

LAKE ECOLOGY WITH PAUL



Paul Garrison
Bureau of Science
Services



WATERSHEDS, LANDUSE, AND SHALLOW LAKES

- **Why does the lake care what you do on the land?**
- **Does the depth of my lake affect the water quality?**

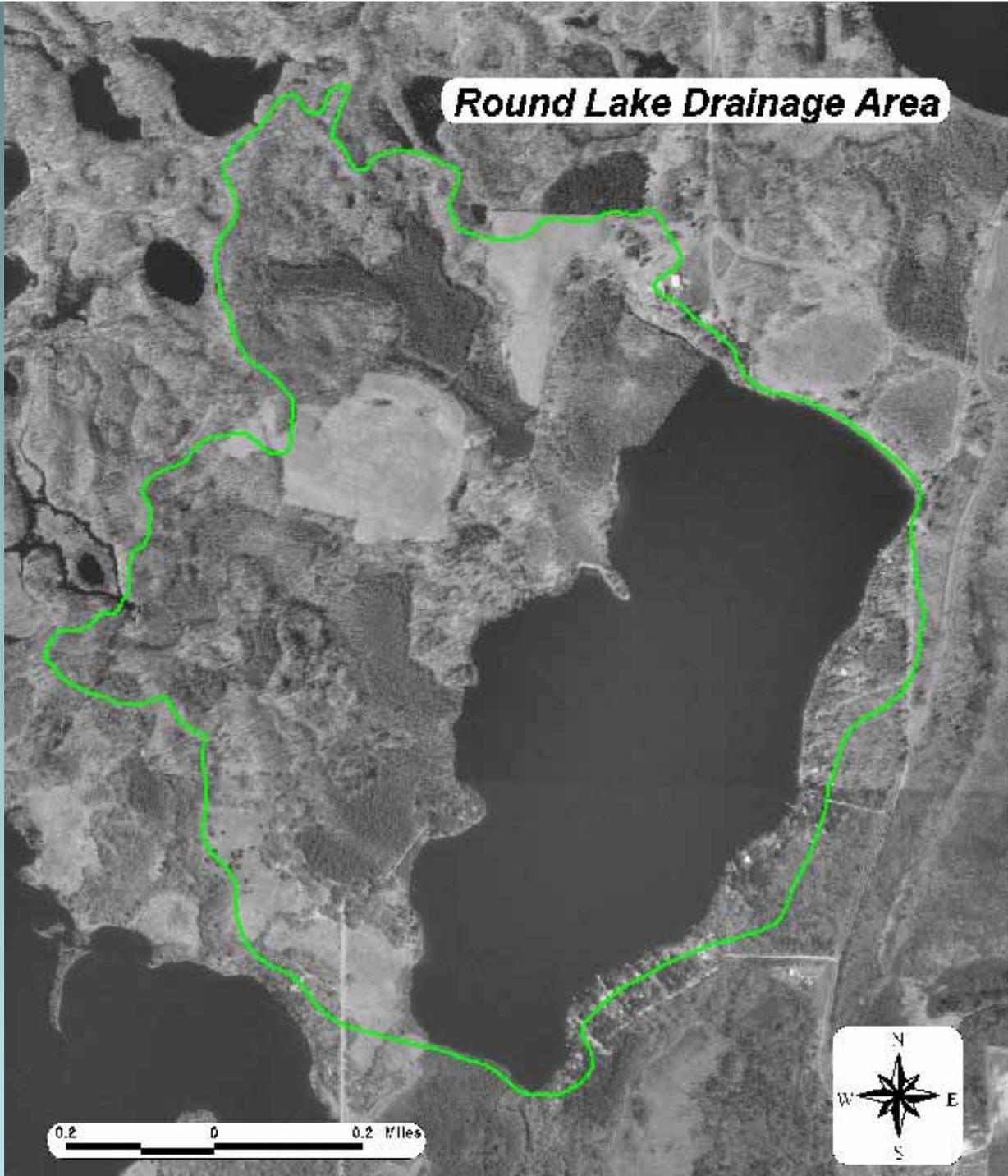
HISTORY IN THE MUCKING

- **Have our lakes always been like this?**

LAND USE AND WATERSHED IMPACTS



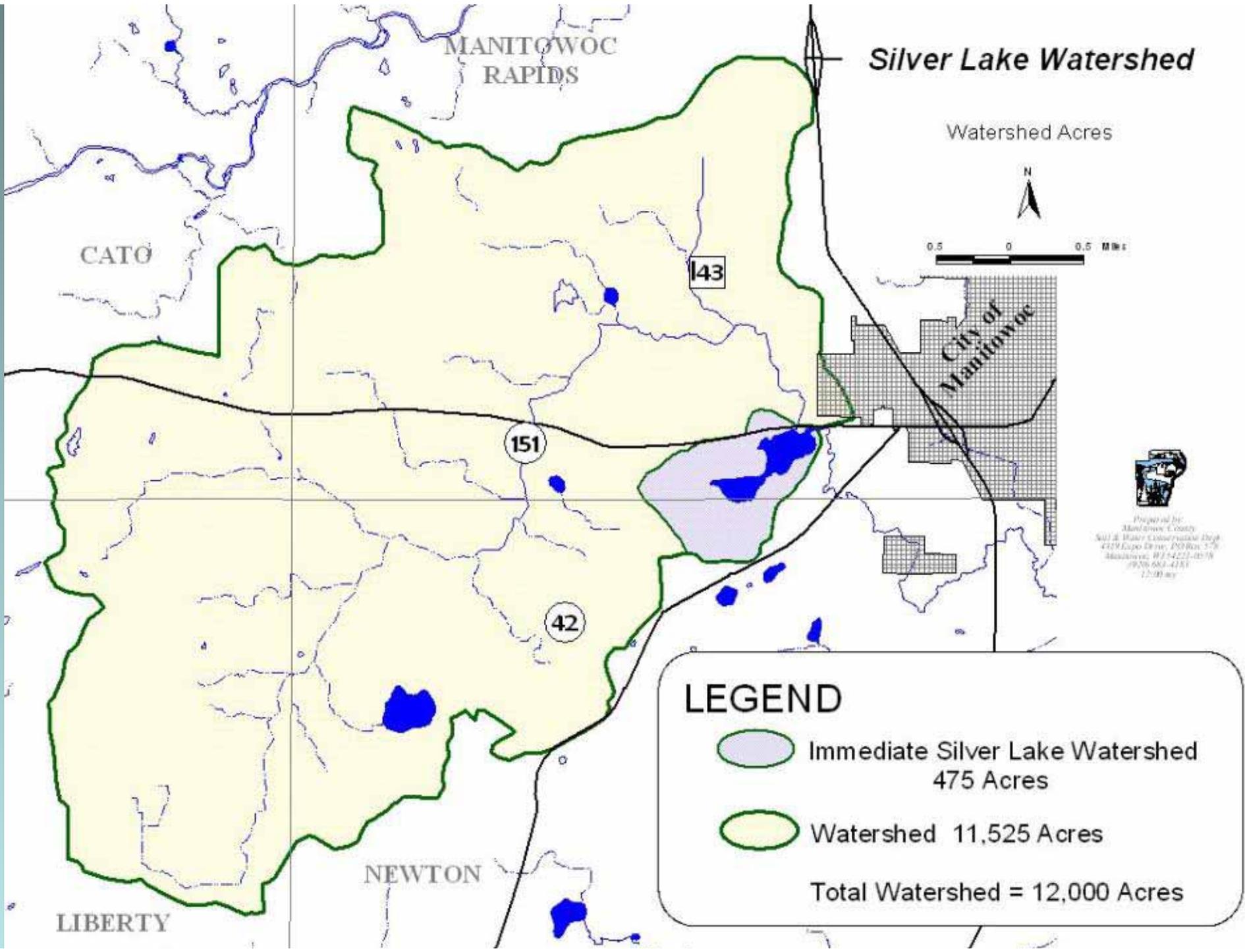
Round Lake Drainage Area



0.2 0 0.2 Miles



Silver Lake Watershed



Watershed Acres



0.5 0 0.5 Miles

City of
Manitowoc



Prepared by:
Manitowoc County
Soil & Water Conservation Dept.
419 Expo Drive, PO Box 576
Manitowoc, WI 54221-0576
(920) 683-4181
12/01/01

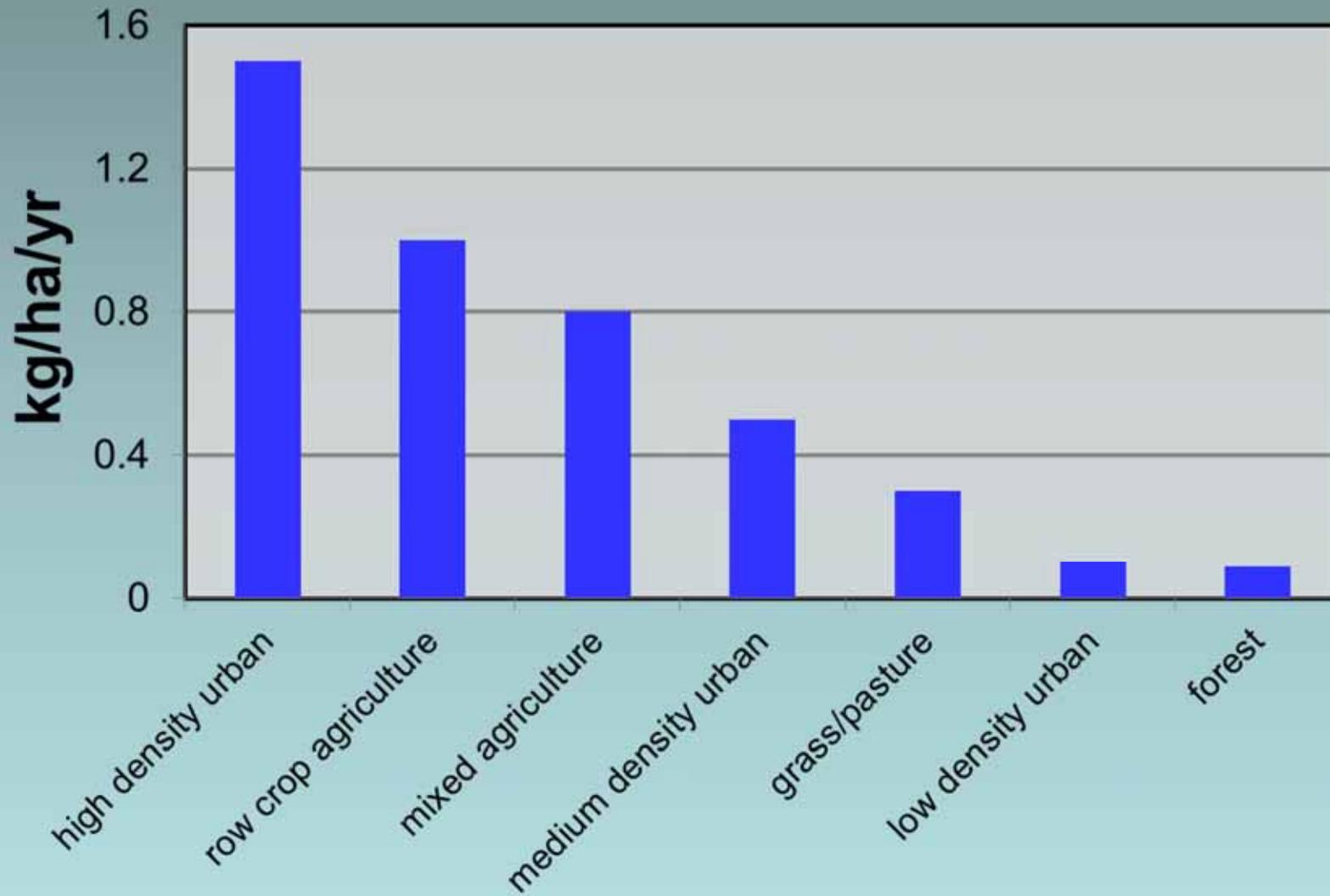
LEGEND

- Immediate Silver Lake Watershed
475 Acres
- Watershed 11,525 Acres

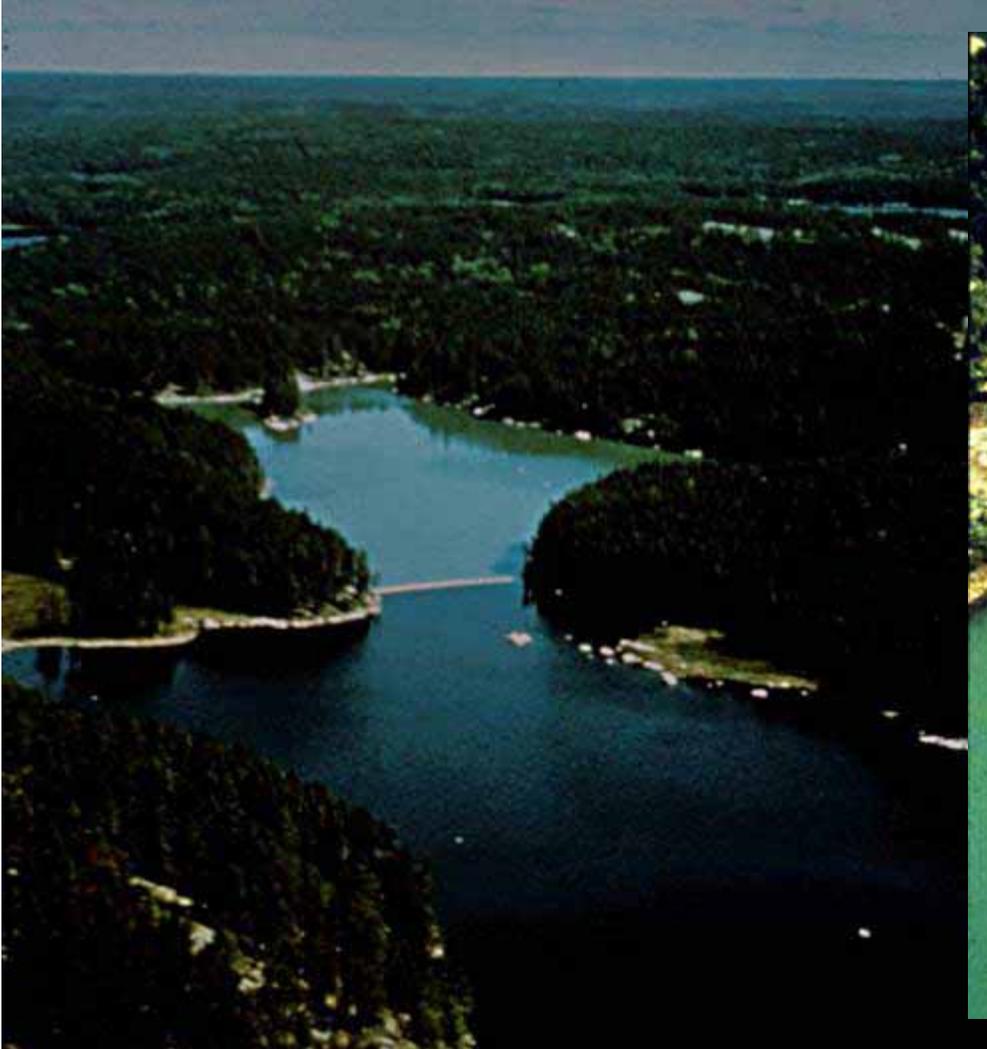
Total Watershed = 12,000 Acres

Phosphorus Export Coefficients

Wisconsin Values



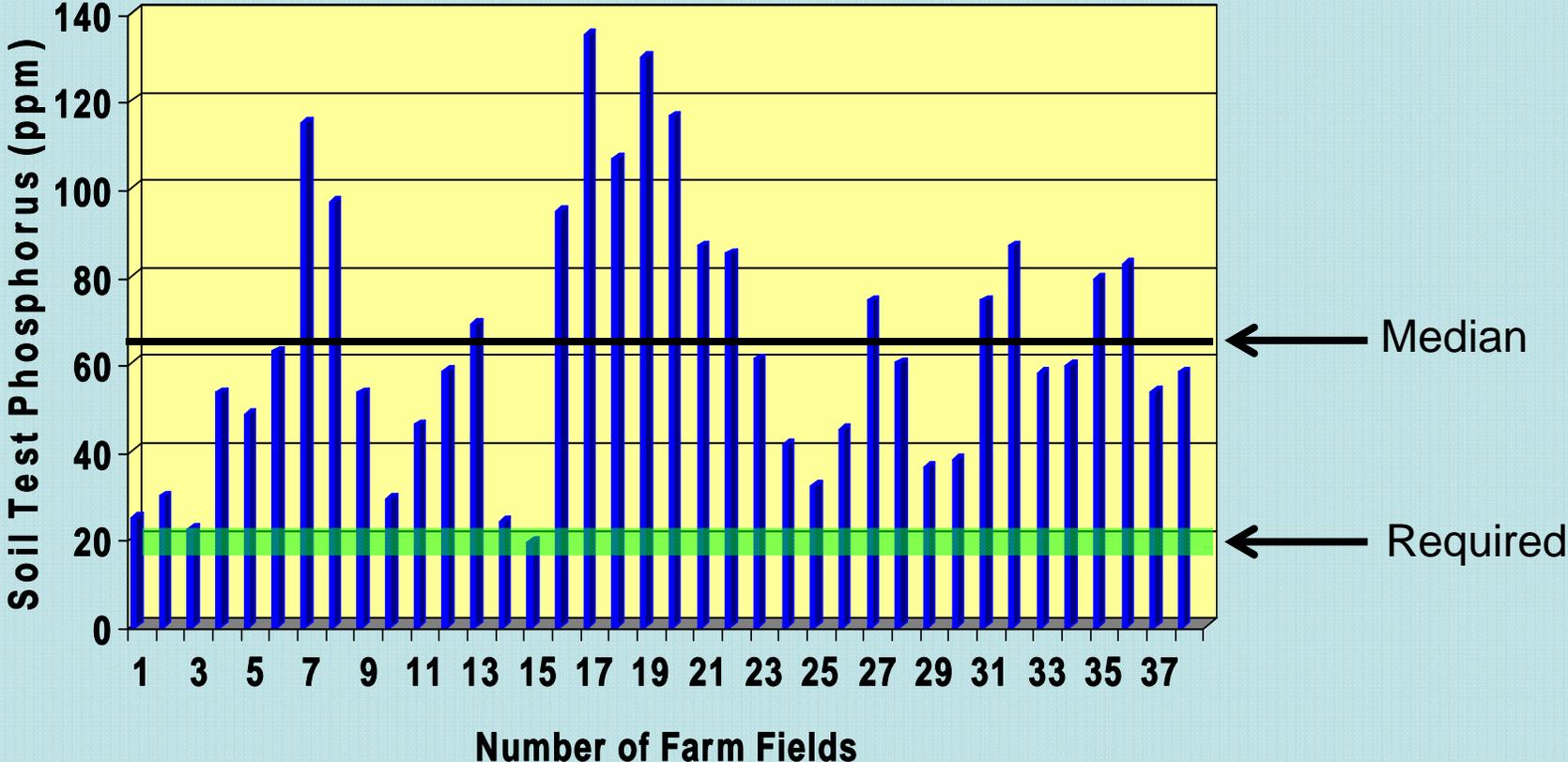
WHY DO WE CARE ABOUT PHOSPHORUS?



AGRICULTURE IMPACTS

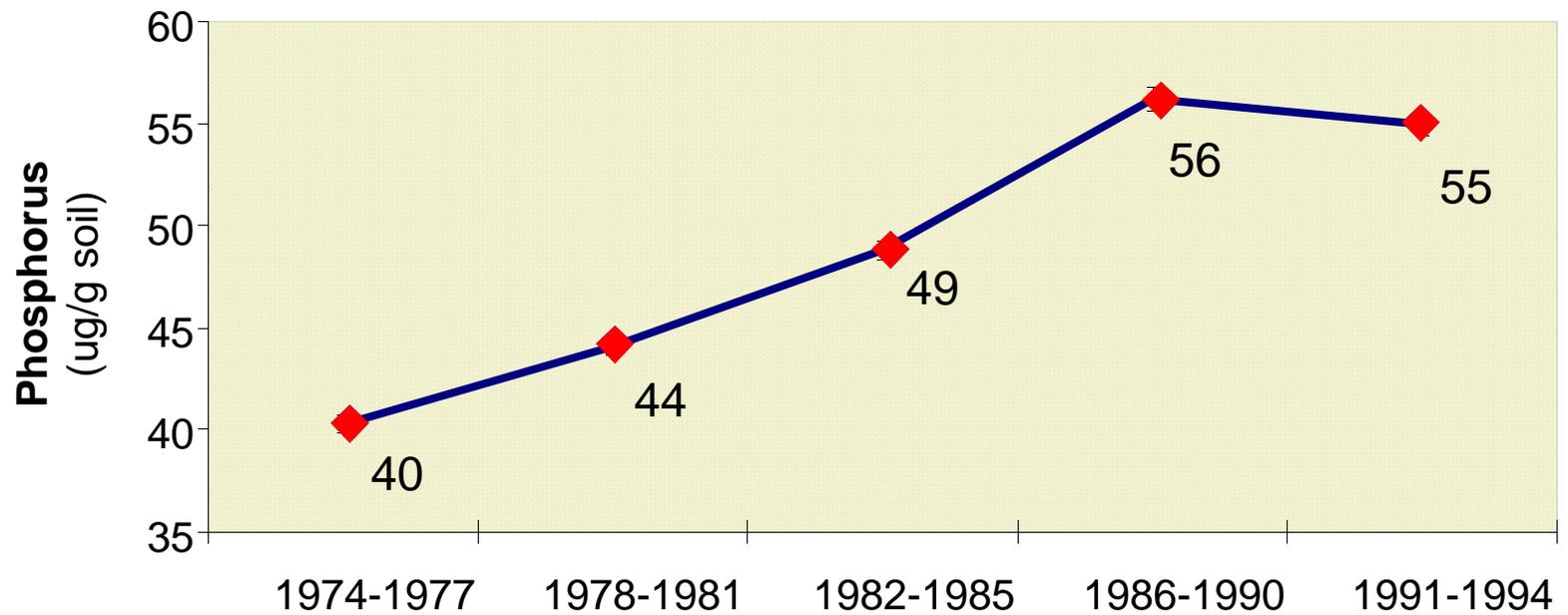


Phosphorus Distribution Dane County - Farm 1



*University of Wisconsin Nutrient
and Pest Management Program*

Dane Co. Soil Test P Data 1974-1994



(after Combs et al. 1996 as reported in Bennett et al. 1999)

WATER BUDGET

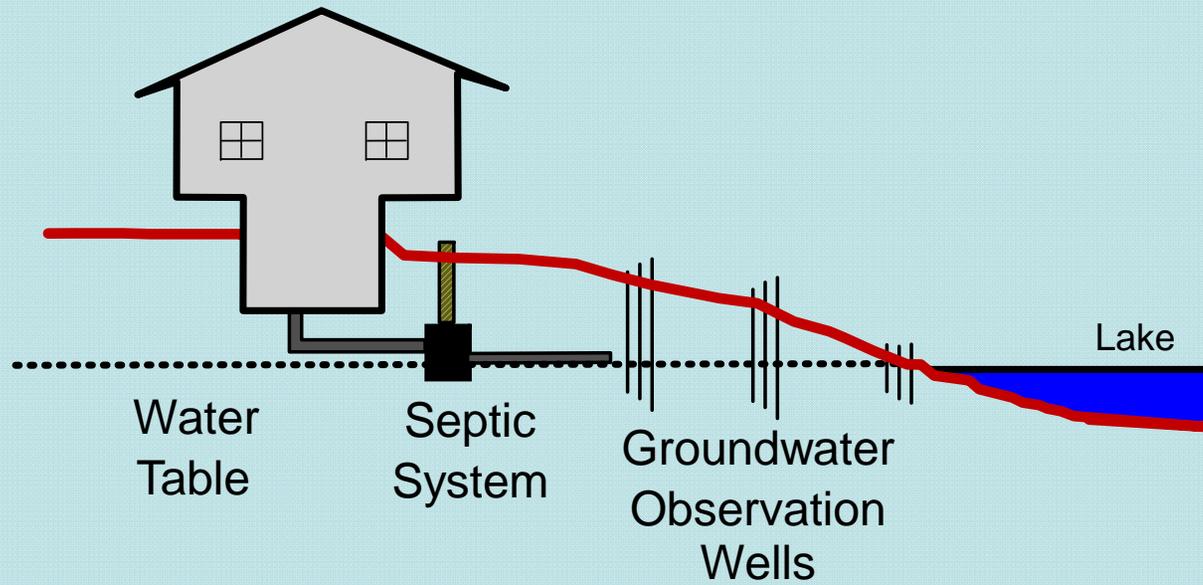
SURFACE WATER



Photo by Paul Garrison

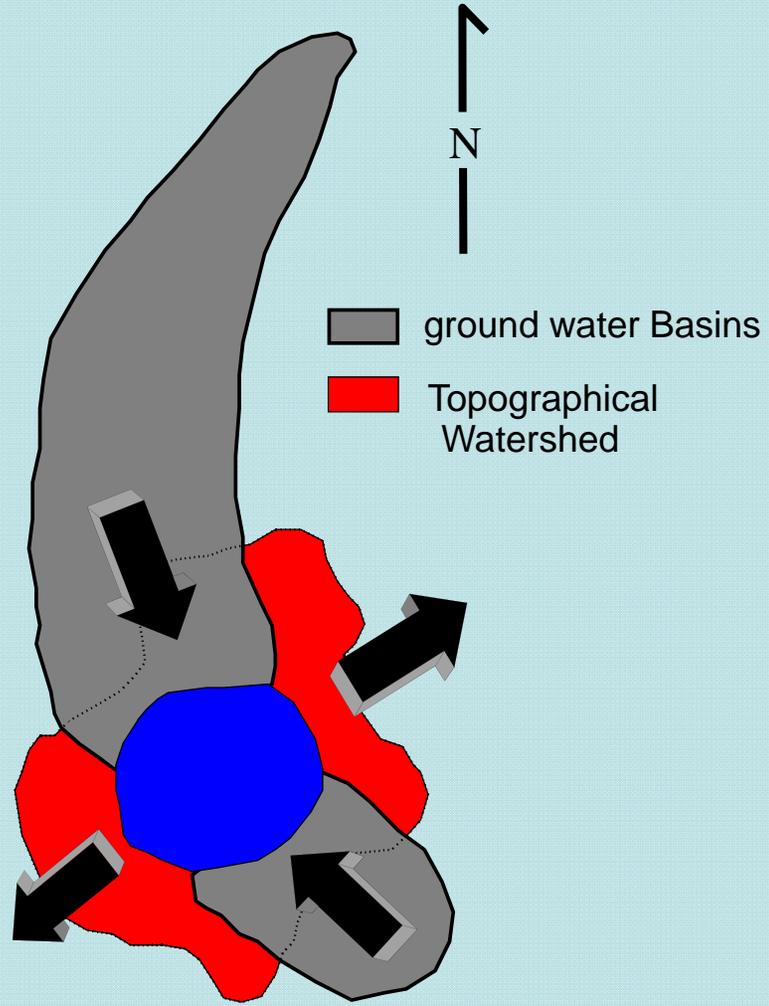
WATER BUDGET

Ground Water

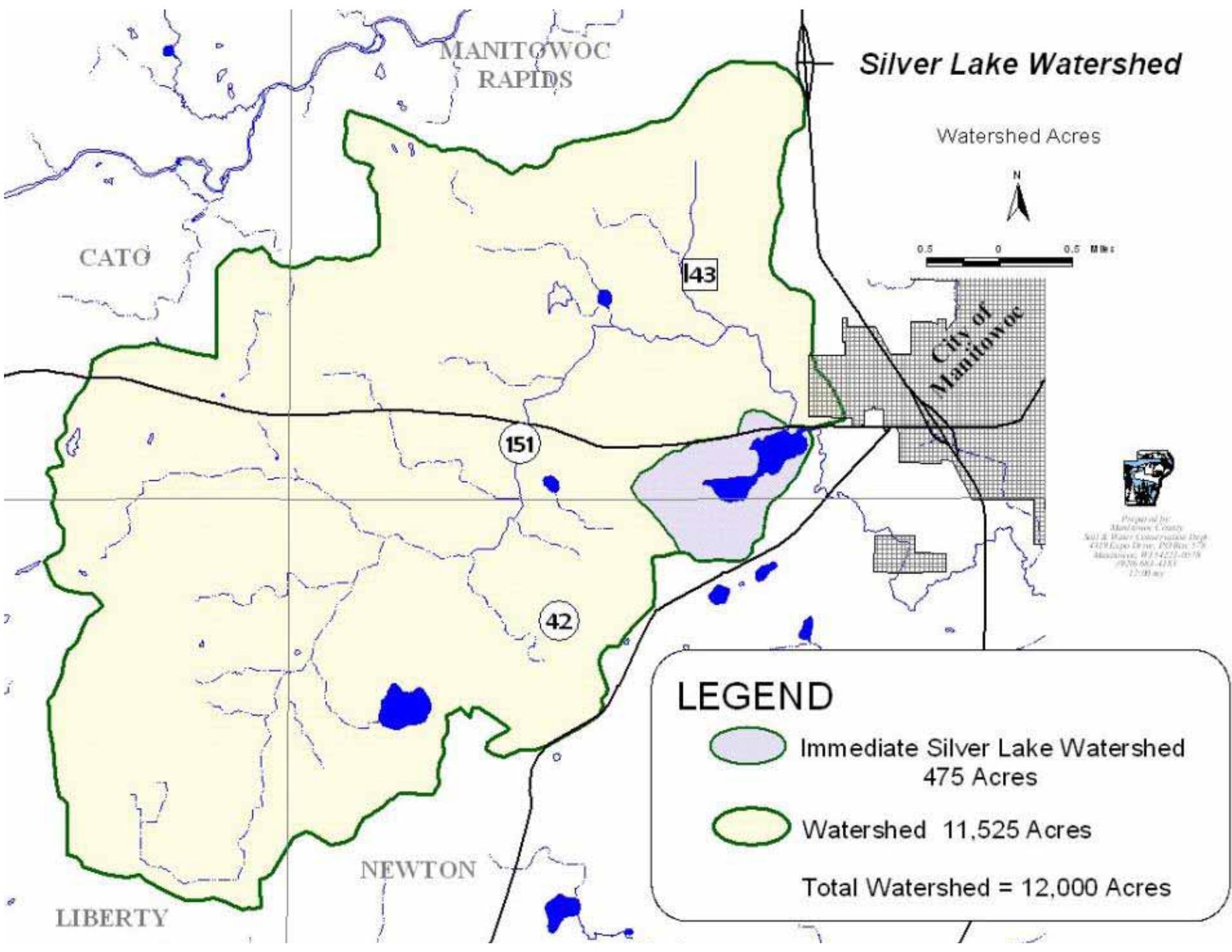


WATER BUDGET

Ground water



Silver Lake Watershed



LEGEND

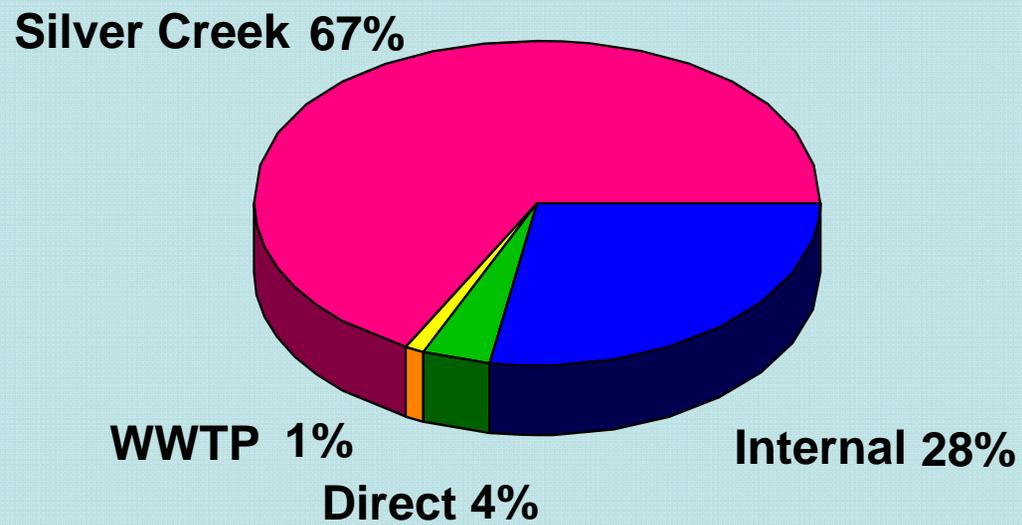
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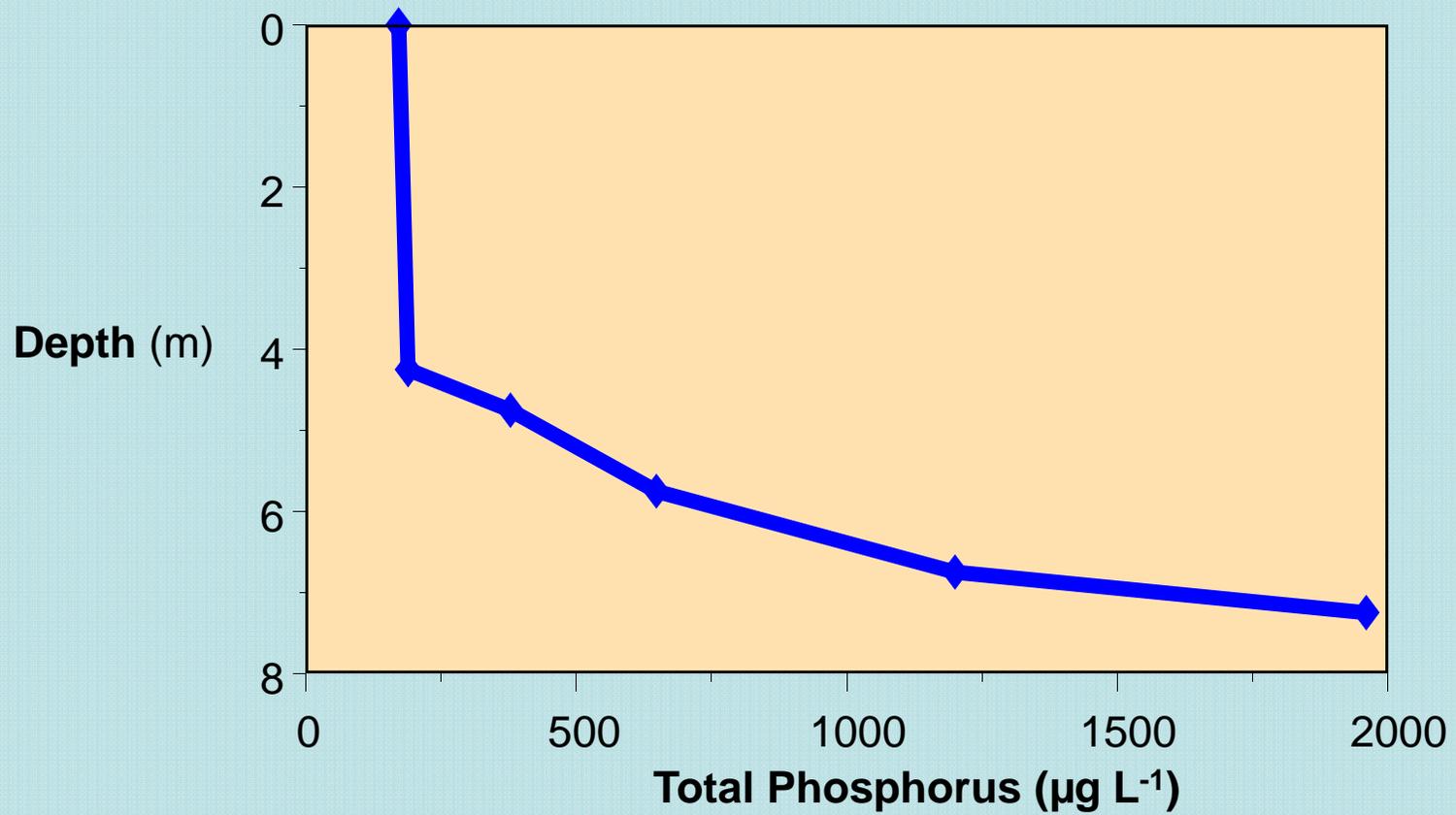
WATER AND NUTRIENT BUDGETS

NUTRIENT BUDGETS



WATER AND NUTRIENT BUDGETS

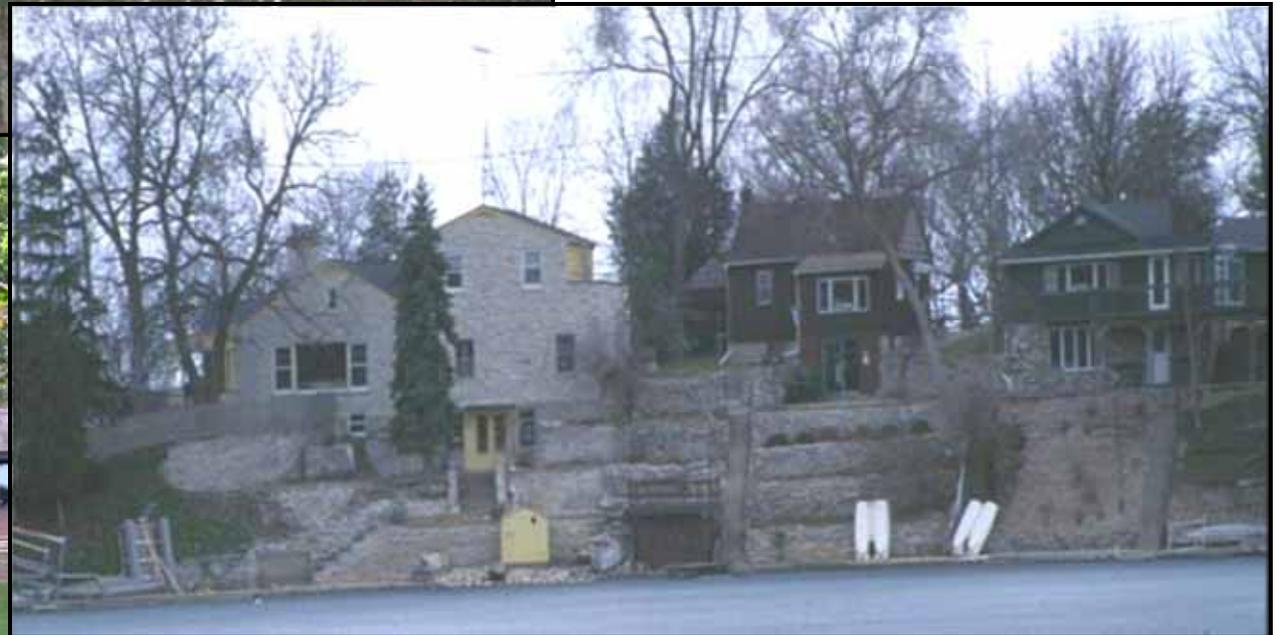
INTERNAL LOADING



BENTHIVOROUS FISH

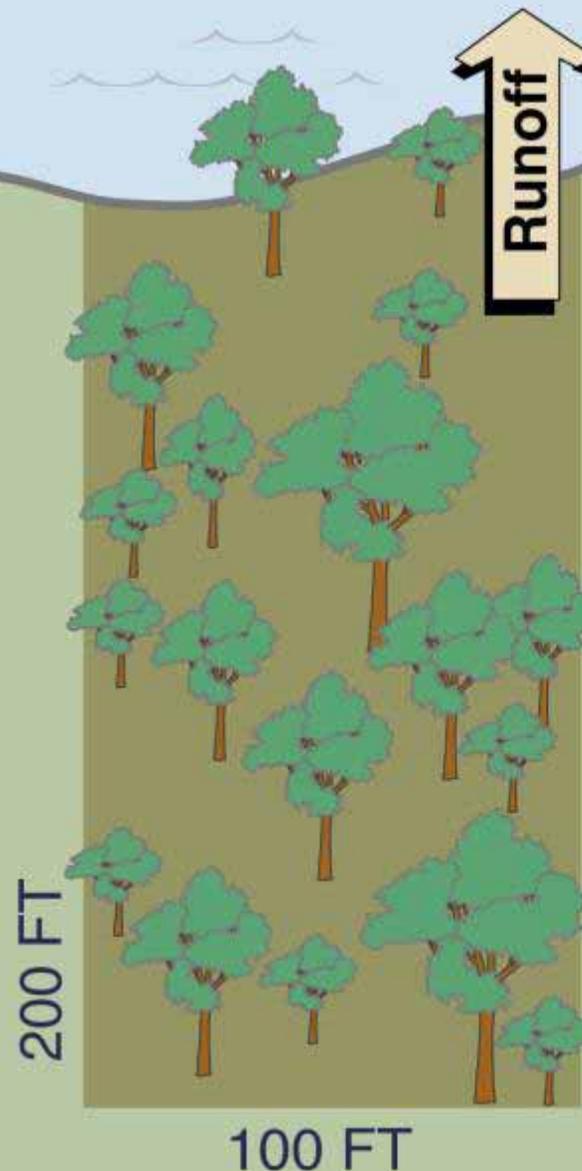


SHORELAND DEVELOPMENT



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

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



IMPACT ON LAKE (April - Oct.)

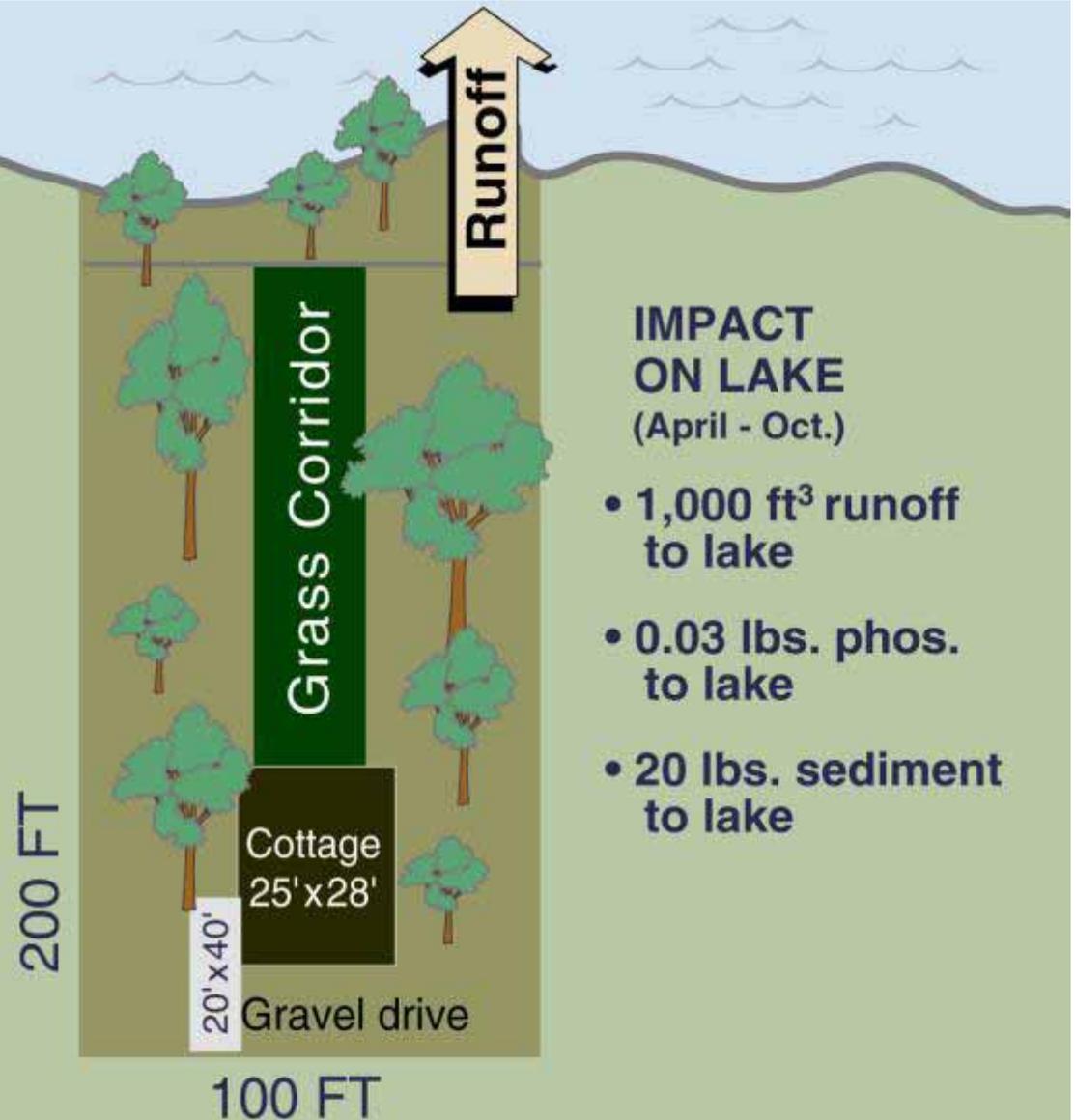
- **1,000 ft³ runoff to lake**
- **0.03 lbs. phos. to lake**
- **5 lbs. sediment to lake**



1940's DEVELOPMENT

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

- maple-beech forest
- 6% slope to lake
- grass corridor 20'-wide
- cottage 700 ft² perimeter
- gravel drive 800 ft²
- 35'-wide buffer strip

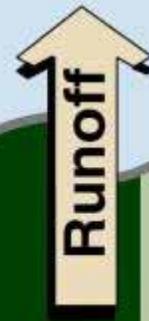
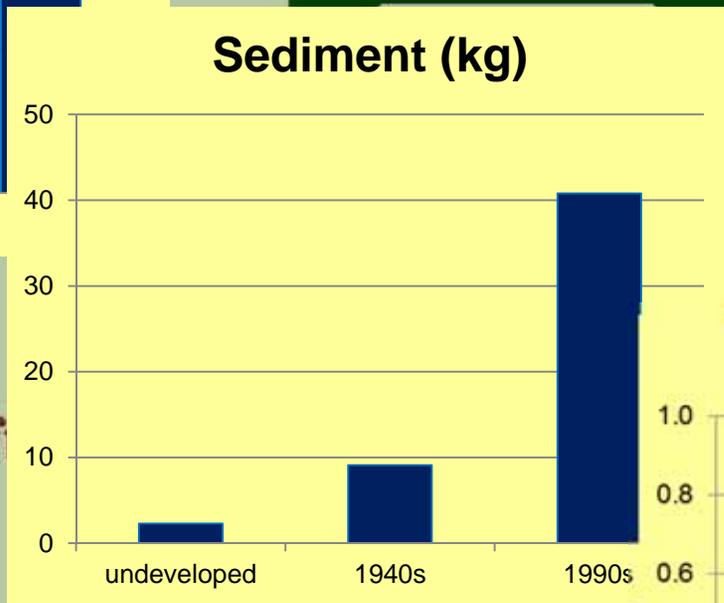
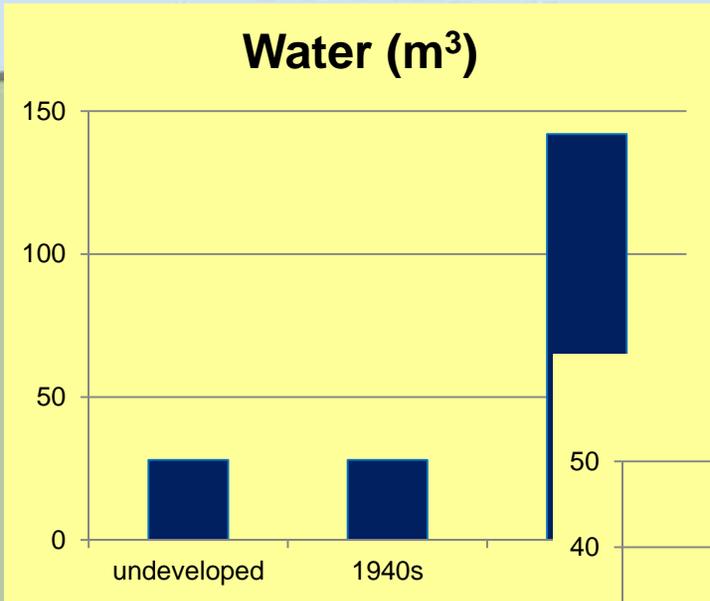




1990's DEVELOPMENT

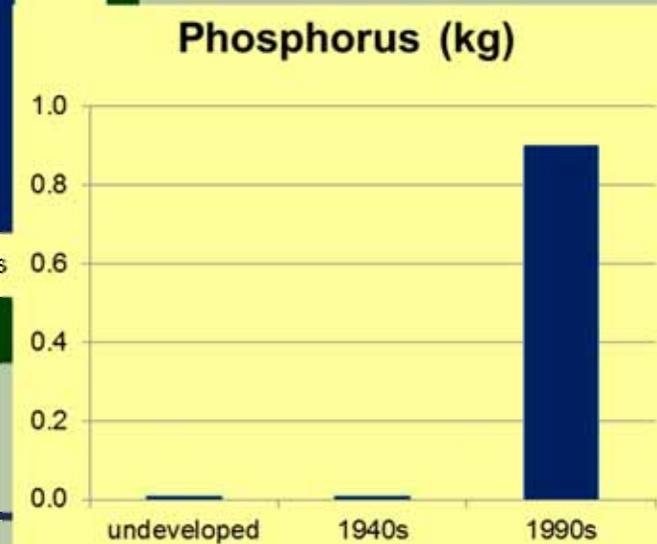
4 26 '94

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



IMPACT ON LAKE
(April - Oct.)

- 5,000 ft³ runoff to lake
- 0.20 lbs. phos. to lake



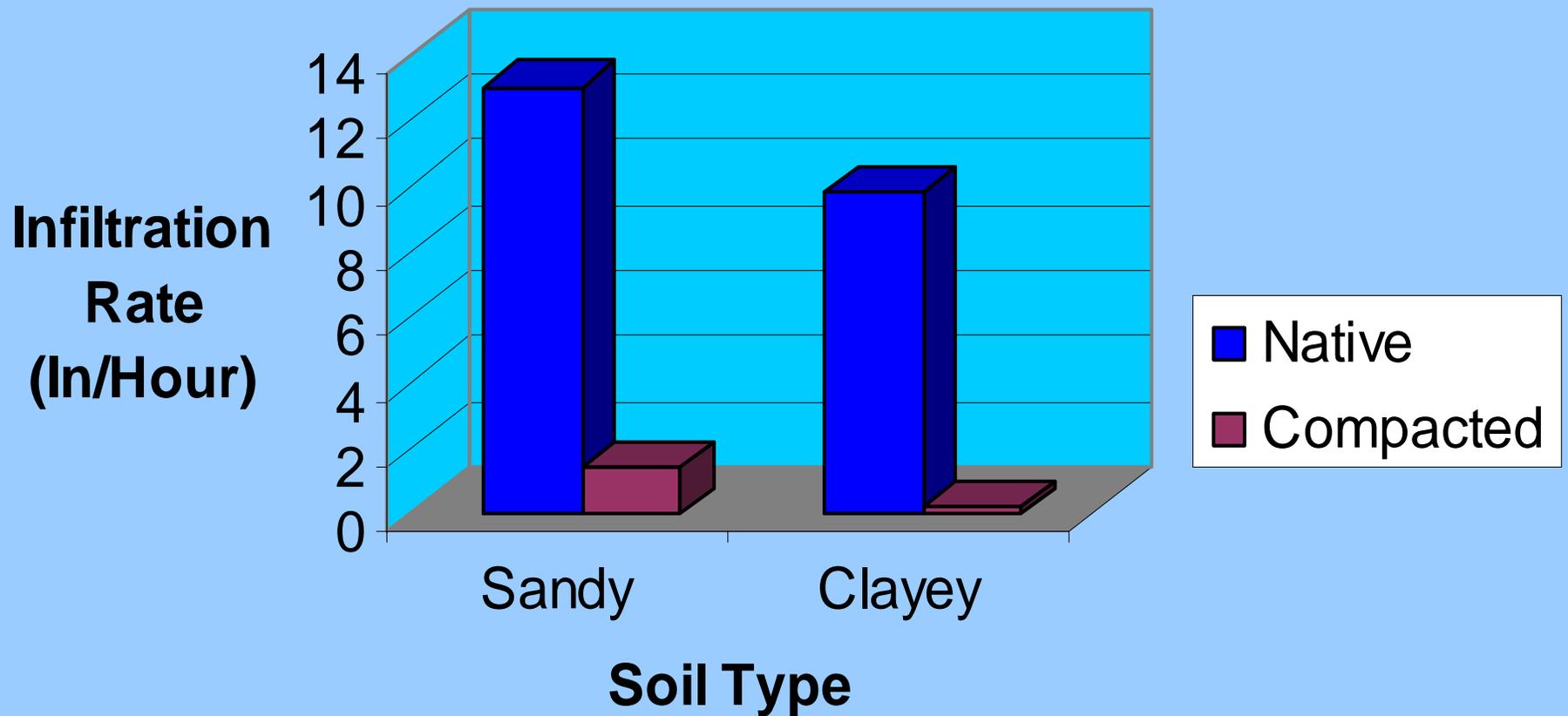
perimeter

- paved drive 770 f

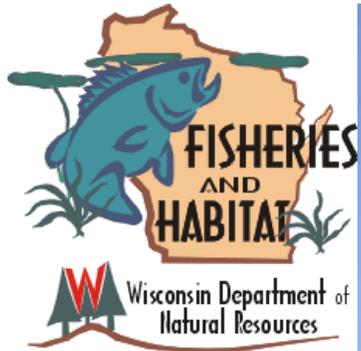
100 FT

Source: Wisconsin Dept. of Natural Resources 1995 John Panuska

Effect of Compaction on Infiltration Rate



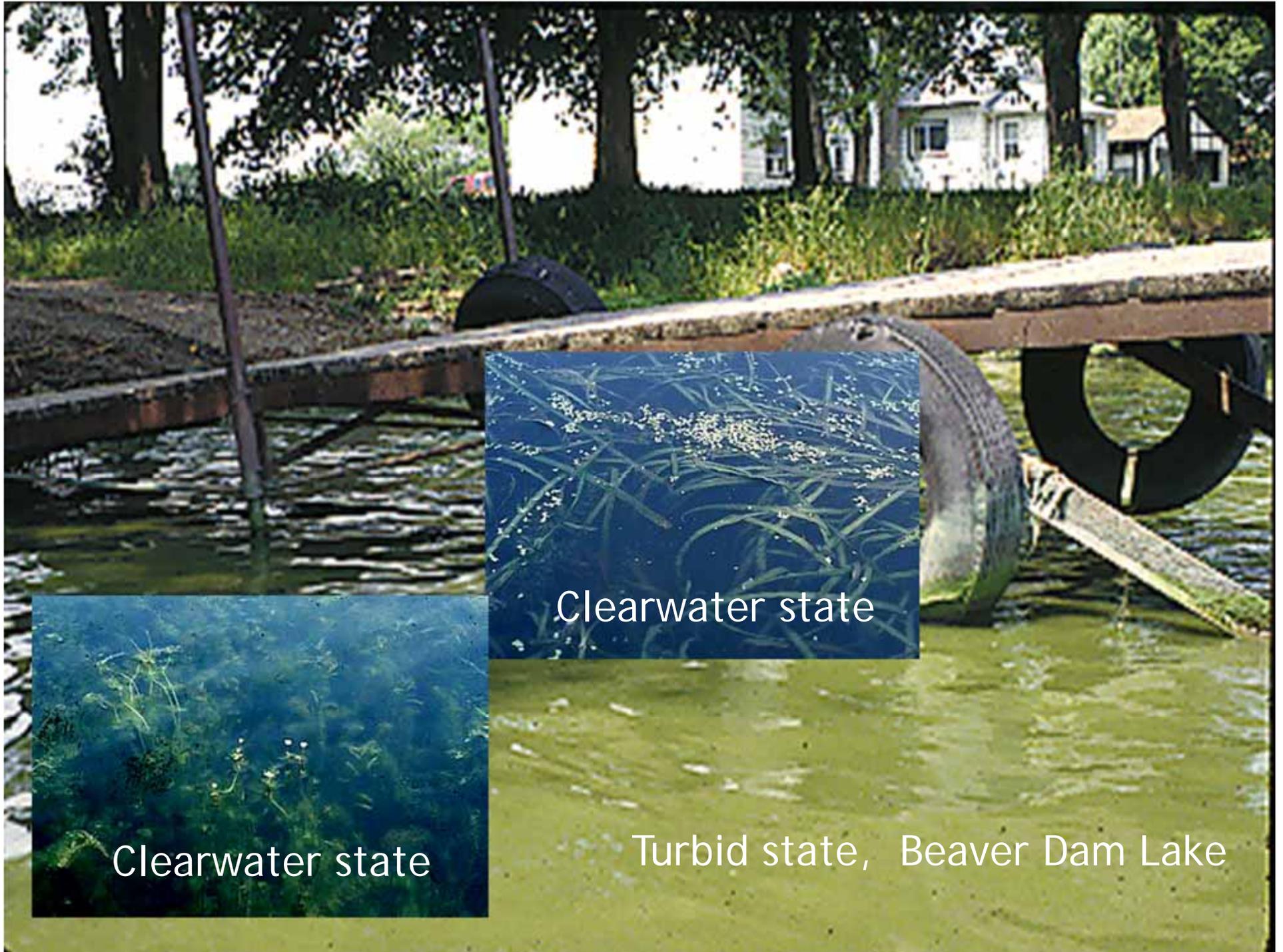
Pitt, et. al., 1999



Restoration and Management of Shallow Lakes

*Paul Cunningham
Bureau of Fisheries, Wisconsin DNR*





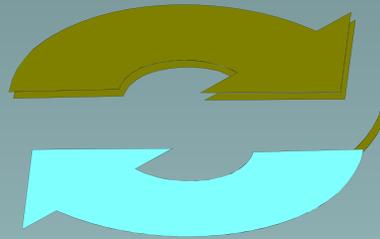
Clearwater state

Clearwater state

Turbid state, Beaver Dam Lake

Shallow Lake Ecology

Clear State



Turbid State

Abundant Rooted Plants

Frequent Algal Blooms

Lower Phosphorus

Higher Phosphorus

Clearer Water

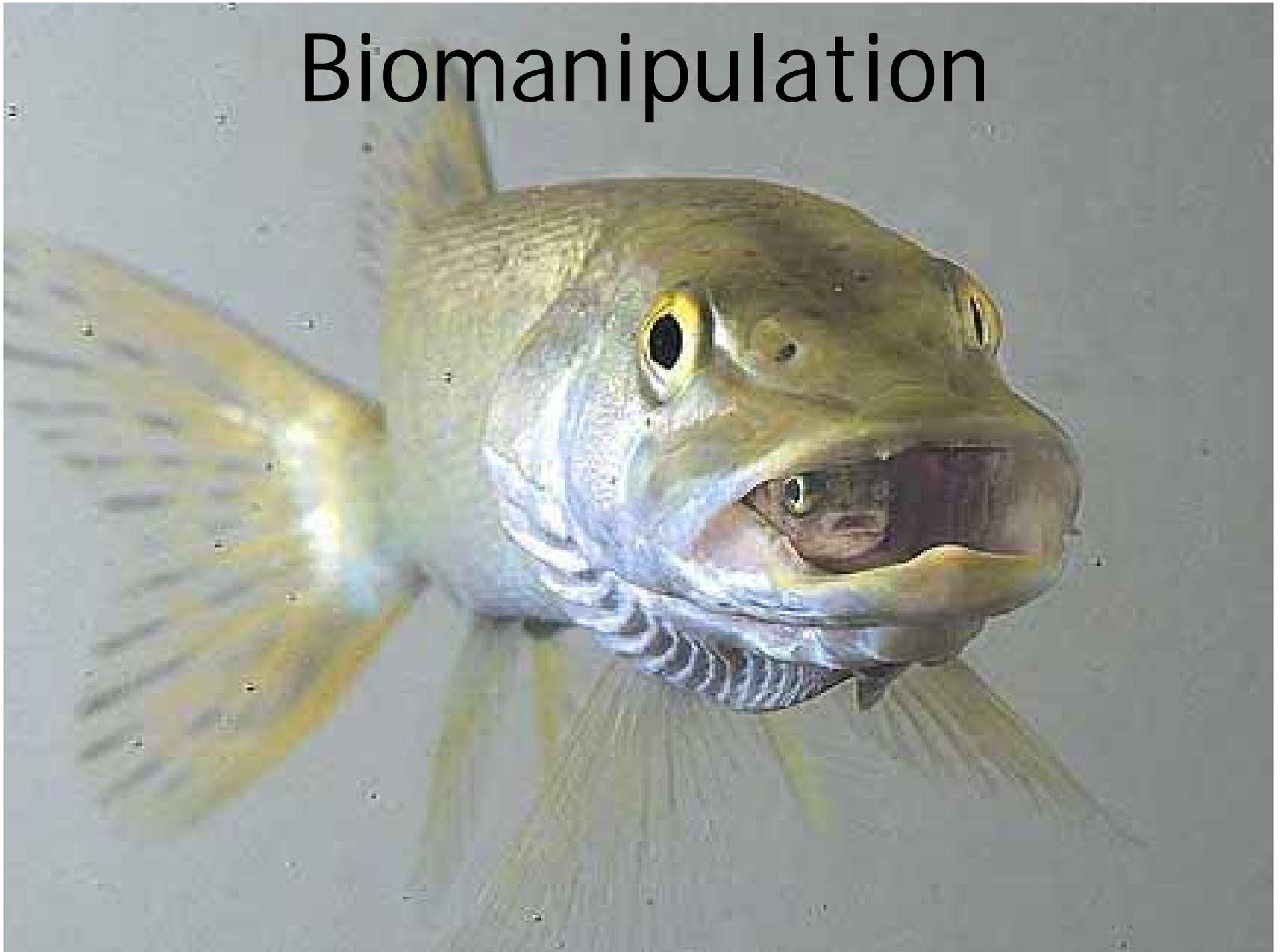
Suspended Sediment

Gamefish Dominate

Carp & Crappies Dominate



Biomanipulation



Rotenone

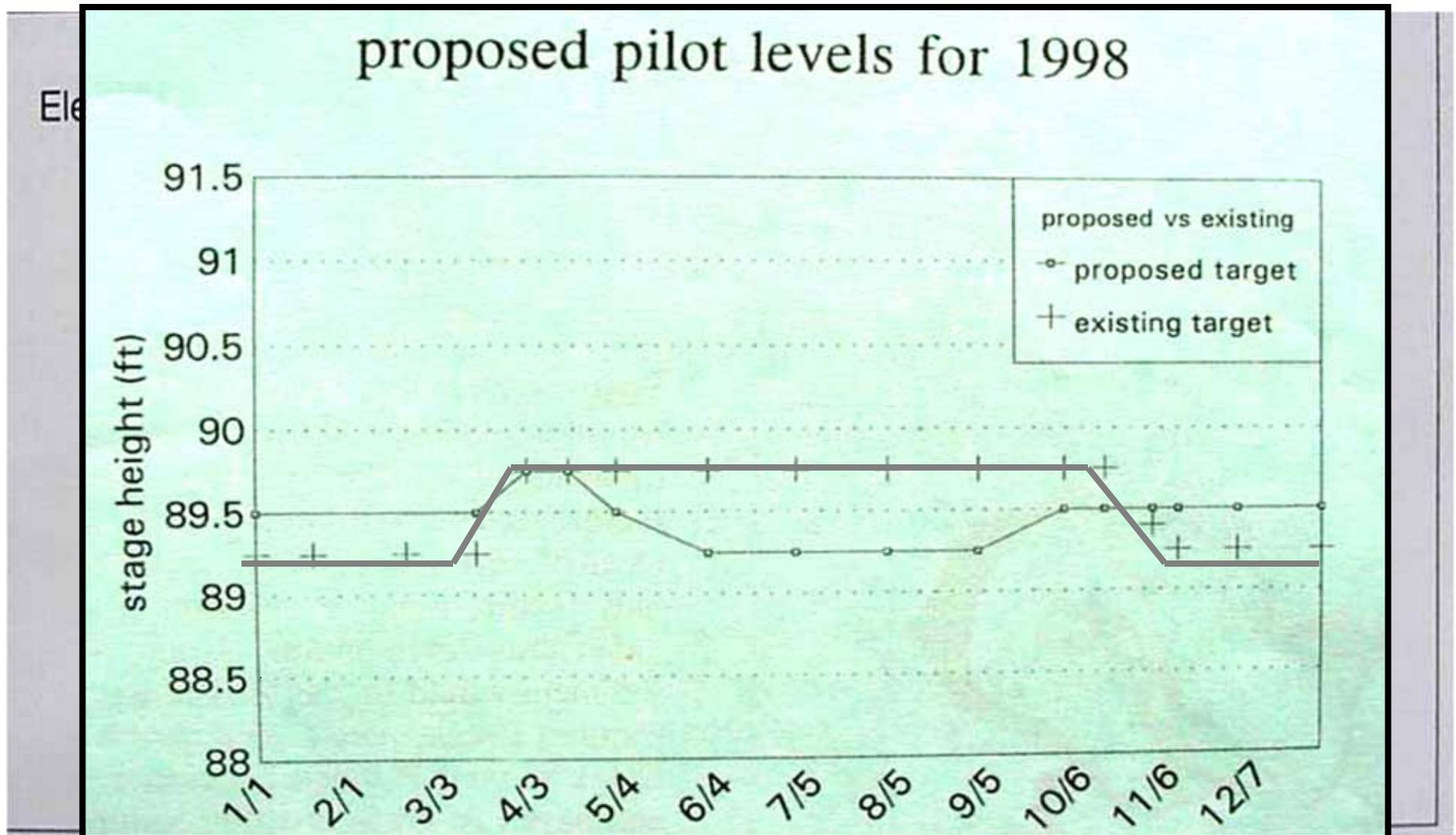


NOW



Seasonal Levels CONVEX or CONCAVE ?

Water levels are Often Managed for Navigation Rather than Plants, Resulting in High Summer Levels, *Opposite* What Nature Intended.



Boats





Paleolimnology or History in the Mucking



HOW DO YOU COLLECT SEDIMENT CORES?

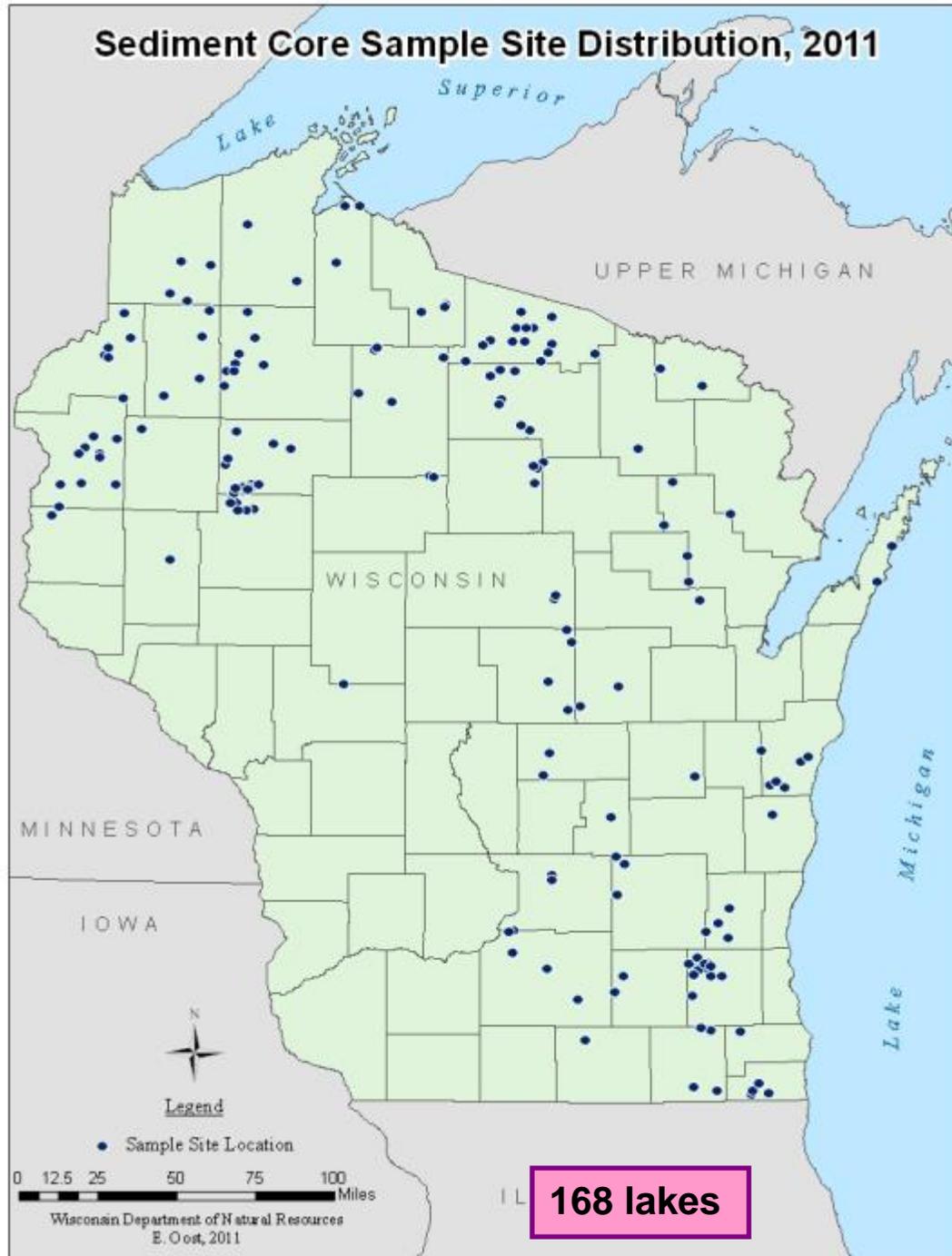


Gravity Corer



Piston Corer

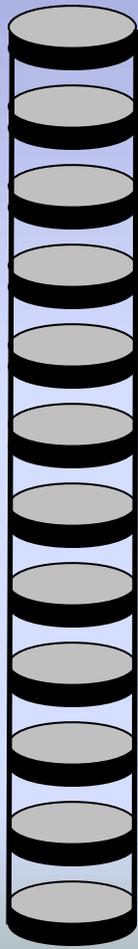
Sediment Core Sample Site Distribution, 2011



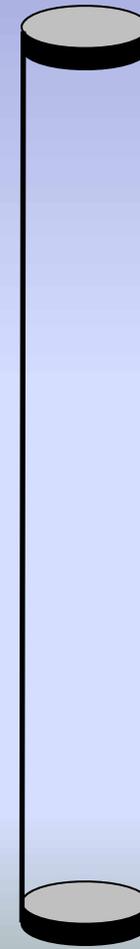
168 lakes

Types of Cores

Full core



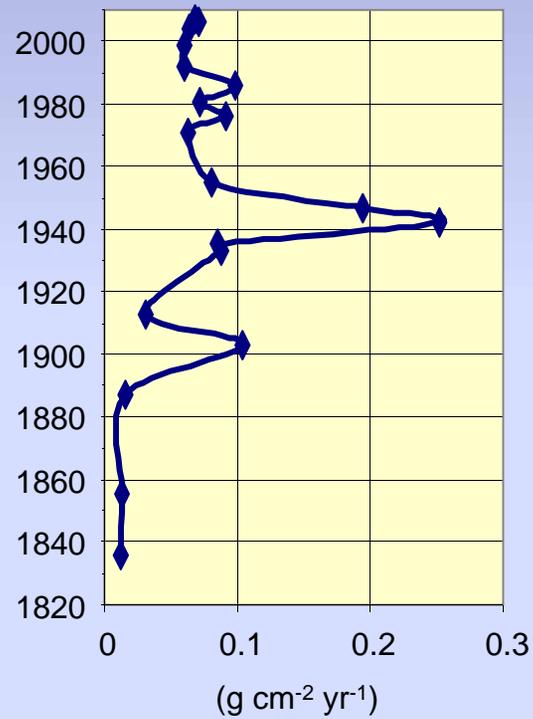
Top/Bottom



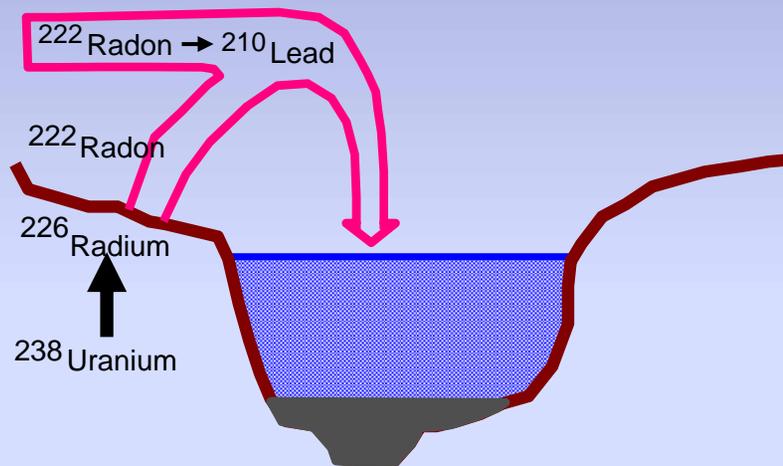
Modern

Reference

Sedimentation Rate



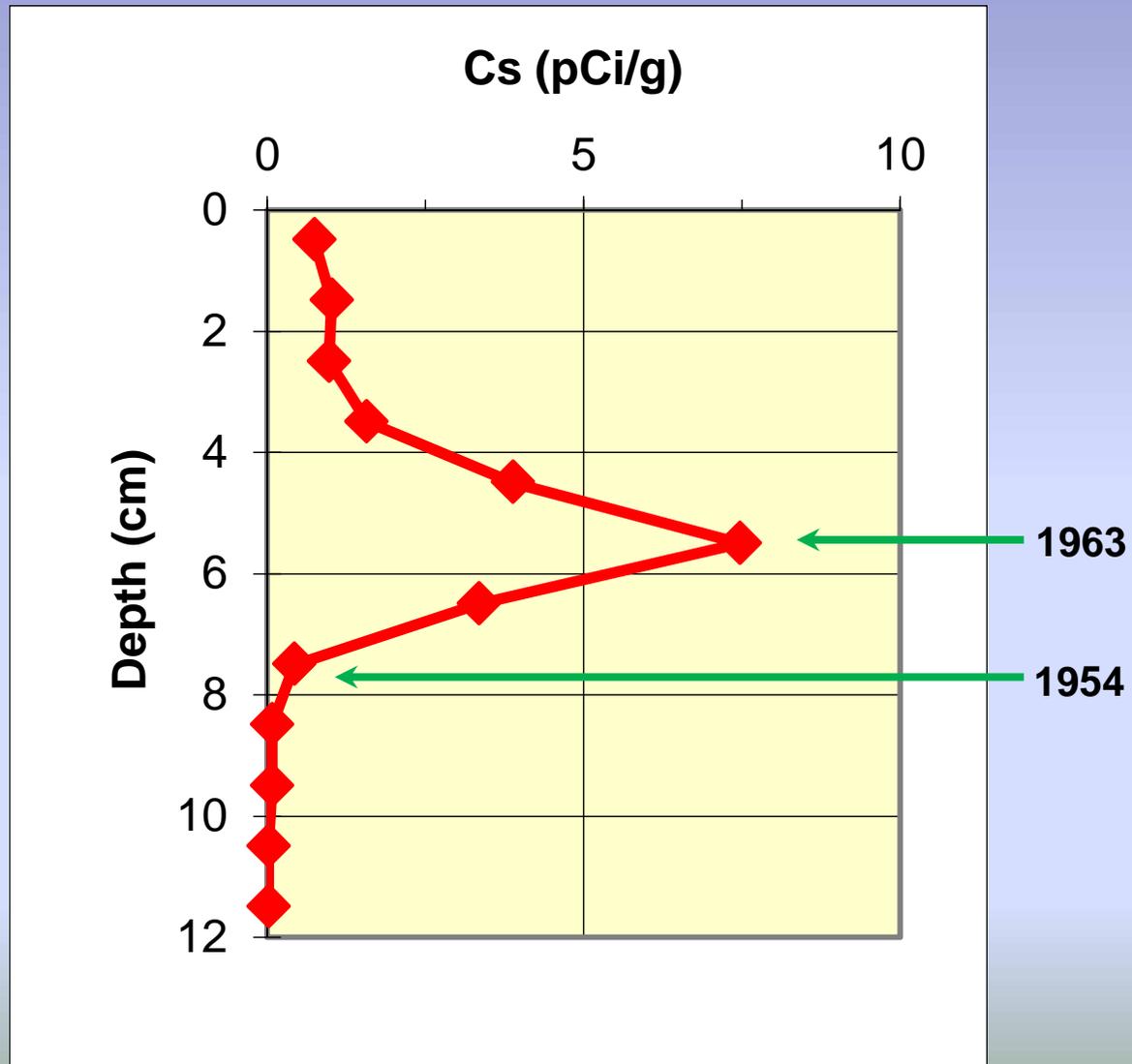
Lead-210 Dating



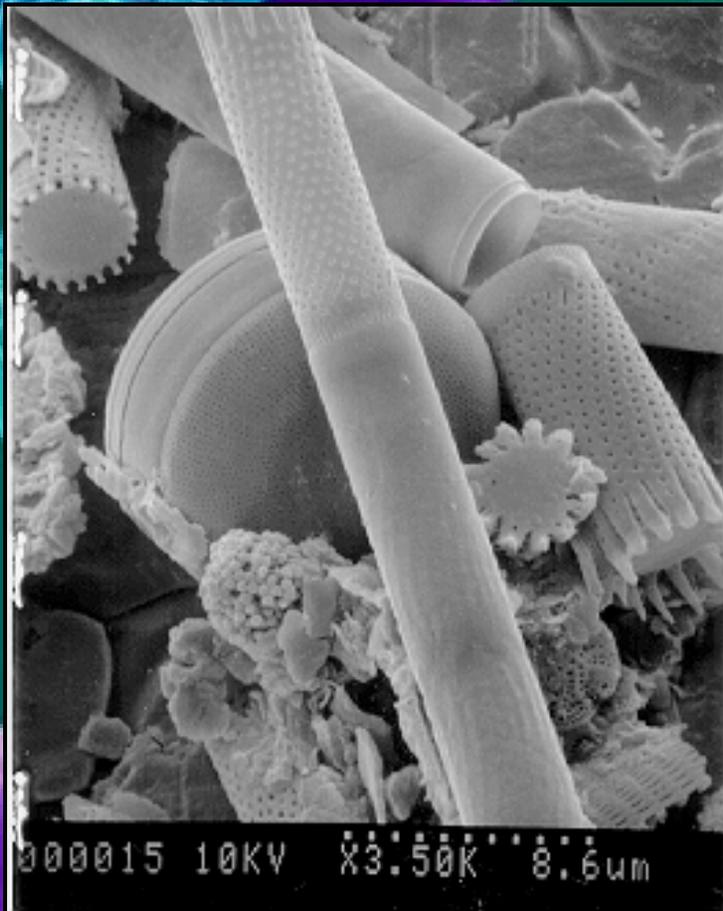
HALF LIVES

$^{226}\text{Radium}$	1024 yr
$^{222}\text{Radon}$	3.8 days
$^{210}\text{Lead}$	22.26 yr

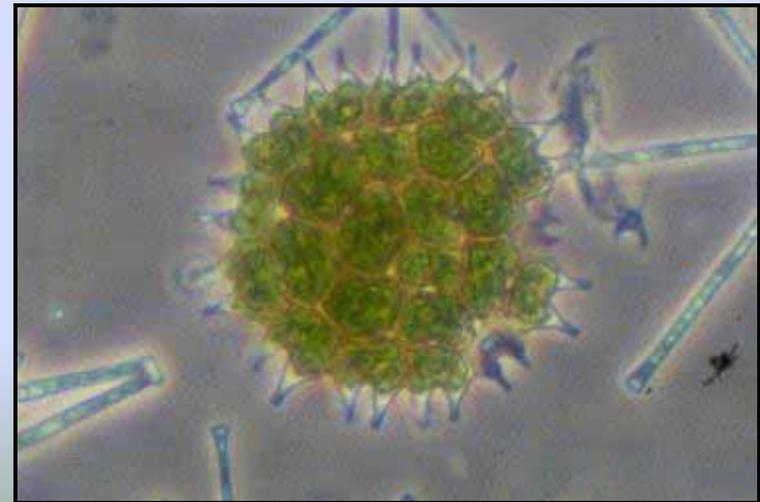
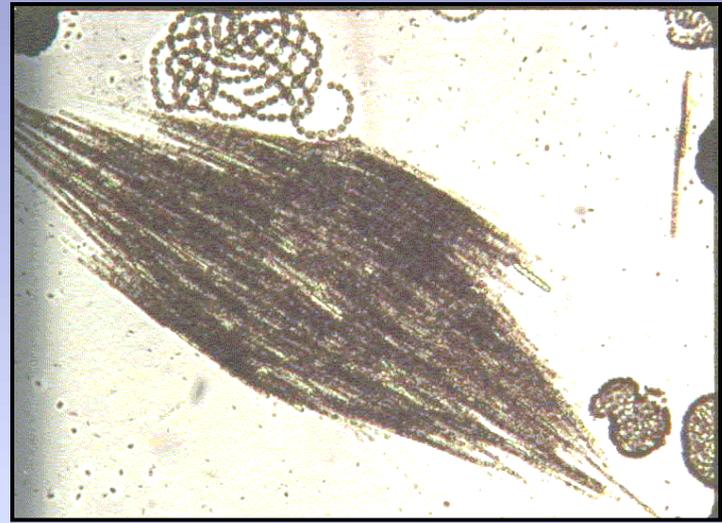
FALLOUT FROM ATMOSPHERIC BOMB TESTING



DIATOMS



BLUE-GREEN and GREEN ALGAE



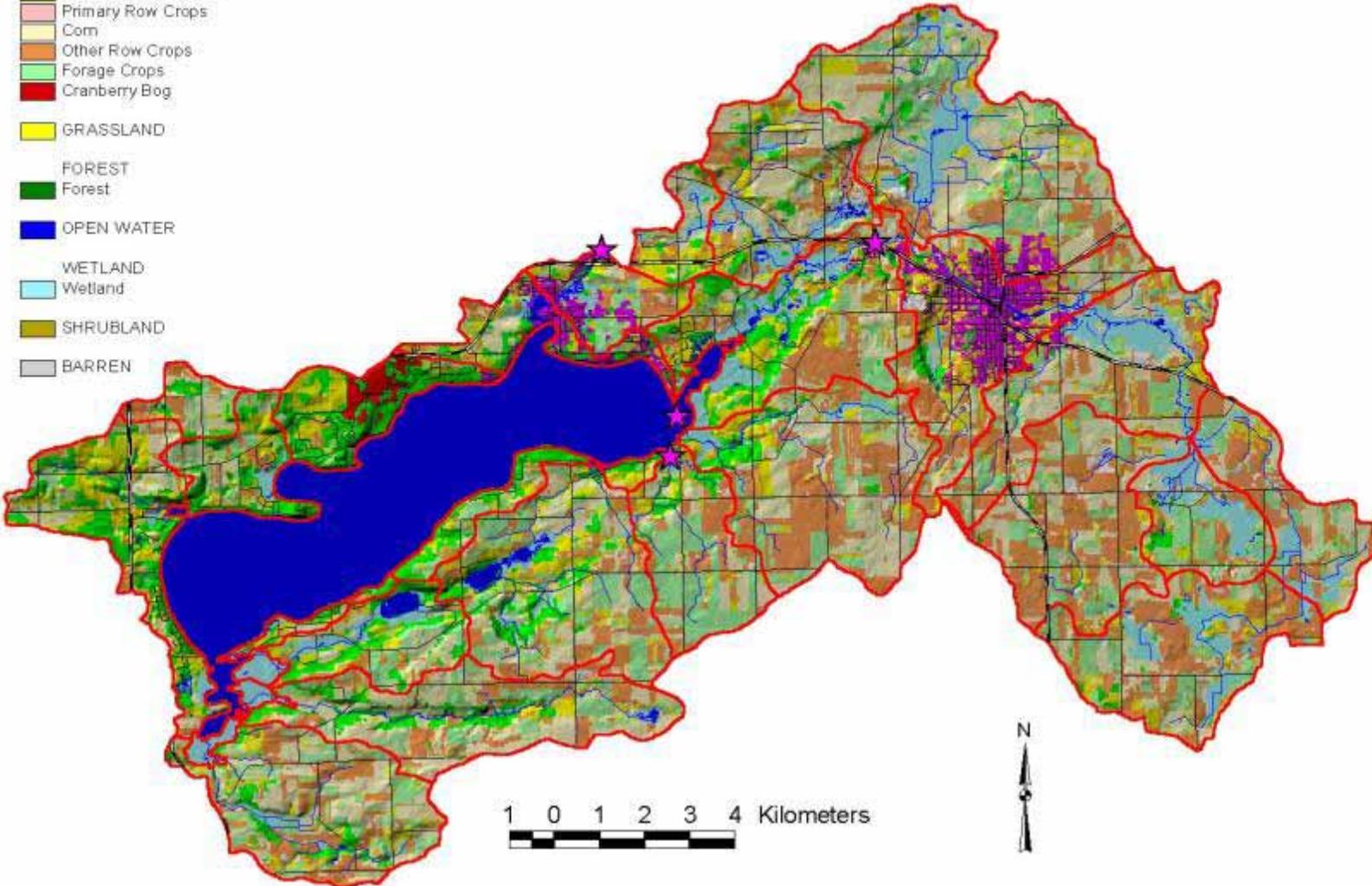
Peter Parks

AGRICULTURE



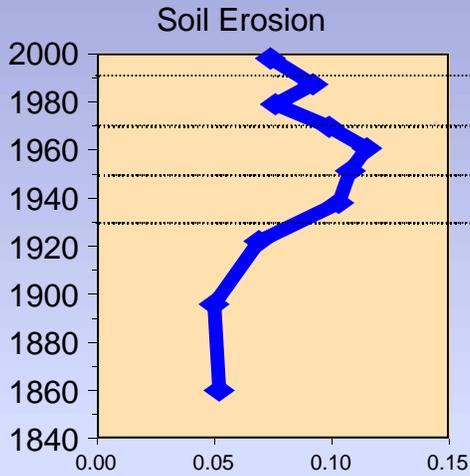
Big Green Lake Watershed Land Cover & Hillshade (WISCLAND 1992)

- Land Cover
- URBAN/DEVELOPED
 - High Intensity
 - Low Intensity
 - Golf Course
 - AGRICULTURE
 - General Agriculture
 - Herbaceous/Field Crops
 - Primary Row Crops
 - Com
 - Other Row Crops
 - Forage Crops
 - Cranberry Bog
 - GRASSLAND
 - FOREST
 - Forest
 - OPEN WATER
 - WETLAND
 - Wetland
 - SHRUBLAND
 - BARREN

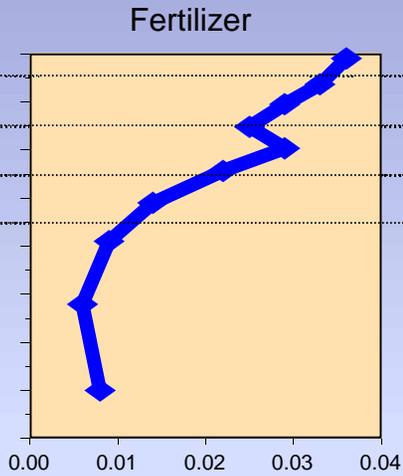


Green Lake

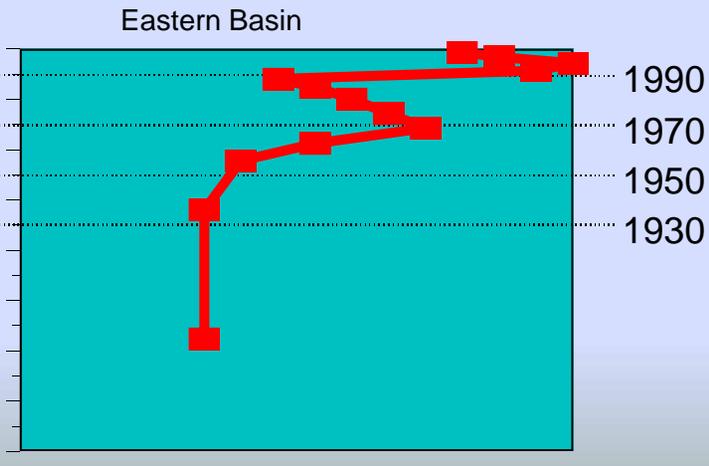
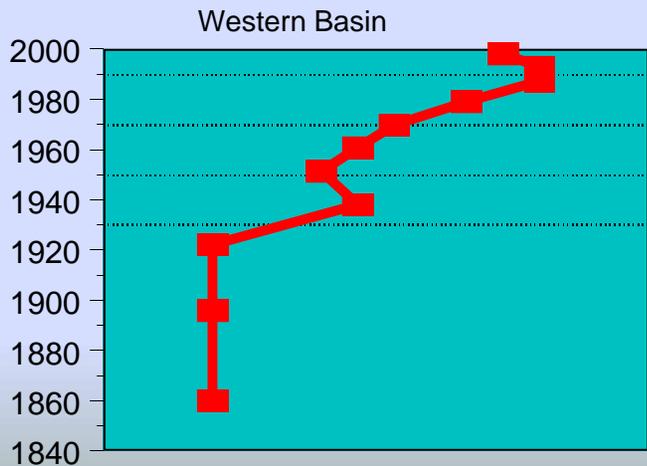
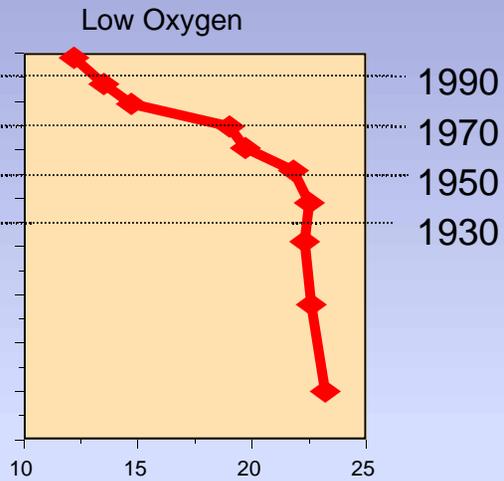
Titanium



Uranium



Manganese



Increasing Phosphorus Concentrations



SHORELAND DEVELOPMENT



circa 1940

2009



Shift in the ratio of isoetids to elodeids



1930s: 50/50



2000s: 30/70

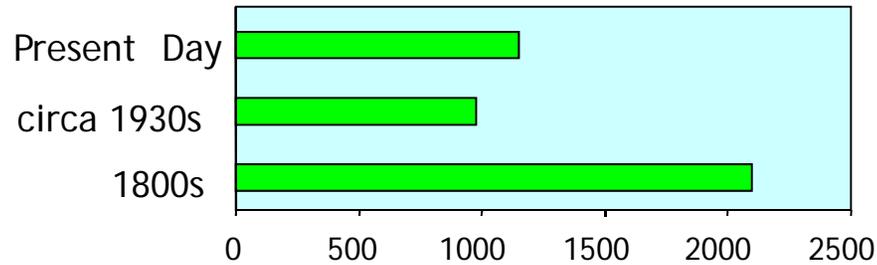
Susan Borman and Ray Newman-U. of Minnesota



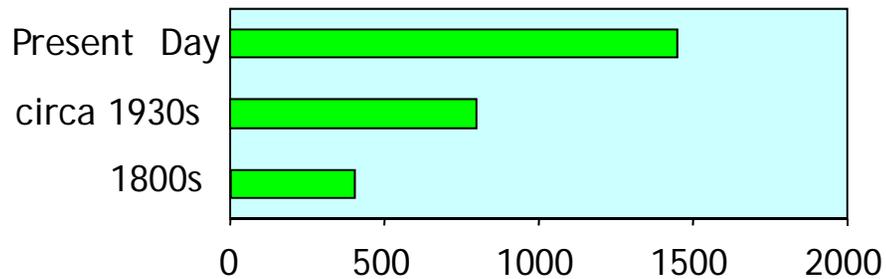
Little
Bearskin
Lake

Little Bearskin Lake

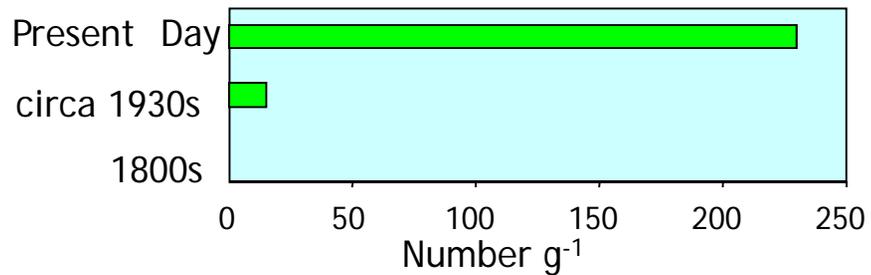
FERNLEAF PONDWEED



COONTAIL

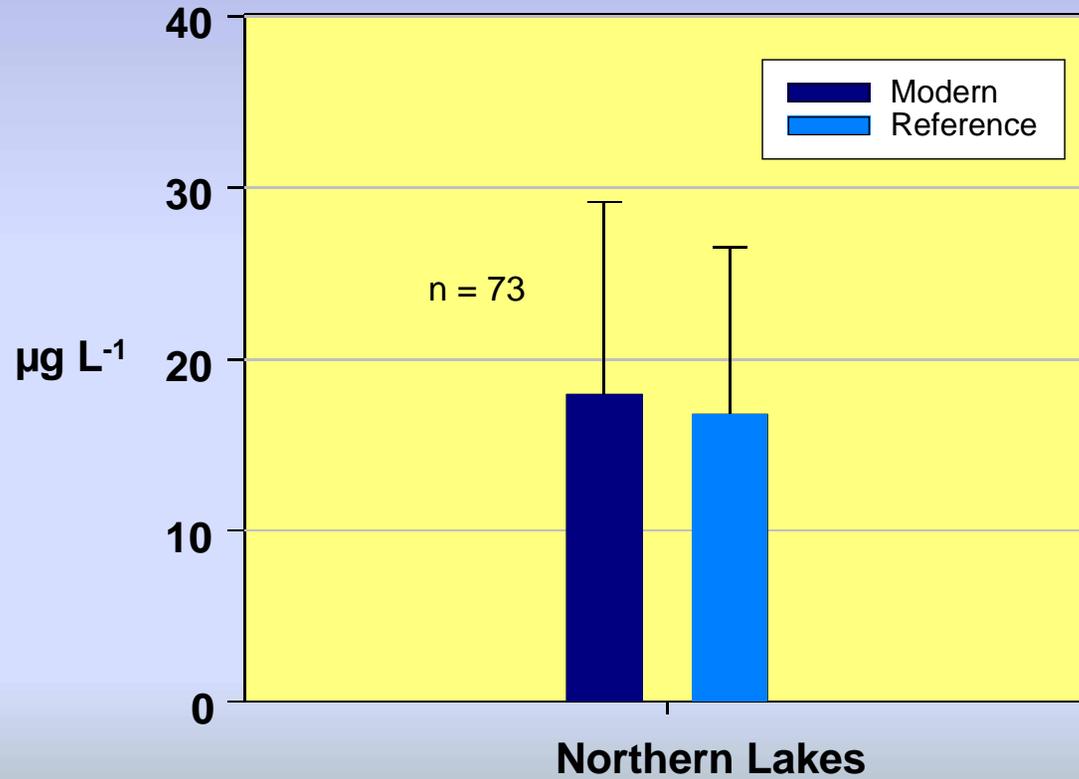


LARGE LEAVED PONDWEED



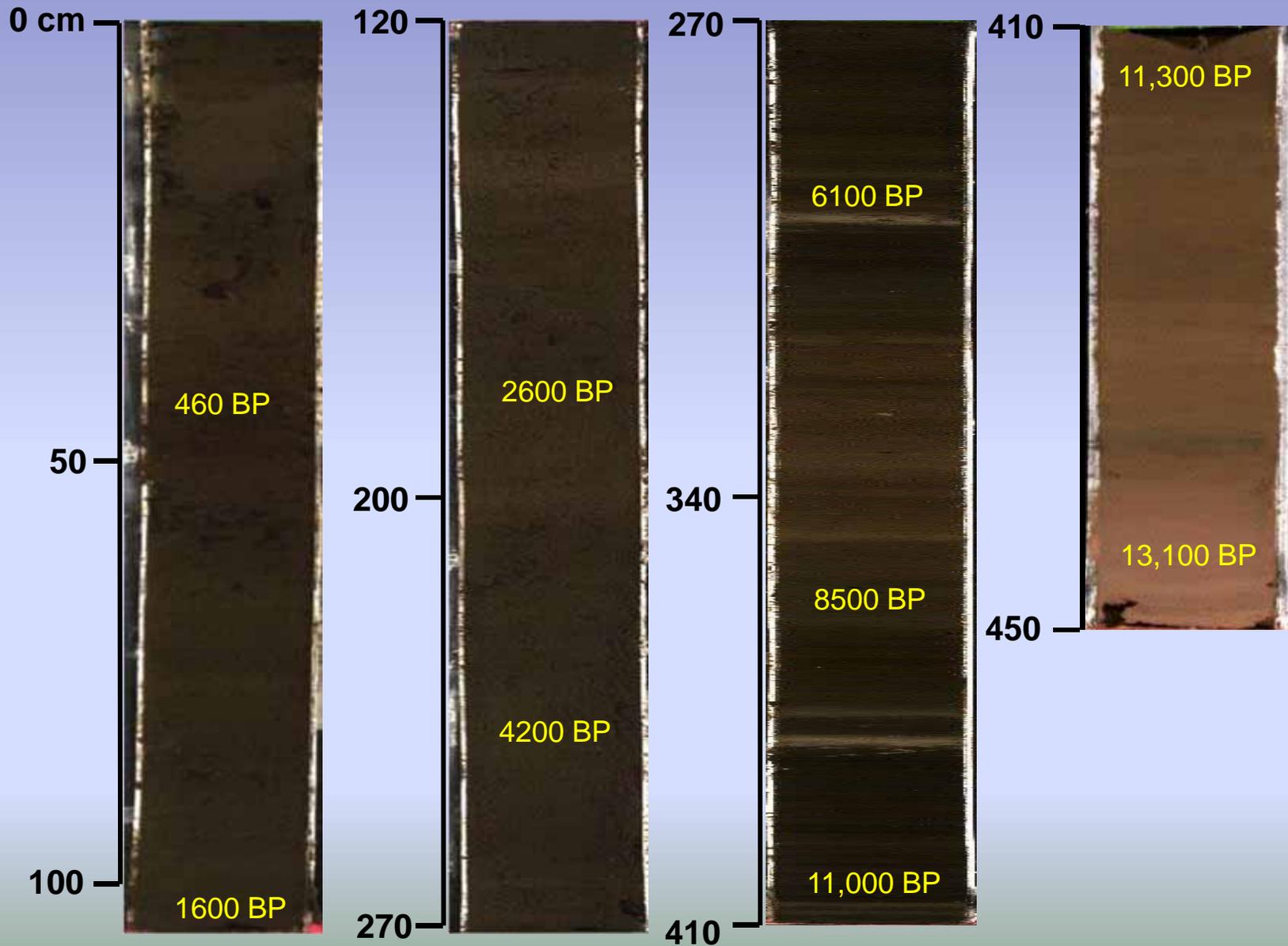
CHANGE IN PHOSPHORUS

PHOSPHORUS

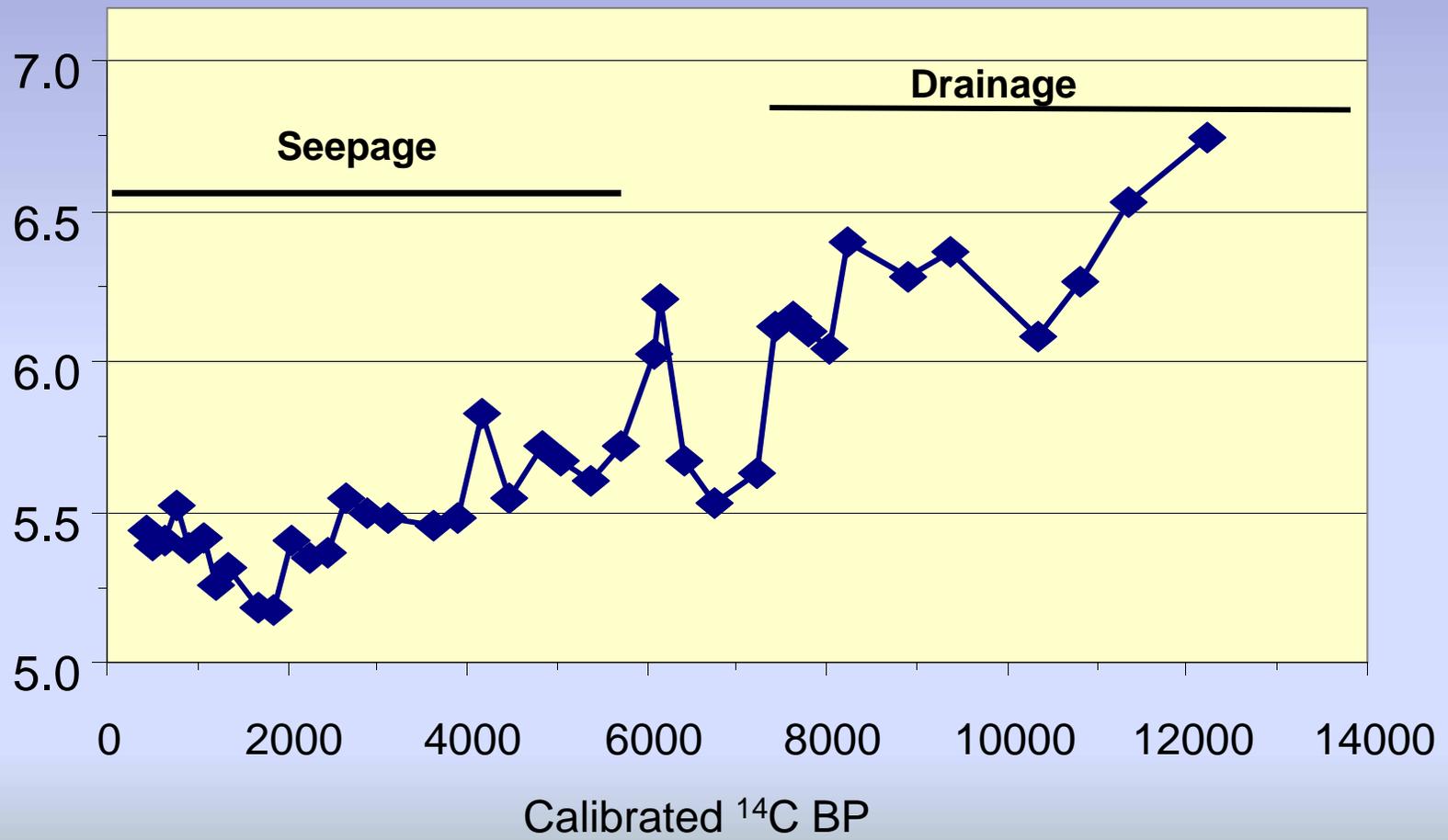


CLIMATE CHANGE





pH



5,000-12,000 yrs BP





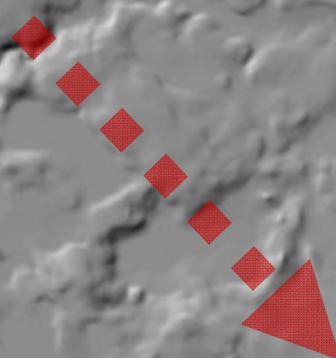
Berry Lake

CHANGING WATER LEVELS

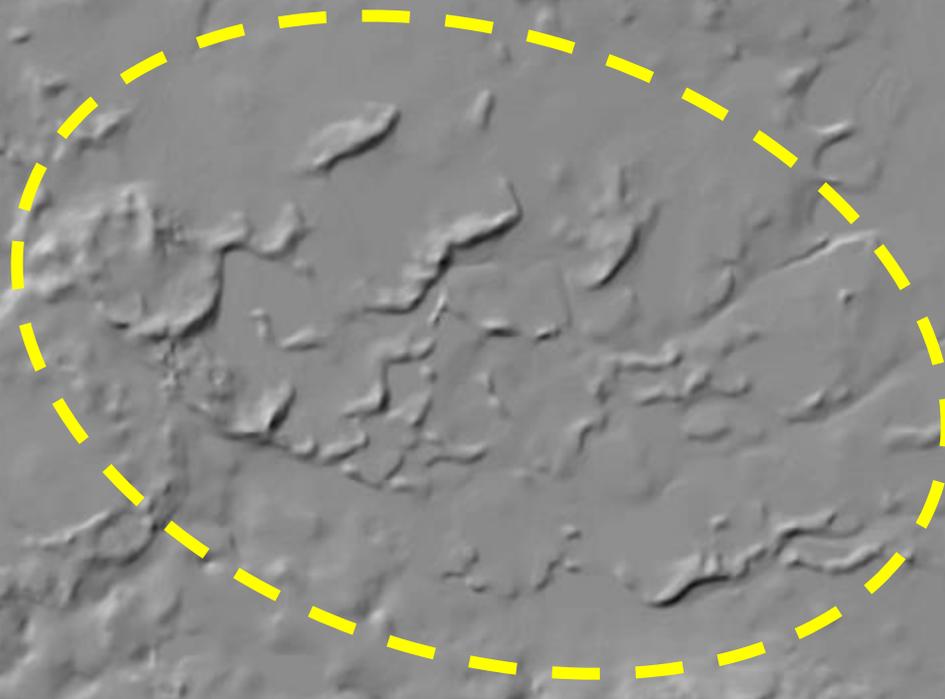


Berry Lake, Oconto County

Wind



Ancient Sand Dunes

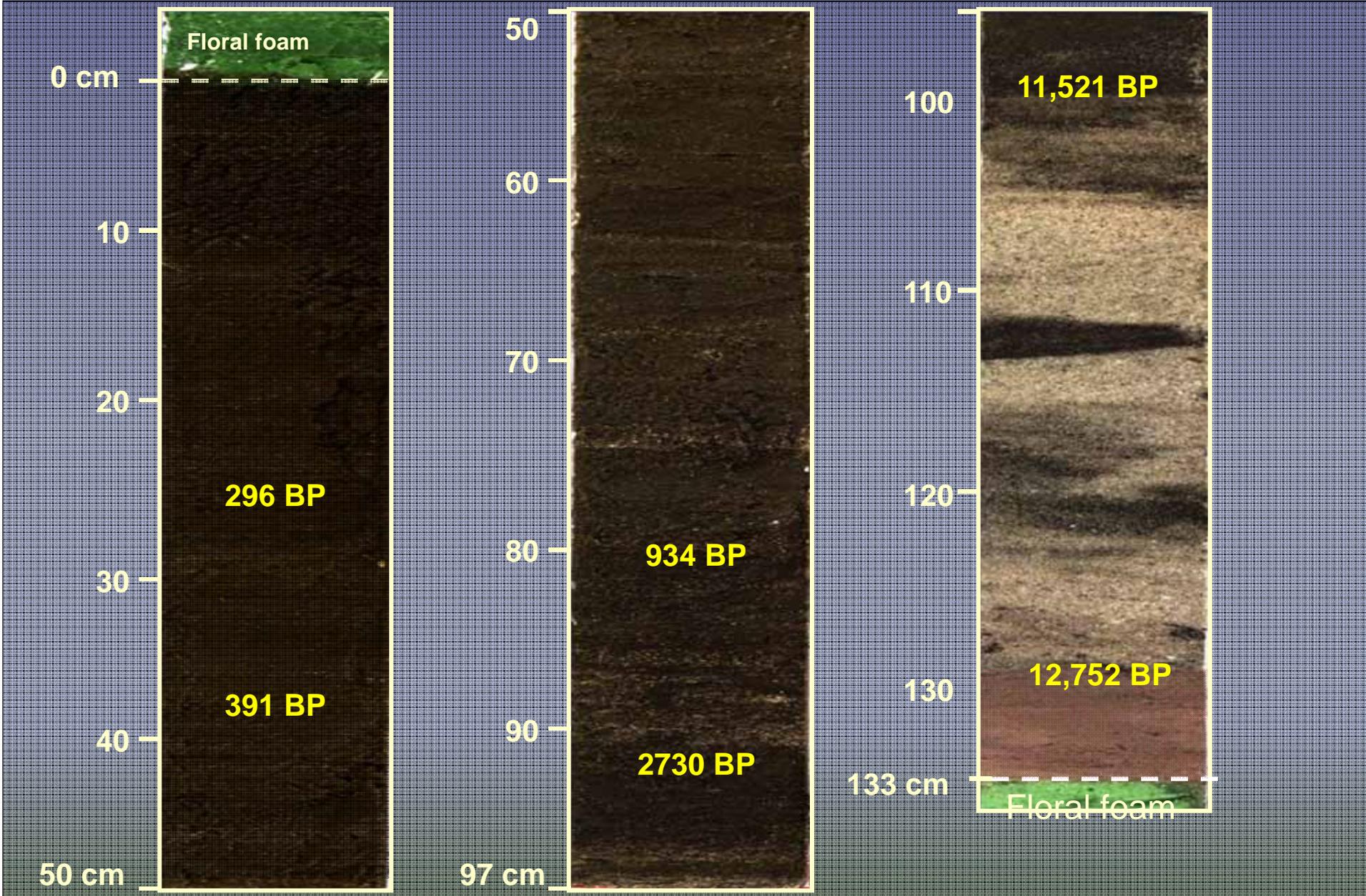


Berry Lake



Berry Lake

Dr. Samatha Kaplan—
UW Stevens Point



LAKETIDES

Winter 2007



Paleolimnology History in the Mucking

Lake folks often get into lively discussions over what the lake used to be like...more plants, fewer plants, clear water; murky water... Is there any way to really know for sure? Well, the answer is yes! In fact we can have a good idea of what lakes used to be like hundreds of years ago with a science called Paleolimnology.

Winter 2008

Paleolimnology A Reflection of Our History

An article in Lake Tides (vol. 32, no. 1), "Paleolimnology: History in the Mucking," discussed how sediment cores are taken and utilized to understand past changes in lakes. This article will take us on a historical journey that links changes on the landscape with environmental impacts to our lakes, which are revealed in the lake sediments.

on the land. The opening of the forest allowed large amounts of sediments and nutrients to be exported from the land to the water.

Major events in the history of our country, like World War II, had definite impacts on our lakes. World War II marked another period in which agricultural practices intensified. To