Understanding Wisconsin River Reservoirs: Lakes or Rivers?

Need to recognize Rule #1 (Scott’s Rule) Nutrient and Sediment Transport Systems

- Rivers cut and move

This is natural!

Always going to have some deposition.

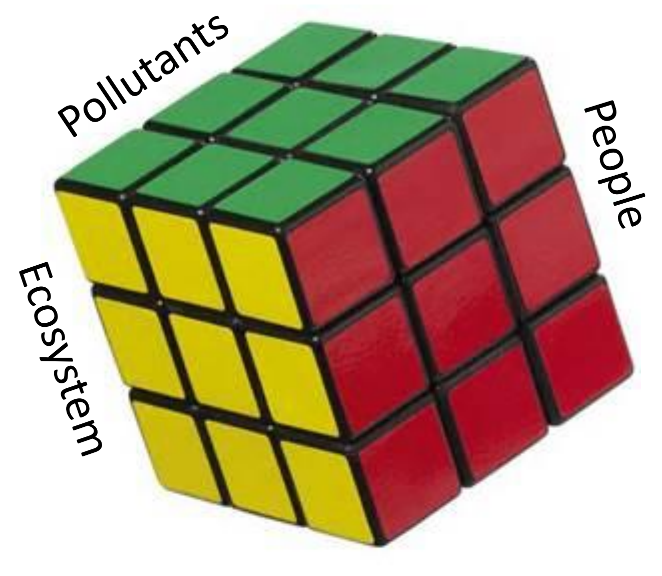
- Material deposit at low energy and erodes at higher energy (we’re going to use velocity and energy as the same)

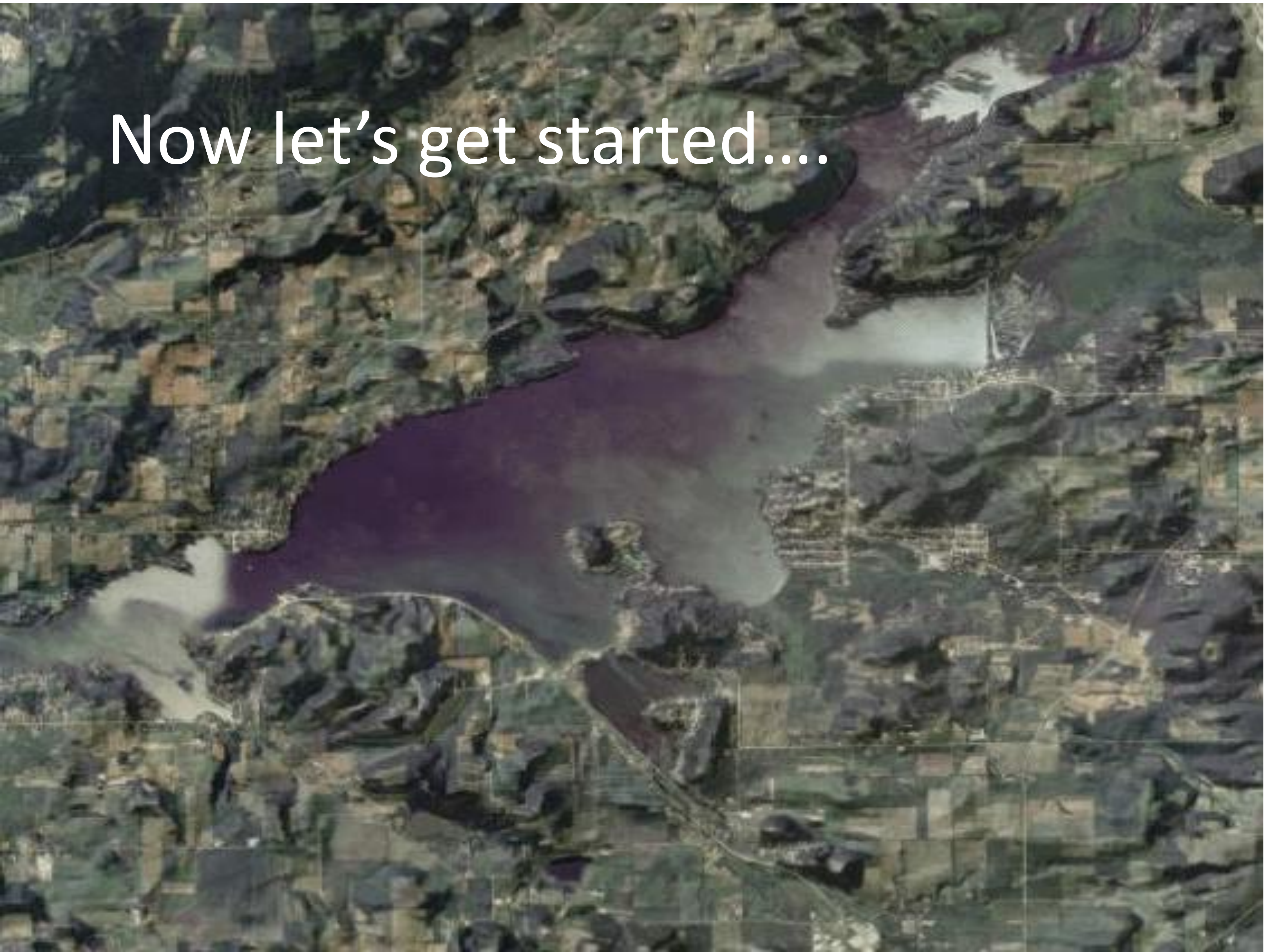
Rule #2: Need to think in a matrix

- Resource management is NOT, A + B = C

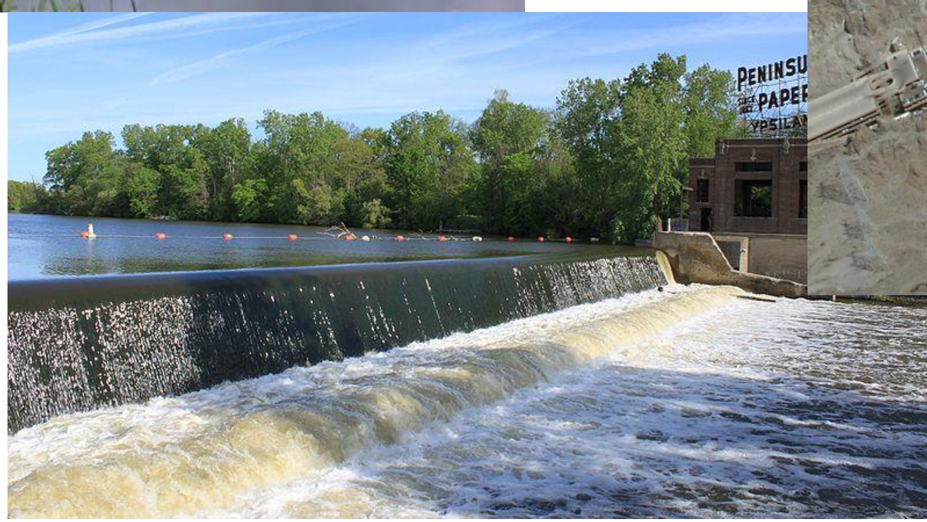
- It's this!

  One action has
  multiple reactions




Now let’s get started….

Fundamentals: Dams Create Reservoirs



So…

So, this:
Q= *v*A or *v*=Q/A

- River slows down when it reaches reservoir
- A increase; v decreases; Q stays the same
- Hydraulic Residence Time (HRT) increases
- “stuff” settles out
- Some “stuff” increases
  algae.

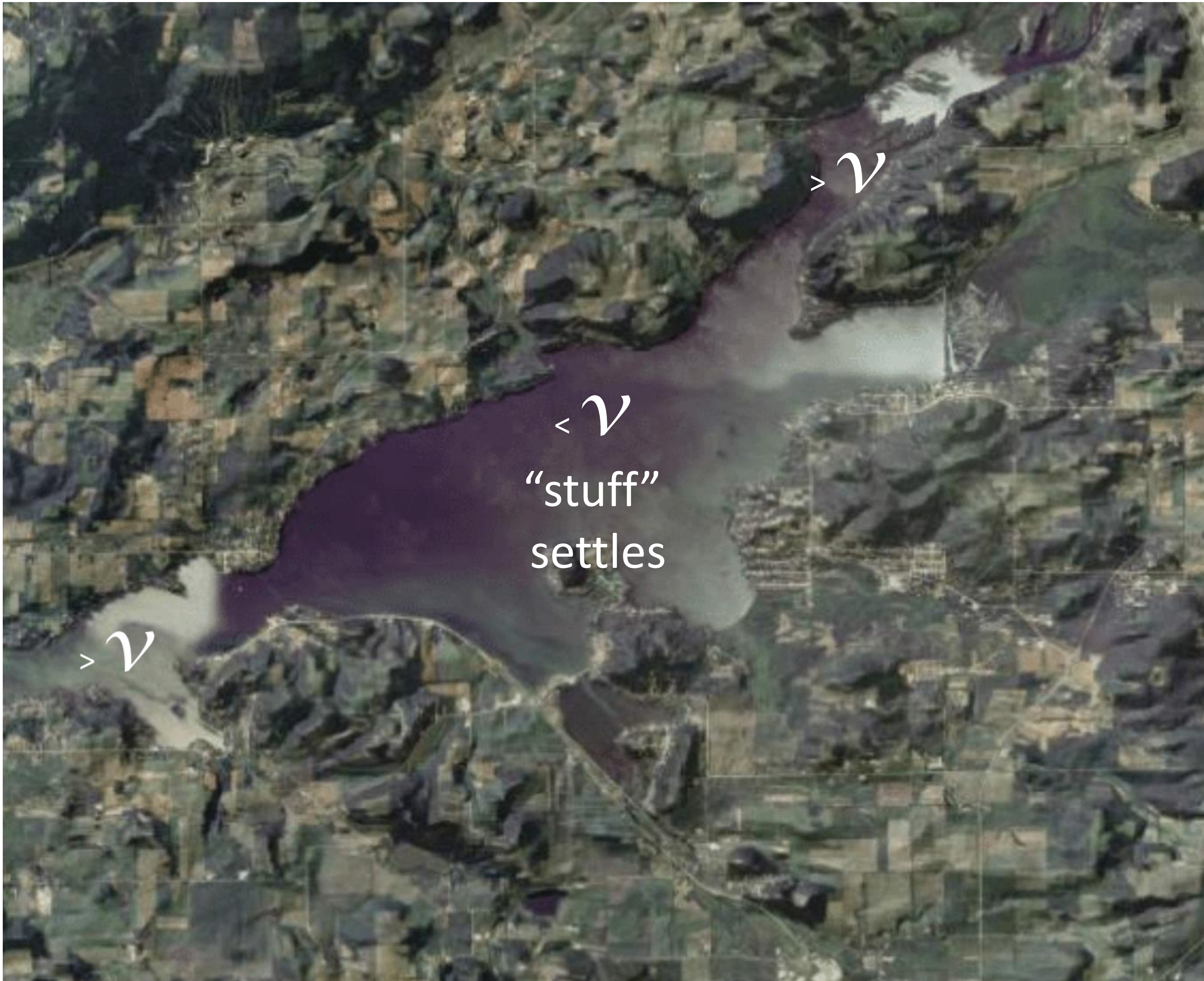
Remember how TP decreased at outlets…

Equation 2.2: Stokes' Law

$$V_s = \frac{g(\rho_s - \rho_w)d^2}{18\mu}$$

where

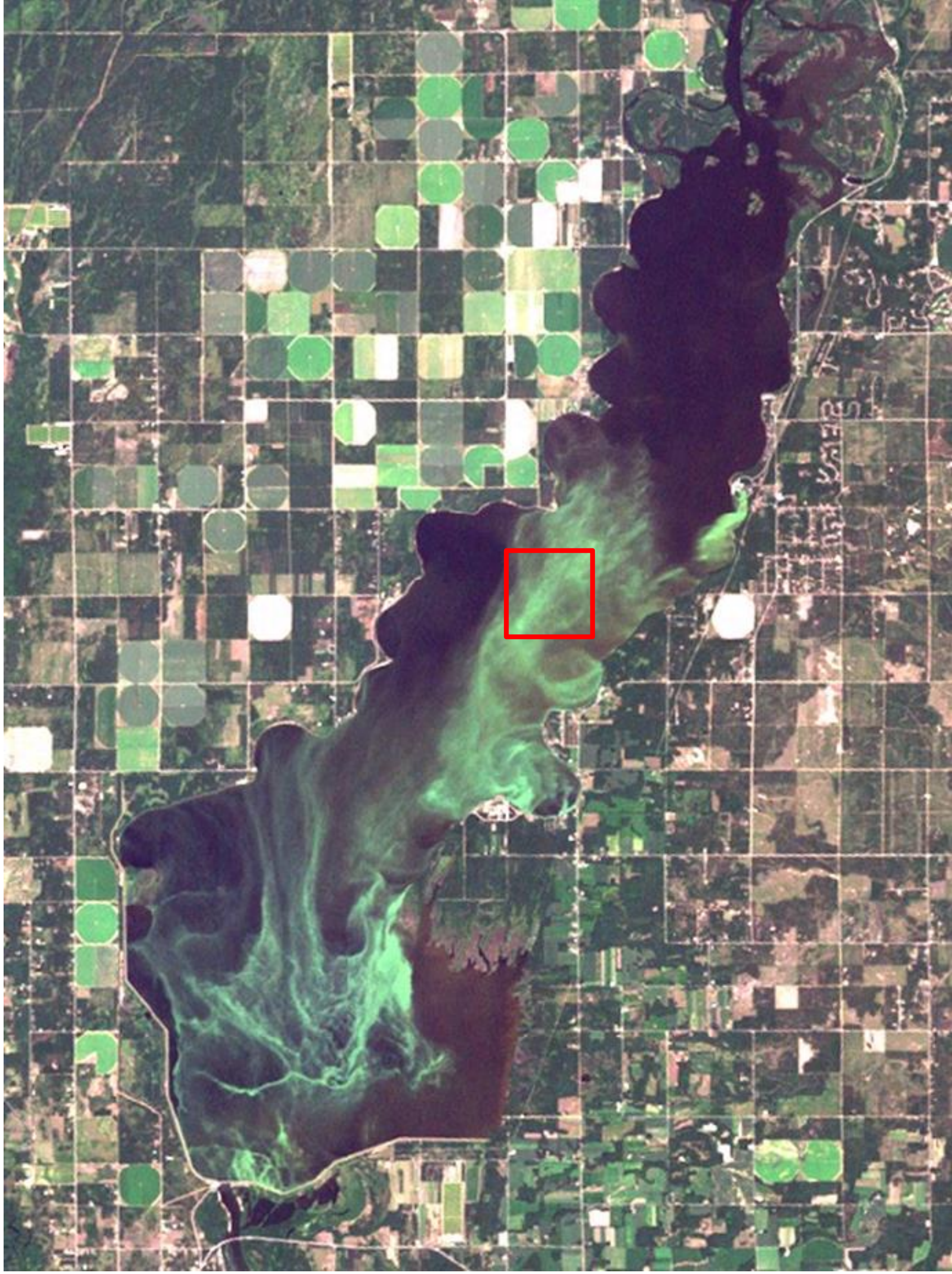
V_s = terminal settling velocity of the solid particle
g = gravitational acceleration
ρ_s = density of settling particle
ρ_w = density of water
d = diameter of particle
μ = dynamic viscosity


> v
< v
“stuff”
settles
> v

Hold on, it's about to get heavy….
- eminem

As HRT increases, the "stuff" in the water (P & N) has more time to increase algal growth. Add heat and droughty conditions, HAB from BGA can increase even more. This leads to decreased water clarity, which increases habitat preference of some AIS like carp. Carp disturb sediment and release nutrients that destroy habit for native species by disturbance and decreased light penetration.

HRT=Hydraulic Residence Time
P = Phosphorus
N = Nitrogen
HAB = Harmful Algal Blooms
BGA = Blue Green Algae
AIS = Aquatic Invasive Species



To complicate things: HRT varies amongst reservoirs and within reservoirs

- As HRT varies, so does behavior
- High HRT, acts like a lake
- Low HRT, acts like a river
- Stuff settles as HRT increases

Statewide Phosphorus (i.e. stuff) Rule

Rivers

100 µg/L

Streams [1]

75 µg/L

Reservoirs

- Not Stratified = 40 µg/L
- Stratified = 30 µg/L

Inland Lakes[2]

Ranges from 15-30 µg/L

Great Lakes

- Lake Michigan = 7 µg/L
- Lake Superior = 5 µg/L

Which one is it?

[1]*All unidirectional flowing waters not in NR 102.06(3)(a). Excludes Ephemeral Streams.*

[2]*Excludes wetlands and lakes less than 5 acres*

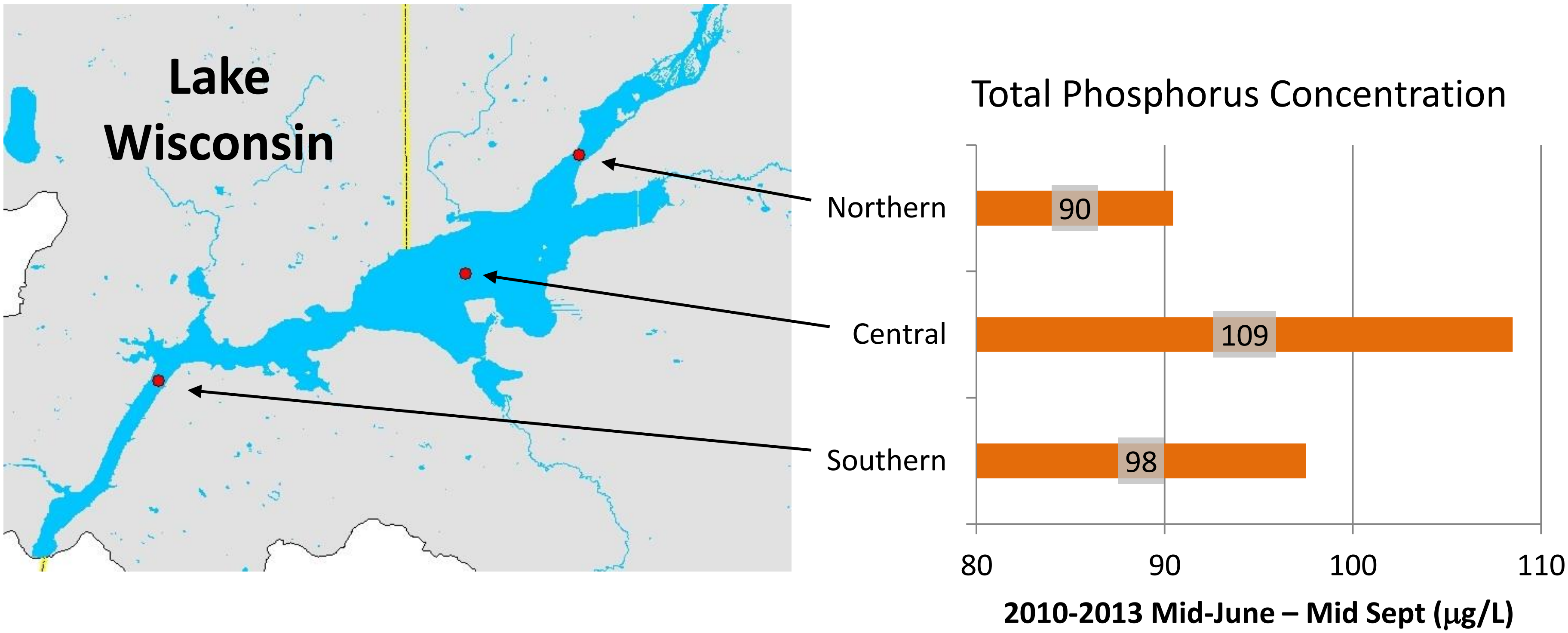
Lake Wisconsin as an example

- Average summer HRT is <14 days
- Lake Wisconsin is a RIVER
- Acts like a lake sometimes
- As HRT increases; BGA increases

Rivers

100 µg/L

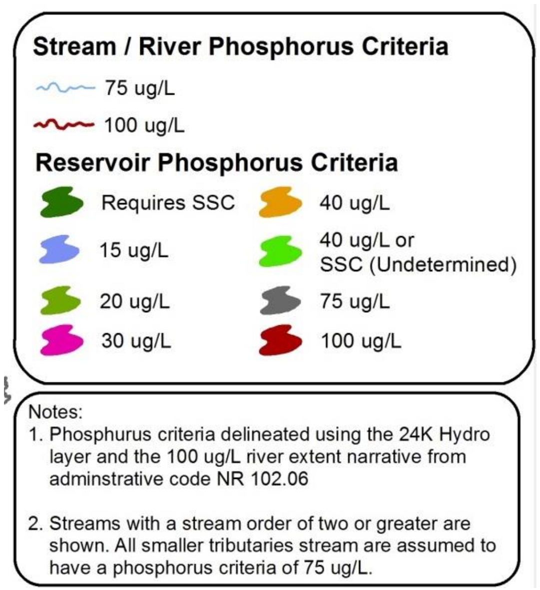
Reservoir Monitoring Results

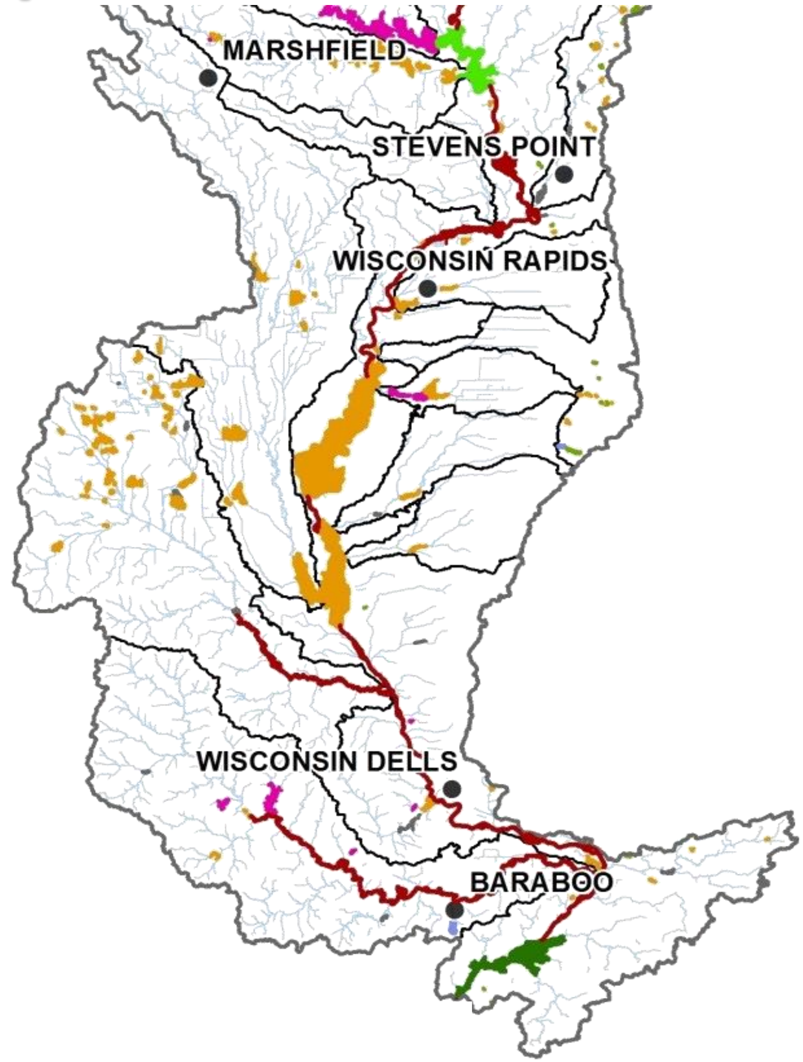


What to do:

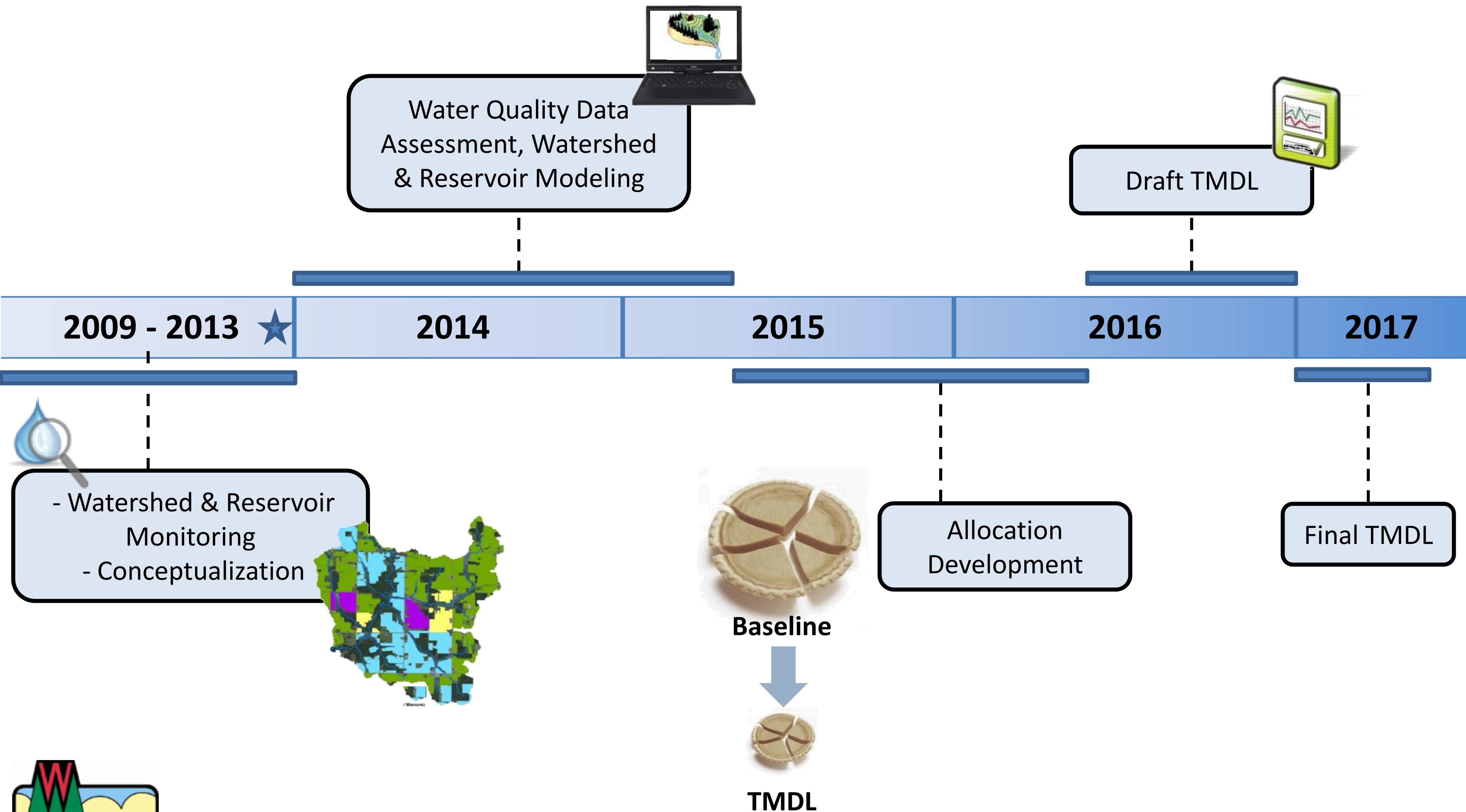
Site Specific Criteria

Wisconsin River Basin Phosphorus Criteria - Central/South





Brings us to the Wisconsin River TMDL



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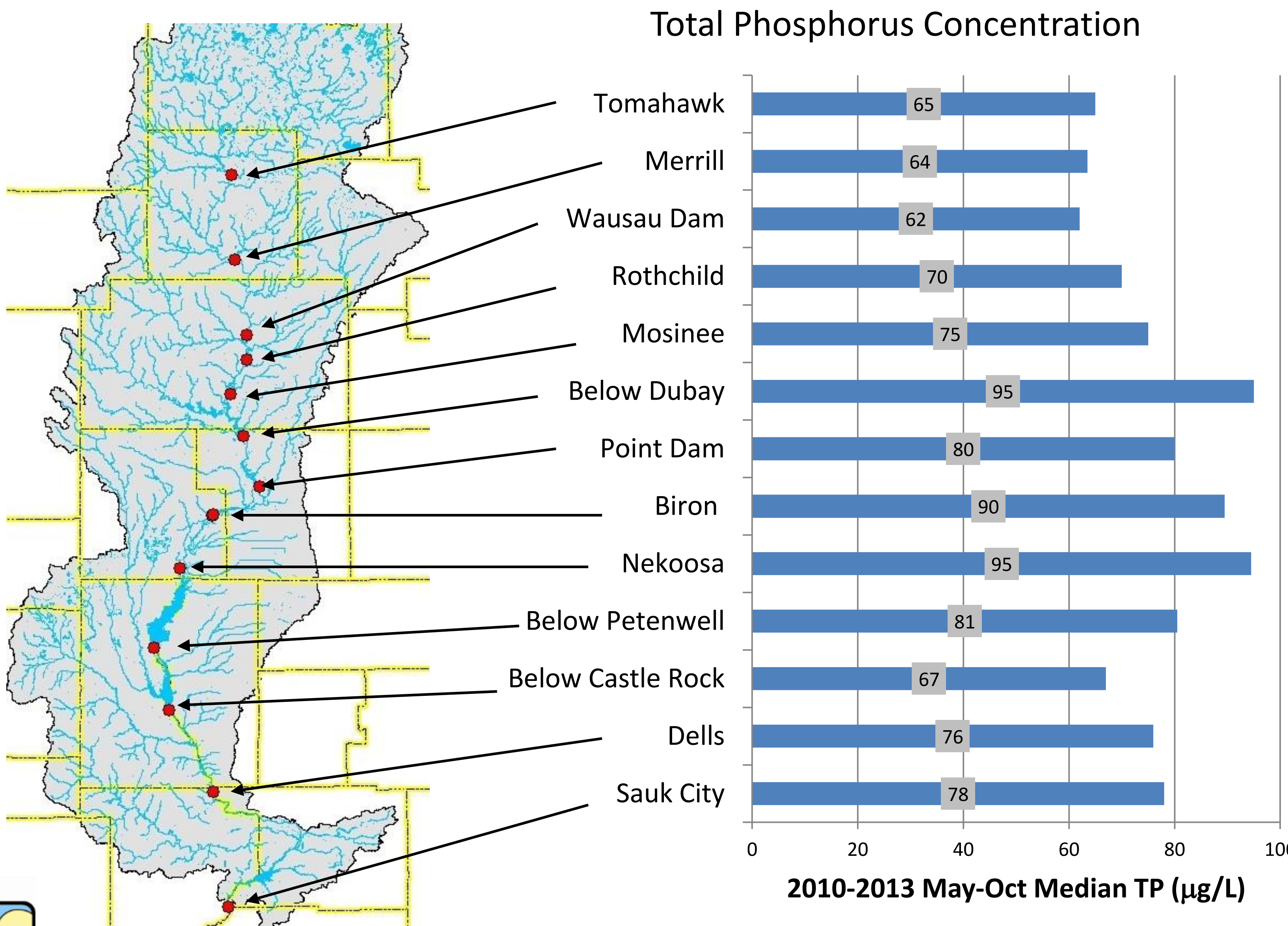
Main Stem Monitoring Results



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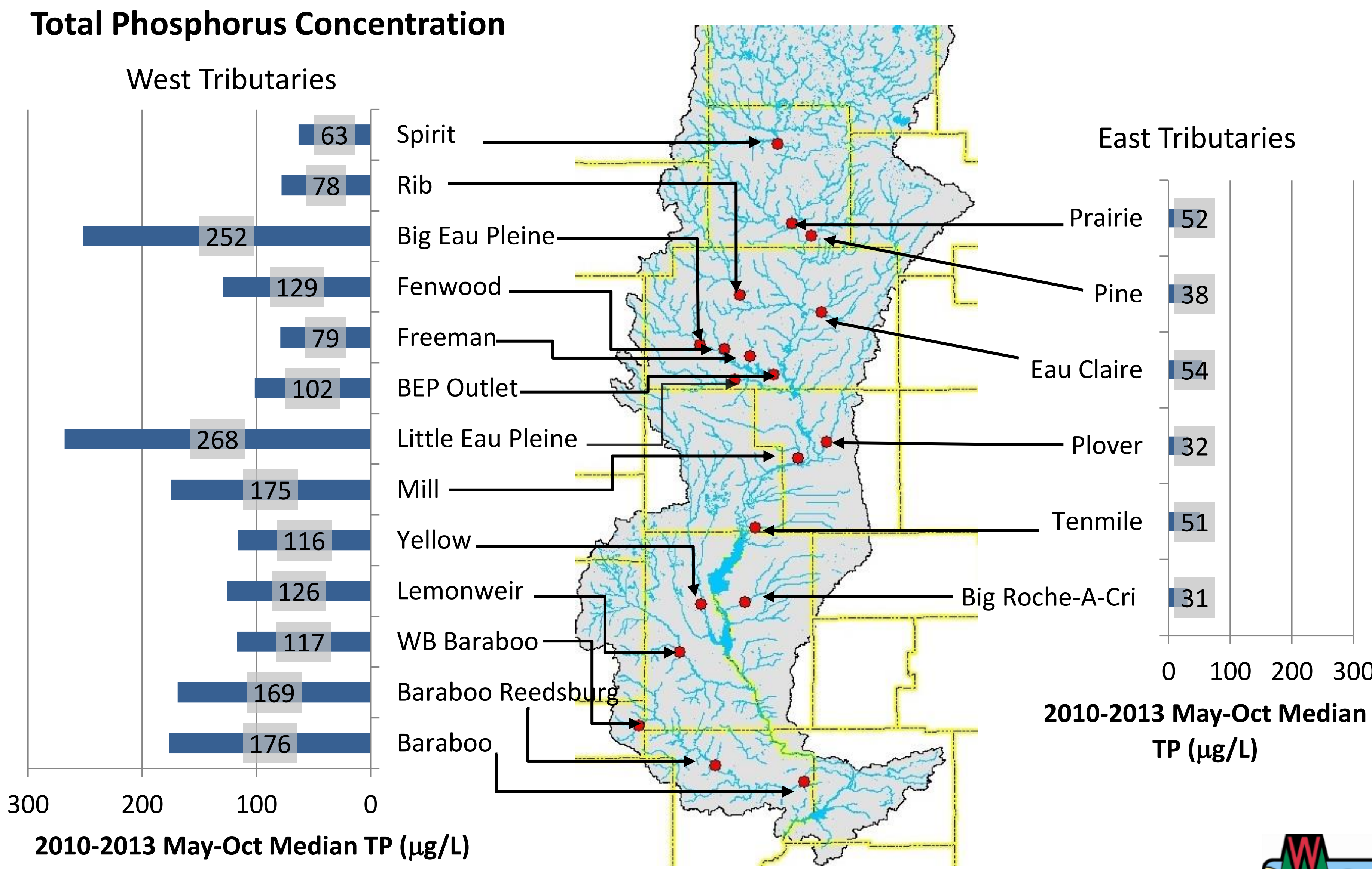
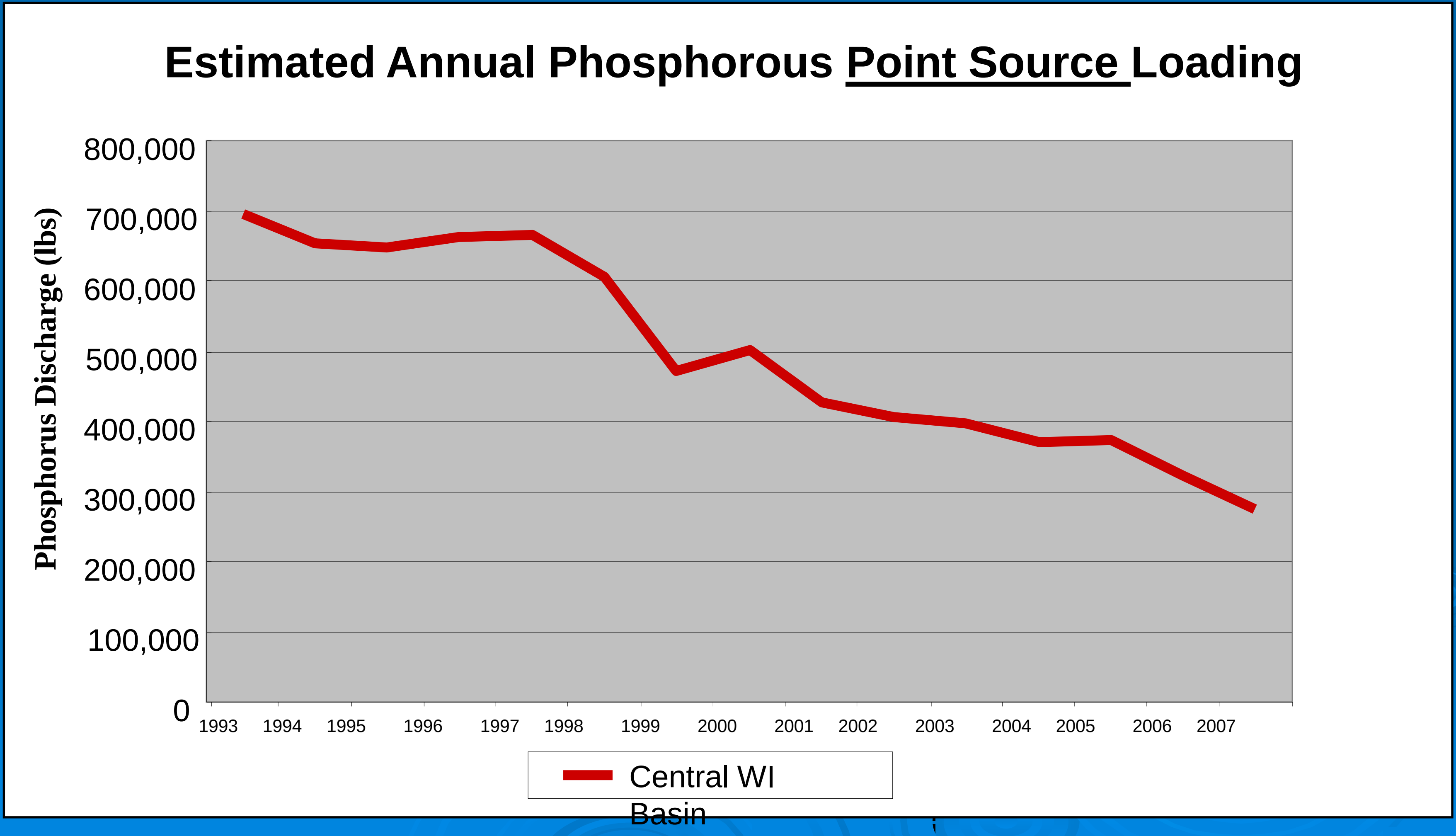
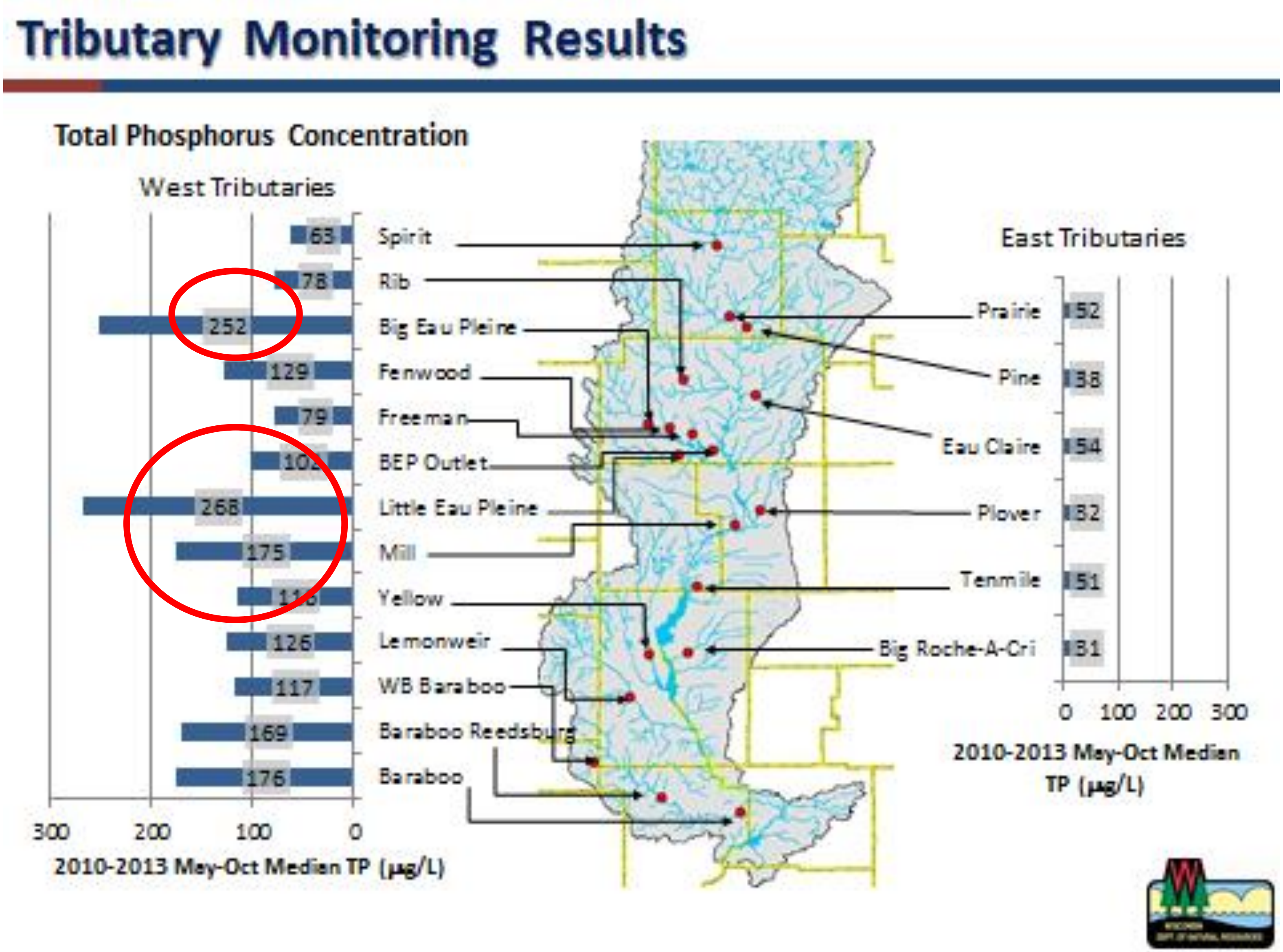
Tributary Monitoring Results



We ARE Making Progress



Need to Address NPS!



One Basin; Two Personalities

- East side, tends to be sandy
- Lower runoff potential
- Different management
- Wind erosion

One Basin; Two Personalities

- West side, tends to be heavier soils
- Higher runoff potential
- Different management

Difficulty of NPS Management

- Hard to pinpoint source
- Lack of incentives (i.e. rules, $$$, etc.)
- Land use patterns
  - Generational ethos
  - Local demands
  - Perceptions

Summary

- A river we want to be a lake
- “stuff” (nutrients and sediment) settles
- Fuels algae, decrease water quality, alters bio
- Active TMDL – need implementation
- Progress has been made
- Work on NPS
- Prevent AIS


Yep, Yep, Yep
Thank You!

What can we do together? Open Discussion

- Show successes
  - NPS control porjects
  - PS success
  - AIS prevention model
- Don’t ignore problems
- I and E
  - Political
- Bigger picture (i.e. watershed to river valley to continental basin)