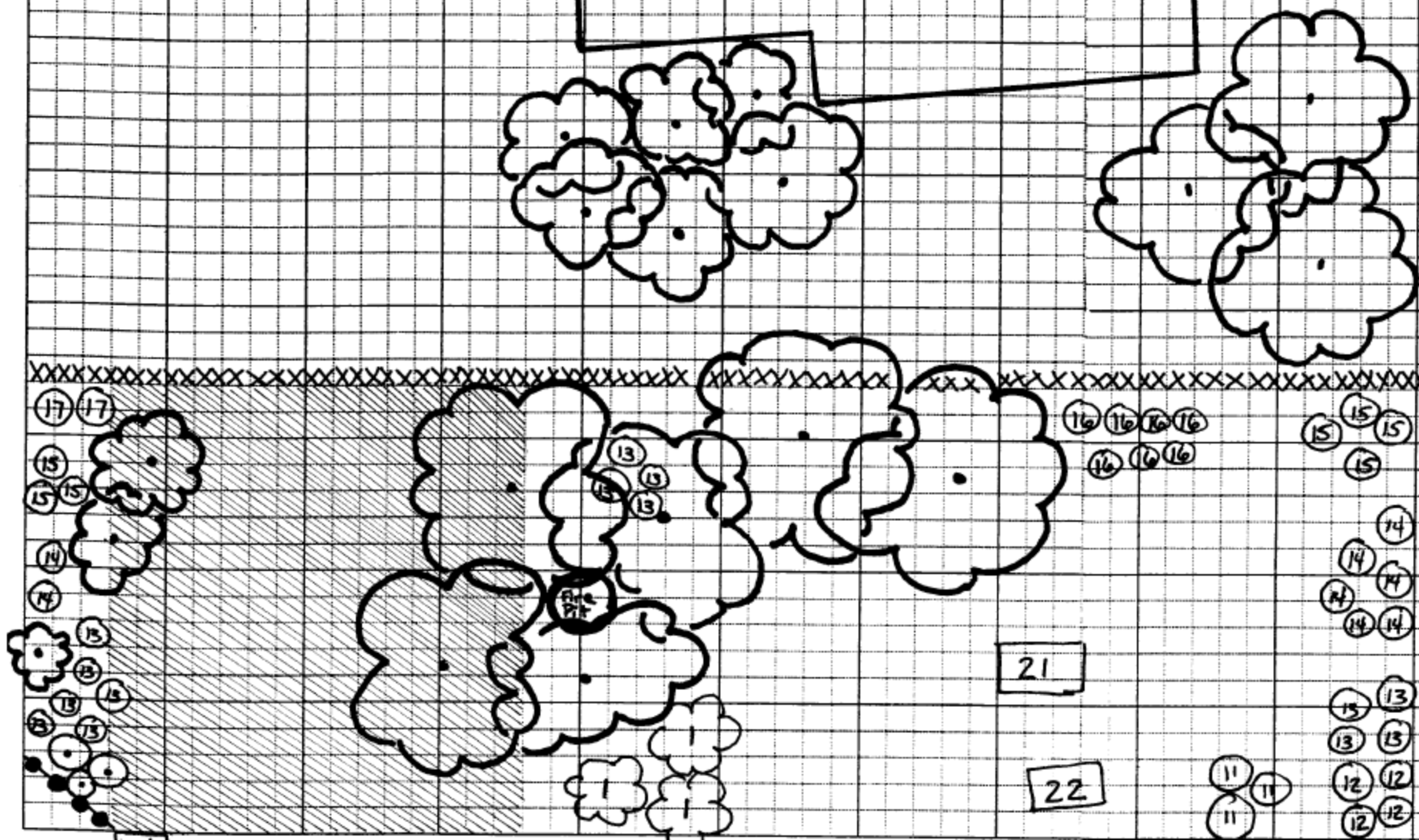
# Initial Plan

Home



# Final Plan

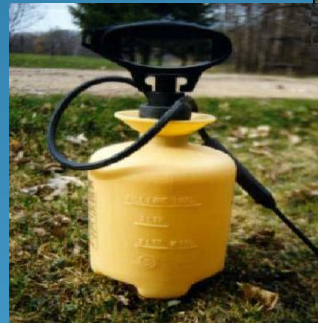
Home



# Site preparation



- Black Plastic
- Soil tilling
- Herbicides





# Reference sites

Find an undisturbed area of your lake similar to your soil, moisture and light conditions and investigate it:

- What kinds of native trees, shrubs, wildflowers are there?
- What densities are these plants found in at the site?
- Look to mimic what you see there in your revegetation efforts

# Implementing a plan

Revegetation:

Three tiers of vegetation: trees, shrubs, and groundlayer—wildflowers, sedges, grasses, ferns



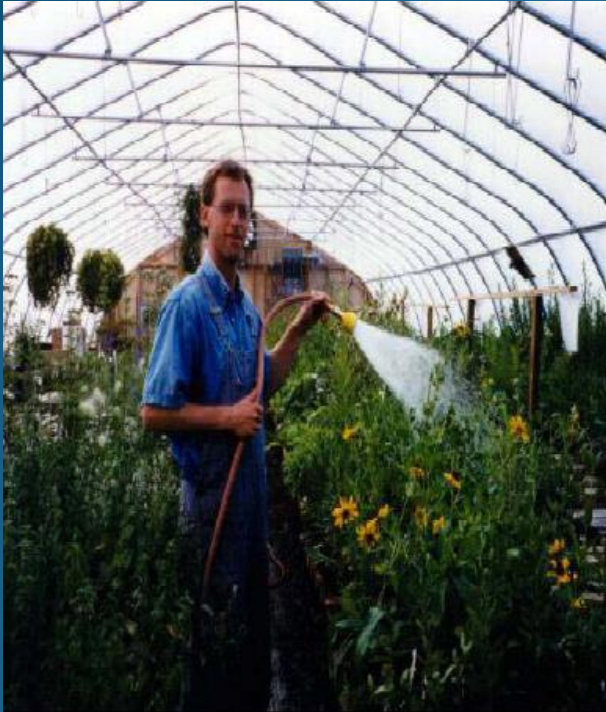
# Plantings



# Plant material types



# Plants from a nursery



- Special orders – plan well in advance
- Determine origin / propagation method
- DO NOT use imported plants

# Native plants

- Conservation of local genetic diversity
- Ability to provide food and shelter for native wildlife
- Improved health and vigor—climatically at home
- Increased survival rates for your plantings—save \$
- Reduced maintenance costs



# Watering-dah

Need to water plantings initially >  
4-6 weeks; 1-2 " per week

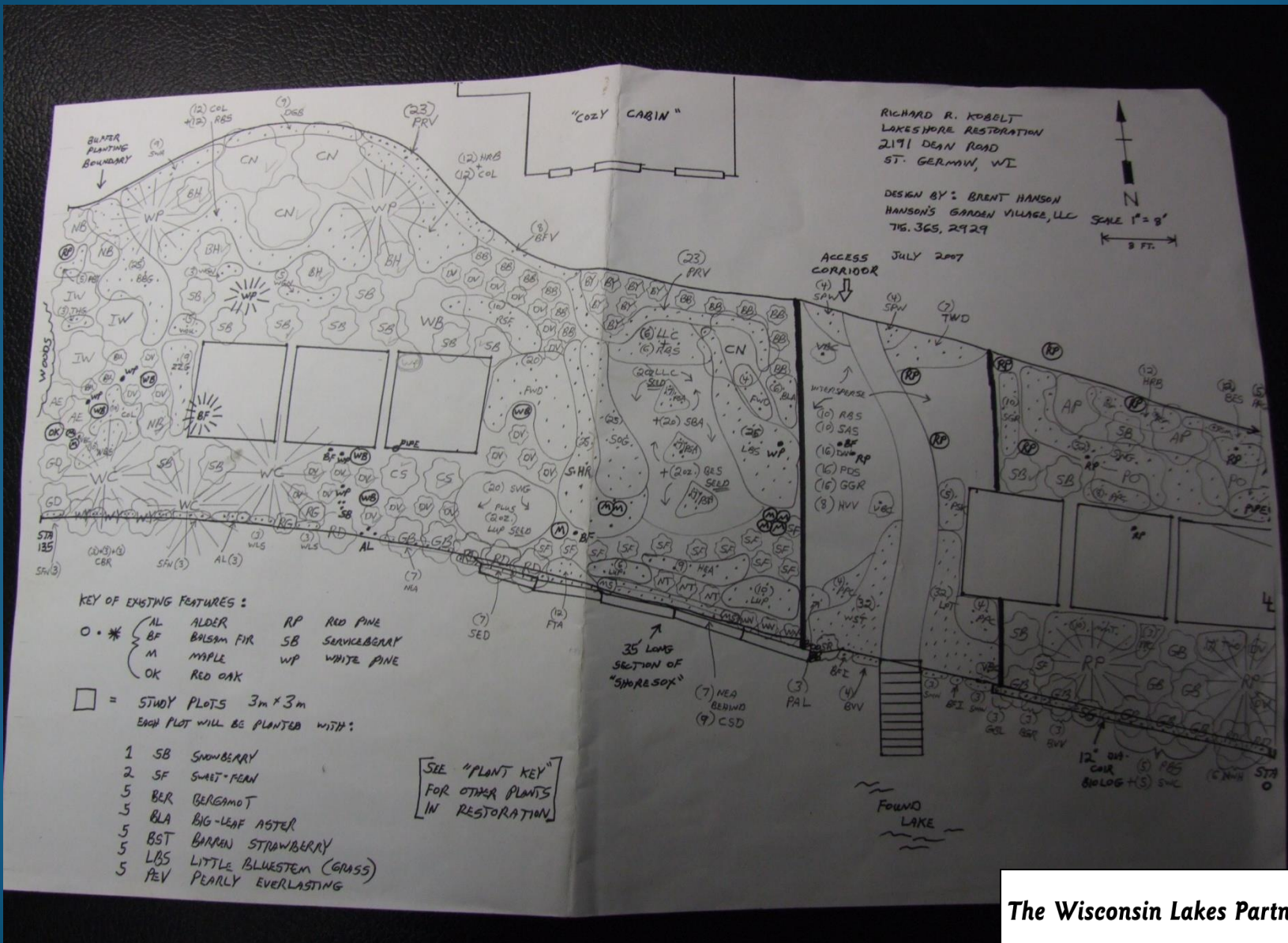


# Deer/rabbit protection





# Planting plan – it may be all you need



# Shoreland restoration & other videos:

< <http://www.extension.umn.edu/Shoreland/videos/index.html> >



## Shoreland Restoration: A Growing Solution

Outlines why natural shorelines help protect water quality and wildlife habitat, and introduces how shoreland property owners can restore natural functions to their shorelines. (15:30)

## Keeping Our Shores: Shoreland Best Management Practices

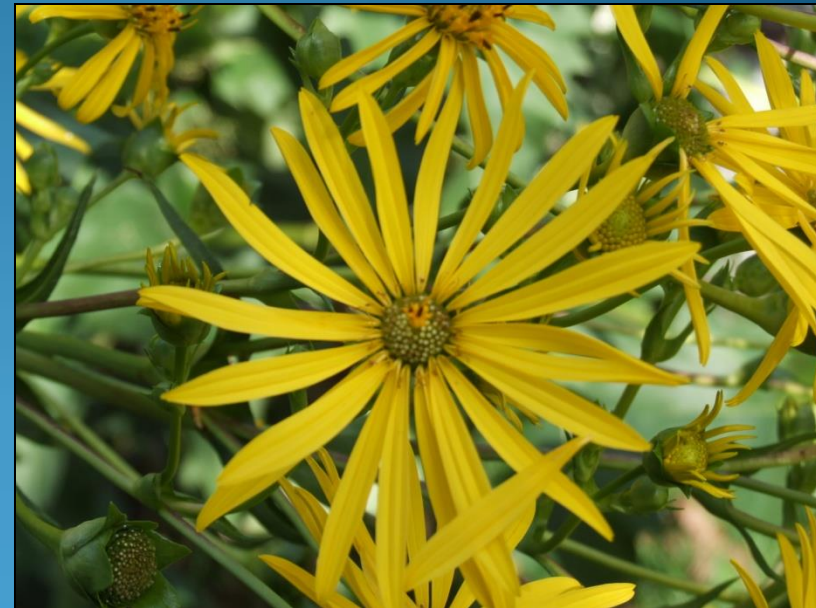
Introduces best management practices that shoreland owners can use to protect the water quality in a lake or river, including shoreline filter strips, proper septic maintenance, and appropriate lawn care practices. (15:20)



# Plant choices > work horse species

What are they? Typically these plants have traits we admire for shoreland habitats:

- Penetrating, deep roots.
- Prolific seeders that pioneer into disturbed ground before weeds and invasive species arrive.
- Many also have rhizomatous, fibrous, and/or clump forming root systems that minimize erosion.
- Most have wildlife habitat benefits of one sort or another too, such as providing nesting material, food, and cover.
- They are tolerant of variability in site conditions for moisture, water depth, soil type, and light.
- They can also be propagated efficiently and in a cost effective manner by nurseries specializing in native plant material production.



## Ten Common Themes of Effective Shoreland Restorations

1. Partnerships Get it Done
2. Funding Can Take Many Forms
3. Plans Matter
4. Use Ecological Design Principles
5. Landowner Values are Met
6. Maintenance is Required
7. Address Erosion Control Concerns
8. Communication
9. Involve the Lake Community
10. Take an Adaptive Approach





# LEAVING A LEGACY

Thanks for all you do toward leaving a legacy of healthy lakes!



# Questions?

Thanks for all you do toward leaving  
a legacy of healthy lakes!



Patrick Goggin / < [pgoggin@uwsp.edu](mailto:pgoggin@uwsp.edu) >

The Wisconsin Lakes Partnership



*“our tools... do not suffice for the oldest task in human history – to live on a piece of land (water) without spoiling it” ..... Aldo Leopold*