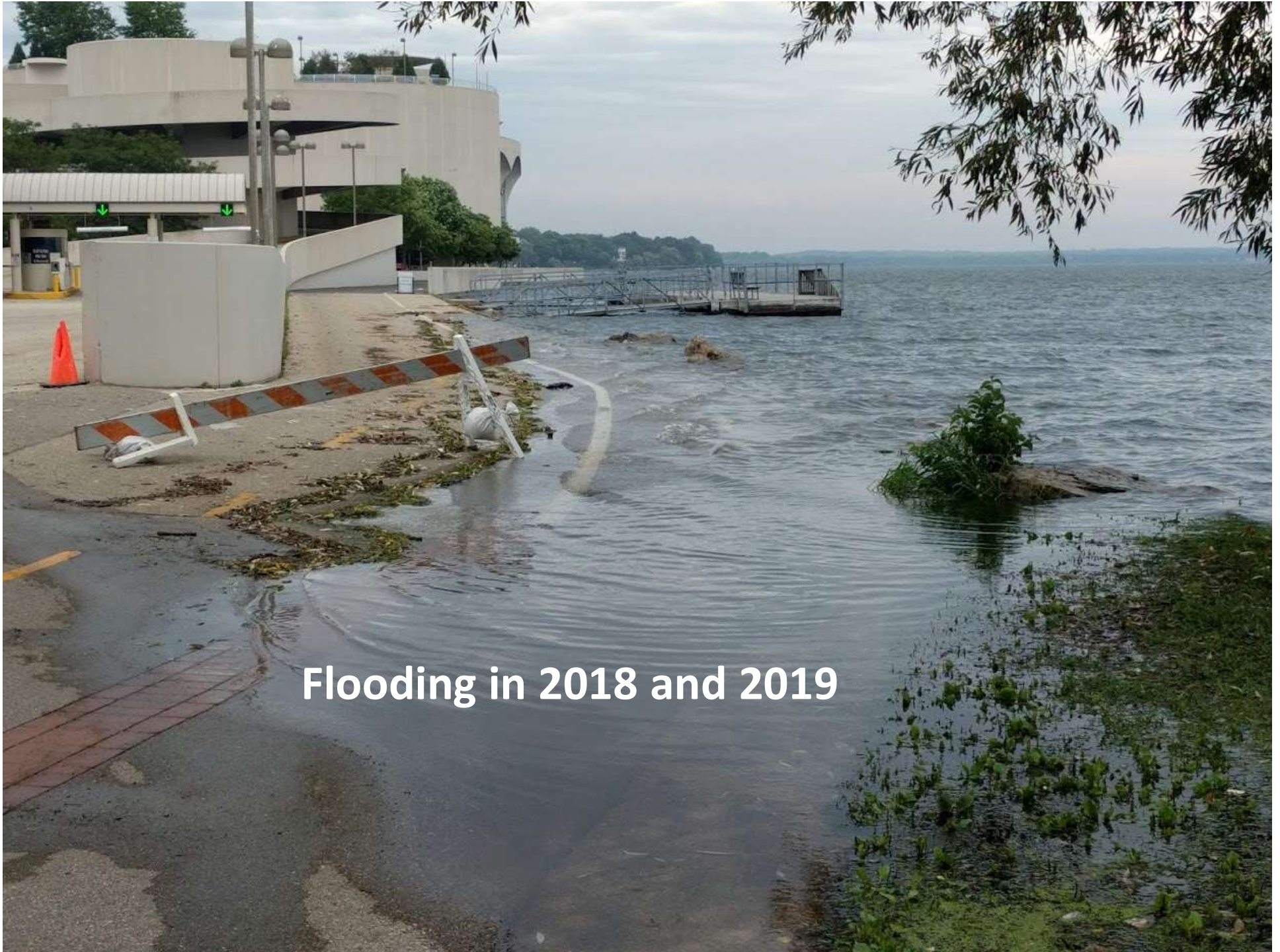




Volunteer Lake Level Monitoring for Management & Research

Katie Hein

Wisconsin Department of Natural Resources




Flooding in 2018 and 2019



Drought in Northern Wisconsin c. 2010

Dick Lathrop



Today's Talk

- Natural lake level fluctuations
- How lake levels affect lake ecosystems
- Why we need lake level data
- How volunteers can monitor lake levels
- How to adapt to fluctuating lake levels

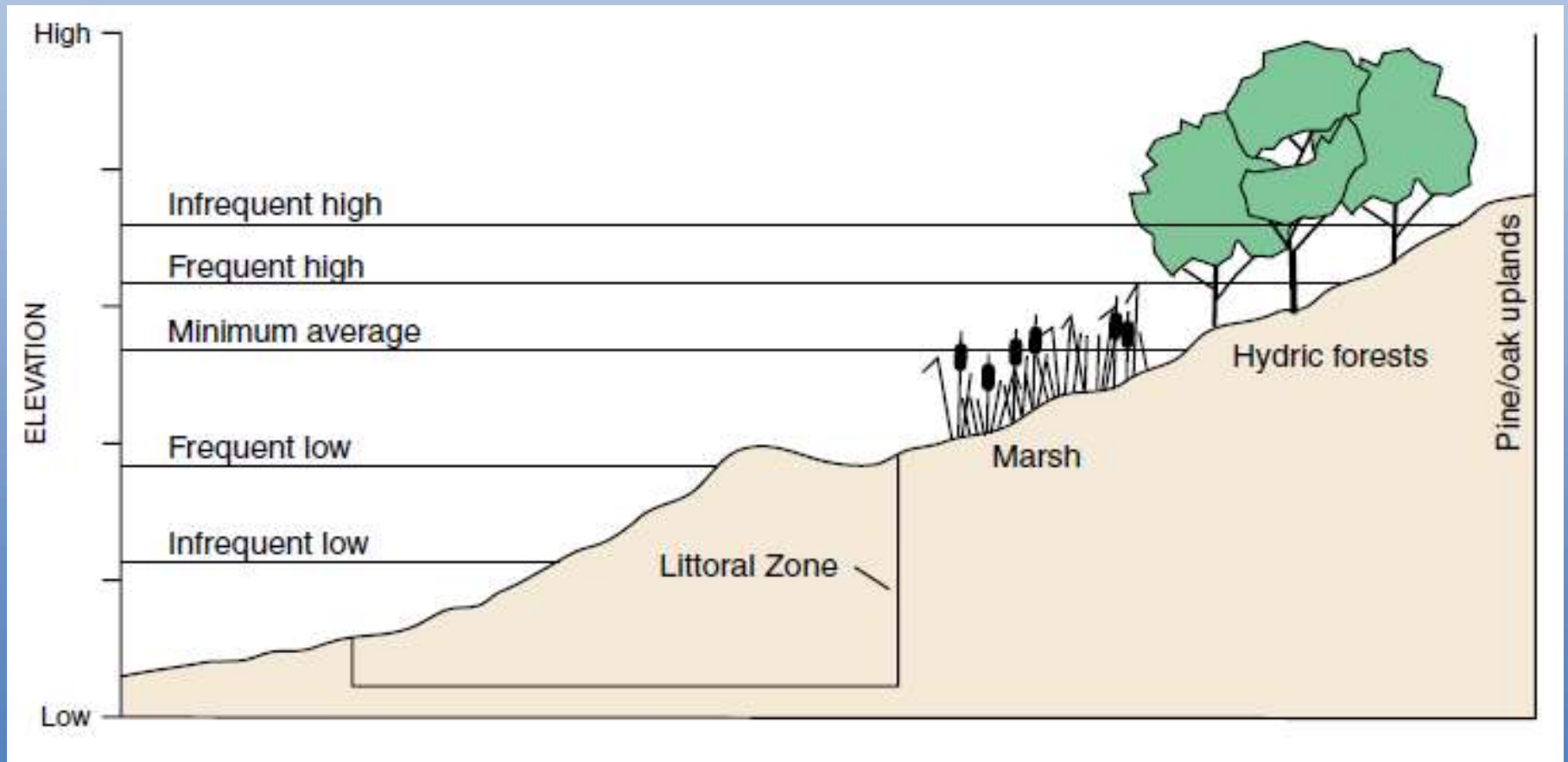
High Lake Levels



Low Lake Levels

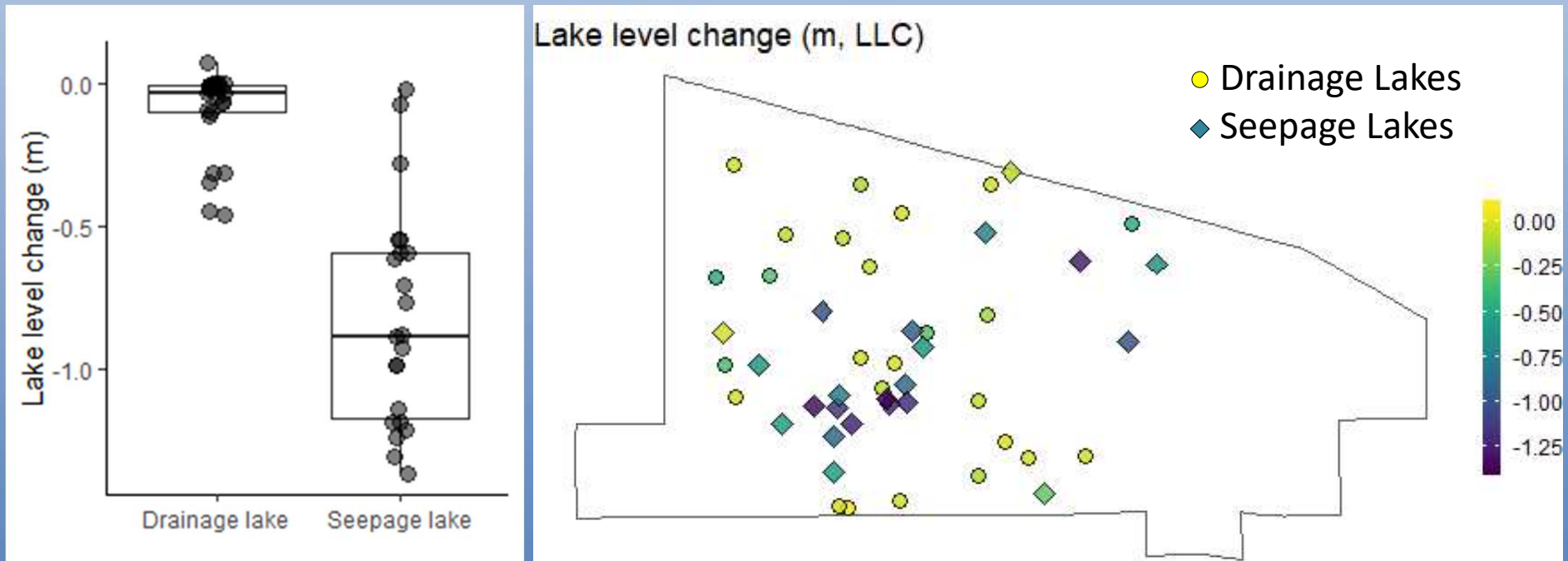


Natural Lake Level Regime

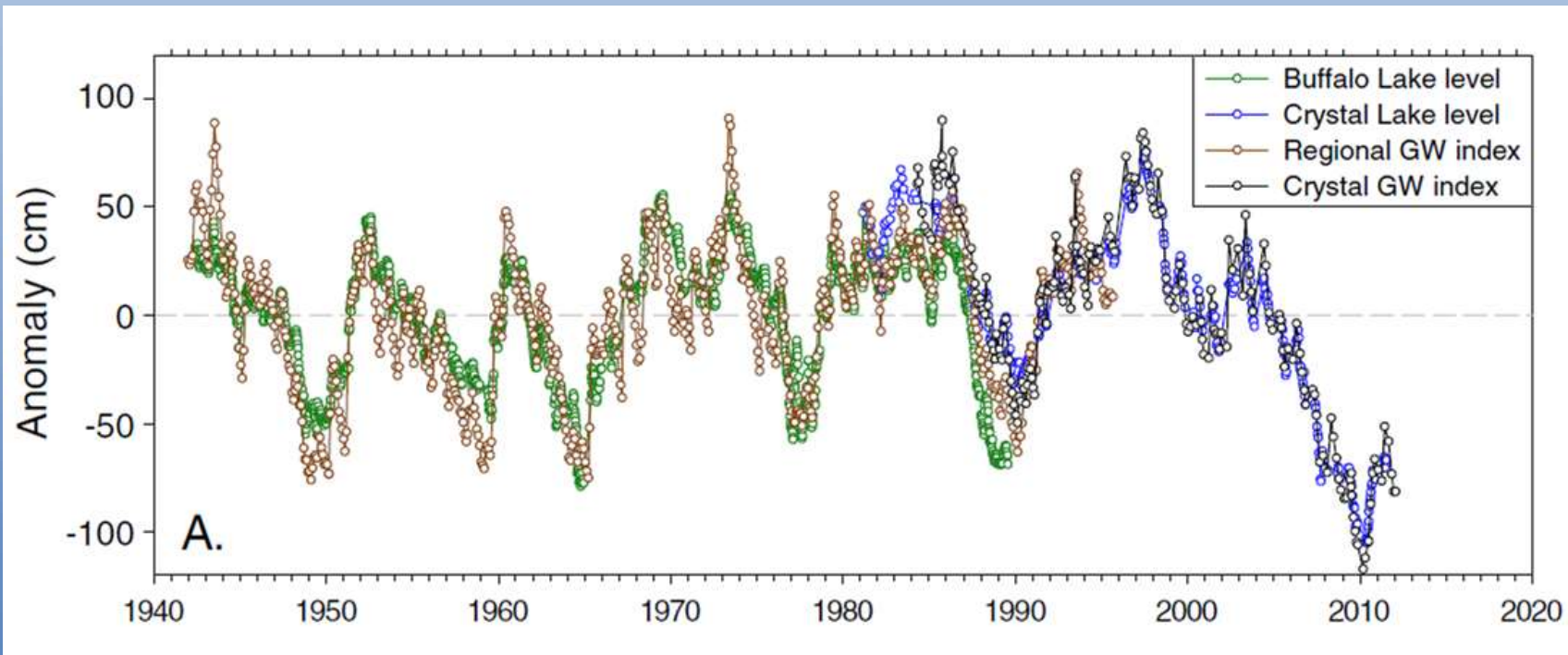


modified from McGrail et al. 1998

More extreme lake level fluctuations in seepage lakes than drainage lakes

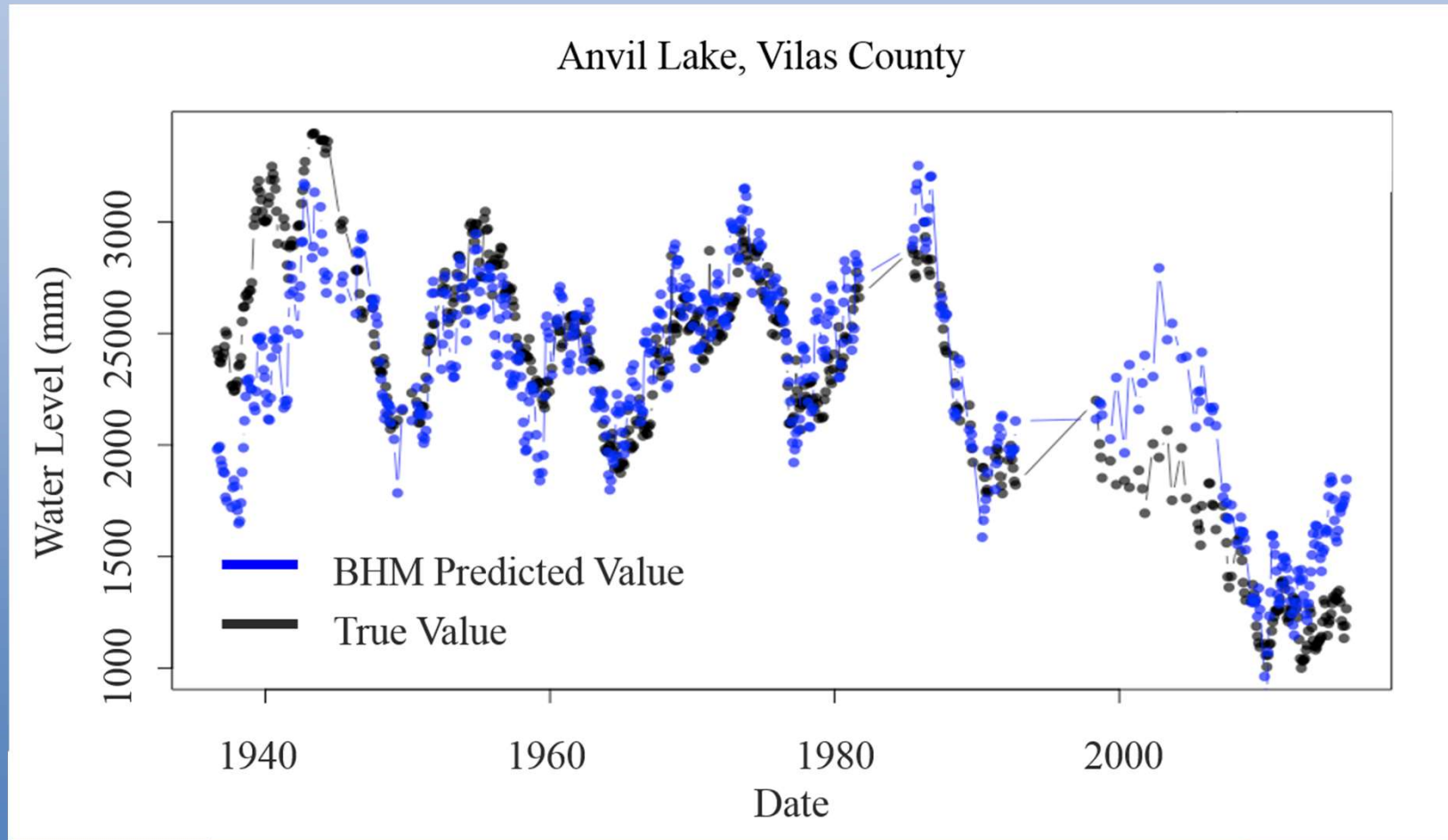


Lake and Groundwater Levels in Northern Wisconsin Cycle Every 11 – 13 Years



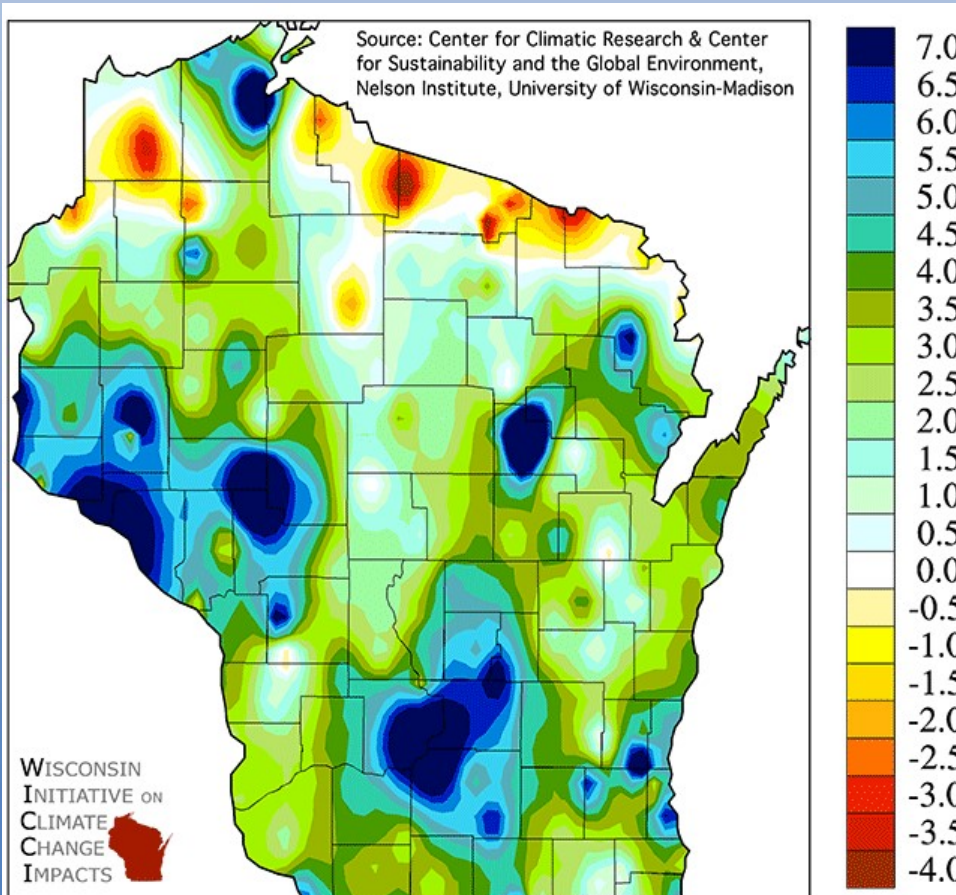
GW = groundwater monitoring wells

8-Year Cumulative Deviation in Precipitation Predicts Lake Levels

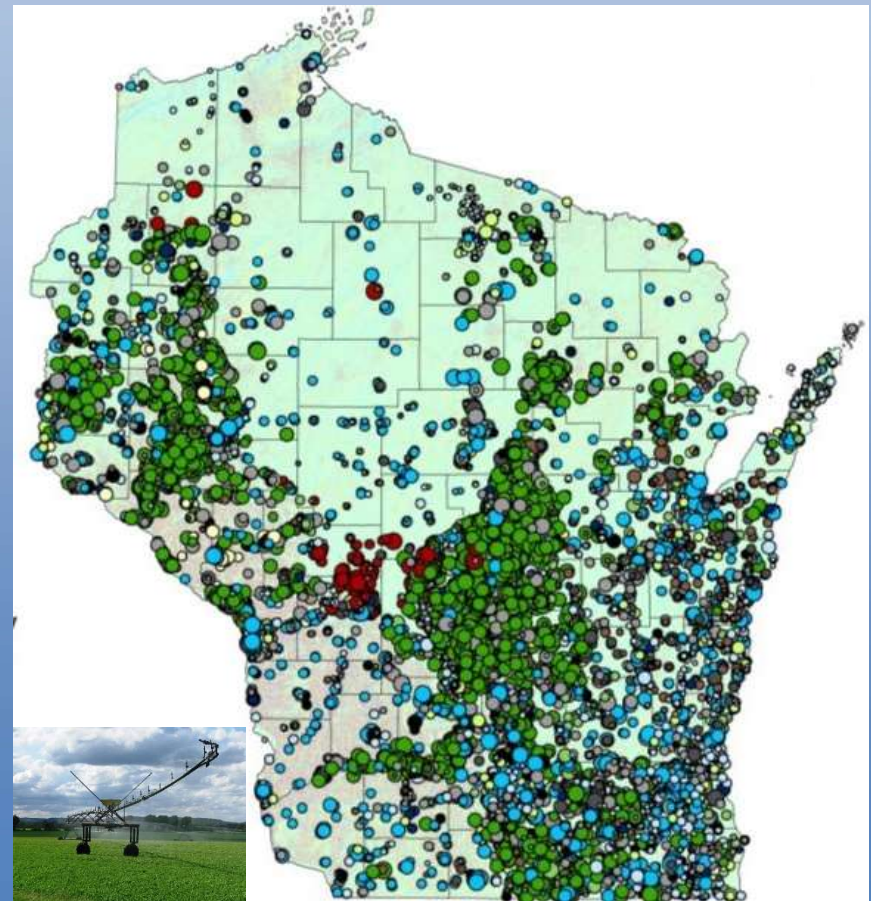


Climate Change & Water Use

Change in annual average precipitation (inches)



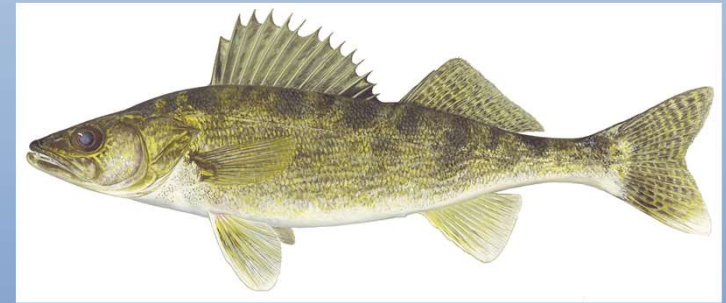
High Capacity Wells 2013



Ecosystem Effects of Lake Level Fluctuations

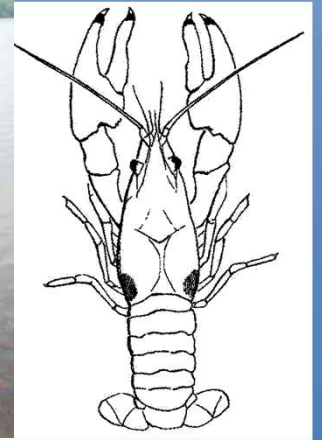
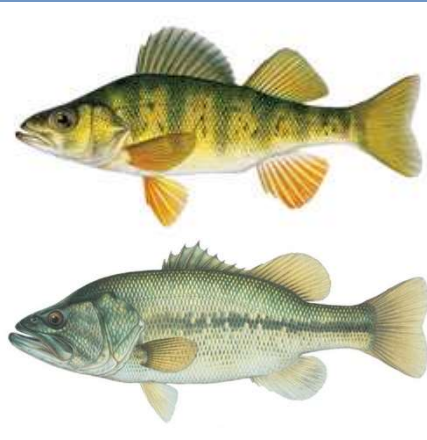
Water Clarity

Mercury Bioaccumulation



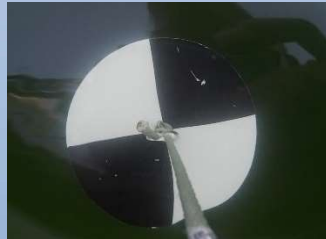
Woody Habitat & Fisheries

Cobble & Rusty Crayfish



Influence of drought on water clarity

More Clear



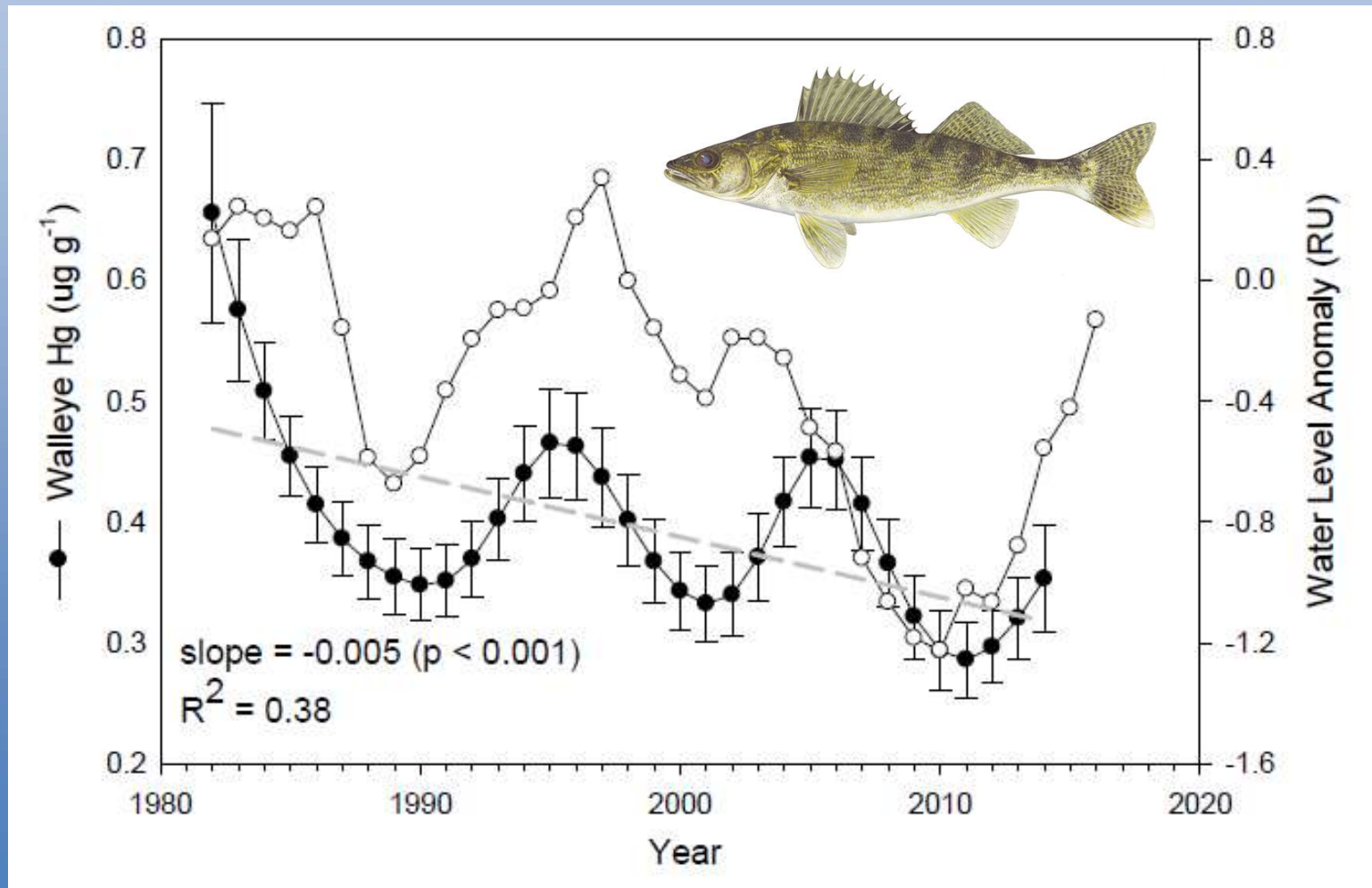
- Dimictic, Oligotrophic lake
- Reduced phosphorus loads
- Reduced shoreline erosion
- Ultraviolet bleaching
- Ex. Silver Lake

Less Clear

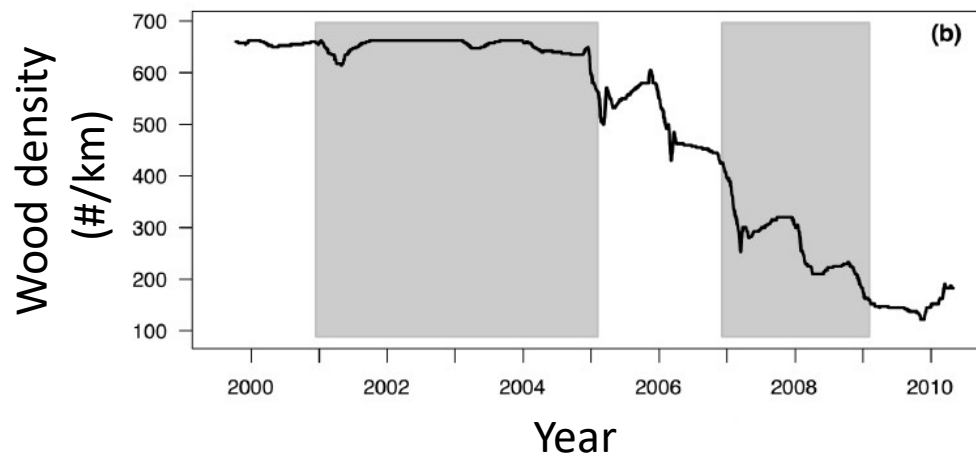
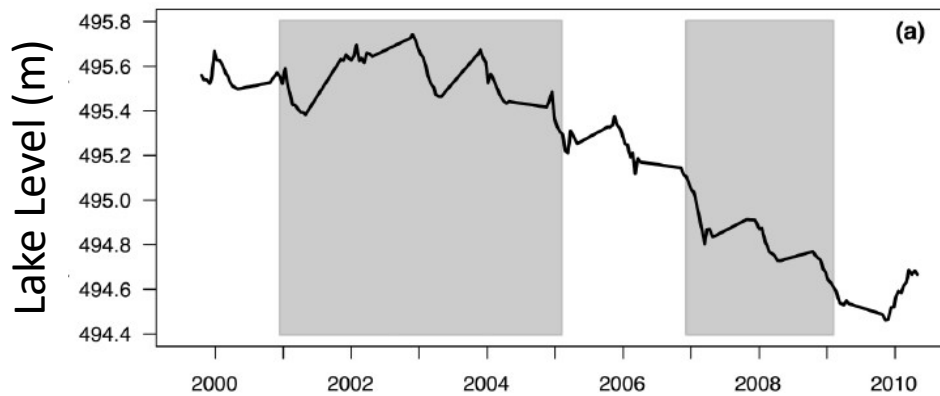


- Polymictic, eutrophic lakes
- Warmer surface water
- Internal nutrient loading
- Concentration of nutrients
- Ex. Shell Lake, Anvil Lake

Higher mercury concentrations in walleye in high water years



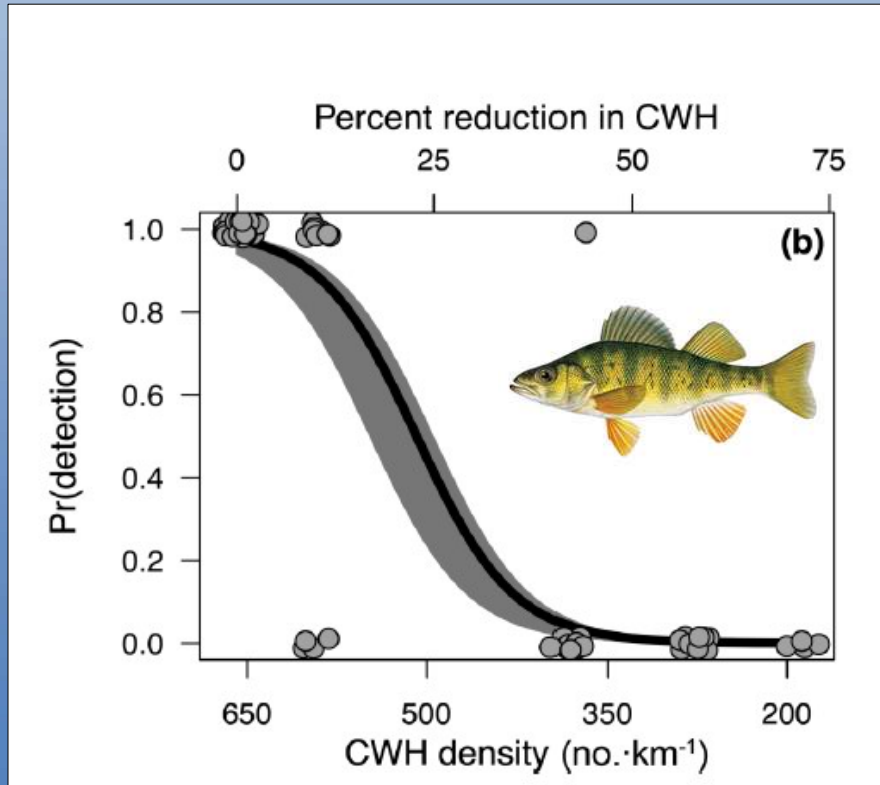
Low lake levels decrease available coarse woody habitat and impact fisheries



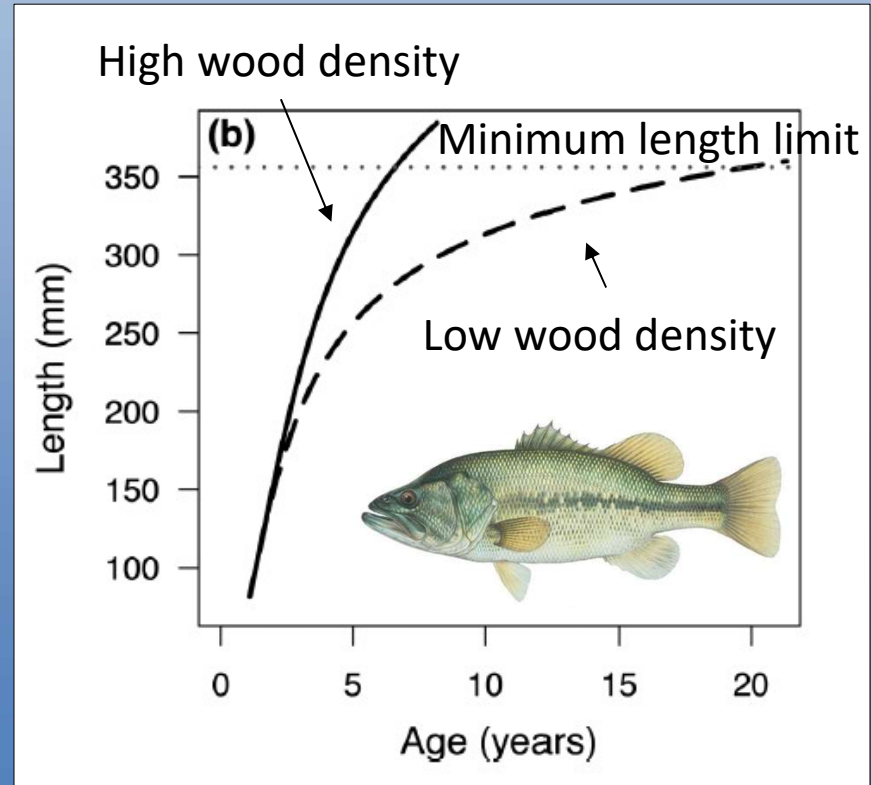
Lake levels in Little Rock Lake declined by >1.1 m and 76% of coarse woody habitat became inaccessible to fish.

Reduced perch abundance and largemouth bass growth rates

Yellow Perch Abundance



Largemouth Bass Growth

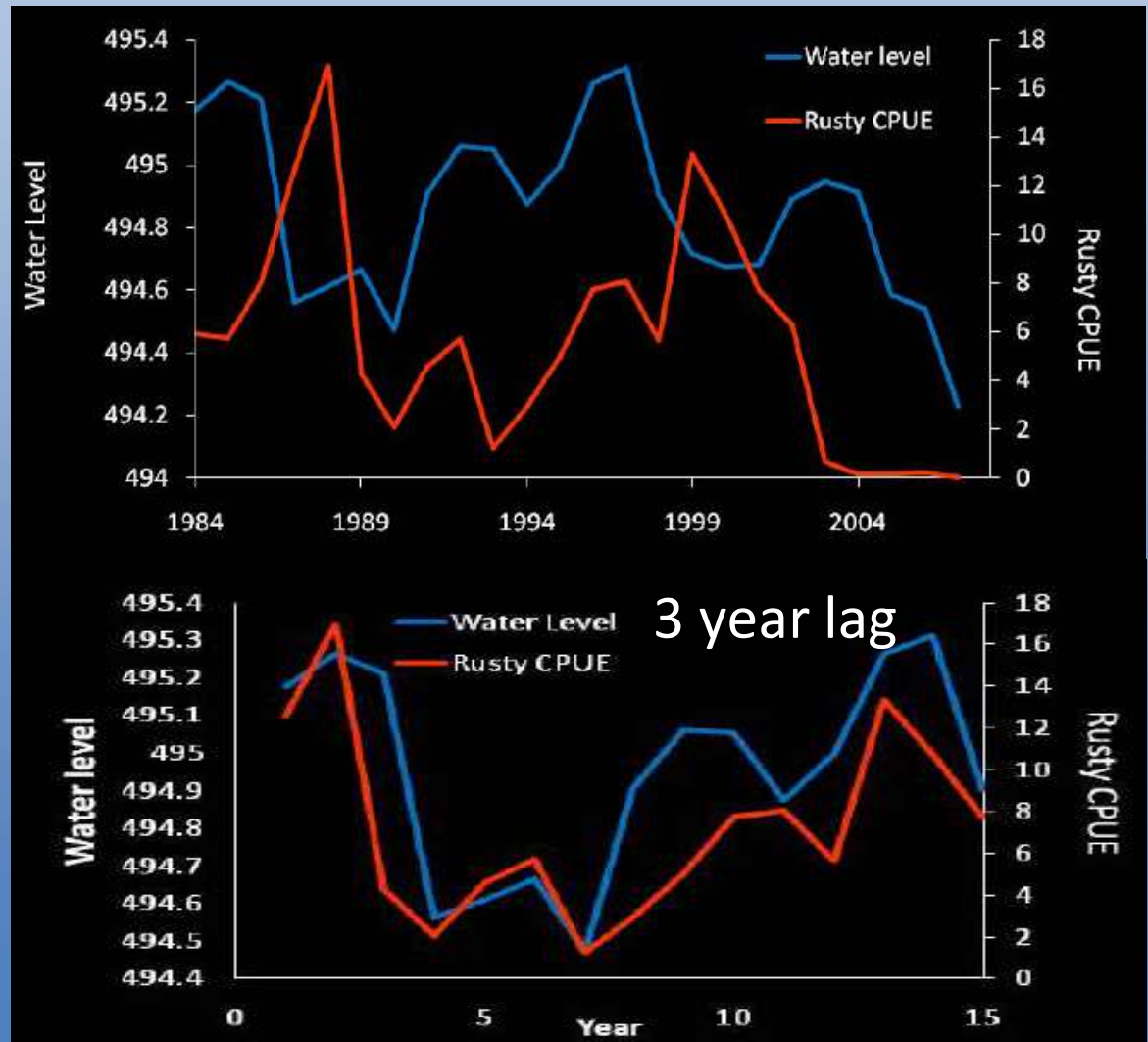


Recruitment of invasive rusty crayfish reduced when cobble exposed

Sparkling Lake, Vilas County



Courtesy of Tim Kratz
UW North Temperate Lakes
Long Term Ecological Research



Lake Ecology & Management

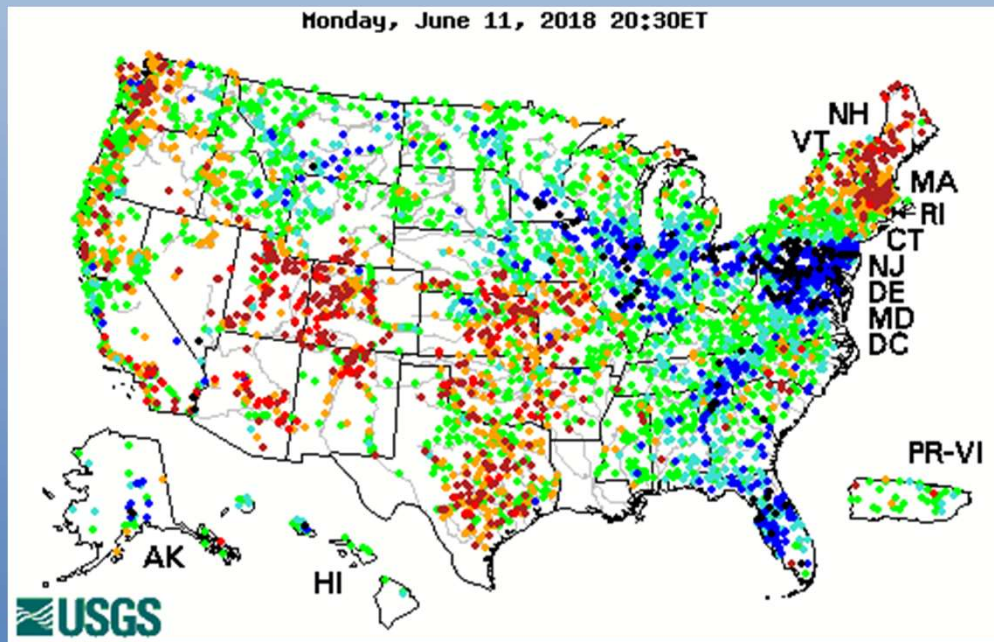
- Recreation
- Navigation
- Water quality
- Habitat
- Biological Community
- Fisheries



Long-term lake level records sparse compared to streams

Lake Staff Gauge

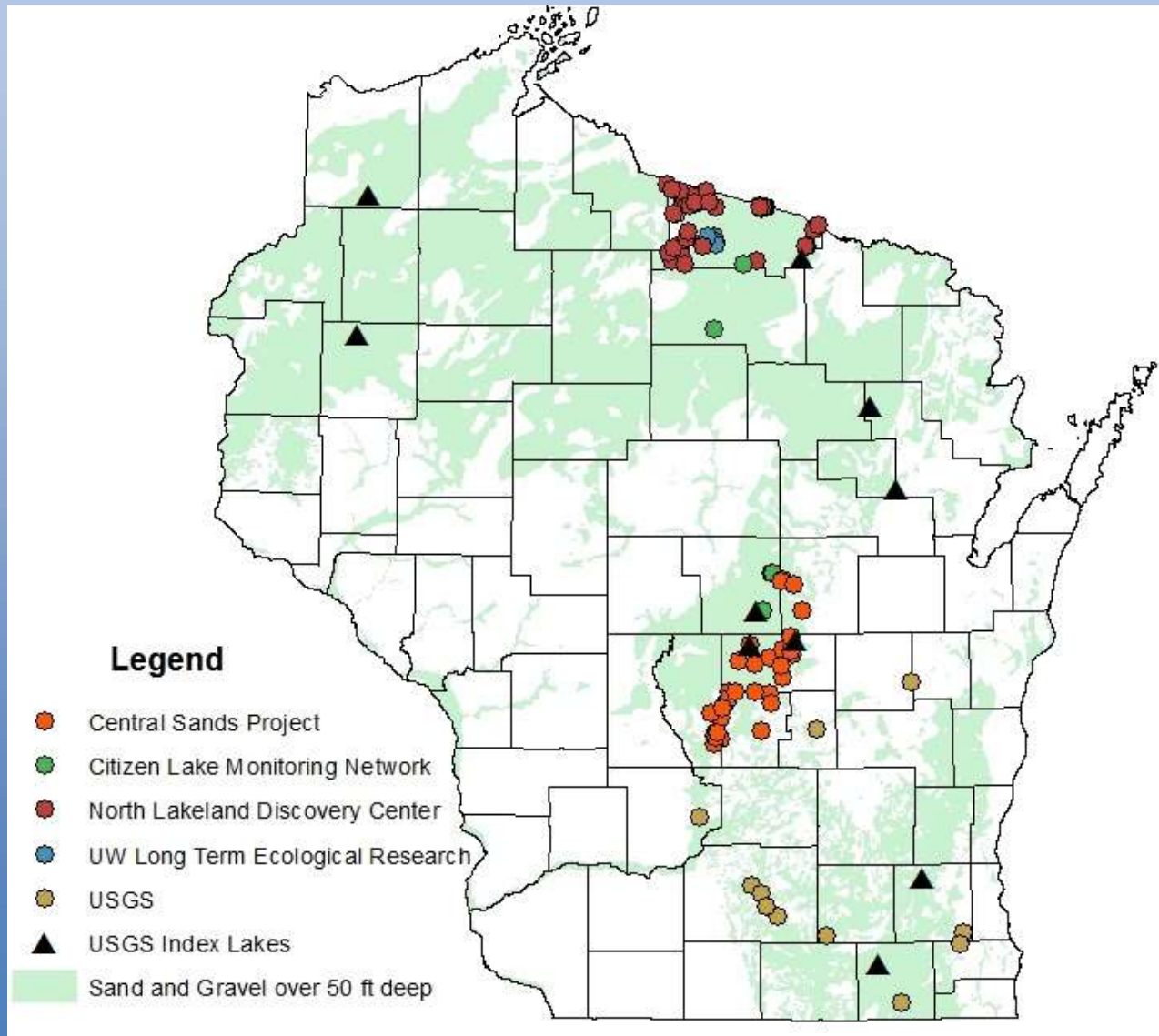
Daily Streamflow Data



Stream Gauging Station



Lake Level Monitoring Prior to 2015 Insufficient



Citizen Scientists to the Rescue!

Water Quality



Water Quantity



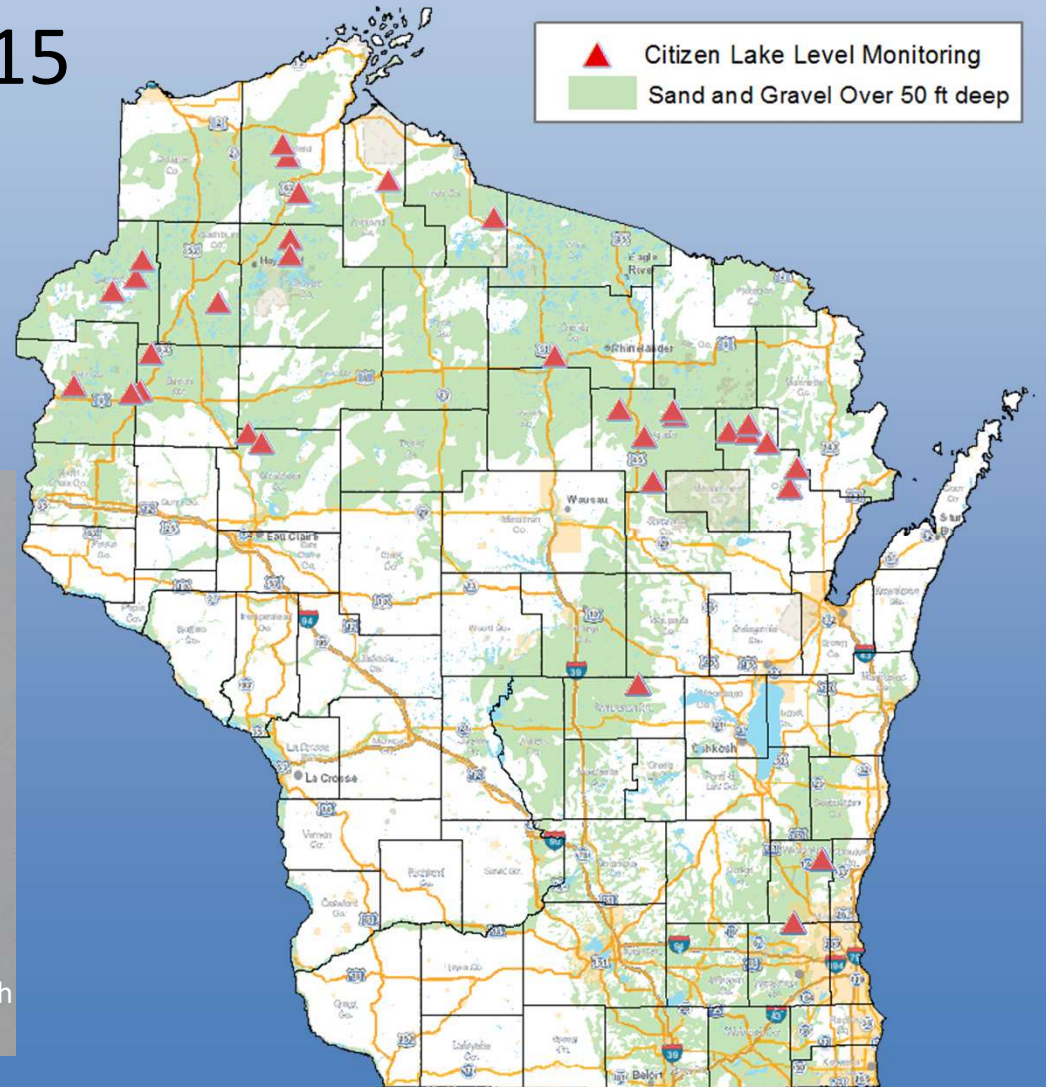
Priorities for Lake Level Monitoring

- Seepage lakes
- Regions without lake level data
- Regions vulnerable to groundwater withdrawal
- Lakes monitored by Citizen Lake Monitoring Network volunteers



Citizen Lake Level Monitoring

- Monitoring since 2015
- 34 lakes
- 14 counties





Volunteers & Coordinators

Volunteer Lake Level Monitoring Protocol Citizen Lake Monitoring Network

Table of Contents

- I. Project Background and Goals
- II. Volunteer Time Commitment.....
- III. Volunteer Duties.....
- IV. Equipment
- V. Safety.....
- VI. Lake Level Monitoring
- VII. Data Management.....
 - Setting up account in SWIMS.....
 - Enter Data in SWIMS.....
 - How to edit lake level monitoring data:
 - View lake level monitoring data
- VIII. Quality Assurance Field Monitoring



Equipment

Data Management

Quality Assurance Checks:

Reference Mark 1: BS1 6.80 FS1 7.37
 GE = CE2 BS2 + 6.86 FS2 + 6.30
 13.66 = 13.67

*Accept Survey Stage 1 if QA checks within 0.01 ft. Use calculated elevations 1 for the r

Lake Level Reading: 1.81 ft

WATER - 8.78



Surveyors

Division of Responsibilities

Surveyors:

- install staff gauge in spring and remove in fall
- submit data

Volunteers:

- read staff gage every week
- submit data

Volunteer coordinators:

- trainings
- communication & support

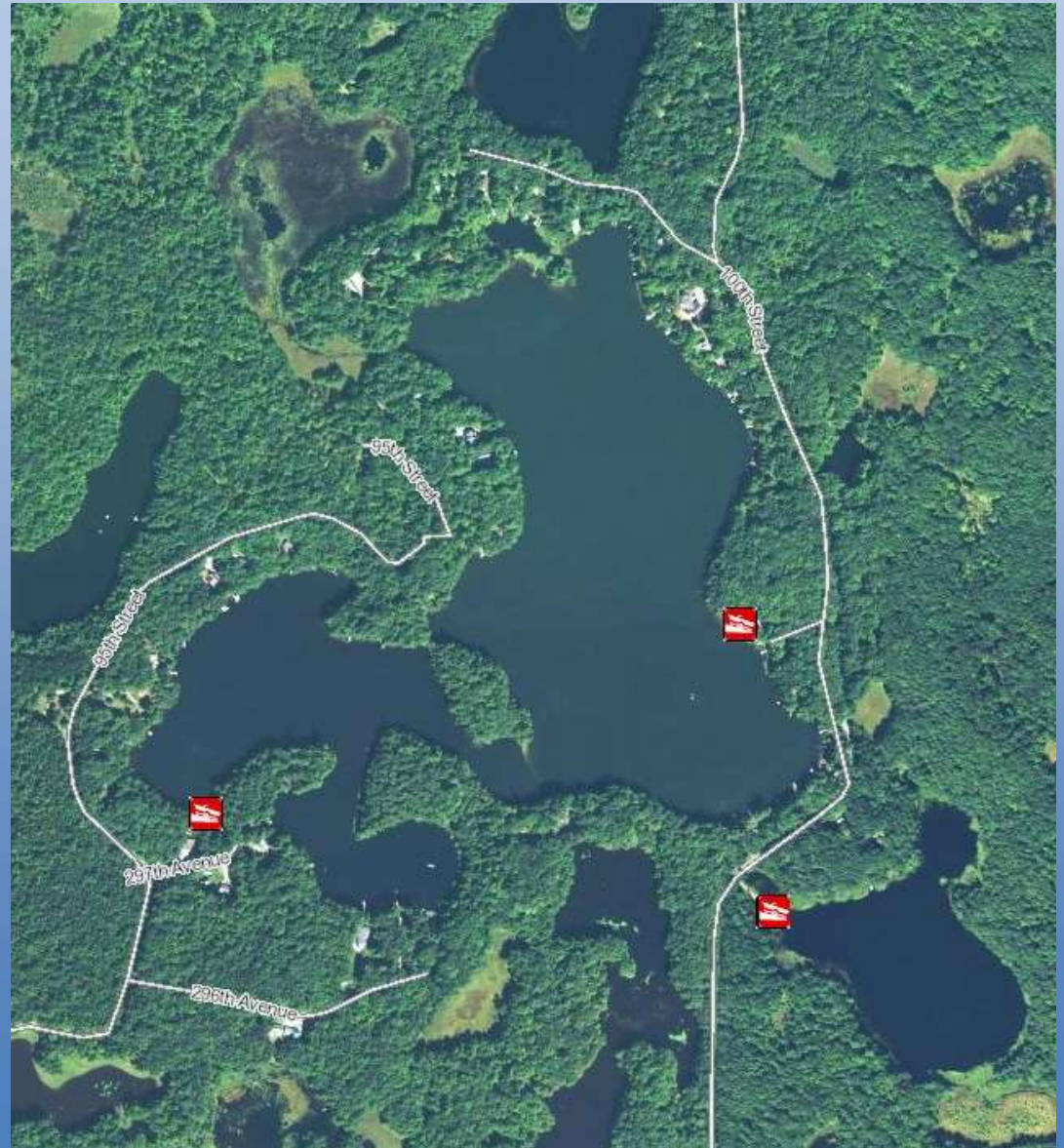
WDNR staff:

- database support
- data analysis



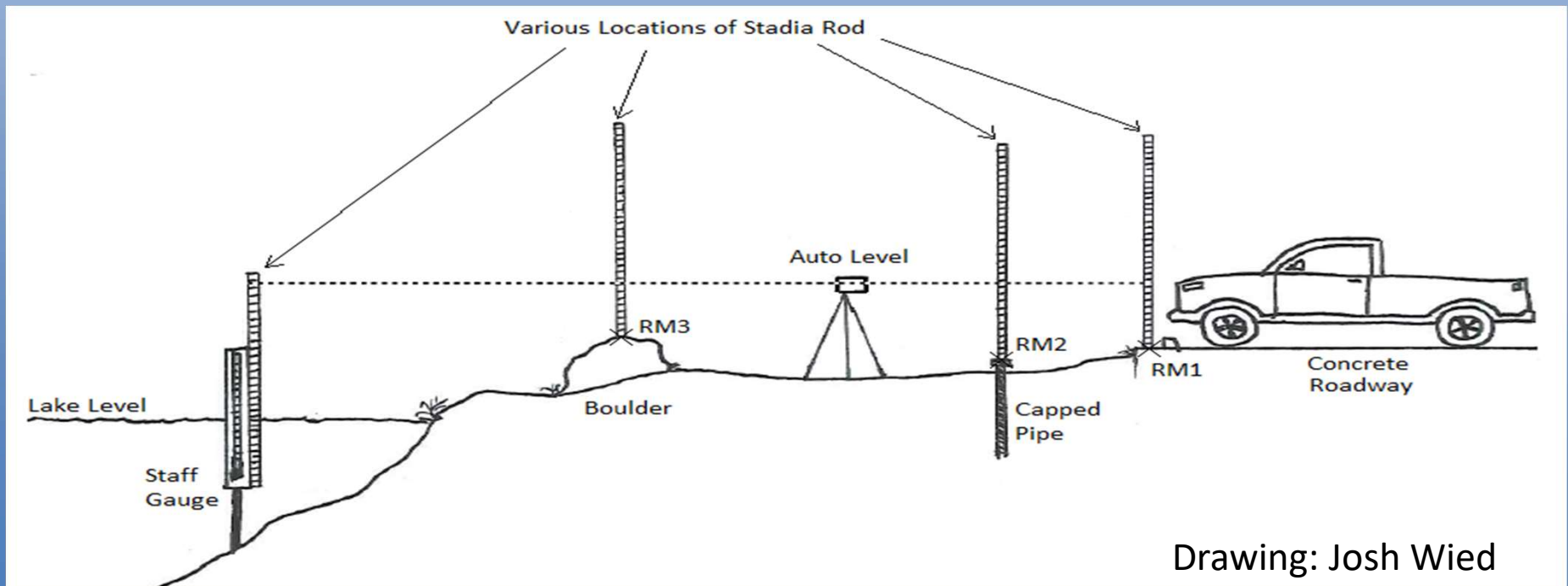
Staff Gauge Location

- Public access
- Existing benchmarks
- Property owner
- Bathymetry
- Boat traffic
- Substrate



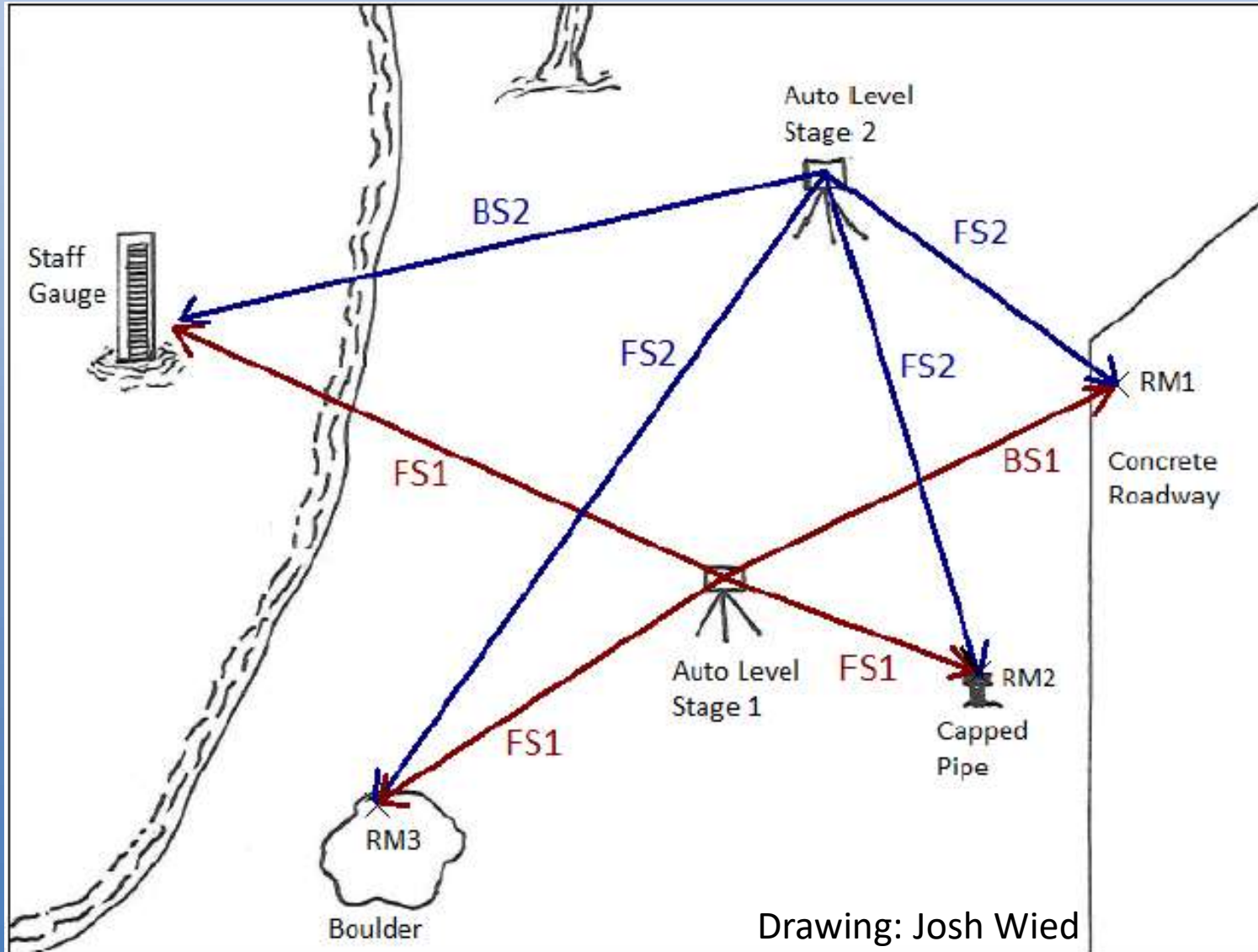
Creating Reference Marks

- Three
- Permanent
- Immobile



Drawing: Josh Wied

Survey the Staff Gauge to Reference Marks on Land



Lake Level Readings



Record date, time, level and details

Date	Time	Water Level Reading	Has the Gauge Moved?	Comments
6/1/2018	9:15 AM/PM	2.06 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Gauge installed yesterday
6/8/2018	8:20 AM/PM	2.00 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Drizzle this morning
6/15/2018	8:45 AM/PM	2.04 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
6/22/2018	9:30 AM/PM	2.10 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
6/29/2018	8:00 AM/PM	2.12 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
7/6/2018	8:10 AM/PM	2.34 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Heavy rain overnight, large change in level
7/13/2018	9:00 AM/PM	2.28 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
7/20/2018	10:10 AM/PM	2.18 ft	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Gauge moved - surveyor contacted
7/27/2018	8:30 AM/PM	2.16 ft	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
8/3/2018	7:45 AM/PM	2.22 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Gauge resurveyed yesterday
8/10/2018	8:00 AM/PM	2.30 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	some rain yesterday afternoon
8/17/2018	7:30 AM/PM	2.26 ft	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	

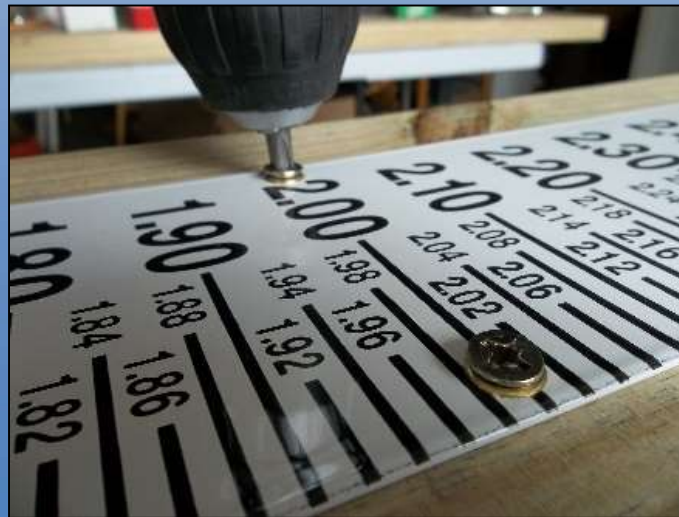
Do-It-Yourself Lake Level Monitoring

Lake volunteer:

- Build staff gauge
- Hire surveyor
- Record and enter data

WDNR:

- Training
- Database support
- Data analysis



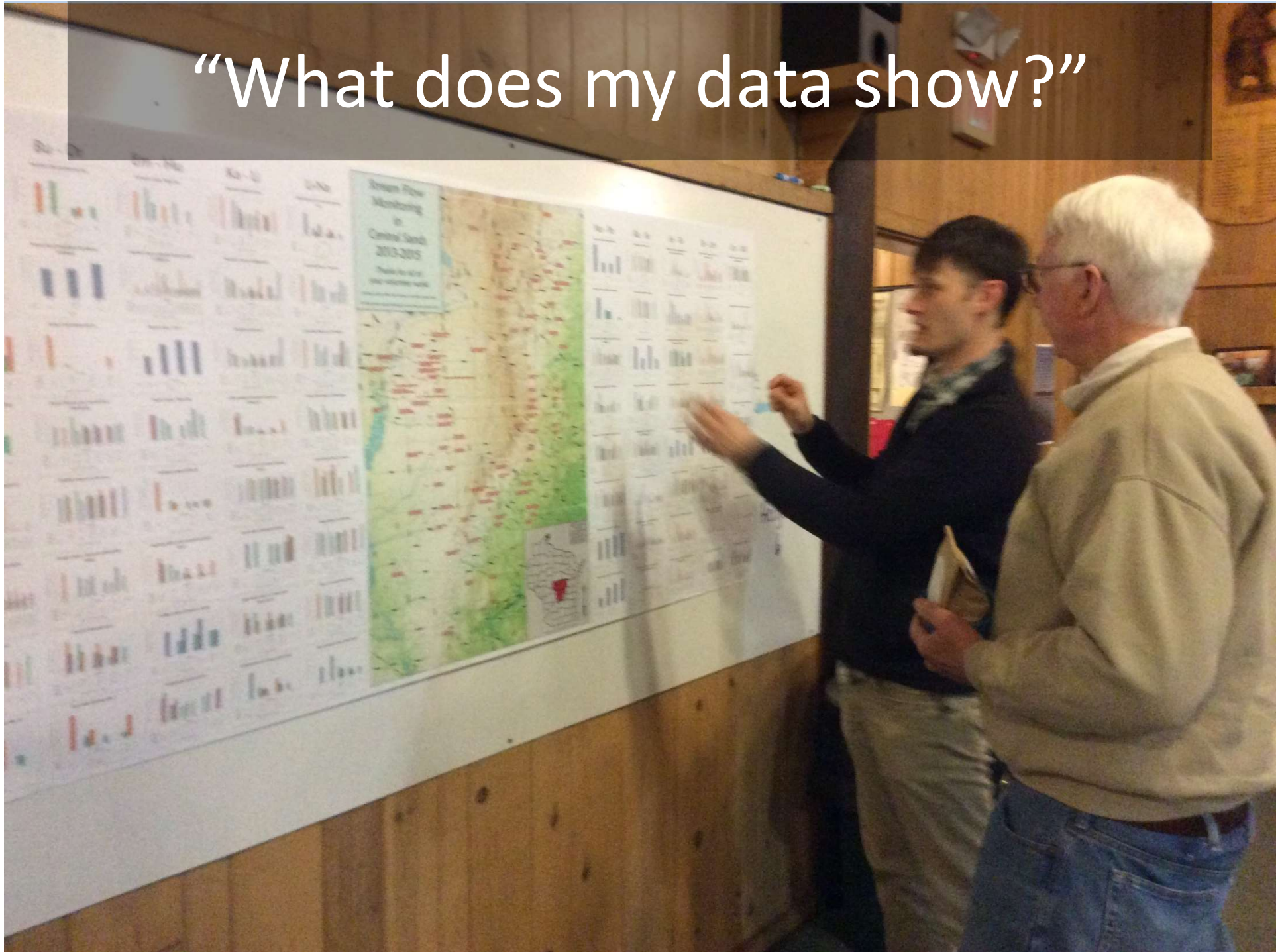
Citizen Volunteers in Central Sands



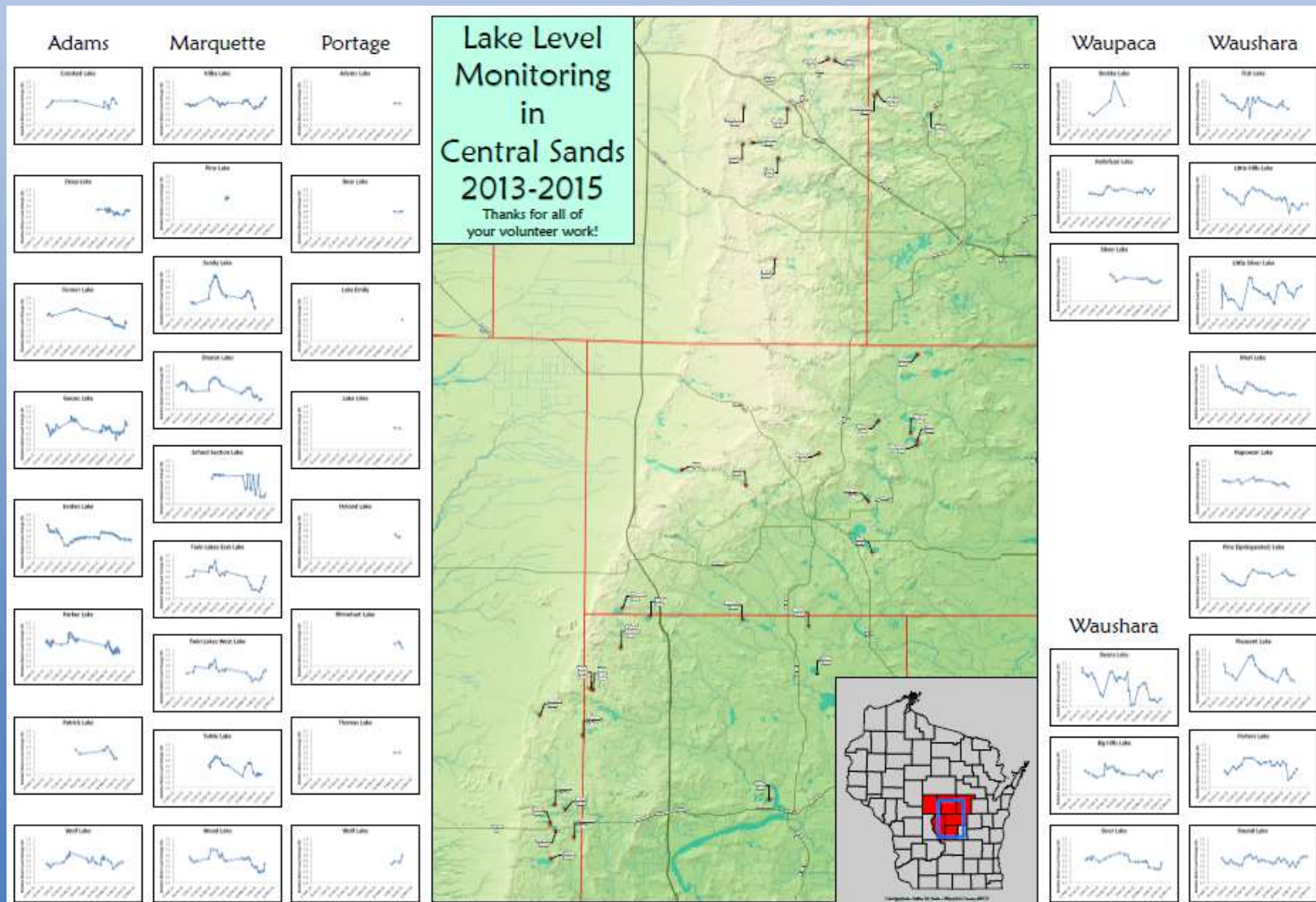
- Monitoring since 2013
- 6 counties
- 80 stream sites
- 40 lakes



“What does my data show?”



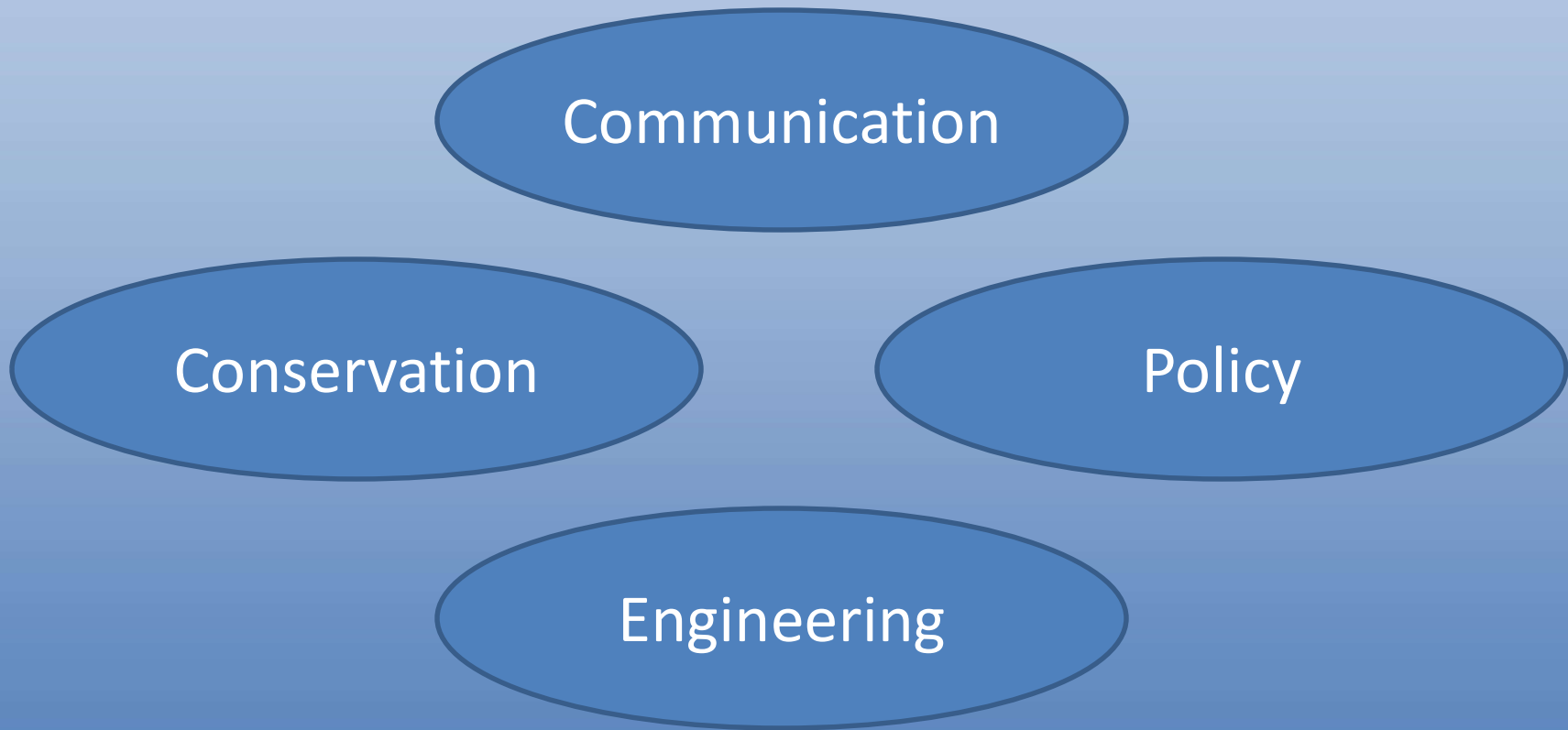
“Please provide materials I can share with others”



“How is my data being used?”



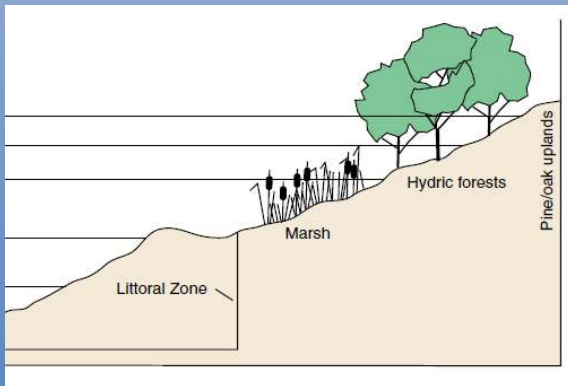
Living with Fluctuating Lake Levels



Living with Fluctuating Lake Levels

Communication

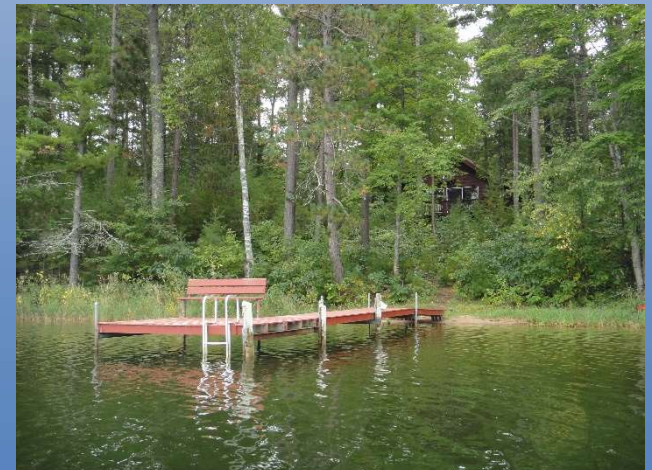
Set Expectations



Monitor Lake Levels



Shift Cultural Norms



Living with Fluctuating Lake Levels

Conservation

Protect riparian habitat

Deep & shallow wood

Water conservation practices



Living with Fluctuating Lake Levels

Zoning regulations

Insurance policies

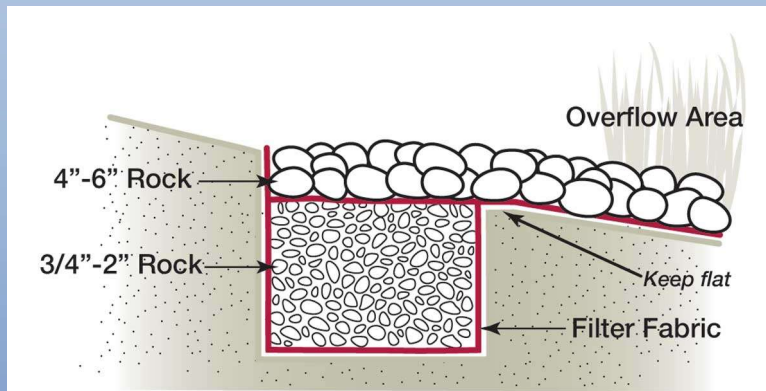
Water use regulations

Water use incentives

Water infiltration incentives



Living with Fluctuating Lake Levels



Water infiltration



Manage lake levels

Floating piers



Engineering

Pump out water



Future for Lake Level Research & Management

Expand Lake Level
Monitoring

Develop Lake Level
Models

Define Natural Lake Level Regime

Impacts:

Physical
Chemical
Biological

Set Management
Targets

Regulatory
policies for
water quantity