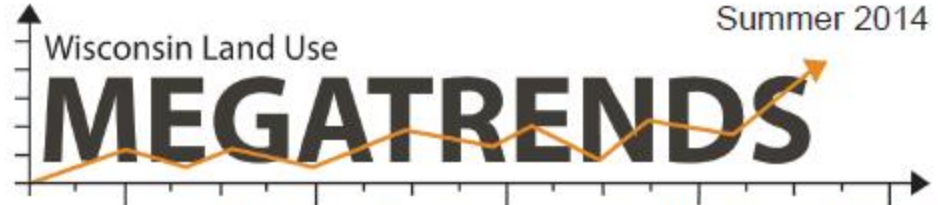
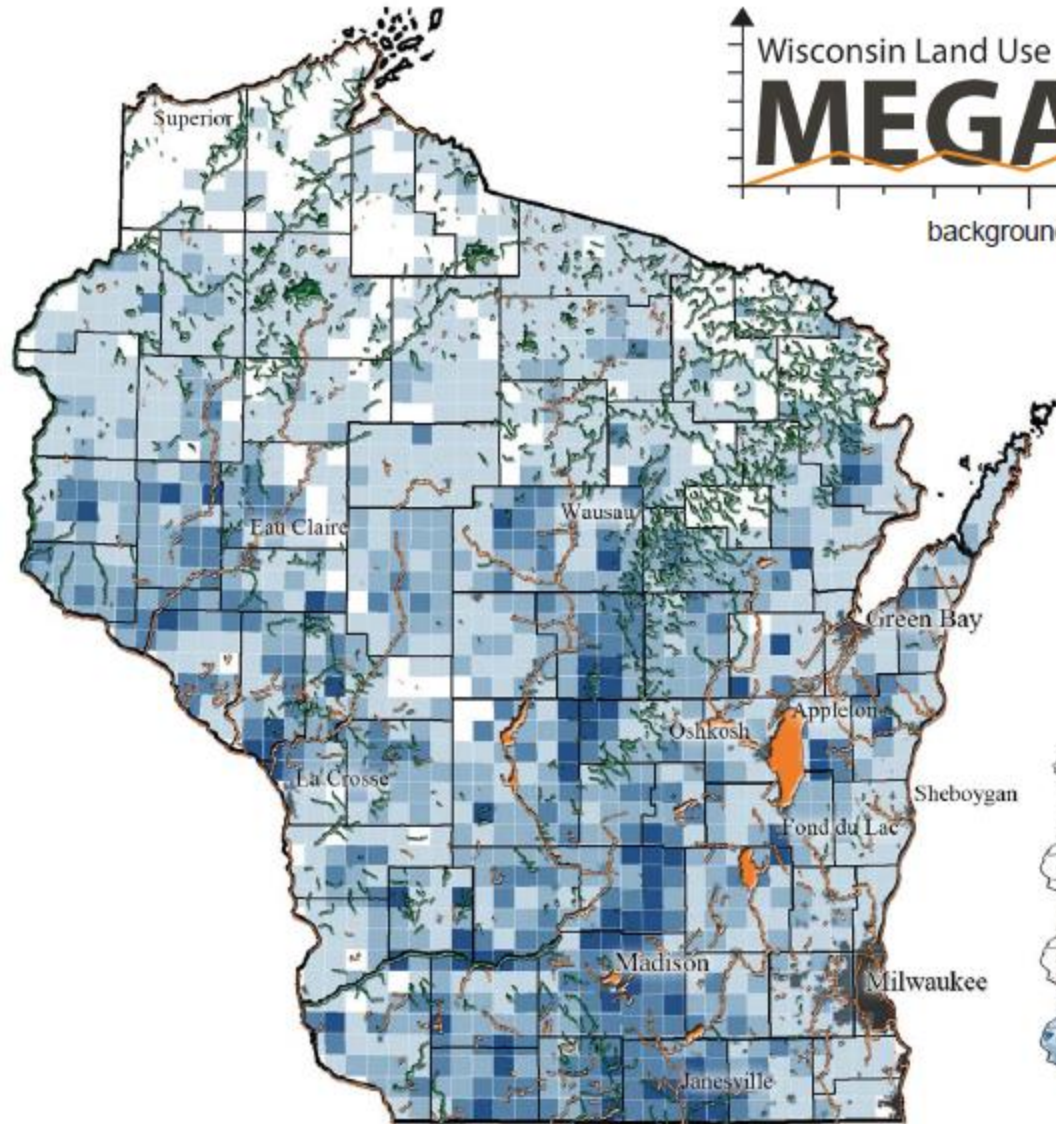


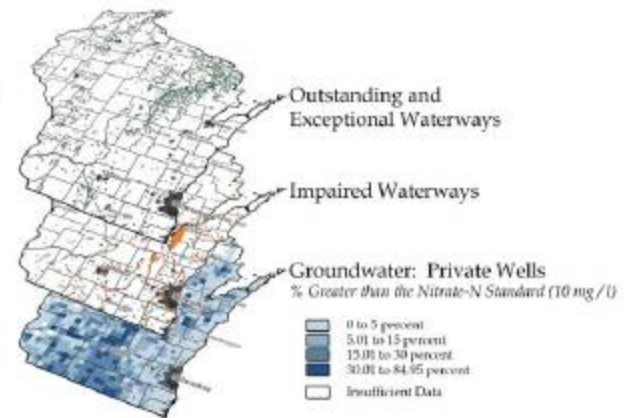
Summer 2014



background, impacts, policy...information you need to know

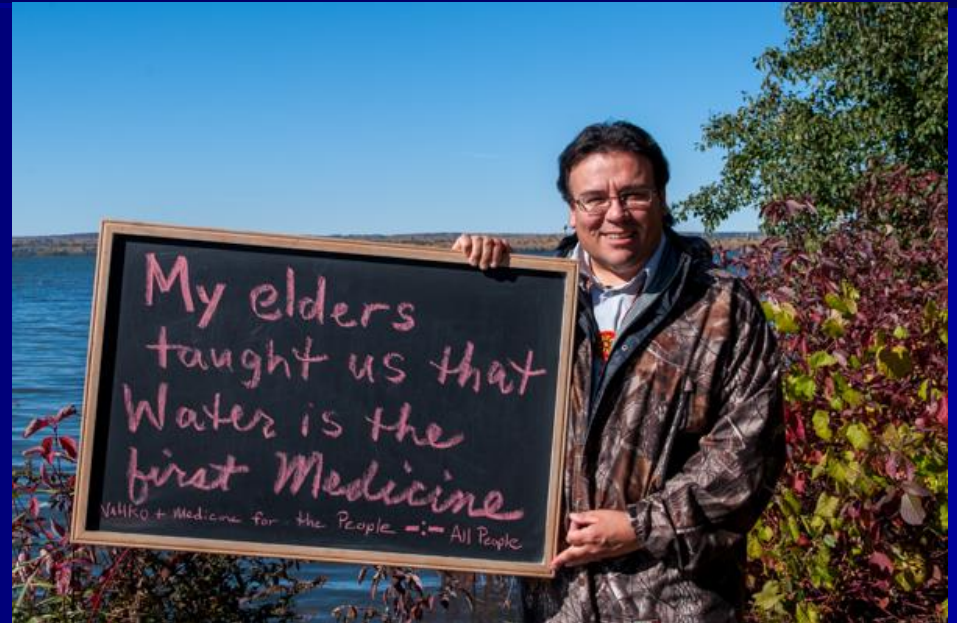


How Healthy Is Your Water?



WATER

How long have we been thinking about water?



"Words for Water" Lake Superior project

Water is Life...and the quality of water determines the quality of life.

Vision statement of the Lake Superior Binational Forum



Your words
for water?



"Words for Water" Lake Superior project

The Public Trust Doctrine

- Wisconsin's waters belong to everyone
- State has obligation to protect public rights in all navigable waters
 - Derived from clause in Northwest Ordinance (1787) and in WI Constitution (1848)
 - Wisconsin's navigable waters are "common highways and forever free" and are held in trust by the Department of Natural Resource
 - **Public rights:** navigation, boating, fishing, swimming, hunting and scenic beauty
 - Rights include protecting spawning grounds, wildlife, and vegetation
 - State shall intervene to protect these public rights



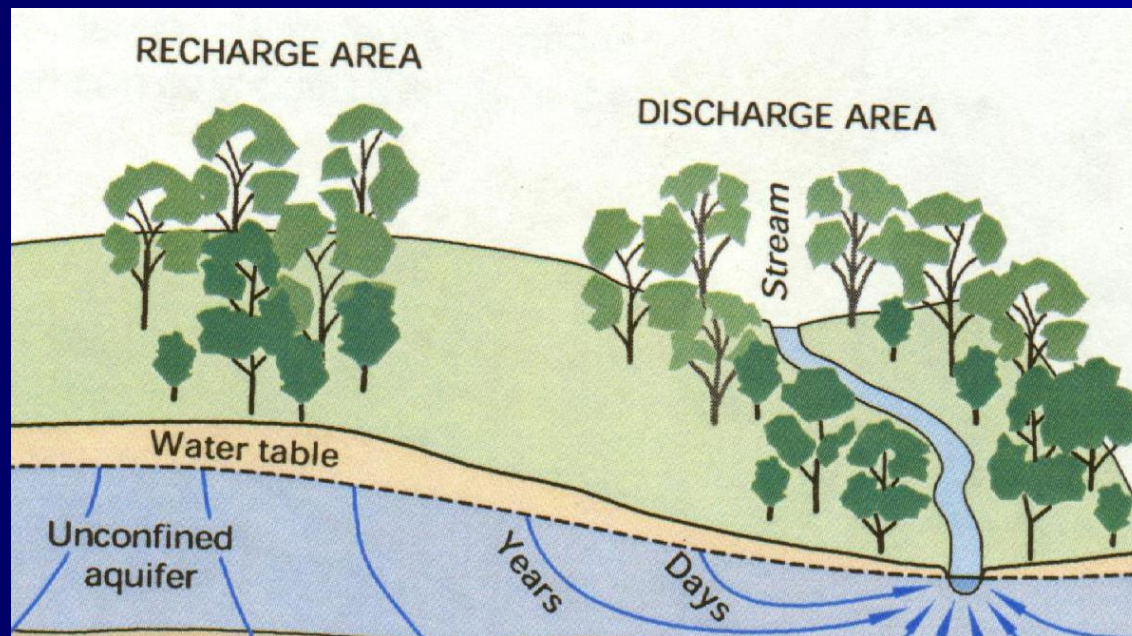
The Public Trust Doctrine

- Riparian owners hold rights in the water adjacent to their property
 - Use of the shoreline
 - Right to access the water
 - Reasonable use of the water
- WI Supreme Court has ruled that when conflicts between riparian rights and public rights exist, the public's rights are primary, and riparian rights are secondary, **again confirming that the waters belong to all of us**
- The purposes of shoreland zoning stems from this doctrine established under Wis. Stats. ss. 281.31, 59.692, 62.231, 61.351
- **"Champions of the Public Trust" videos**



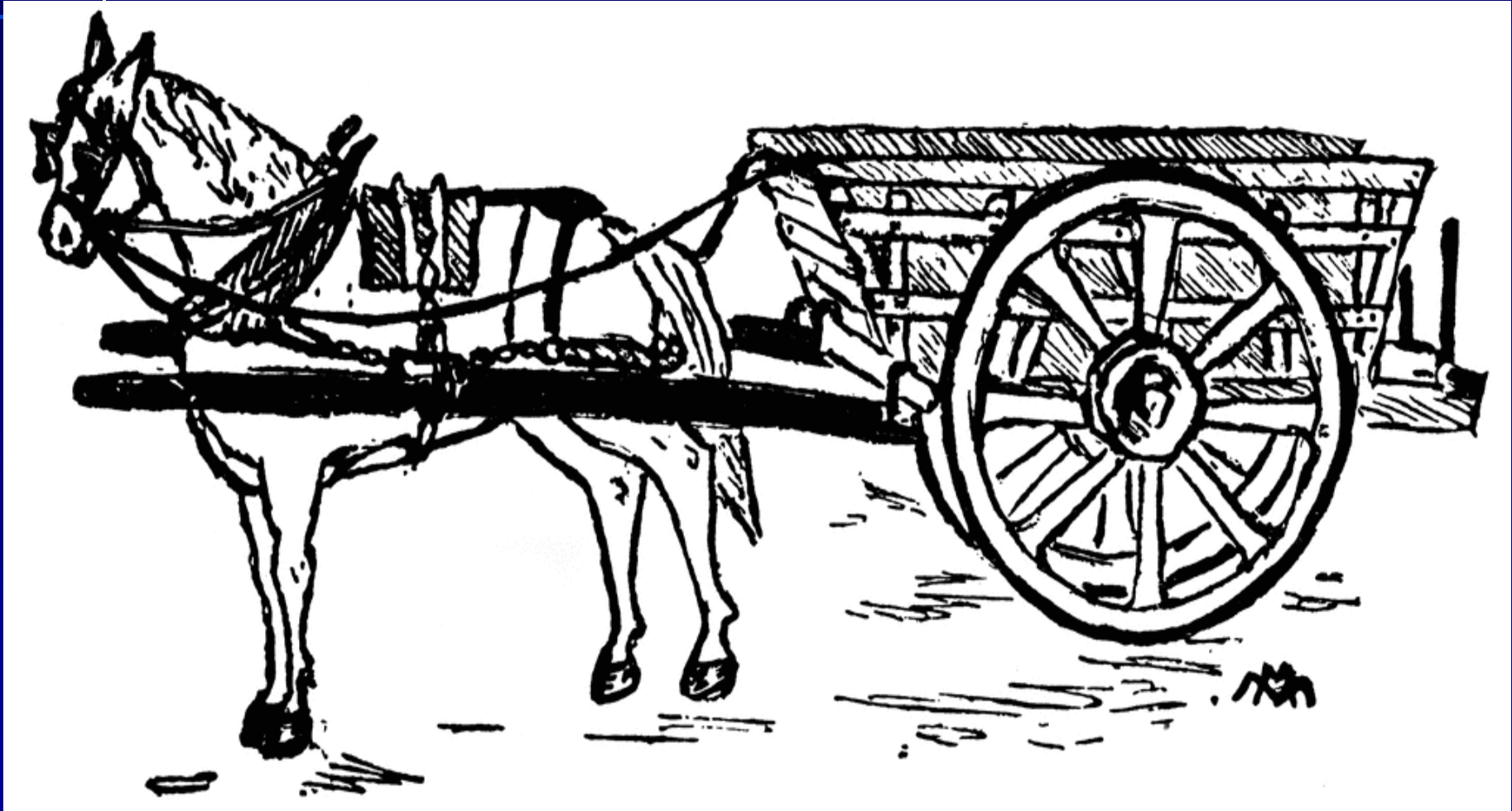
Land, lakes, streams and groundwater are connected

- **Water quantity** and **quality** depends on what happens on the land, especially land closest to the water
- How much water soaks in? How much is pumped out?
- Are chemicals applied to the land?



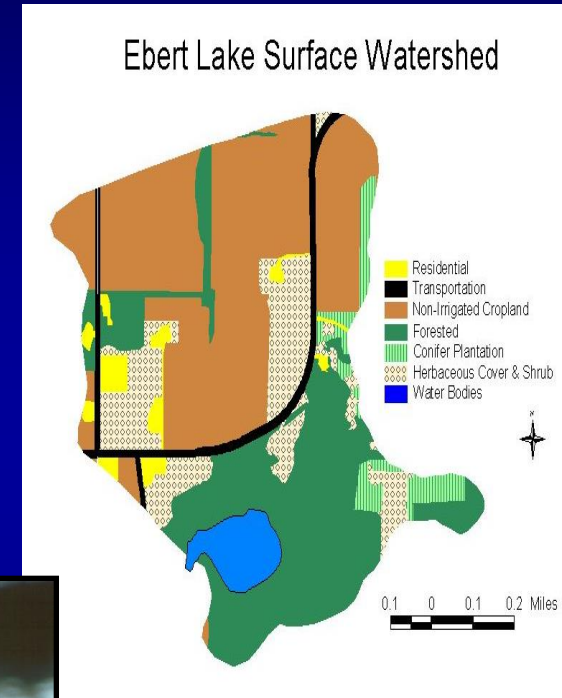
Community planning-goals

Zoning— 1 way to achieve goals



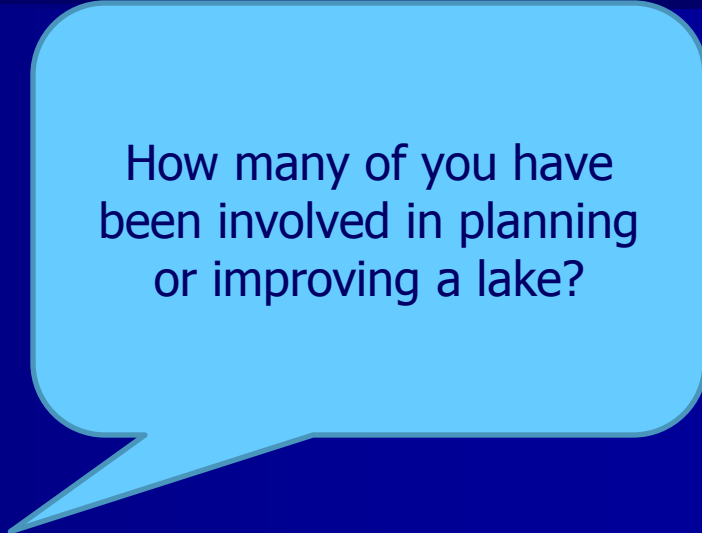
Lake study/plan may include

- Land use in watersheds
- Water quality
- Frogs
- Invasive species
- Fish
- Aquatic plants
- Algae
- Birds
- Shoreland survey



Tools for implementing community/lake plans

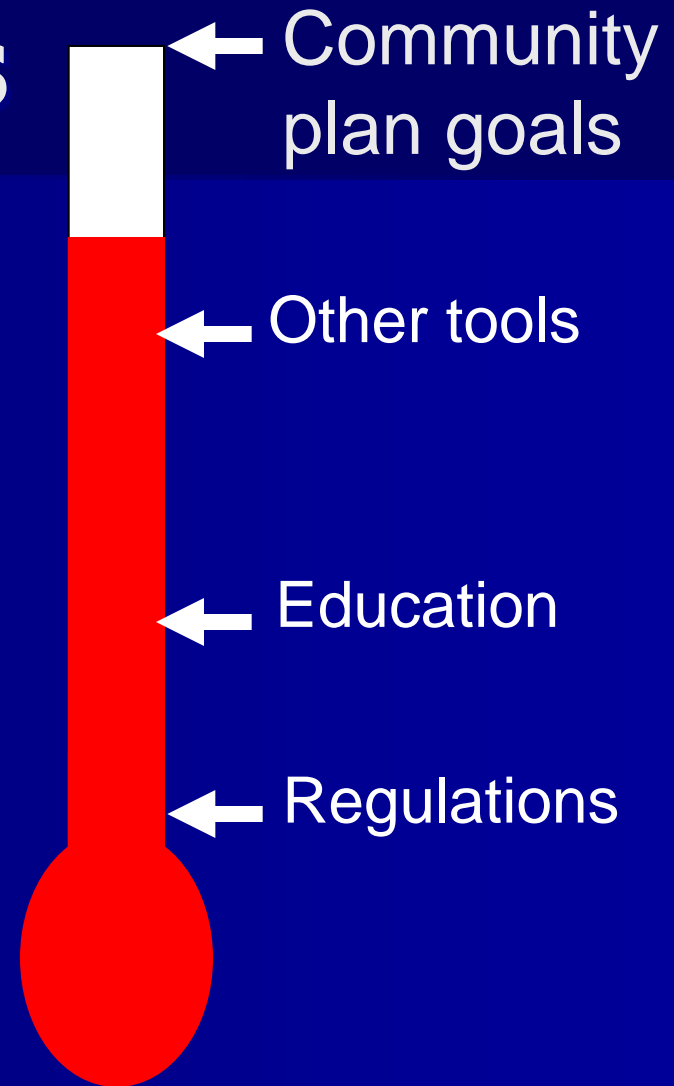
- Zoning
- Subdivision Regulations
- Driveway ordinances
- Education programs
- Incentives
- Land purchases
- Etc. etc. etc.



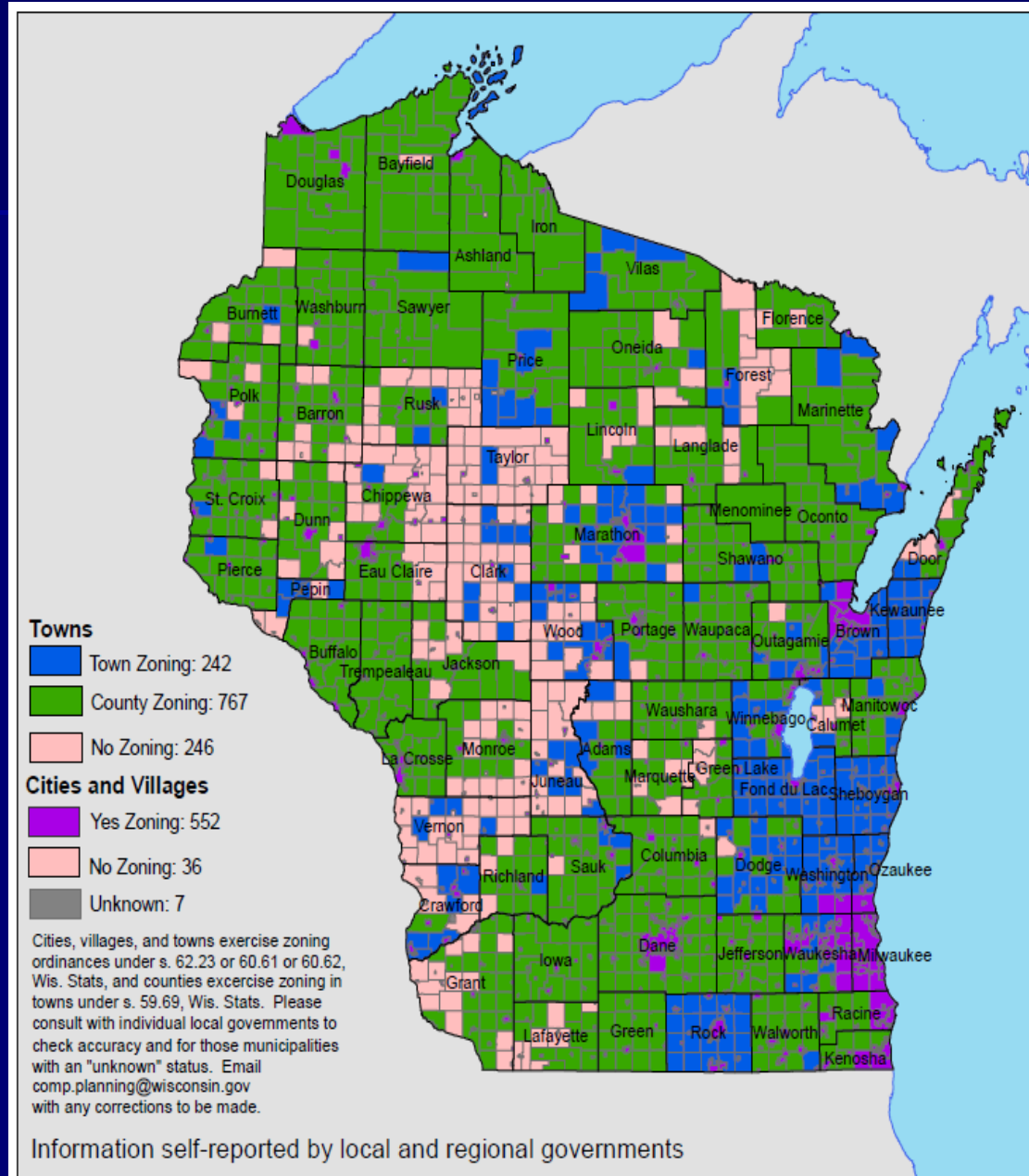
How many of you have been involved in planning or improving a lake?

To achieve goals

More than one tool is often required to achieve optimum performance



Who has general zoning?

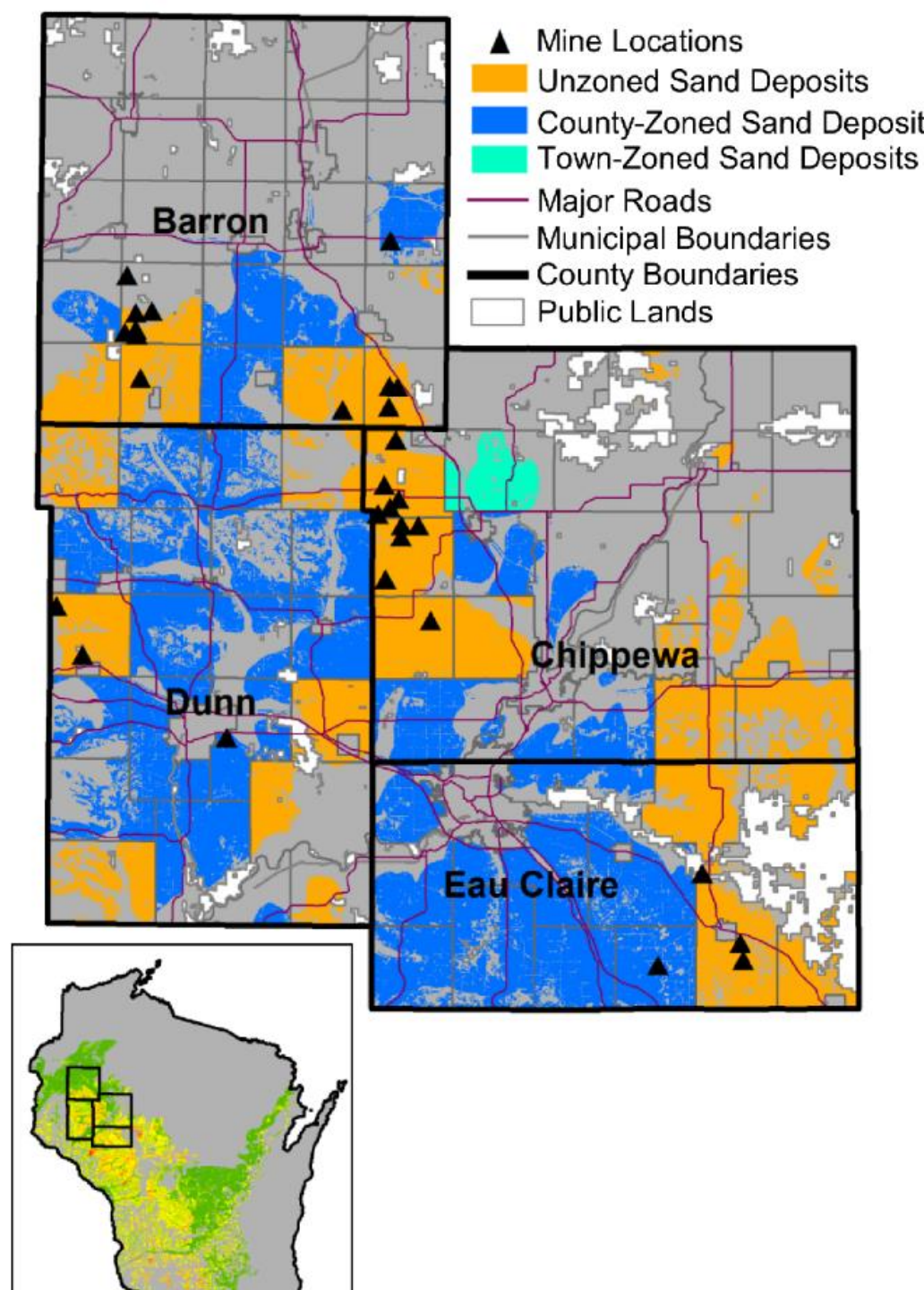


Locally Undesirable Land Uses (LULUs)

Frac Sand Mines are Preferentially Sited in Unzoned Rural Areas

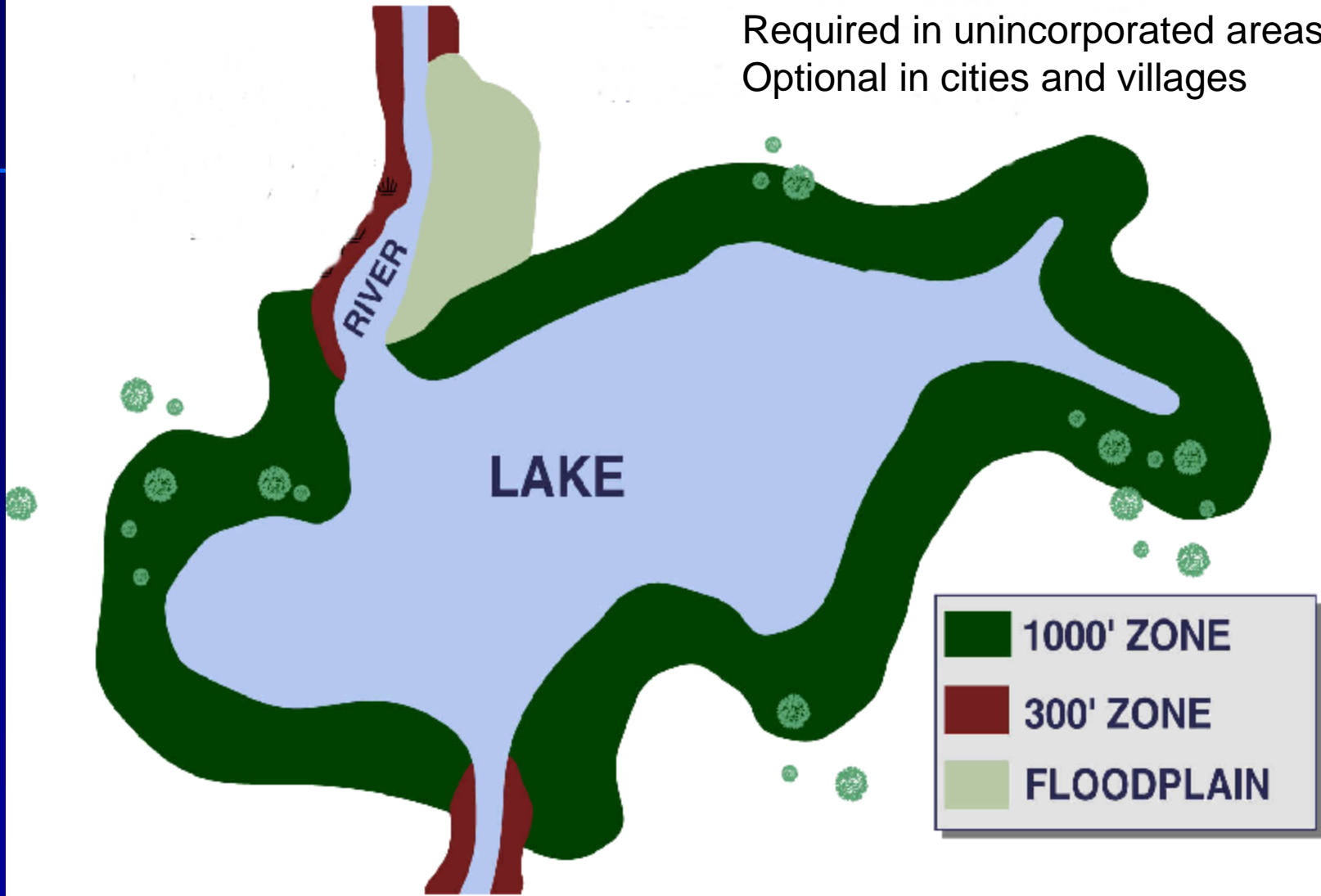
Locke, Accepted at PLOS ONE

- Figure 4. In seven of the nine counties having some unzoned land and at least three frac sand mines, mines were more concentrated in unzoned areas than would be expected due to geological suitability and transportation proximity alone.
- The predicted mine count in unzoned townships (statewide) was over two times higher than that in zoned townships.



Shoreland zoning applies near lakes & rivers

Required in unincorporated areas
Optional in cities and villages



Shoreland Zoning

- In June 1966, the Wisconsin Legislature passed Water Resources Act
 - Included provisions for a statewide shoreland zoning program for all unincorporated areas
- Effective shoreland ordinance administration requires a **working partnership** between WI DNR & local governments
- **Local government** is responsible for administration and enforcement

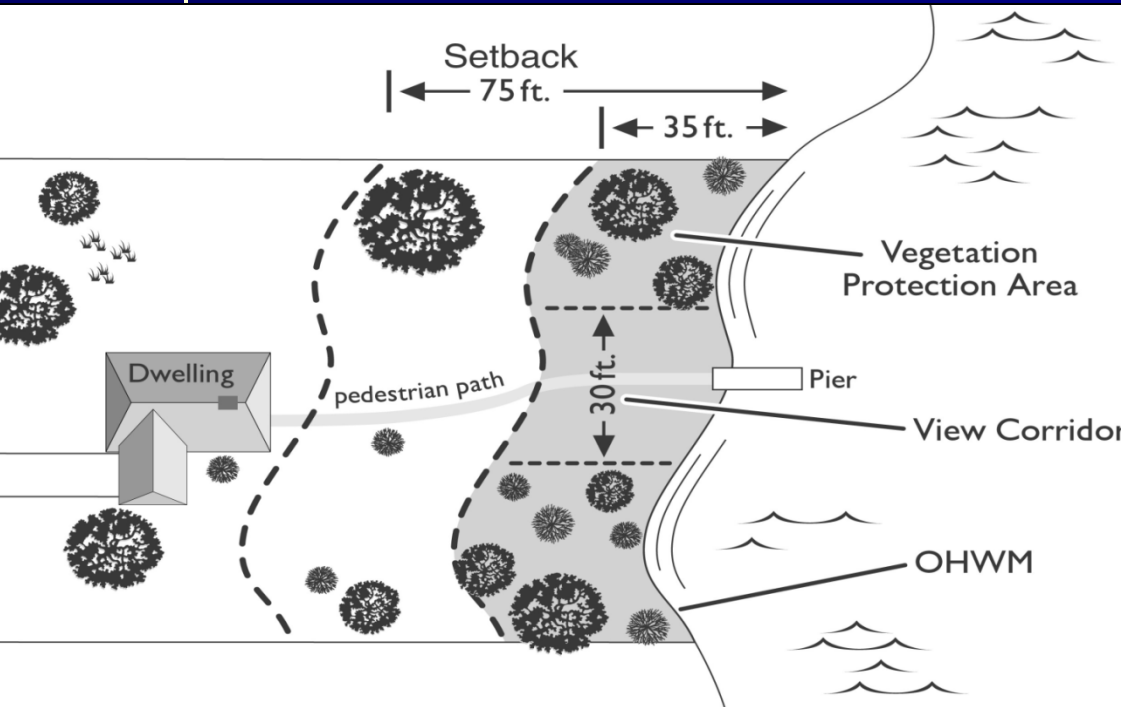
Purposes of shoreland zoning include...

- Prevent and control water pollution
- Protect spawning grounds, fish and aquatic life
- Reserve shore cover and natural beauty



s. 281.31 Wis. Stats.

How do shoreland standards prevent & control water pollution?



1. Curb pollutants at their source such as eroding soils
2. Cut runoff that carries pollutants to the waterway by minimizing impervious surfaces
3. Capture and cleanse pollutant-carrying runoff with shoreland buffers or rain gardens

SHORELAND ZONING is in place to protect our lakes and rivers

- Wisconsin Administrative Code **NR 115** provides mainly minimum standards for shoreland zoning



With shoreland zoning



Without shoreland zoning

What have we learned from science and economics?

In the last 45 years since WI shoreland zoning was
first adopted

Waterfront property values & water quality

Is there a connection?



“More polluted lakes have less valuable property than do cleaner lakes.”

E.L. David, *Water Resources Research*, 1968

Water quality & economics

- A study of over 1200 waterfront properties in Minnesota found when water clarity changed by 3 feet changes in property prices for these lakes are tens of thousands to millions of dollars





Effects of impervious surfaces

(based on the last 20 years of research)

- IS prevent water from soaking into the ground, which is the cool groundwater that enters lakes and streams during dry periods

Pollutants in Runoff



Bacteria

Nutrients that Deplete Oxygen

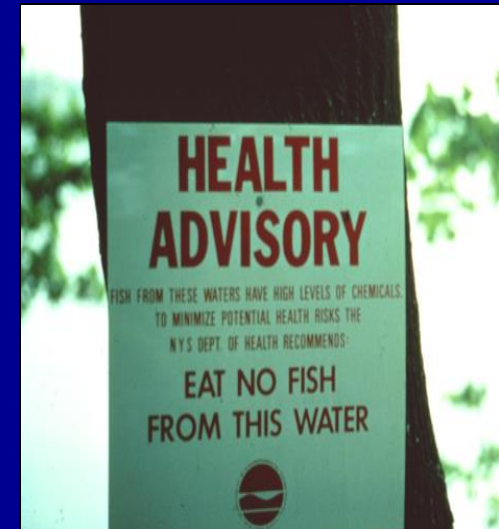
Pesticides

High Temperature

Oil & Grease

Muddy Water

**Heavy Metals
(e.g. Zinc, Copper, Lead)**



More Impervious Surface = Less Fish

Fish found in streams when impervious surface in the watershed was:

Less than 8%

8 - 12%

Greater than 12%

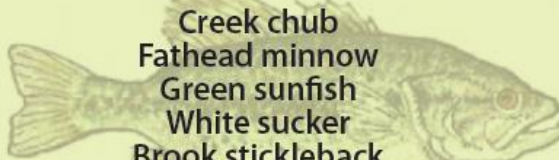
More Impervious Surfaces in Watershed 



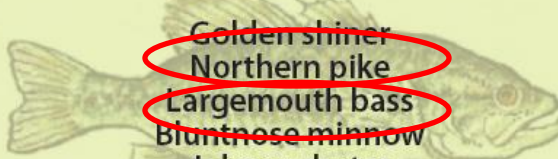
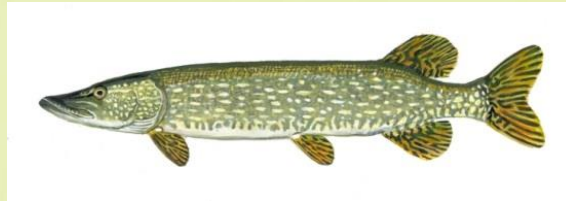
Iowa darter
Black crappie
Channel catfish
Yellow perch
Rock bass
Horneyhead chub
Sand shiner
Southern redbelly dace



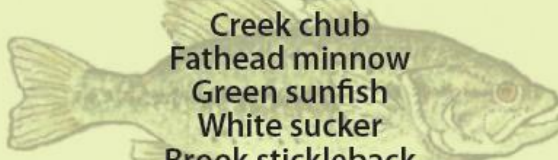
Golden shiner
Northern pike
Largemouth bass
Bluntnose minnow
Johnny darter
Common shiner



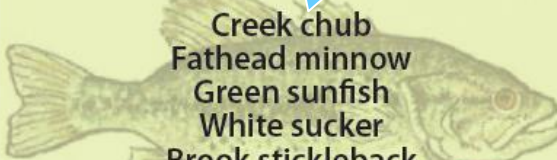
Creek chub
Fathead minnow
Green sunfish
White sucker
Brook stickleback



Golden shiner
Northern pike
Largemouth bass
Bluntnose minnow
Johnny darter
Common shiner



Creek chub
Fathead minnow
Green sunfish
White sucker
Brook stickleback

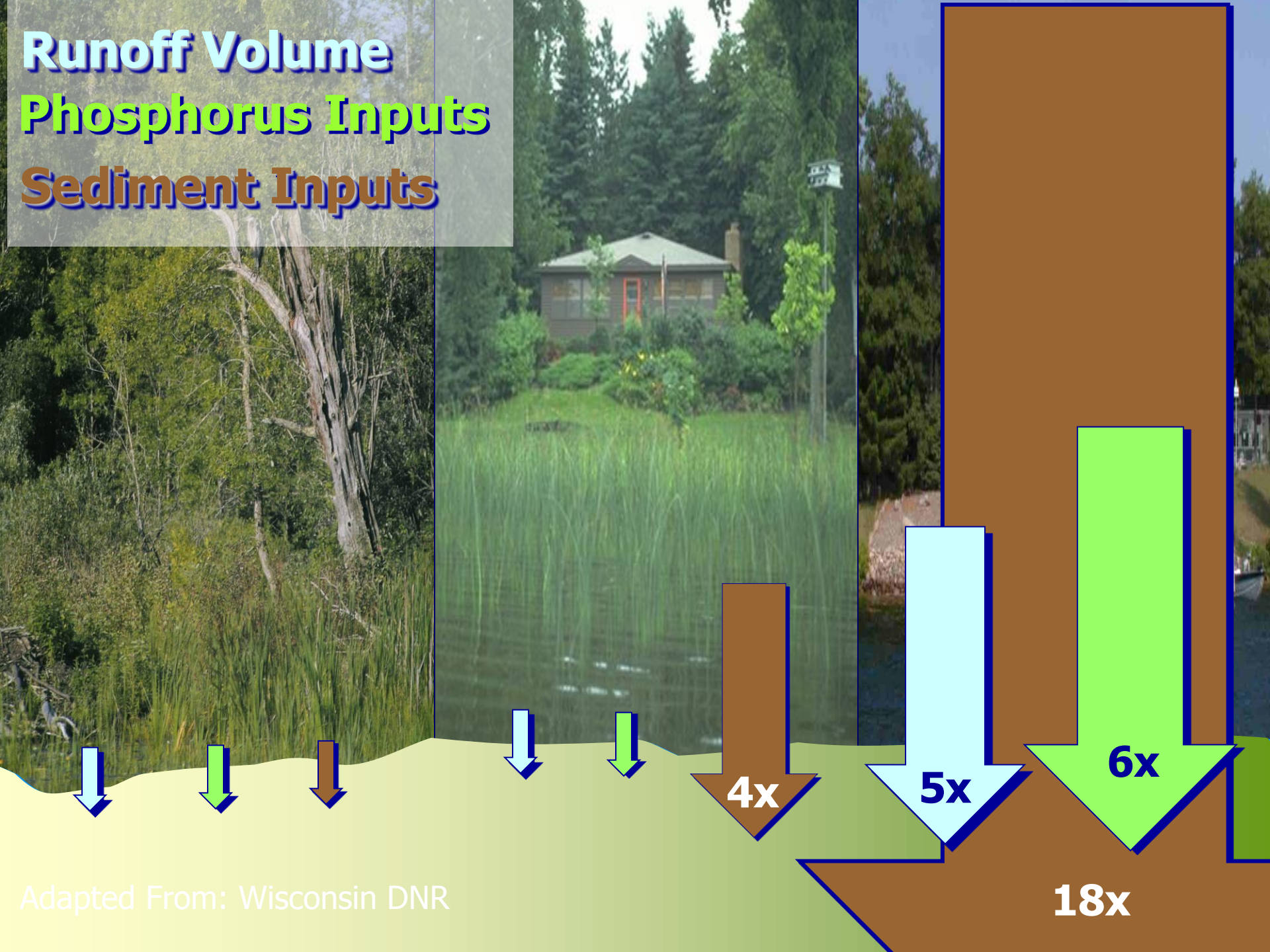


Creek chub
Fathead minnow
Green sunfish
White sucker
Brook stickleback

2008 study of 164 WI lakes found the same trend

Fewer species of fish 

Runoff Volume
Phosphorus Inputs
Sediment Inputs



Adapted From: Wisconsin DNR

More hard surfaces cause



- **Larger and more frequent floods**



- **Less groundwater** leads to lower stream flows & warmer water temperatures during dry periods

Brook Trout and Brown Trout

- Require cold, clean, high-oxygen water to survive
- Part of their diet consists of aquatic insects and small fish, whose populations decrease with increased runoff and sedimentation
- When impervious surfaces covered more than 11% of a watershed, trout were eliminated from streams

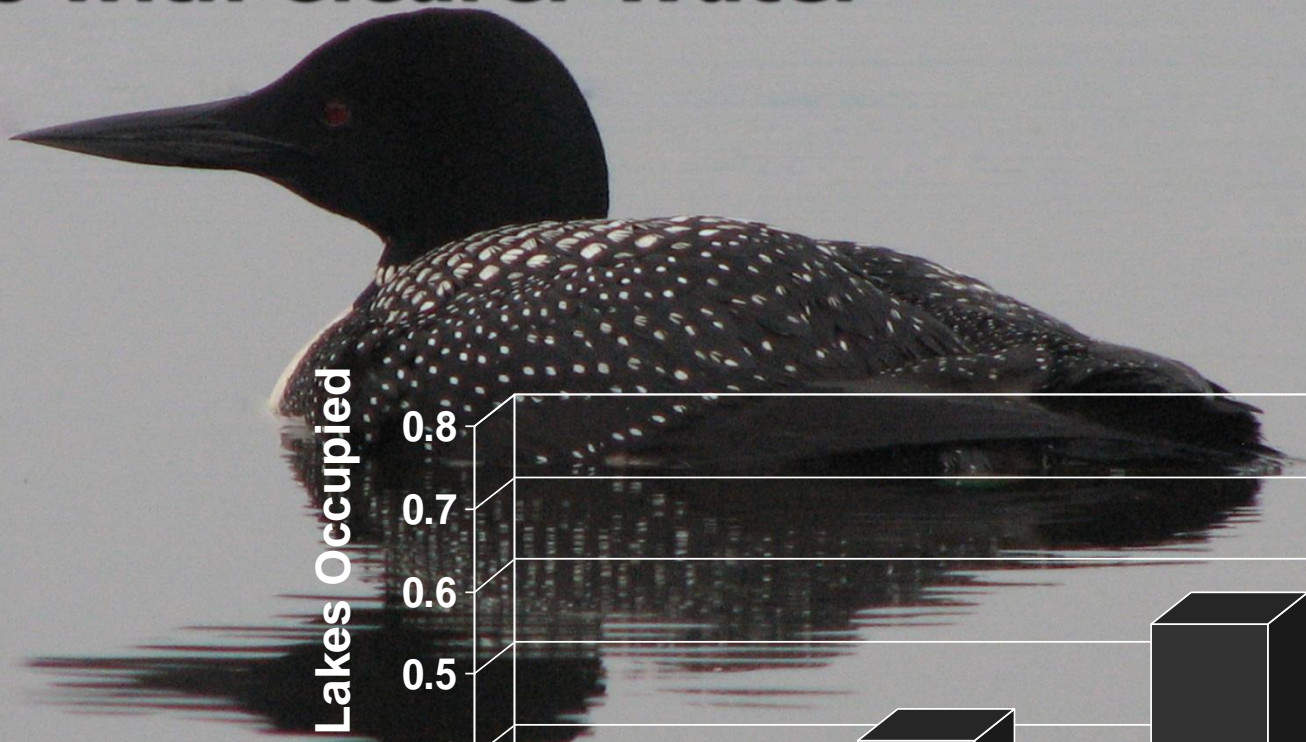


Walleye

- Walleye prefer to spawn on gravel- and cobble-covered bottoms.
- They typically spawn between mid-April and early May in Wisconsin when spring runoff is highest.
- The runoff from impervious surfaces can cause soil erosion. When the spaces between the rocks and gravel become blanketed with silt, walleye eggs can die quickly due to lack of oxygen.



Wisconsin Loons More Likely Found on Lakes with Clearer Water



Proportion of Lakes Occupied

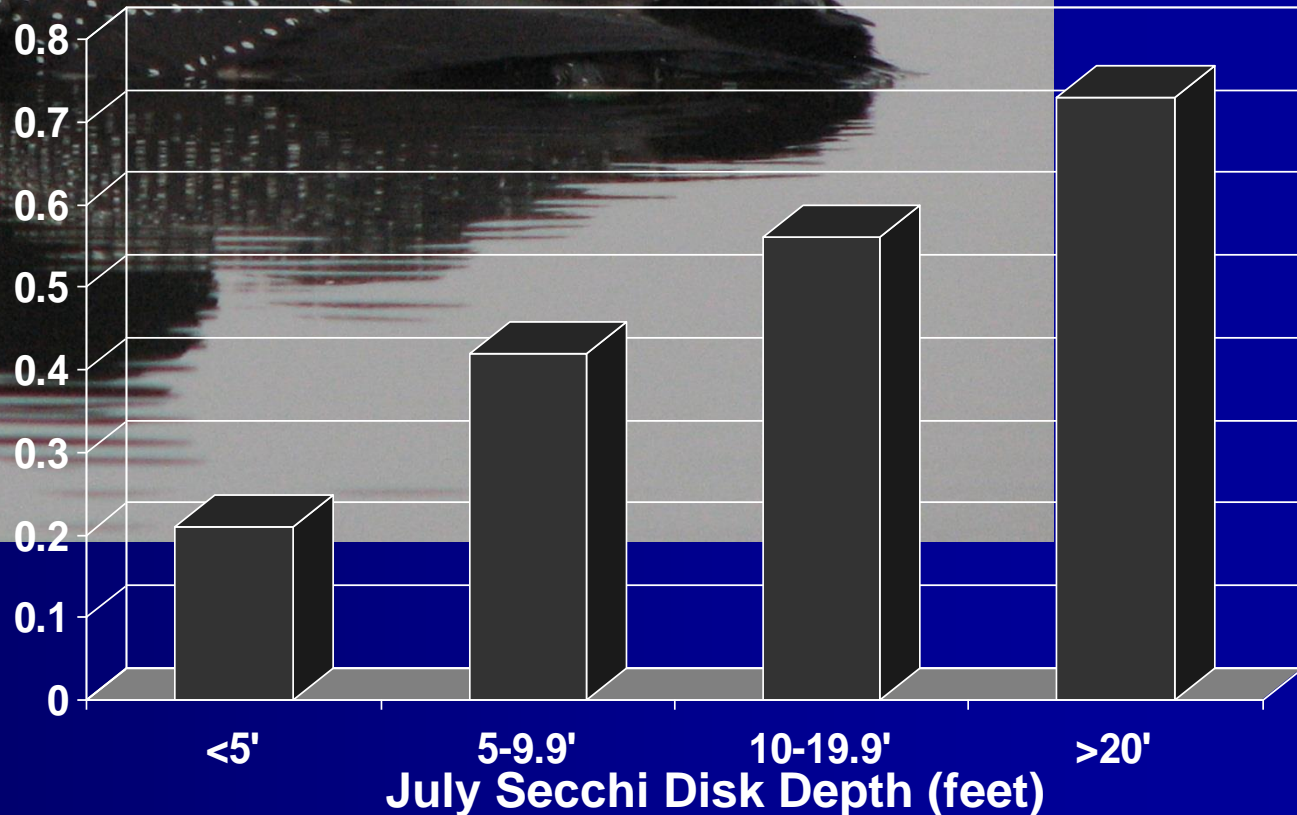


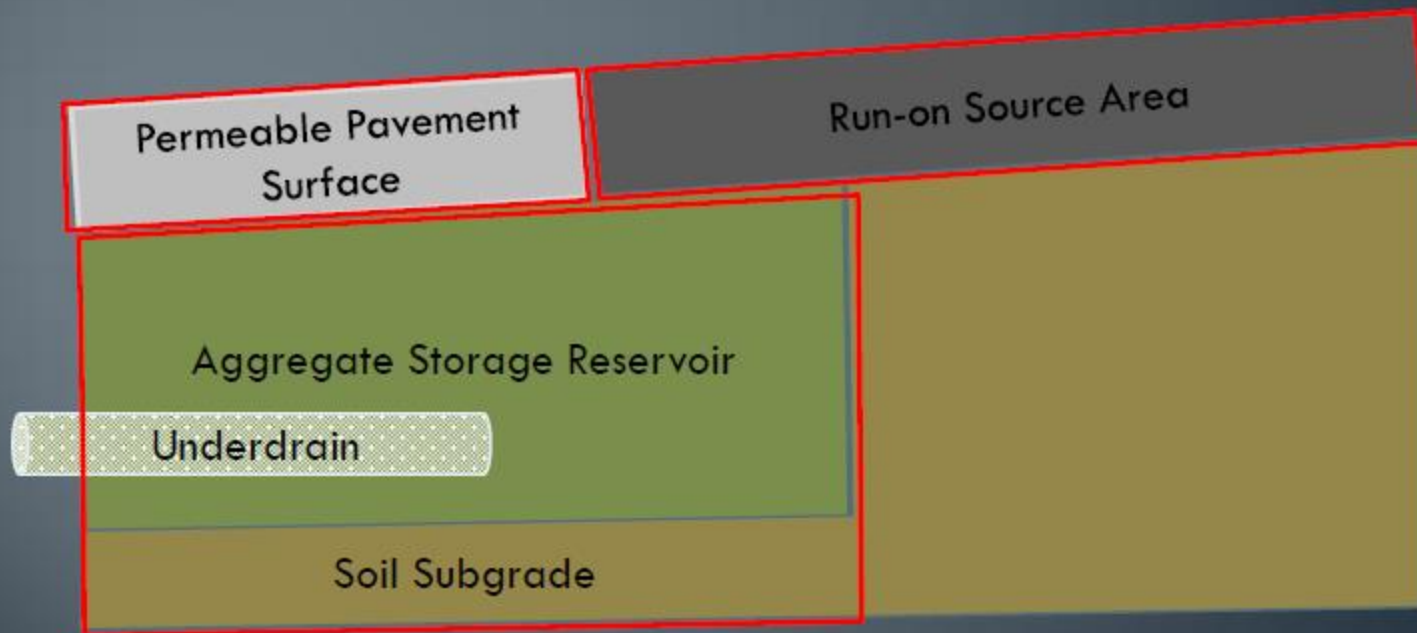
Photo credit
Doug Killian

Permeable Pavement - Definition

A pavement system designed to achieve water quality and quantity benefits by allowing movement of stormwater through the pavement surface and into a base/subbase reservoir. Examples include *pervious concrete (cast-in-place or precast)*, *porous asphalt* and *permeable pavers/blocks*.

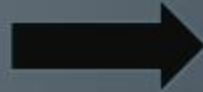


Permeable Pavement System



Surface Cleaning Requirements (1008)

- Clean the pavement surface **using industry recommended methods**, such as regenerative air or vacuum sweeping, at least twice per year.
- If water ponding persists on the pavement surface after a storm event, clean the pavement surface to mitigate clogging.



Pressure Washing with Vacuum



N. Passini - Spancrete



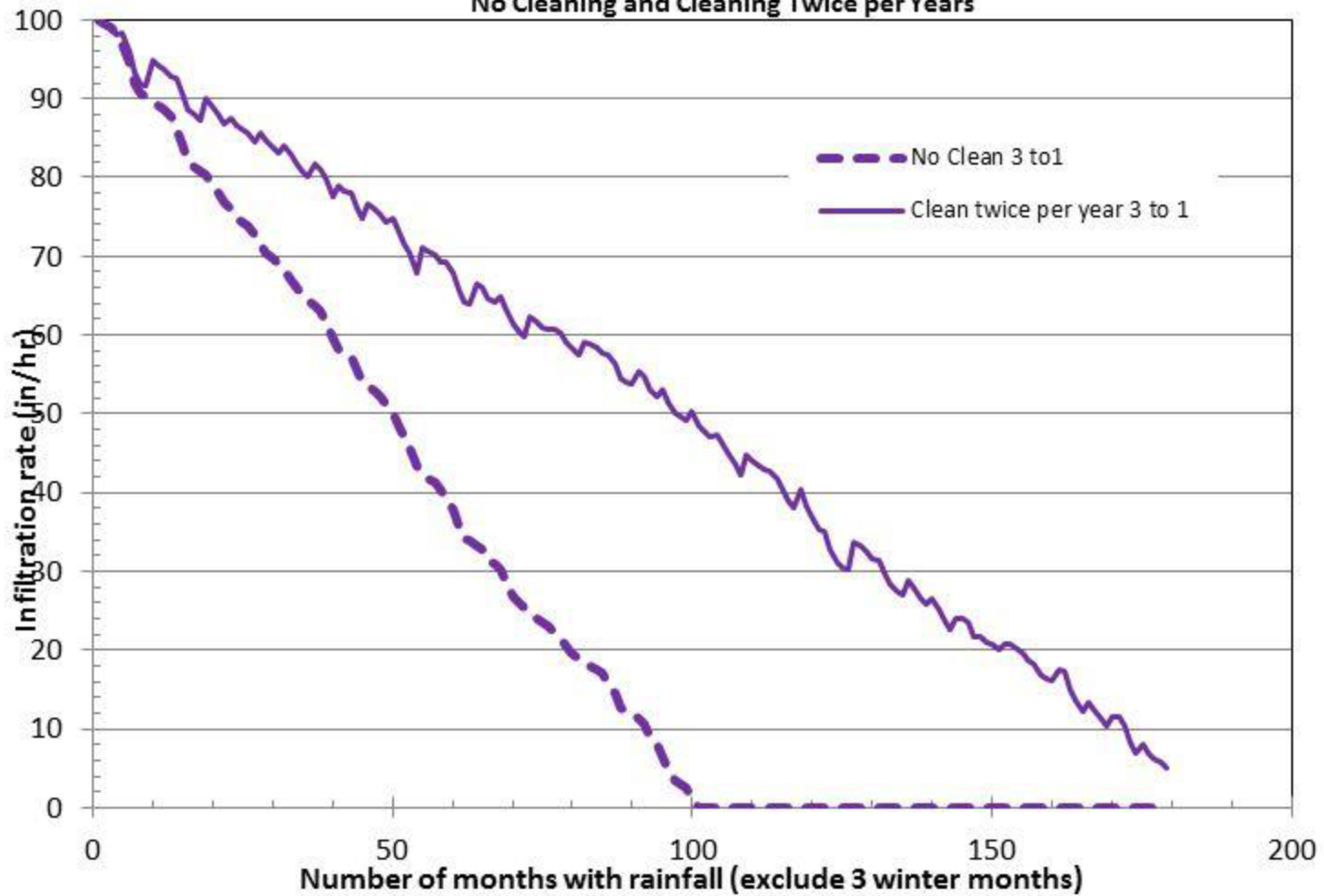
Credit: TCA

This vacuum-excavator combines pressure washing and vacuuming to provide deep cleaning of clogged pervious pavements.



N. Passini - Spancrete

Average monthly infiltration rate on 3:1 ratio of
Permeable Pavement when Loading Rate is 0.6 lb/sq-ft
No Cleaning and Cleaning Twice per Years





Impervious surfaces impact:

1. Water quality and property values

2. Fish

- When water runs over asphalt or shingles and into a lake or stream, it gets warm. Some fish can't take the heat.
- Northern pike & largemouth bass are gone above 12% impervious
- Trout are gone above 1% impervious

Climate change

3. Wildlife

What can buffers do if they're big enough?

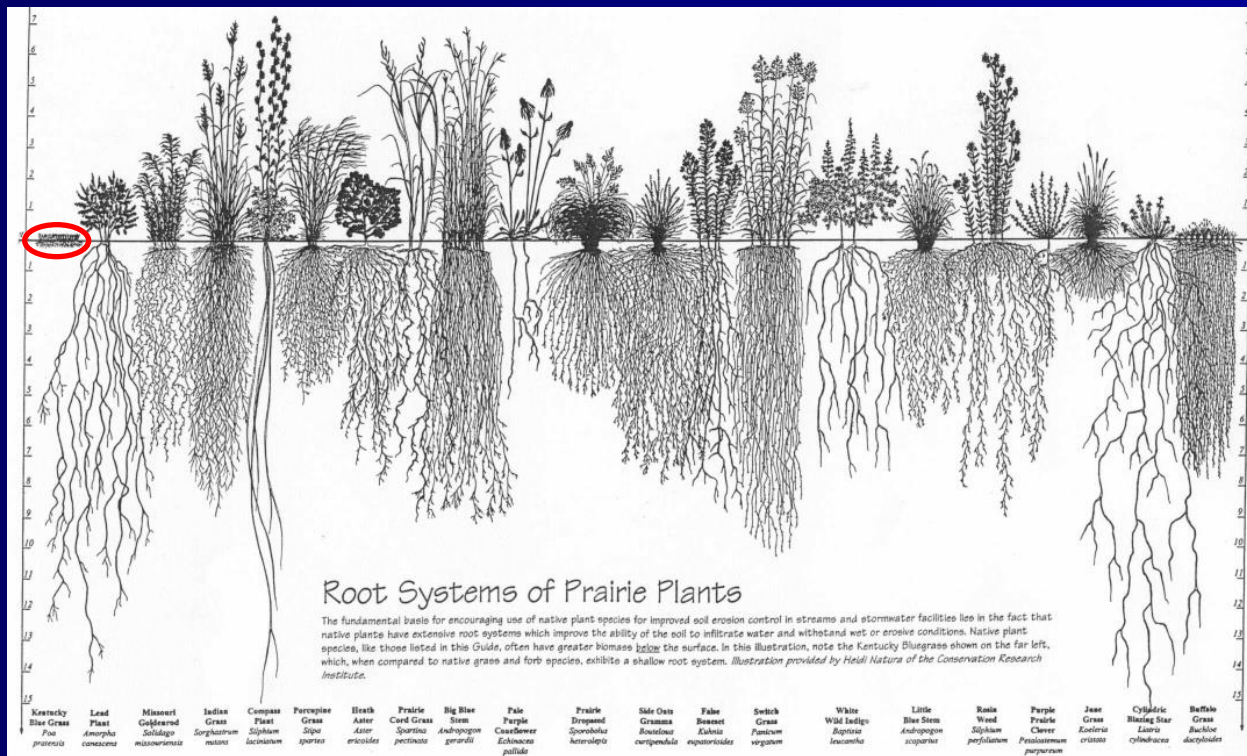
Stormw



700

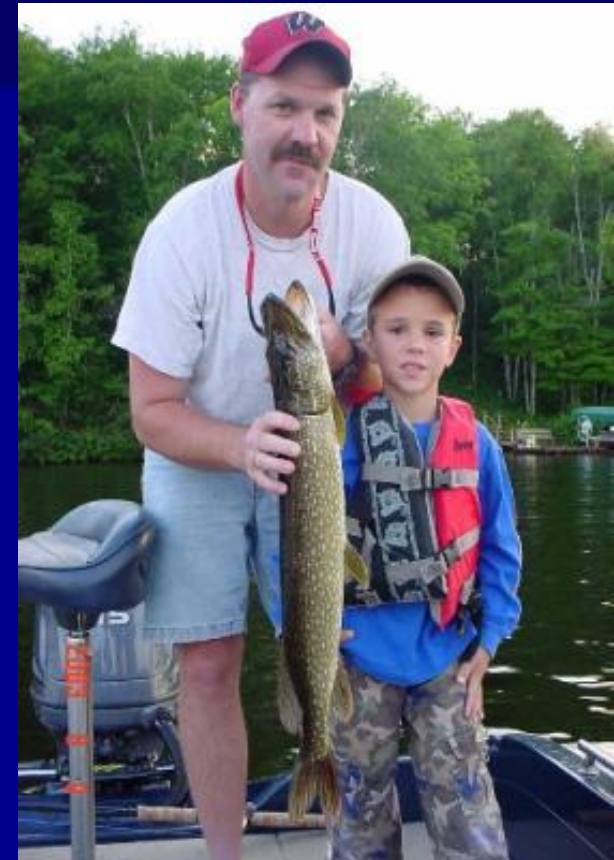
How do buffers work?

- Hold soil in place to prevent erosion
- Slow down runoff and let it soak into the soil
- Provide food and shelter for wildlife



Shoreland conclusions

- The quality of a lake or river depends on what's happening on the land around it
- Shoreland zoning is an effective tool to protect lake health and fisheries
- When impervious surfaces exceed 12% of a river's watershed, northern pike and trout are eliminated
- Shoreland zoning was updated in 2010 based on science & 8 years of public input.



Aquatic plants protect water quality, fish & other animals

- Hold bottom sediment in place, maintaining clear water
- Absorb nutrients
- Produce oxygen for fish
- Fewer plants may lead to more algae



Protect plants from chemical, mechanical and recreational damage

Aquatic pesticides

- Aquatic plants form the foundation of healthy lake ecosystems
- Northern native aquatic plant protection strategy
 - Folks can't just treat native plants because they don't like them
 - The burden of proof is on them to show the plants are such a nuisance that watercraft cannot navigate through them
- Pesticide applications to control native plants are decreasing and in some counties nonexistent. Pesticide applications to control invasive apps seem to have stabilized



Aquatic pesticides

- Susan Borman did her Ph.D. on native aquatic plant community changes in NW seepage lakes. Her work showed that subtle land use changes could shift plant communities from short-growing sensitive species to taller-growing more nuisance type species. The driver was probably increases in nutrient-rich substrate caused by construction site erosion and perhaps post-construction storm water.
- There are lots of unique, special concern, and sensitive species in NW WI
- The most common pesticide applied directly to WI lakes is 2,4-D, sold as Navigate and Aqua-Kleen. The WI Dept of Health Services says health effects include:
 - Increased risk of lymphoma – cancer affecting immune system
 - Increased risk of certain birth defects from high level exposure
 - Kidney and liver damage from long-term, high level exposure

Water quality

Well water quality viewer

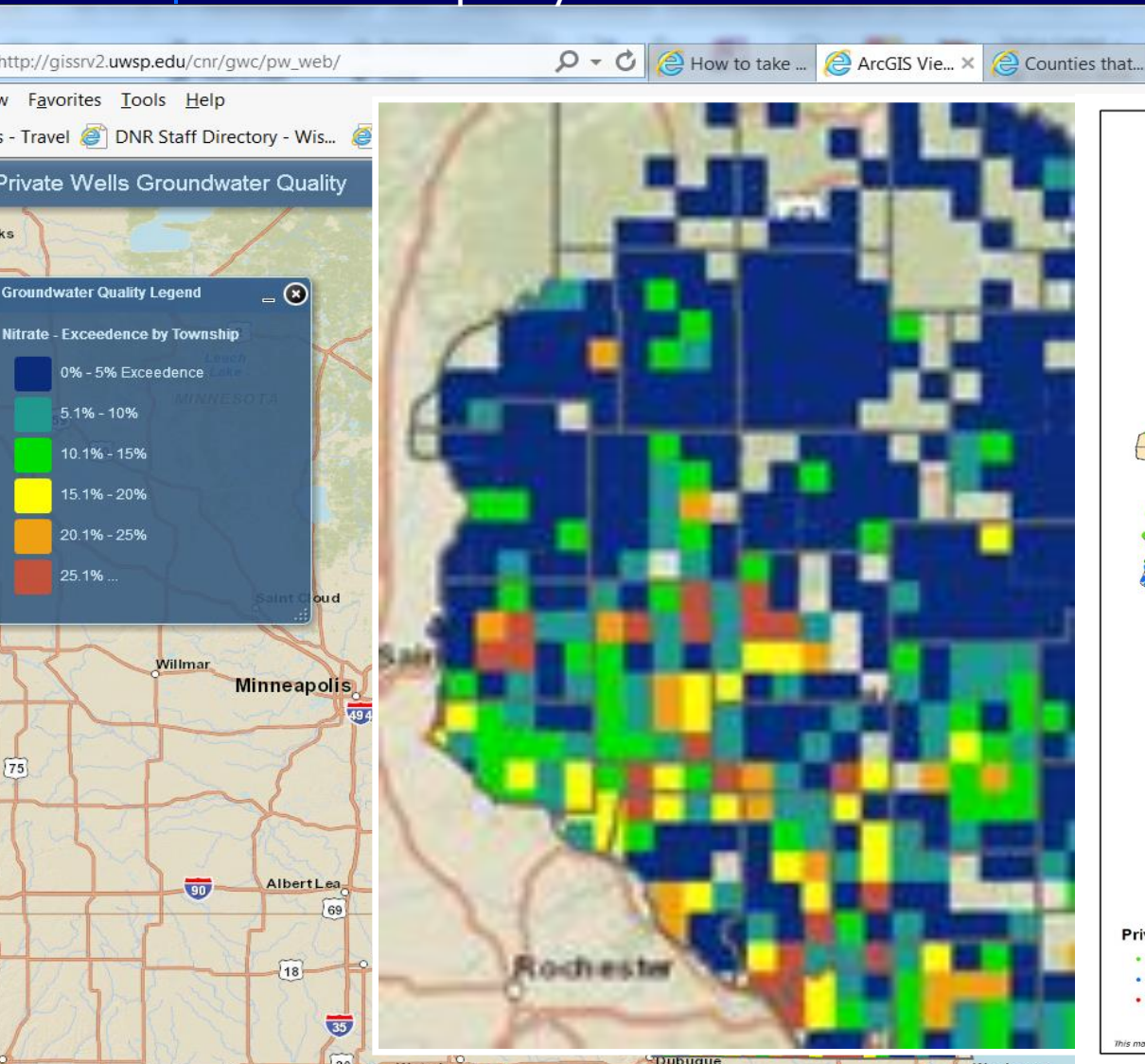
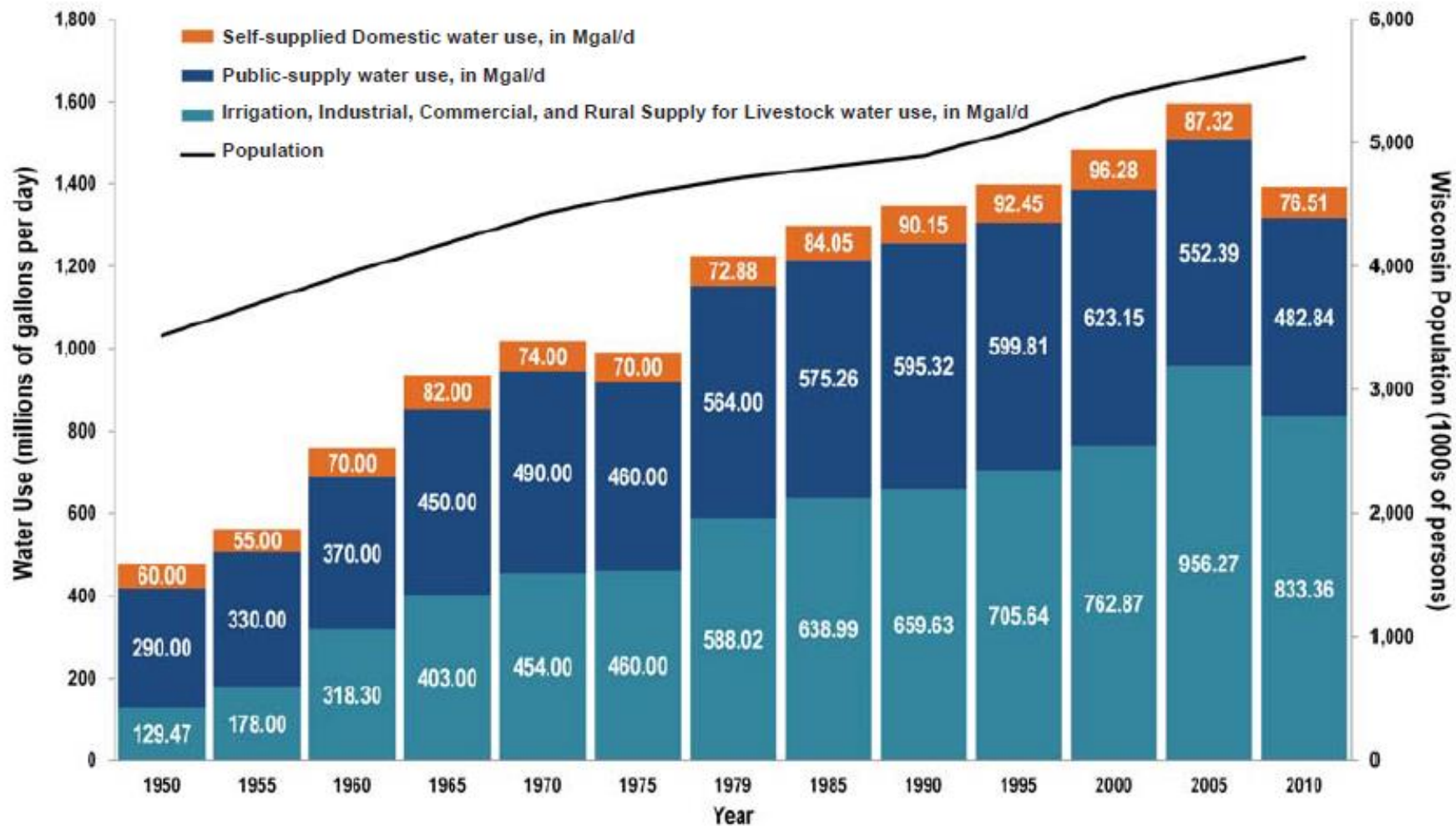


Figure WU3

Water Use Data from 1950-2010

This graphic does not include water used in the generation of power.¹²



Pesticide use on WI crops

Annual use on major agricultural crops:

- 13 million pounds of pesticides in WI

- Over 2 pounds per person

Annual use on turf:

- ~1 million pounds in WI

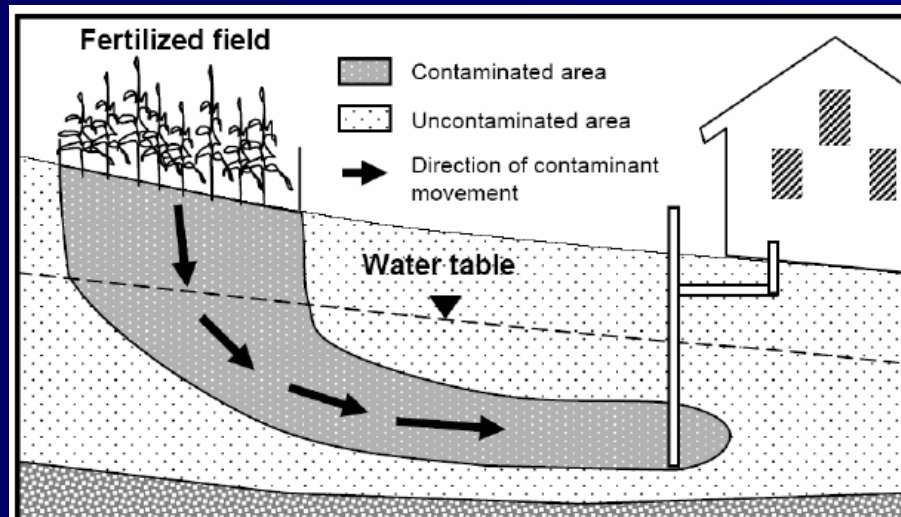
8.5 million pounds per year applied in WI to field corn used for

- ethanol
- animal feed
- exports



After pesticides are sprayed, where do they go?

- People who apply pesticides
- Soil, tracked into homes
- Air, drifts for miles
- Plants, that become food
- Runoff, goes into lakes & streams
- Drinking water



Average pounds of pesticides applied per acre in Wisconsin

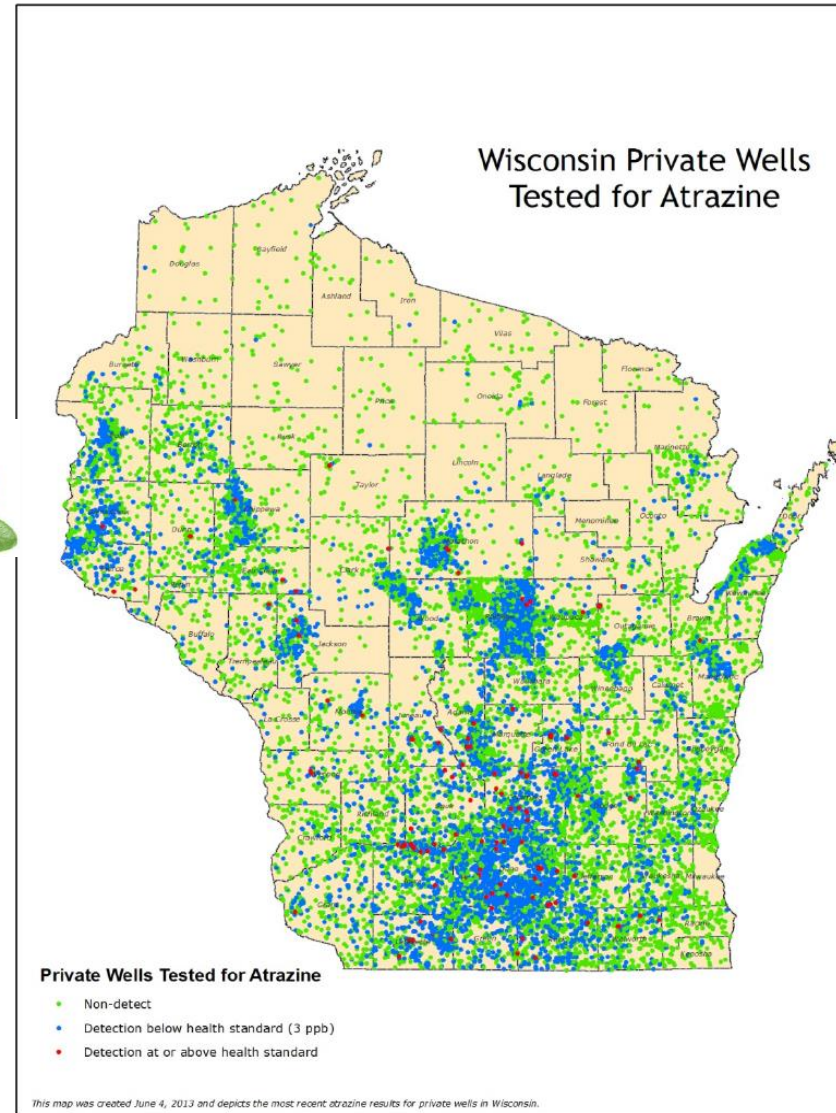
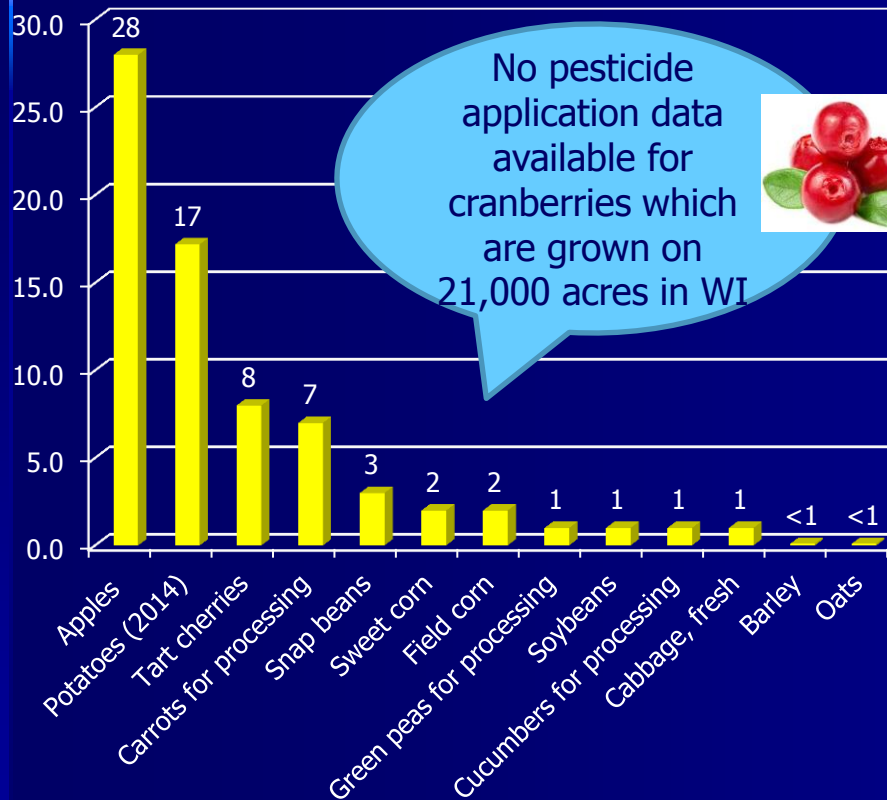


Figure 1: Private wells tested for atrazine in Wisconsin as of June 2013 (source: DATC)

1 of every 3 private drinking water wells in WI contain pesticides or metabolites

Health & quality of life: Cancer

Top ag pesticides in WI

1. Glyphosate (corn & soybeans)
2. Acetochlor (corn)
3. Metolachlor (corn)
4. Atrazine (corn)
5. Chlorothalonil (potatoes; cranberries?)

Top lawn & garden pesticides in U.S.

1. 2,4-D
2. Glyphosate
3. Carbaryl
4. MCPP
5. Pendimethalin

- Known or likely to cause cancer in humans
- Unknown or possibly causes cancer/Not classifiable
- Not likely to cause cancer in humans according to the

Glyphosate = Roundup™

March 2015: World Health Organization states glyphosate probably causes cancer in people

In WI 4 million pounds glyphosate per year total applied to corn and soybeans

Applied to some road right of ways

Will USEPA revise their analysis? EPA currently says long-term exposures of glyphosate over the MCL has the potential to cause kidney damage, reproductive effects.

Will USDA test for it in foods?

Learning abilities: ADHD & IQ



- Researchers from Harvard studied 1139 children representative of the U.S. population. **Children with higher OP exposure were more likely to be diagnosed with ADD or ADHD.**
- Studies in urban and rural areas found that **children born to mothers with higher levels of OP pesticides in their urine during pregnancy had lower IQ scores at ages 2-3 and 6-9.**
- **OP exposures in EU** associated with 13 billion lost IQ points and **59,000 cases of intellectual disability** requiring special education.

Bouchard et al. 2010., *Pediatrics*. (study of 1139 children representative of US population)

Marks et al. 2010. *EHP*. (Rural agricultural children; Salinas Valley, CA)

Rauh et al., 2006. *Pediatrics*. (NYC, chlorpyrifos use for roach control high until 2001)

Haviland, Porter et al. 2009. *Reproductive Toxicology*

Bouchard, M.F. et al. 2011. *EHP*. (Rural agricultural children; Salinas Valley, CA)

Engel, S.M. et al. 2011. *EHP*. (Inner city children; NYC)

Rauh, V. et al. 2011. *EHP*. (Inner city children; NYC)

Bellanger et al. 2015. *Journal of Clinical Endocrinology & Metabolism*.

American Academy of Pediatrics

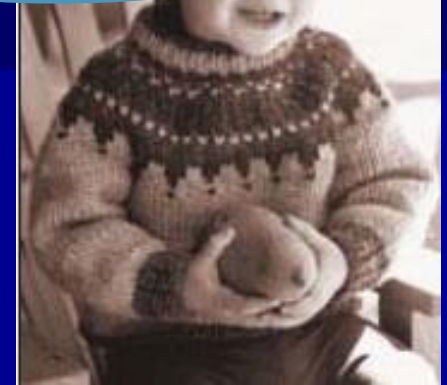
- **Buy organic foods if possible.** Children that eat an organic diet have lower exposure to certain pesticides.
- **Wash fruits and vegetables before eating.** This removes some, but not all pesticides
- **Prenatal and early childhood exposure** to pesticides is associated with pediatric cancers, decreased cognitive function and behavioral problems.
- **Pesticide spray drift** is important for residences near treated crops



Eating organic

"Organic" means grown without synthetic pesticides.
"Natural" has no definition.

- Eating organic food significantly lowers exposure to organophosphate pesticides



5 studies have reached this conclusion:
Curl, et al. 2003
Lu et al., 2006
Lu et al., 2008
Oates et al., 2014
Curl et al., 2015

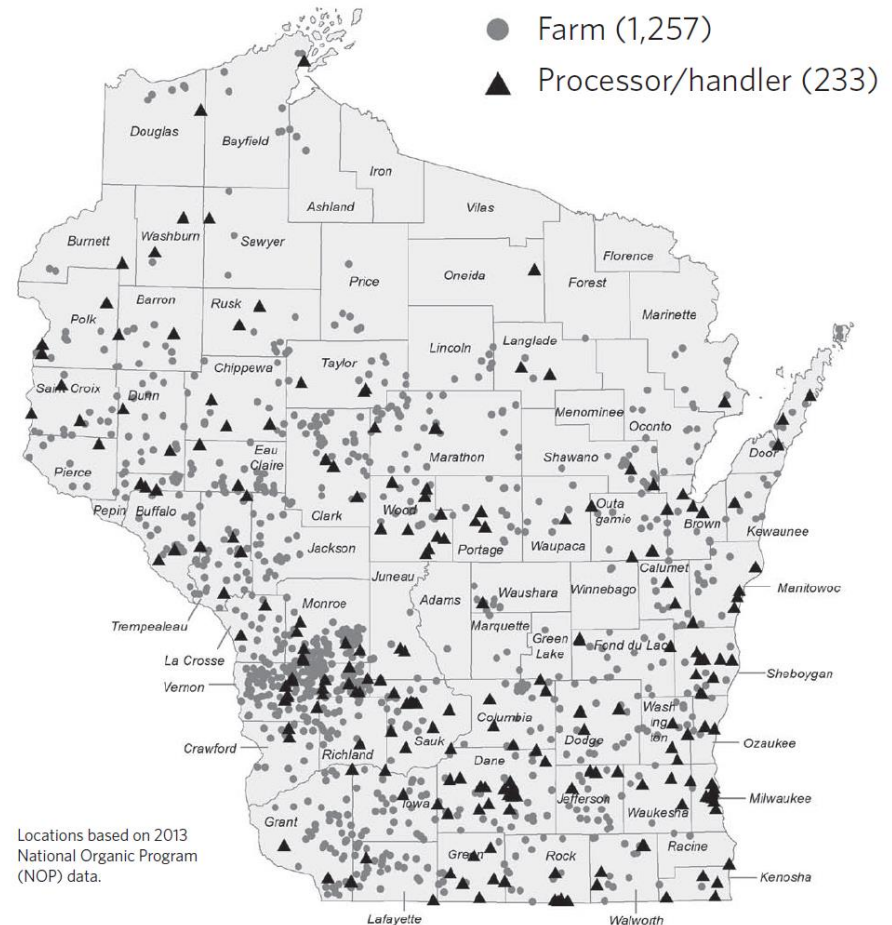
More organic farms & processors

In Wisconsin

- Over 1,200 organic farms; 77% growth since 2005
- \$122 million in organic commodity sales in 2012
- 233 organic food processors
 - Dairy
 - Meat
 - Vegetables & fruit
- Started in 2012



Wisconsin certified organic farms and processors/handlers, 2013



Mercury



- Persistent and bioaccumulative pollutant that accumulates in fish & people
- In WI, power plants burning coal are the largest source of mercury
- Clean Power Plan will reduce coal use
- Eating too much high-mercury fish harms our health, particularly the developing nervous systems of babies



Safe-eating guidelines - for most of Wisconsin's inland (non-great lakes) waters

Women of childbearing years, nursing mothers and all children under 15 may eat:

1 meal per week - Bluegill, crappies, yellow perch, sunfish, bullheads and inland trout;

and

1 meal per month - Walleye, pike, bass, catfish and all other species.

Do not eat - Muskies.



Black Crappie



Muskellunge

Women beyond their childbearing years and men may eat:

Unrestricted* - Bluegill, crappies, yellow perch, sunfish, bullheads and inland trout;

1 meal per week - Walleye, pike, bass, catfish and all other species;

and

1 meal per month - Muskies.



Bluegill



Channel Catfish

Economics

- More than 1 million anglers generate more than \$1.4 billion in trip and equipment expenditures every year
- Greater water clarity results in \$ millions in increased property values
- Study in Vilas County showed that more restrictive shoreland zoning regs have a positive influence on property values
- WI is second only to Florida in the total number of seasonal homes; depends on high quality lakes

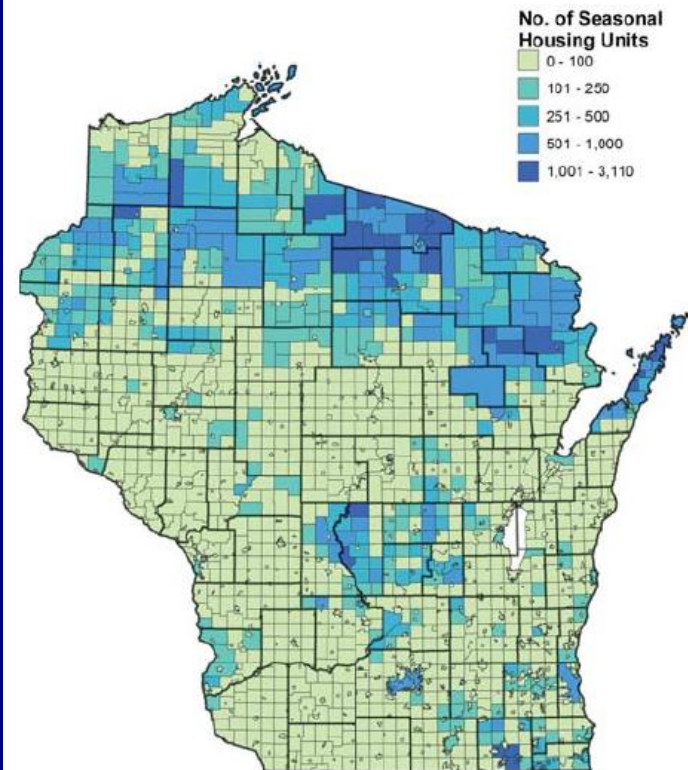
Direct Visitor Spending per Capita

The map illustrates direct visitor spending per capita by miles of shoreline.



Second Home Ownership

The map shows seasonal housing units by municipality.



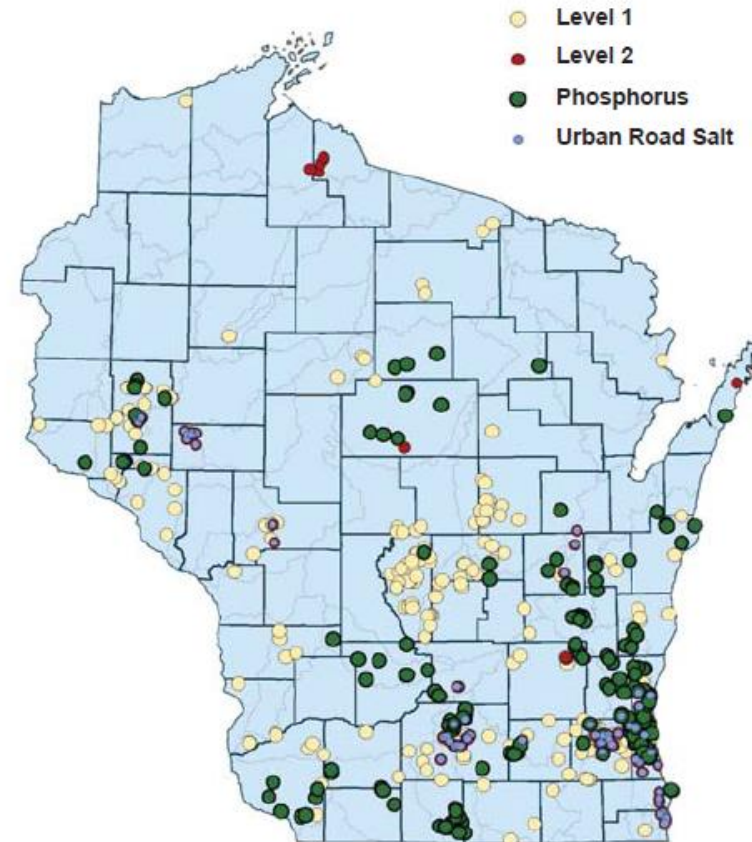
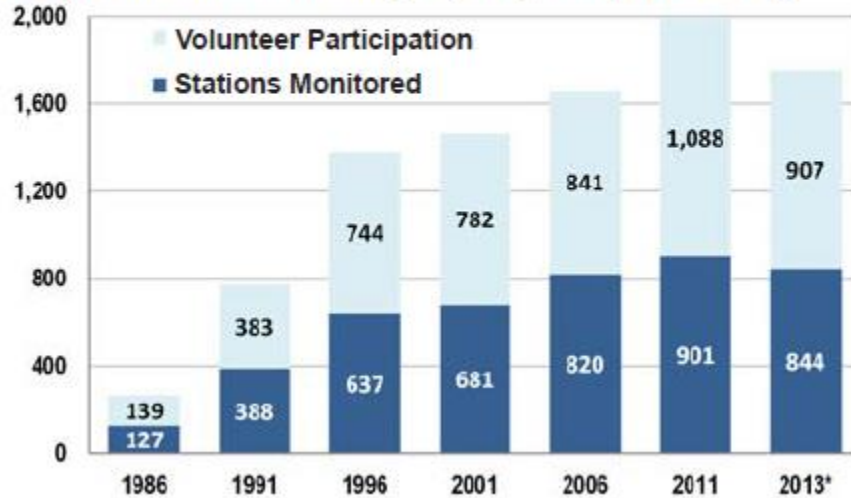
Volunteers

Water Action Volunteers 2013 Stream Monitoring Program Stations (Courtesy of Water Action Volunteers)

Figure RS3

Volunteer Participation

Participation is measured every 5 years, except for 2013 (*).

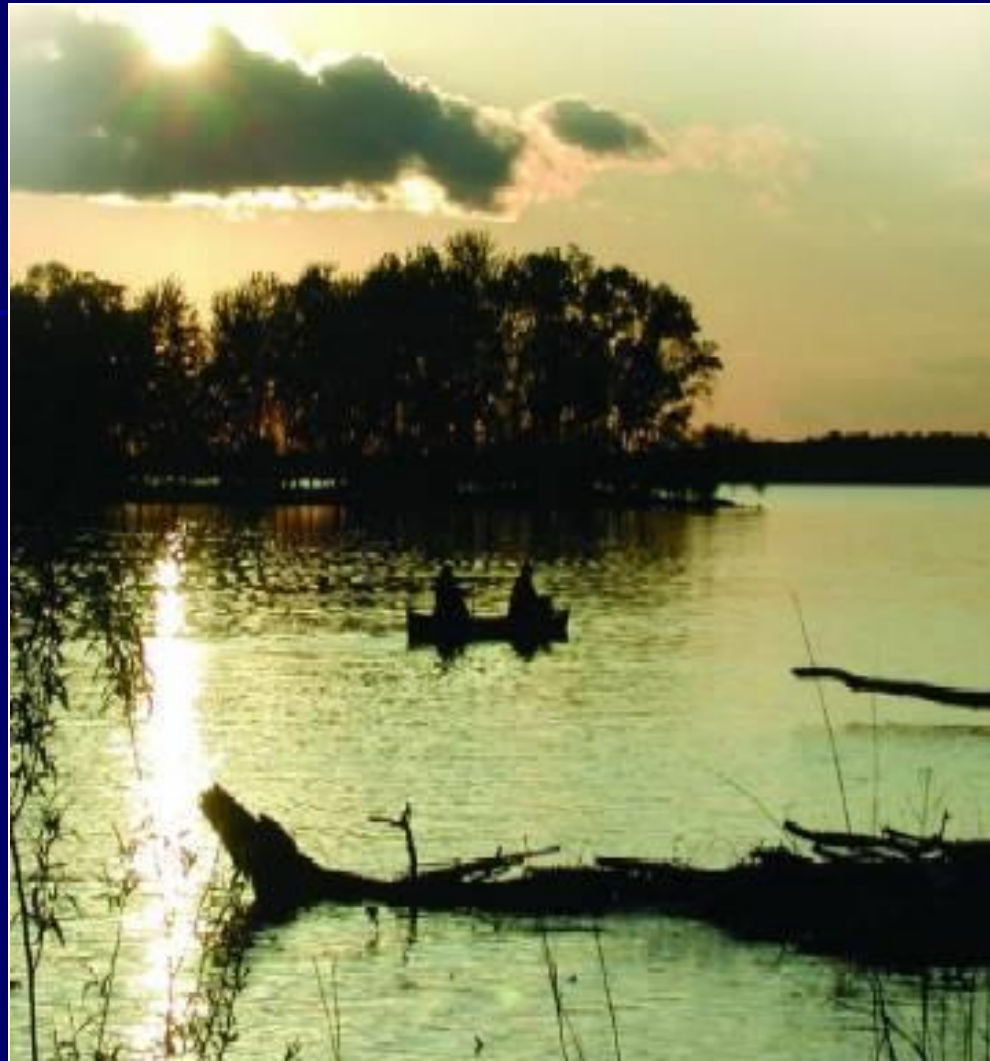


- Citizen Lake Monitoring Network
- Water Action Volunteers (streams)

Conclusions

- Water is a big part of our history, business, recreation and health
- Water quantity and quality depend on what happens on the land, especially land closest to the water
- Taking care of our waters for future generations takes all of us





Healthy shorelands provide some of the most effective protection for the lakes and streams of Wisconsin