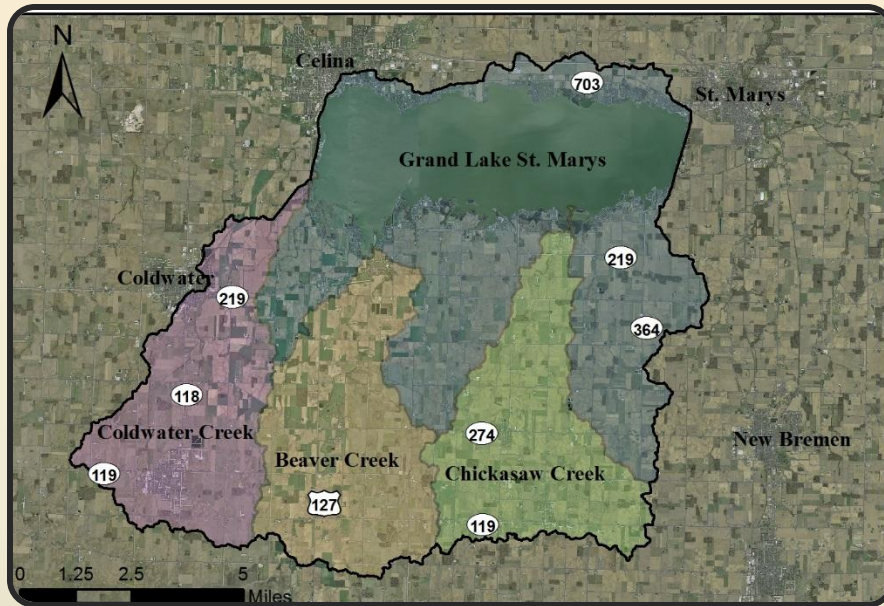


# WETLANDS AND WATER QUALITY IN THE GRAND LAKE ST. MARYS WATERSHED



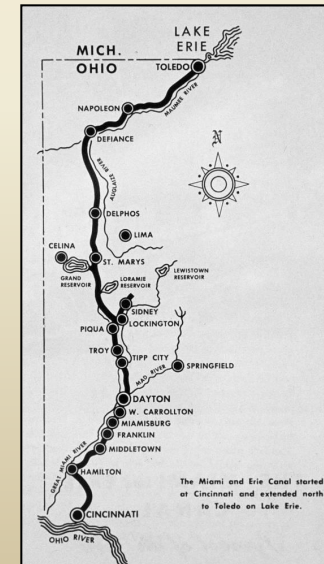
**STEPHEN J. JACQUEMIN**  
WRIGHT STATE UNIVERSITY – LAKE CAMPUS



# A Brief History of the Lake



- Prior to settlement in the early 1800s the area was largely wetland, prairie, and forest habitats
- GLSM was constructed (1830s) early in settlement period as part of Miami – Erie Canal
- The canal, coupled with late 1800s oil reserve drilling and the dawn of agricultural efforts, helped drive the original economic / population engines of the area – providing conduits for movement of people and goods
- Following canal and oil boom era ~early 1900s – GLSM repurposed for recreation focus
  - Hereafter, water quality becomes the unseen force underpinning the lake and community itself



# Grand Lake St. Marys Watershed

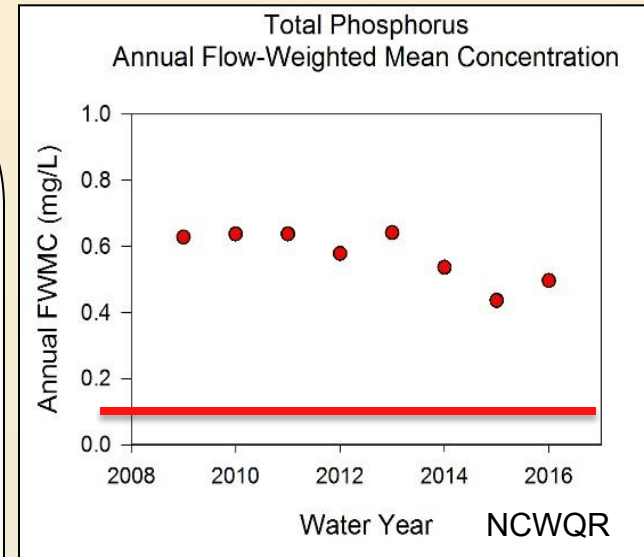
- Mercer / Auglaize Counties, Ohio
- Watershed is 241 km<sup>2</sup> (~60,000 acre) area
- Social, economic, and environmental value
- 1<sup>st</sup>/2<sup>nd</sup> order streams drain into reservoir
- Reservoir constructed 1837-1845
  - large (52 km<sup>2</sup>), shallow (~1.5m), and mixed (15+km fetch wave length)
- Watershed primarily agricultural crop/livestock
- Experiences internal and external loading



# Historical State of the Watershed



- Unfortunately, High levels of nonpoint nutrient rich runoff accumulated over time – leading to poor water quality
- Testing in the late 90s early 2000s documented :
  - Streams flowing into GLSM in the 75th+ percentile for nutrient concentrations nationwide (USEPA 2009)
  - Soils in the watershed ranking in 90th+ percentile for nutrient levels (Ohio P Task Force 2013)
  - HAB activity (toxins) in GLSM ranking in the 99th percentile nationwide (USEPA 1999)
- Tipping point was reached in early 2000s with declining water quality impacting drinking water, recreation, health, aesthetics, and local economy impossible to ignore . . .
- Watershed officially declared **DISTRESSED** in 2011
  - Decade that follows marks a distinct regime shift in the management of the watershed



**Over the past decade -  
Grand Lake has become  
a focal point for  
understanding nutrient  
runoff and conservation**

# Watershed Efforts

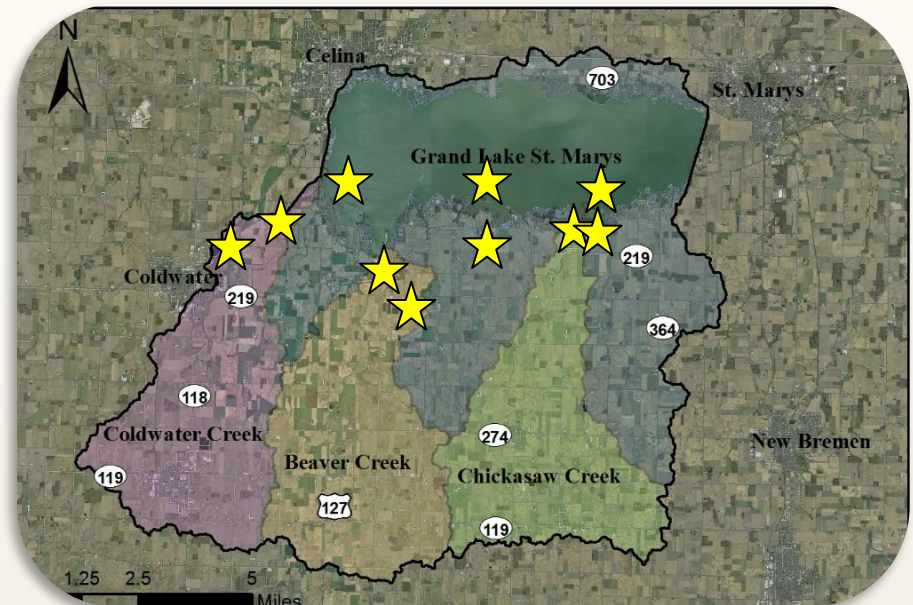
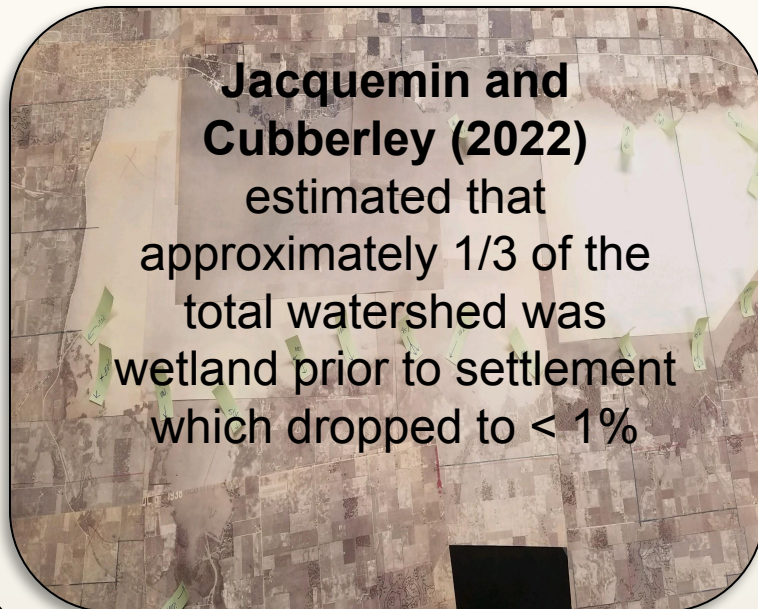


- 2011 Distressed Watershed Ruling signified a regime shift in management style
- GLSM watershed efforts since this period highlight the implementation of innovative BMPs, regulations, and conservation practices to reduce nutrient runoff - 2013 takes off
  - Comprehensive Efforts
    - Nutrient management plans (now over 90% of acres) informed by soil testing
    - Cover crops (increasing acres utilizing cover crops)
    - Stream restoration projects
    - Edge of field runoff practices (retention ponds, saturated buffers, bioreactors, inlets)
  - Manure Nutrient Focus
    - Winter manure ban (prohibited Dec. 15 to Mar. 1)
    - Manure storage structures (~80 constructed from 2010 to 2013)
    - Manure transfers (90% of chicken litter is exported)
    - New manure dewatering technologies being explored
  - Communication Efforts
    - Local collaborative groups such as Ag Solutions, LIA, LRC encourage communication
  - **Habitat Restoration**
    - **Restored wetlands**



# Reestablishing Balance in the Watershed

*Beginning with distressed watershed rules – hundreds and hundreds of acres of best management practices, nutrient management planning, communication efforts, and natural habitat restorations such as **wetlands** have been prioritized – leading to an increase in biodiversity in the watershed and further nutrient remediation leading to cleaner water flowing into the lake*

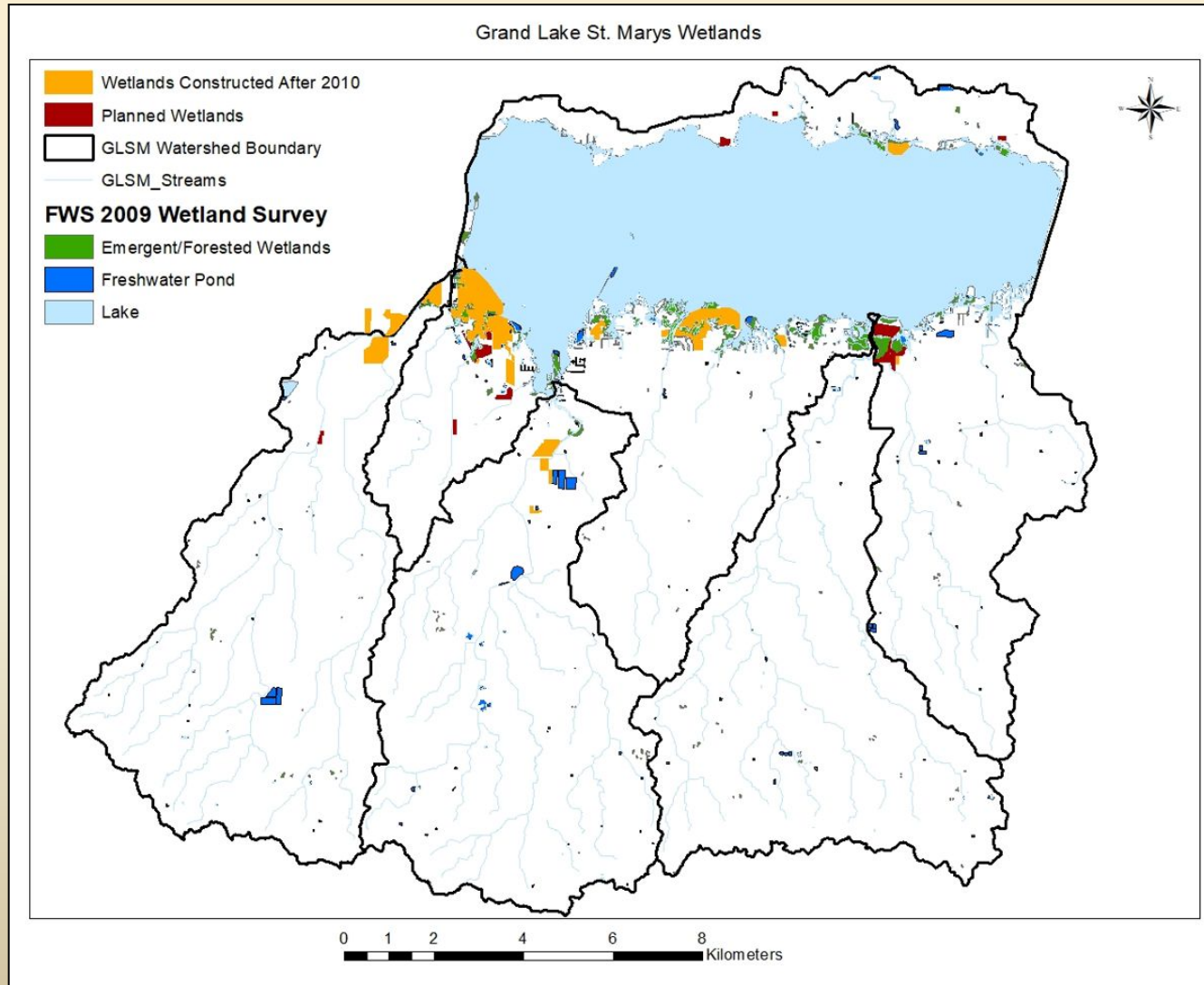


# What Is A Wetland?

- Areas of transition between land and water - typified by *hydric* soils, biota, and water
- Act as valuable areas for water storage, water pollutant reduction sites, recreation zones, biodiversity hotspots, and many more!
- Historically these habitats have been treated as nuisances that need to be drained for public good - unfortunately, that has largely happened with Ohio losing 90+% statewide
- We must recognize the good these systems can do and how we can restore



# Reestablishing Natural Habitats In GLSM



~1,000  
Acres  
and  
Counting  
of  
Restored  
Wetland  
Habitat

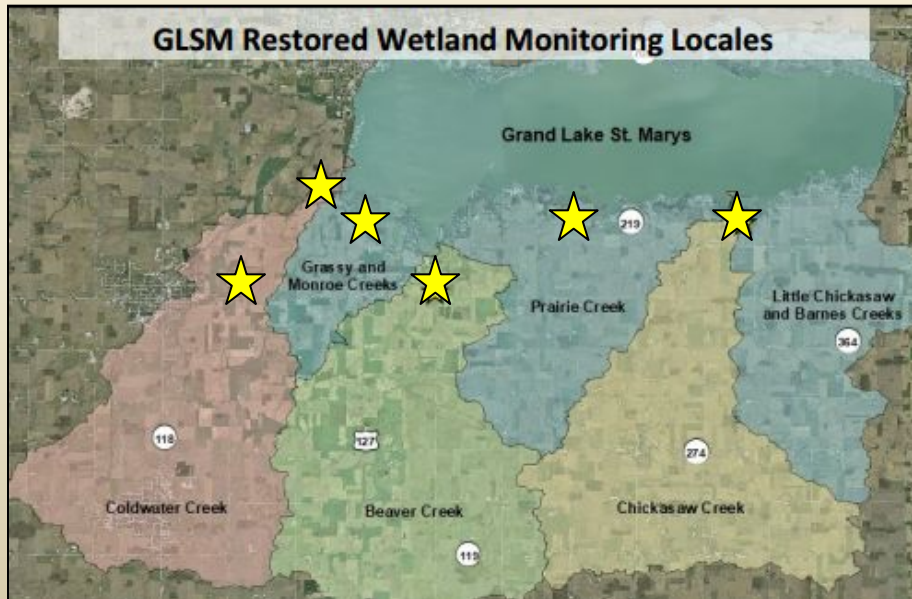
<0.5%

TO

~2+%

# Wetlands in Grand Lake St. Marys

- **Wetlands in GLSM >5 Acres Include:** Prairie Creek, Grassy/Monroe Creek, Beaver Creek, Big Chickasaw Creek, Little Chickasaw Creek, Burntwood Creek, Rosenbeck Wetland, Northshore Greenspace Wetlands, Gilliland Wetlands, Redwing Nature Preserve, Wildlife Refuge Wetland Complex, as well as a series of Littoral Wetlands on the main tributaries where they enter into the lake
- 2025 saw active monitoring on 6 of these  2026 will expand monitoring network



*Monitoring involves weekly measurement of inflow and outflow nutrient and sediment concentrations as well as continuous measurements of flow into and out of each wetland*

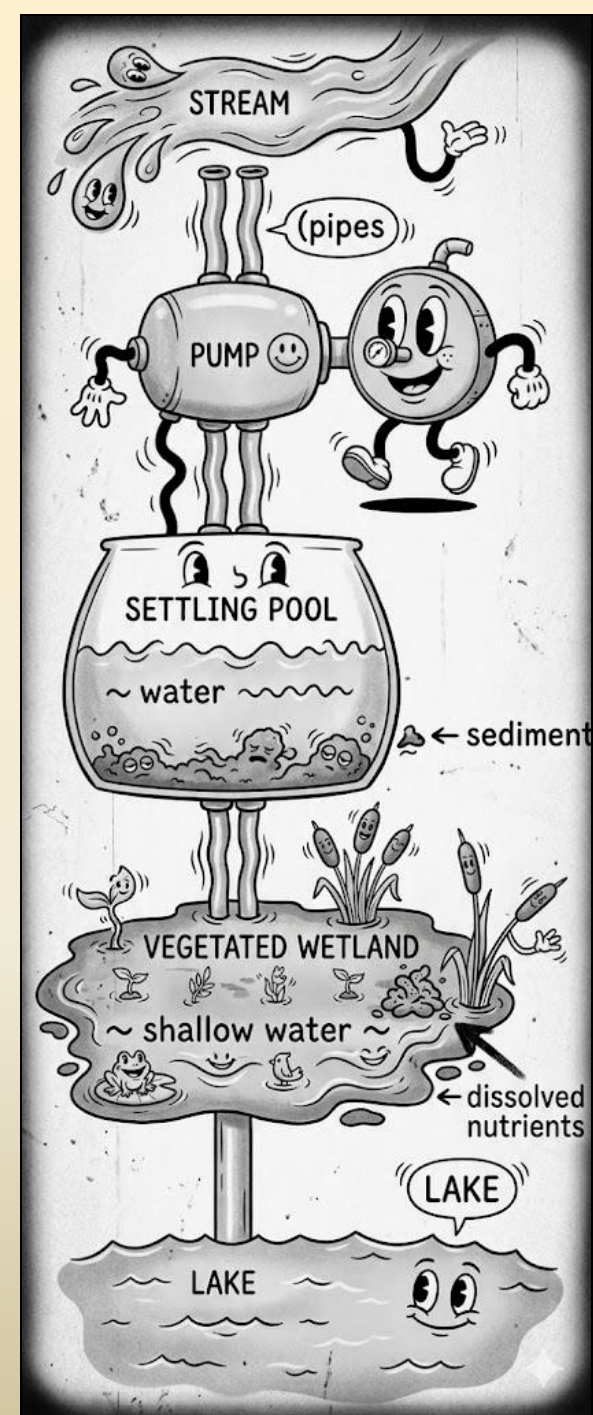
# Wetland Restoration Design in GLSM

Wetlands are generally designed in GLSM to maximize nutrient reduction efficiency

Design and Implementation Funded Through Clean Ohio, H2Ohio, OEPA, etc.



Designs involve processing zones (settling pools, shallow vegetated flats, etc.)



# Wetland Case Study: Coldwater Creek



Clean Ohio Land  
Purchase

~\$1,000,000 Wetland  
Design/Construction

~\$10,00 Wetland Annual  
Operation Cost

**~25 Acres Of A 12,300 Acre Subwatershed**

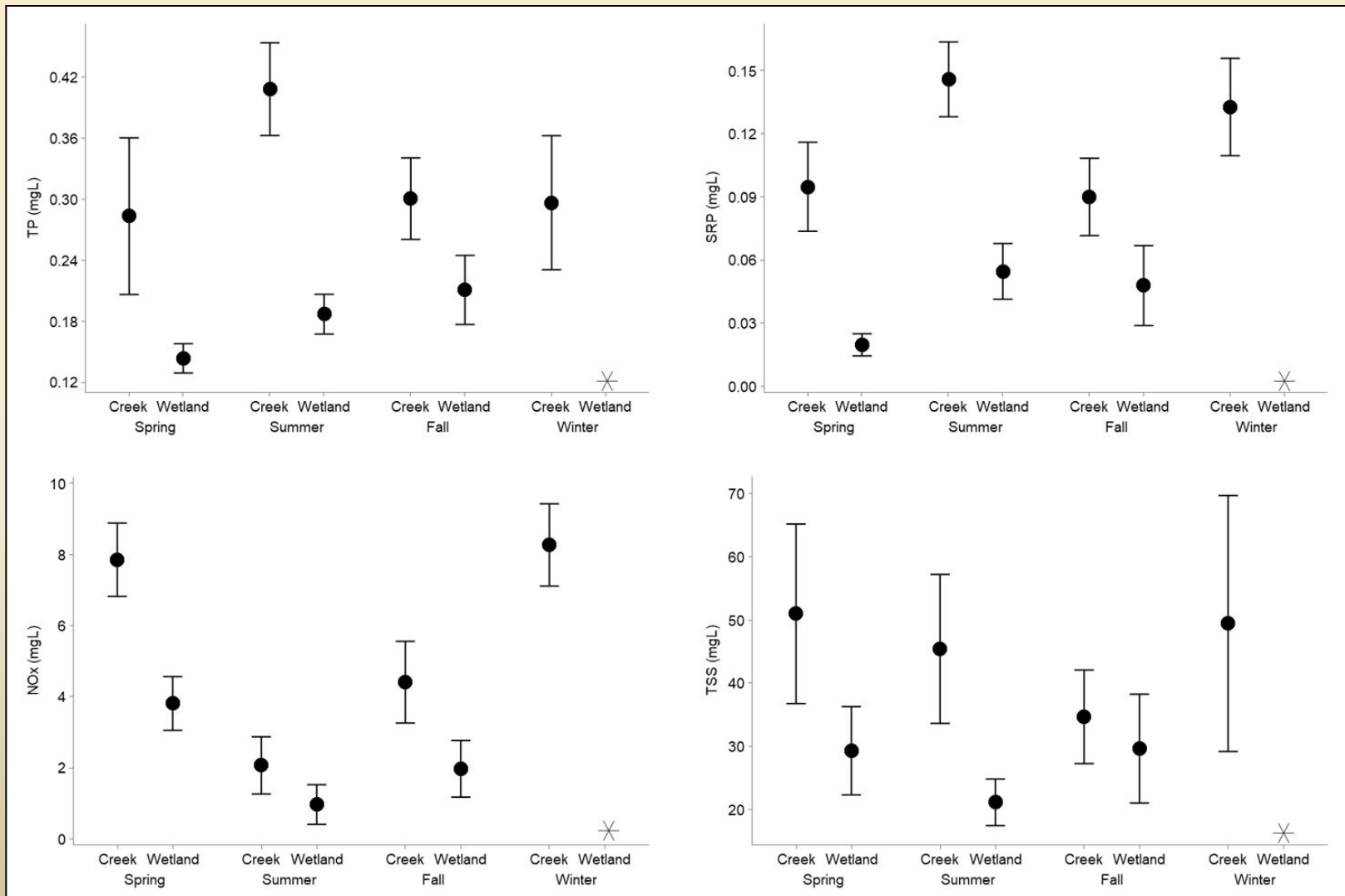
# Wetland Case Study: Coldwater Creek

*Coldwater Creek Today - With Many Others In The Watershed Like It . . .*



# Wetlands- Just How Effective Are They in GLSM?

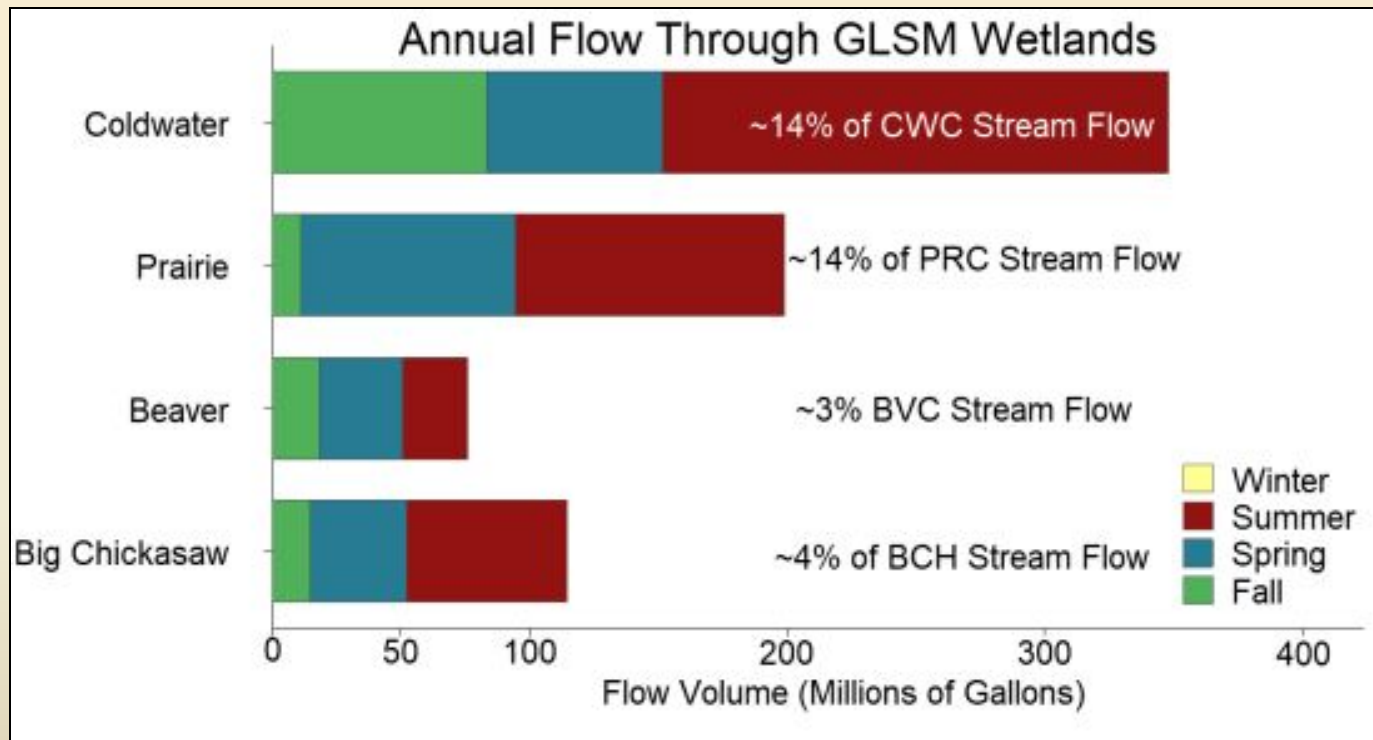
~50 to 75+% Nutrient Concentration Reductions Across The Board



# Wetlands- Just How Effective Are They in GLSM?

Majority Stream Volume Processed In Several Seasons

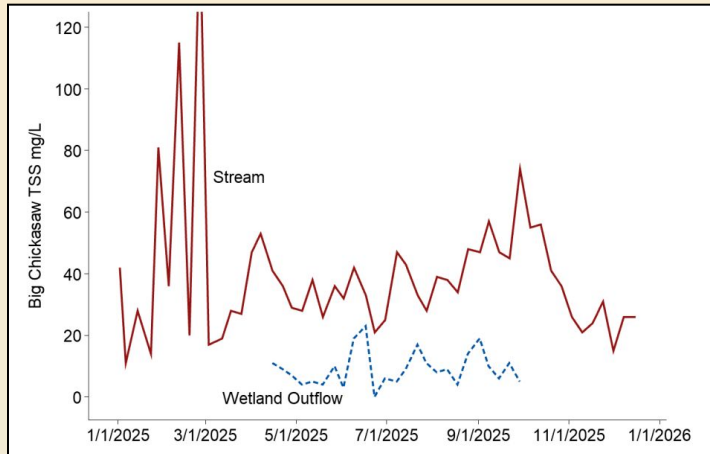
## 2025 Wetlands in Review



Peak Effectiveness During Summer – Residence Times of ~3.5 days

# Wetlands- Just How Effective Are They in GLSM?

## Overall Nutrient Reductions 2025 Wetlands in Review



## - These 4 Wetlands Removed

- ~ 30,000 pounds of nitrogen
- ~ 1,000 pounds of phosphorus
- ~ 160,000 pounds of sediment

**2026 Will See 10+ Wetlands Added To WSU Wetland Monitoring Program**



# Wetlands- Just How Effective Are They in GLSM?

## *Putting Things in Context . . .*

- Coldwater Creek is situated on 0.3% of the subwatershed area (30 ac)
- Operates about 55% of the days of year
- Yet **processes** the equivalent of 15% of the annual stream flow achieving tremendous nutrient concentration reductions THAT when you extrapolate load indicates an average annual processing potential of 2% N, 5% P, and 5% TSS total annual load reduction



# Have Wetlands Improved The Lake?

- *Beyond The Obvious Reductions In Nutrient Runoff*
- *Where Wetlands Interface With GLSM - There Is A 75+% Decline in HABs*



Grand Lake St Marys

Littoral Wetland

Prairie Creek

# Wetlands- Just How Effective Are They in GLSM?

Biodiversity Upticks, Recreation Opportunities, & Economic Lifts

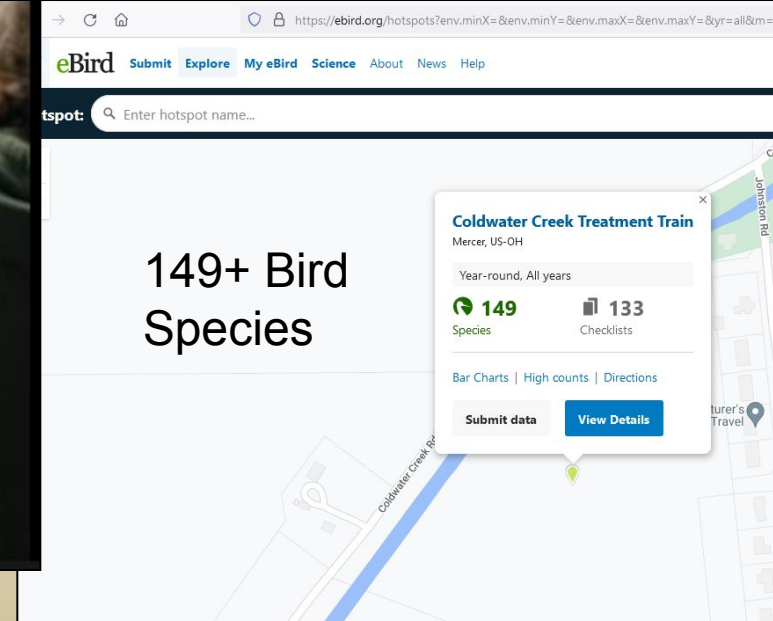
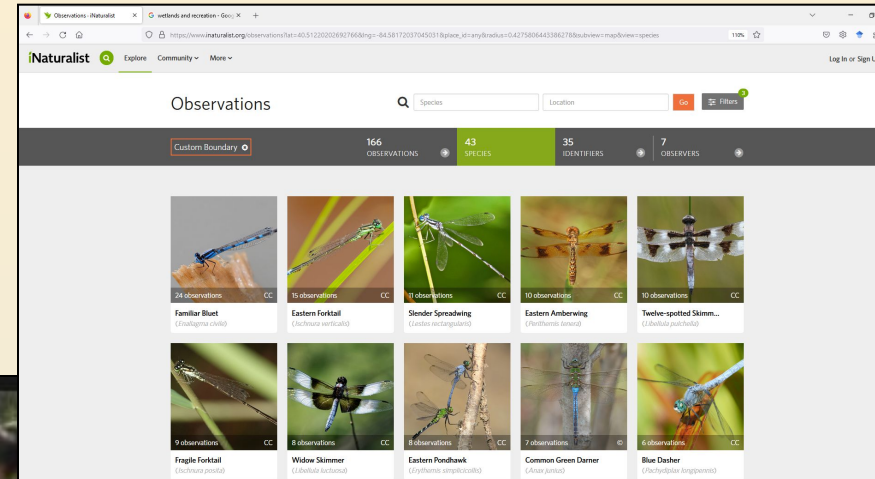
## Valuing Urban Wetlands: A Property Price Approach

Brent L. Mahan, Stephen Polasky and Richard M. Adams

Land Economics

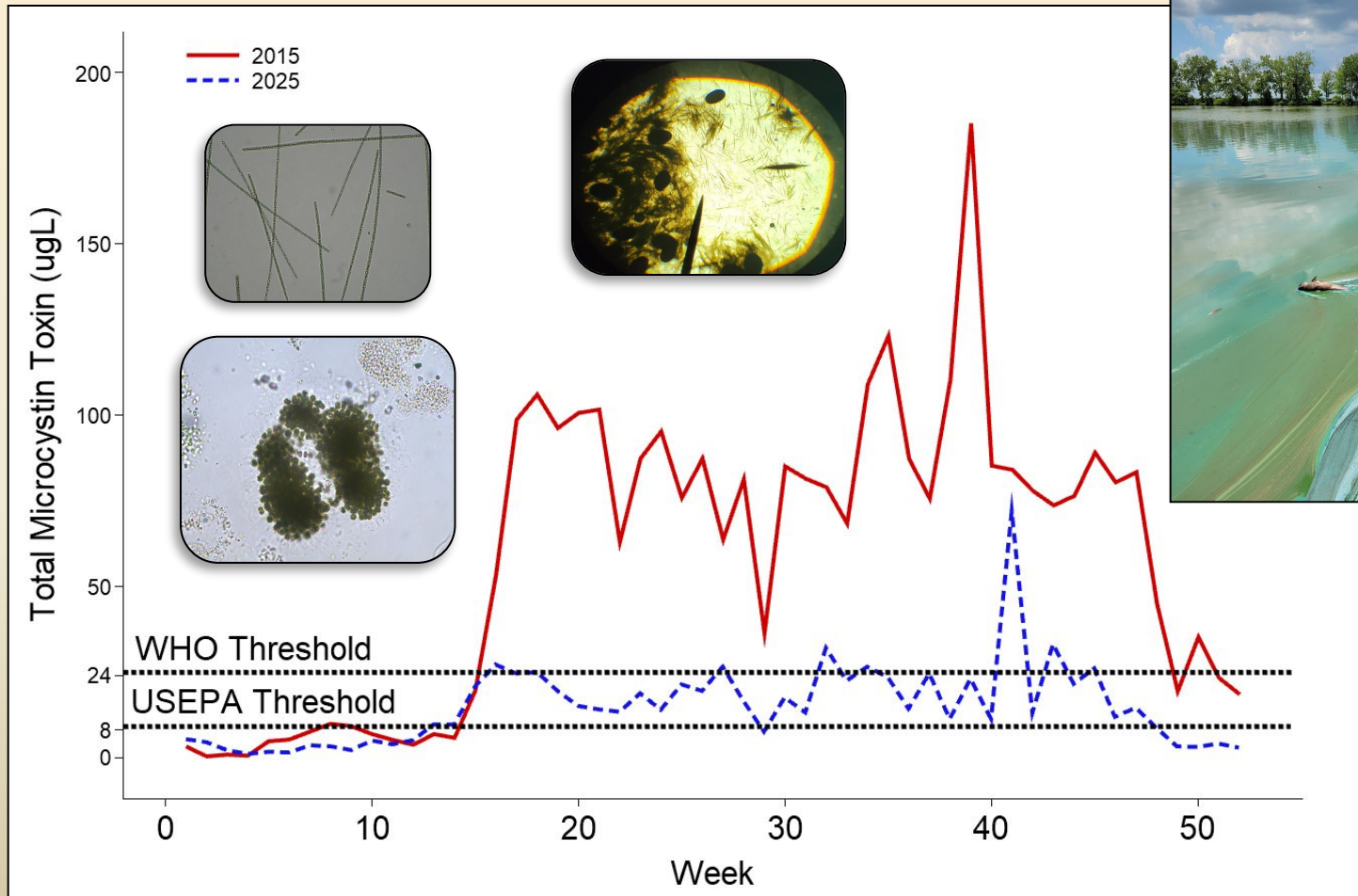
Vol. 76, No. 1 (Feb., 2000), pp. 100-113 (14 pages)

Published By: University of Wisconsin Press



# HABs and Grand Lake St Marys - Encouraging Changes As a Result of Nutrient Reductions . . .

A Decade of Change: 2015 vs. 2025

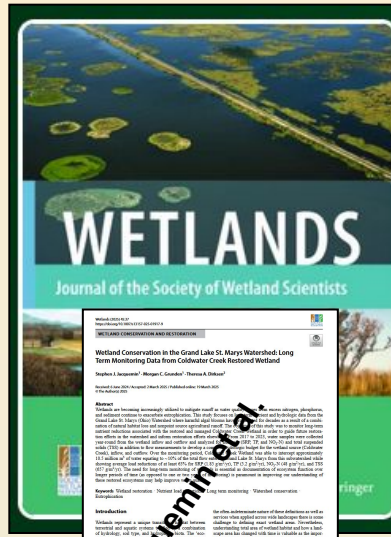


# Want To Learn More About GLSM Wetlands?



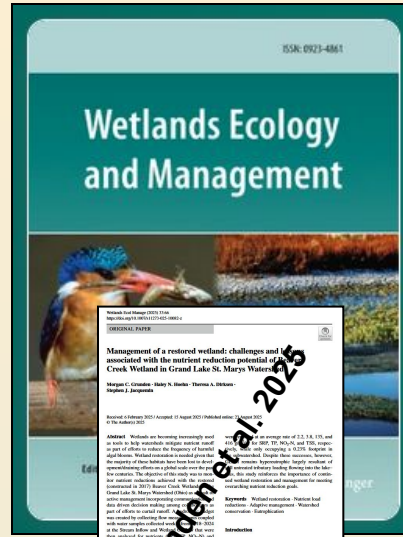
Journal of Environmental Quality  
TECHNICAL REPORT  
Changes in Water Quality of Grand Lake St. Marys Watershed Following Implementation of a Distressed Watershed Rules Package  
Stephan J. Jacquemin, Leah M. Tomlin, Thomas A. Dikens, and Greg McElroy

Jacquemin et al. 2018



Wetlands  
Journal of the Society of Wetland Scientists  
Wetland Conservation in the Grand Lake St. Marys Watershed: Long Term Monitoring Data from Colchester Creek Restored Wetland  
Stephan J. Jacquemin, Greg McElroy, Leah M. Tomlin, and Thomas A. Dikens

Jacquemin et al. 2025



Wetlands Ecology and Management  
Management of a restored wetland: challenges and lessons associated with the nutrient reduction potential of a restored wetland in Grand Lake St. Marys Watershed  
Stephan J. Jacquemin, Leah M. Tomlin, Thomas A. Dikens, and Greg McElroy

Grunden et al. 2025



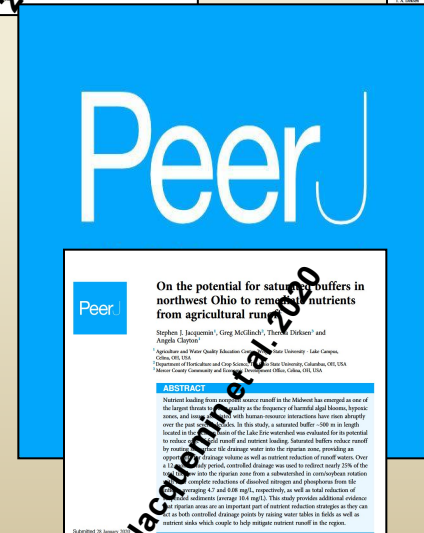
nature  
SCIENTIFIC REPORTS  
Long term water quality improvements associated with the restored Prairie Creek Wetlands in Ohio's Grand Lake St. Marys Watershed  
Stephan J. Jacquemin, Leah M. Tomlin, Thomas A. Dikens, and Greg McElroy

Jacquemin et al. 2026



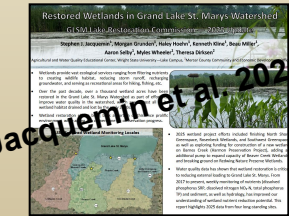
The American Midland Naturalist  
An International Journal of Ecology, Evolution and Environment  
Documentation of a Massive Fish Die Off on Grand Lake St. Marys: Notes on Long-term Changes in Fish Assemblage and Watershed Habitat over the Past Century  
Stephan J. Jacquemin, Leah M. Tomlin, and Thomas A. Dikens

Jacquemin et al. 2020



PeerJ  
On the potential for saturated buffers in northwest Ohio to remove nutrients from agricultural runoff  
Stephan J. Jacquemin, Greg McElroy, Leah M. Tomlin, and Thomas A. Dikens

Jacquemin et al. 2020



Restored Wetlands in Grand Lake St. Marys Watershed  
GLSM LIA Restoration Commission  
Stephan J. Jacquemin, Leah M. Tomlin, Thomas A. Dikens, and Greg McElroy

Jacquemin et al. 2026

# SO ... Has GLSM Improved Over the Past Decade?

YES!



GLSM is not 'fixed' by any means - BUT significant improvements have been made

# Moving Forward

*More Restored Habitats Throughout the Watershed - Including Upstream and Downstream Wetlands on Every Creek and Redesigned Stream Channels*  
*Working with Farmers and Landowners on Continued Edge of Field Practices and Continued Efforts to Improve Nutrient Management*



# Thank You

A SPECIAL THANK YOU TO ALL OF THE WRIGHT STATE LAKE CAMPUS STUDENTS FROM OVER THE YEARS FOR HELPING MONITOR AND IMPROVE WATER QUALITY. ADDITIONALLY, THIS WORK WOULD NOT HAVE BEEN POSSIBLE WITHOUT COLLABORATION WITH THE LAKE RESTORATION COMMISSION.



Wright State University  
Lake Campus