

Understanding the Phosphorus Loading Targets for Lake Erie and Evaluating Progress

Dr. Jeffrey M. Reutter

Retired Director

Ohio Sea Grant & Stone Lab, The Ohio State University

Past Chair of the Board, The Nature Conservancy in Ohio

Questions for Today's Talk

- **What are the phosphorus reduction targets?**
- **When and how were the targets established?**
- **What will success look like?**
- **How should we measure progress? Explain.**
- **Why is it wrong to say we are halfway to our goal?**
- **Do I like H2Ohio?**
- **What are the highlights of the recent IJC Manure Collaborative Report?**

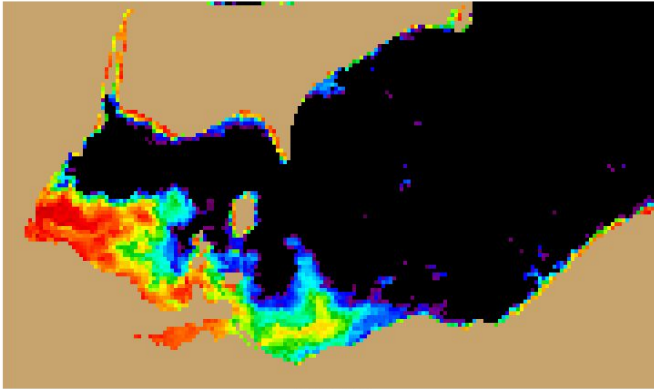
Annex 4 Targets for GLWQA

- I Chaired Annex 4 Objectives and Targets Task Team of GLWQA (September 2013-May 2015)
 - HABs: 40% Spring (1 March-31 July) reduction in **TP** and **DRP** loading to Western Basin (Targets = 860 MT TP; 186 MT DRP)
 - DRP is most important
 - To track progress: use FWMC, not load or actions (BMPs) on the land
 - FWMC = Load / discharge
 - Load depends on discharge (how much rain we get)
 - Problems with using BMPs: Faulty estimated reductions for BMPs, BMPs for manure not good, farmers are not truthful, only measuring positive actions and not negative
 - Target FWMC for Maumee River: TP = 0.23 mg/l; DRP = 0.05 mg/l
 - US and Canada Agree to Annex 4 Targets (Feb. 2016)
 - Ohio, Michigan, and Ontario agree to hit target by 2025
 - Zero progress to date = no change in FWMC (clarify later)

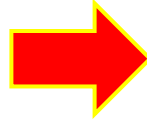
Noteworthy efforts before Annex 4:

- We explained problem to farmers and agencies in Feb 2010 (~15 yrs)
- Set 40% reduction target with Ohio P Task Force in March 2013 (~11yrs)
- IJC agreed with 40% reduction target in October 2013
- Using regulations, we reduced sewage load by 62% in 9 years (1972-81)

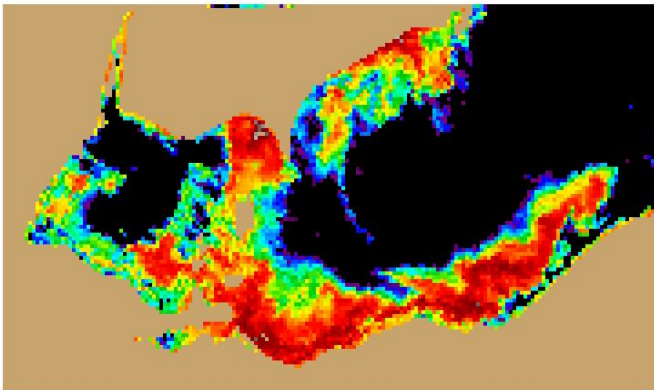
Visualizing a 40% Reduction Using 2008, 2011, and 2012



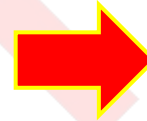
2008



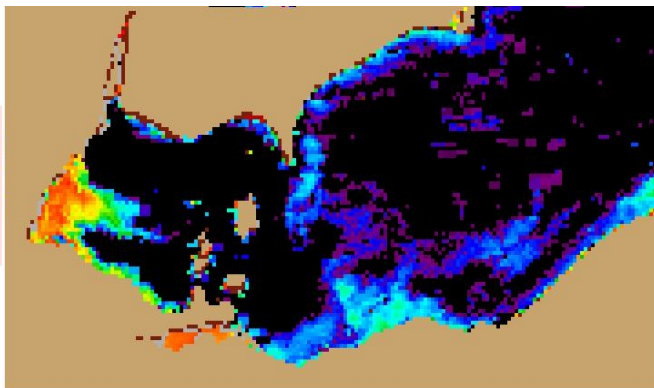
Ann. discharge = 8.0 billion m³
Spring discharge = 3.4 billion m³
Ann. P load = 3,800 tonnes
Spring P load = 1,400 tonnes



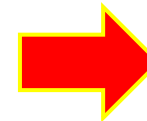
2011



Ann. discharge = 6.2 billion m³
Spring discharge = 5.0 billion m³
Ann. P load = 3,100 tonnes
Spring P load = 2,300 tonnes

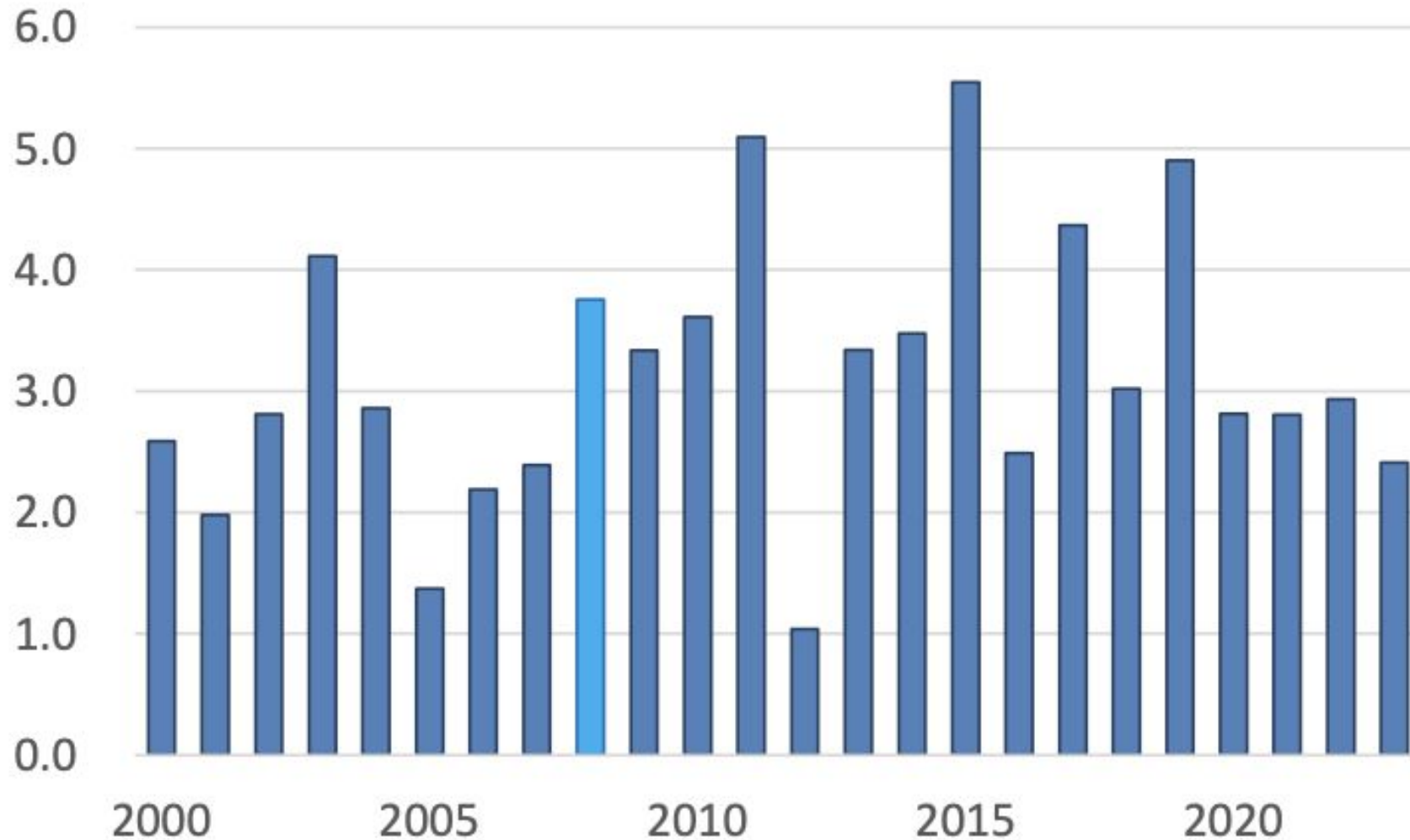


2012



Ann. discharge = 6.1 billion m³
Spring discharge = 1.0 billion m³
Ann. P load = 2,500 tonnes
Spring P load = 400 tonnes

Maumee River Spring Discharge in cubic km



2023 TP Spring Load

Water Monitoring Summary

March 1, 2023- July 31, 2023

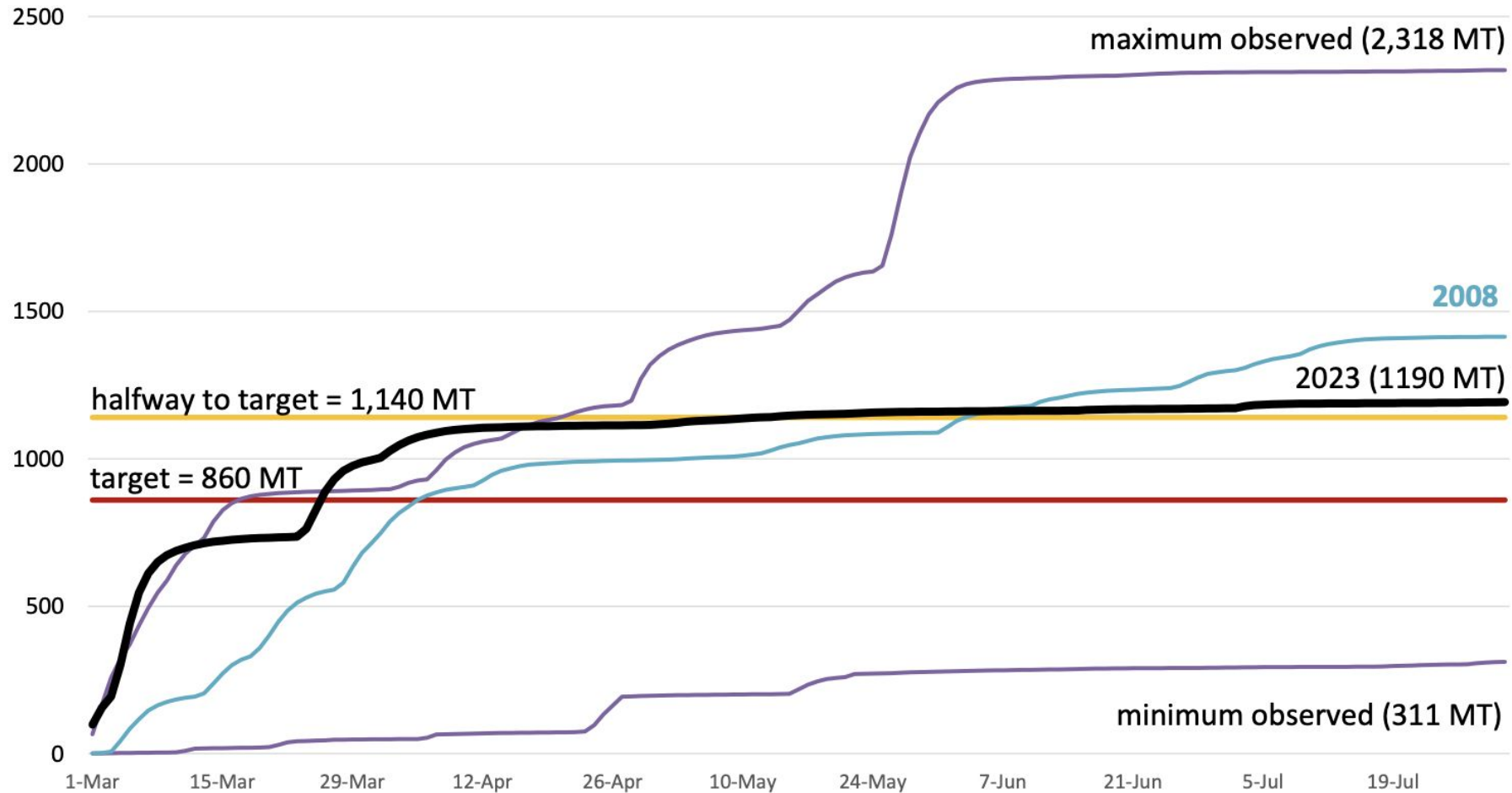


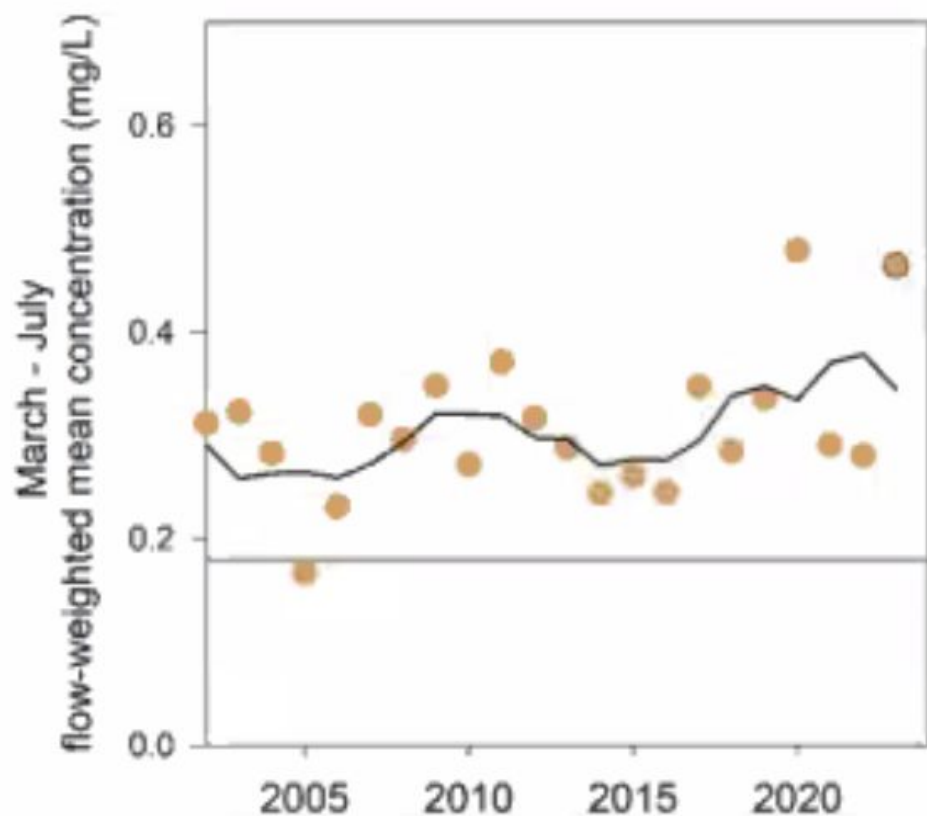
Figure 5: Cumulative total phosphorus loads in metric tons at the Maumee River at Waterville station (1) in March-July 2023 compared to maximum and minimum cumulative daily values for the period 2002-2020 and the cumulative chart for the baseline year of 2008.

Maumee River in Waterville

$$\text{Concentration} = \frac{\text{Load}}{\text{streamflow}}$$

How does 2023 compare to past concentrations?

Total Particulate Phosphorus



Currently → 0.464 mg/L

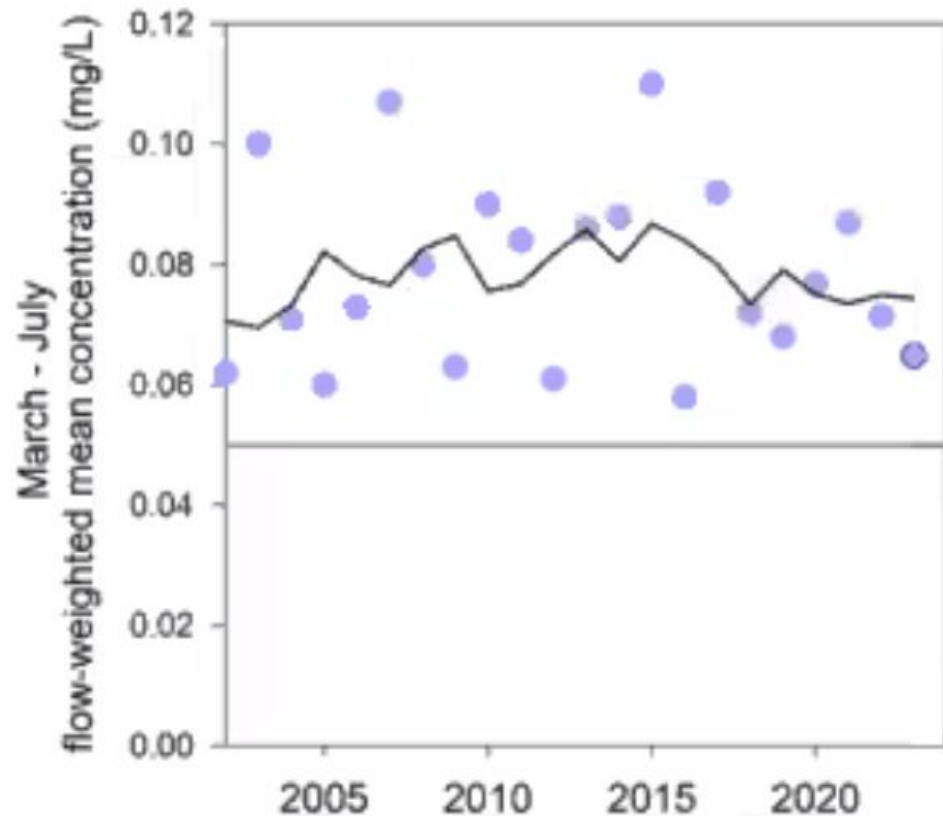
Average → 0.297 mg/L

Target → 0.180 mg/L

— 5 year running average

— Concentration Target

Dissolved Reactive Phosphorus



Currently → 0.065 mg/L

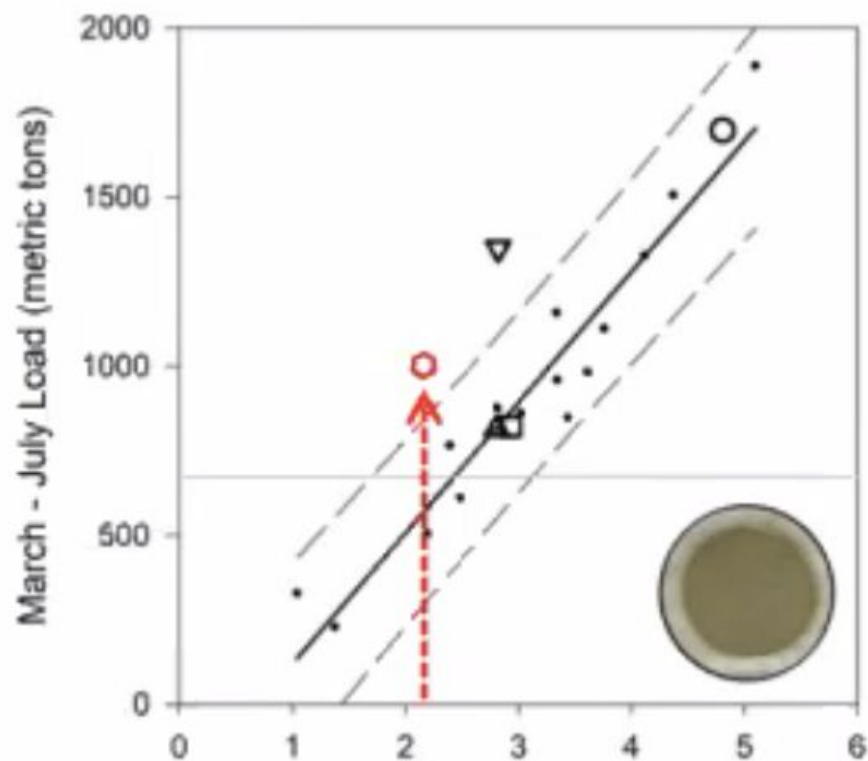
Average → 0.080 mg/L

Target → 0.050 mg/L

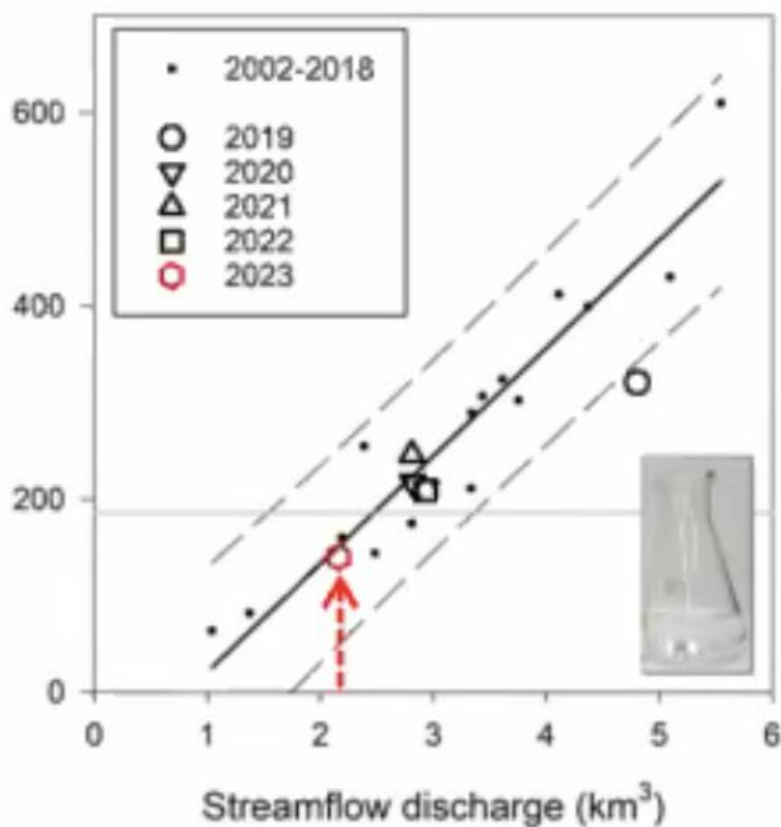
Are 2023 loads where we would expect based on 2002-2018?

(current loads as of June 25th)

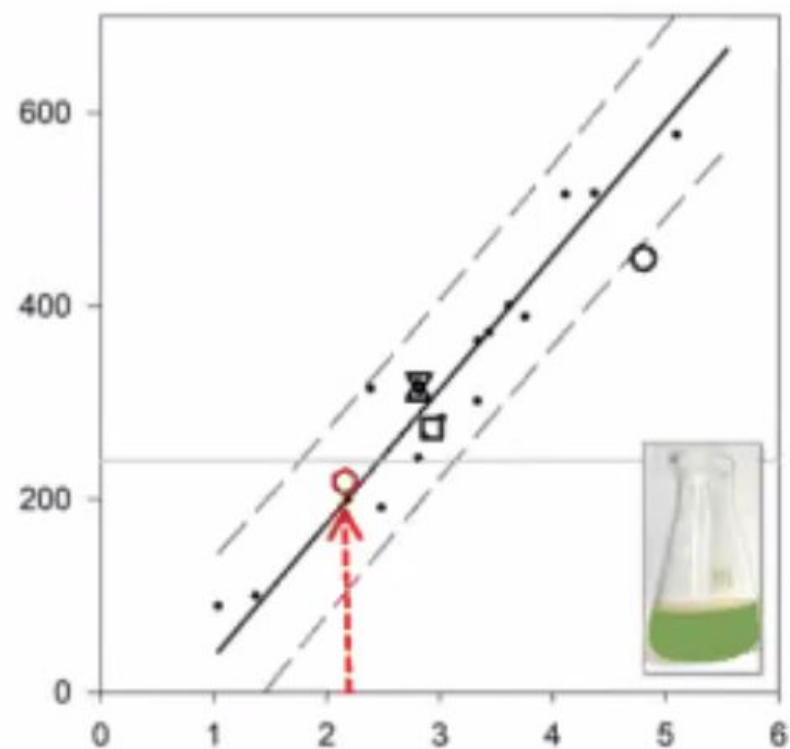
Total Particulate P



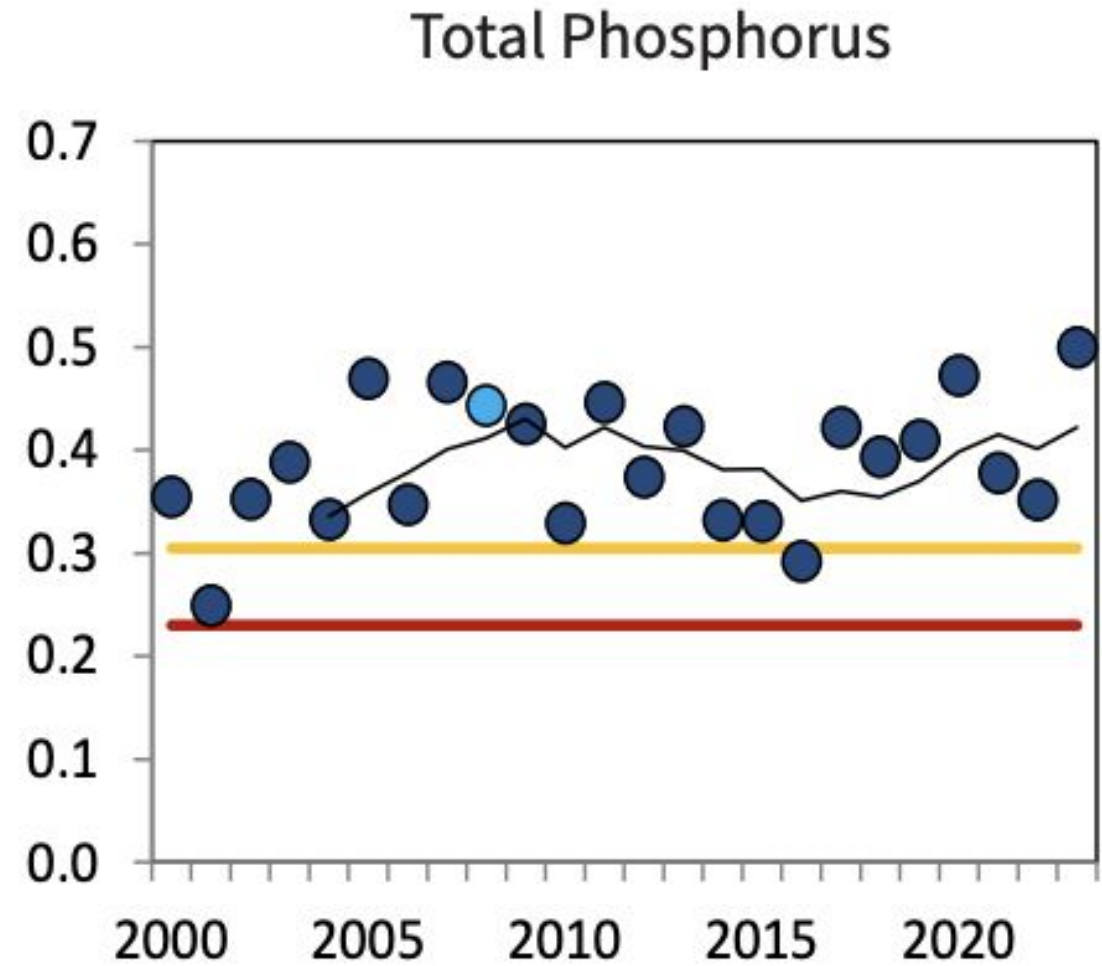
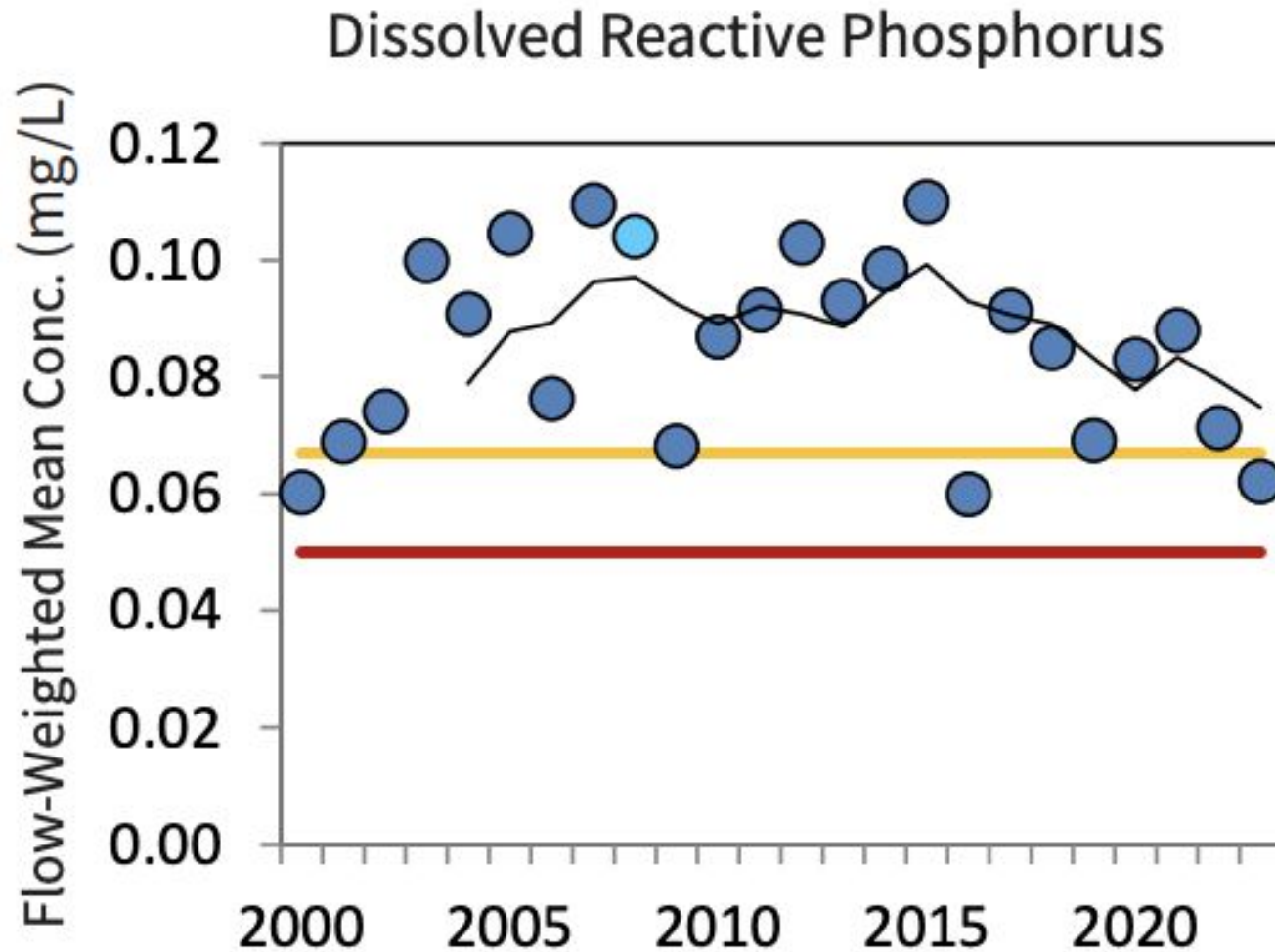
Dissolved Reactive P



Total Bioavailable P



Maumee River DRP and TP FWMC



Less Ag P Applied in 2019 Led to Less DRP Transported to Lake Erie

Guo, Johnson, LaBarge, Penn, Stumpf, Baker, & Shao (2021)

- 1. 62% reduction in P application due to weather**
- 2. Resulted in 29% less load to Lake Erie than predicted by discharge volume**
- 3. Higher STP levels lead to higher DRP runoff concentrations**
- 4. Fields with STP levels of 100 ppm legacy fields**
- 5. Crop removal of nutrients brings down STP 1-5 ppm per year**
- 6. Optimum agronomic range for STP in Ohio, Michigan, and Indiana is 20-40 ppm Mehlich-3**
- 7. Relationship between STP and DRP in Ohio indicates a value of 30 Mehlich-3 produces DRP concentrations of 0.048 mg/l**

Manure and Commercial Fertilizer

- No difference when applied in equal amounts, but animal operations are allowed to apply too much manure, i.e., >4 times the amount of P that is needed for crop production. This is major source of legacy fields (fields with too much P—STP 100+ ppm).
- **If those guidelines are followed, at a minimum, those fields will release P at a rate 60-200% over Annex 4 target for DRP, 0.05 mg/l (0.08-0.15 mg/l)**
- Runoff concentrations go up precipitously when STP above 120 ppm.
- The worst legacy fields are around animal operations (20-40 times more P than is needed for max. crop production).
- Regulated CAFOs are supposed to follow **application guidelines**.
 - 700 or more dairy cows
 - 2,500 or more hogs
- Unregulated CAFOs or 1-Unders (just below the CAFO size) are growing rapidly. They don't have to follow **application guidelines**.
- 90% of animal operations in Auglaize Watershed are 1-unders (unregulated).
- Majority of manure is spread within 2 miles of the barn.
- Since 2002, commercial fertilizer use in the Auglaize Watershed has remained relatively constant, but manure use has doubled and continues to grow.
- From 2005-2018 >40% increase in CAFOs in Maumee and number of animals increased from 9-20 million (animal units increased 88%)

Recent Report Findings (IJC Manure Collaborative, 2023)

- Since 2002, commercial fertilizer use in the Auglaize Watershed has remained relatively constant, but manure use has doubled and continues to grow.**
- Majority of manure is spread within 2 miles of the barn.**
- Ontario, Ohio, and Indiana have significantly different guidelines and definitions of large animal operations. Collaboration on streamlining guidelines that impact the Lake Erie watershed is needed to develop an action plan that is consistent across the watershed.**
- In the U.S., the greatest growth in the number of animal operations has been in the smaller, unpermitted operations. They constitute over 90% of the animal operations in the Auglaize Watershed and evidence suggests they generate the majority of the manure.**
- Gathering data on the locations of animal feeding operations, locations of manure application, and other farming practices is almost impossible.**

Questions

Dr. Jeff Reutter,
Reutter.1@gmail.com

Recommendations to Reach Targets—1

- 1. Ban P applications (manure and commercial fertilizer) on all fields with STP over 40 ppm Mehlich-3 (enough for max crop production).**
- 2. Reduce definition of Large CAFOs by 90%**
- 3. Immediate moratorium for all Ohio on new animal operations and additional animals at existing operations until HAB problem is solved.**
- 4. Develop a plan to immediately get STP levels for all fields.**
- 5. Require National Pollutant Discharge Elimination System (NPDES) permits on all animal operations with liquid manure.**

Recommendations to Reach Targets—2

- 6. Prohibit manure from outside the Maumee watershed from coming into the watershed.**
- 7. All water quality programs designed to protect water quality and ecosystems should be in OEPA or directly controlled by USEPA.**
- 8. Move environmental programs and compliance programs out of Ohio Department of Agriculture (ODA).**
- 9. Make ODA only an agriculture marketing program.**
- 10. Develop immediate air quality monitoring programs for animal operations. Monitor releases from barns.**

Recommendations to Reach Targets—3

- 11. Require ODA to monitor and submit annual reports with locations of all animal operations and the number of animals at each operation.**
- 12. Eliminate restrictions and create incentives for farmers to put in solar fields and wind turbines. Consider placement of solar fields on legacy fields.**
- 13. Support research on manure treatment technology and energy production from manure.**
- 14. Manure that can't be spread on fields should go to sewage treatment plant.**

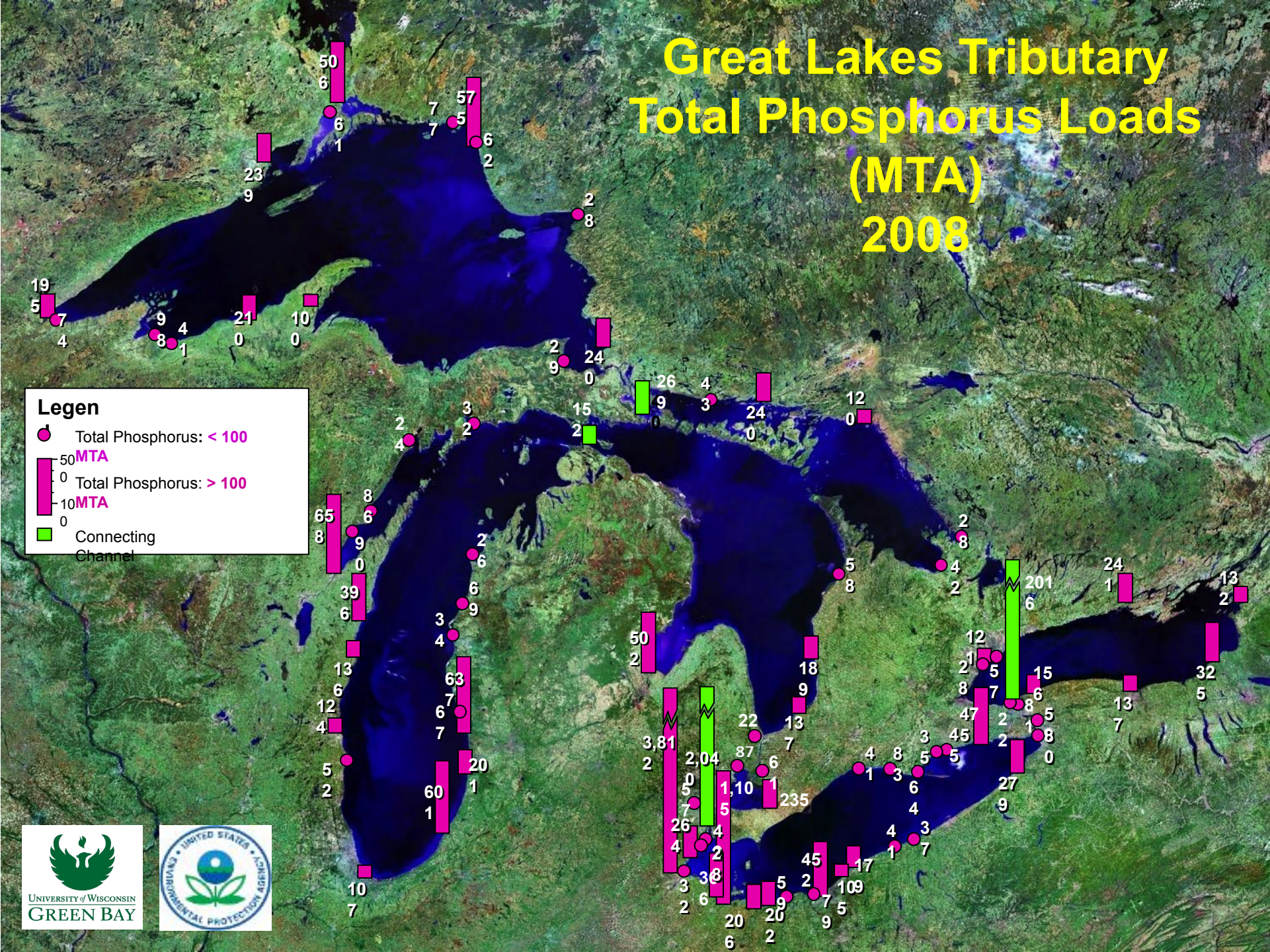
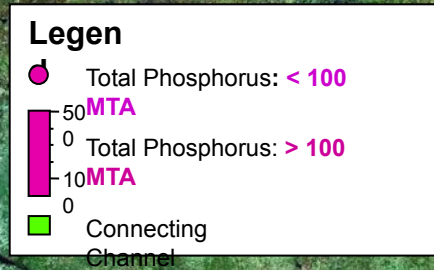
DRP Reduction is Most Important

- TP load to Lake Erie hasn't changed from 1970s
- TP = Particulate P + DRP
- DRP is ~20% of TP
- DRP is 100% bioavailable
- Annex 4 Rept said we needed both DRP and TP reductions, **but DRP was most important.**
- PP reductions are now less important for HABs
 - At time of Annex 4 report, we thought PP was 26-50% bioavailable.
 - Now believe PP is only 8% bioavailable.

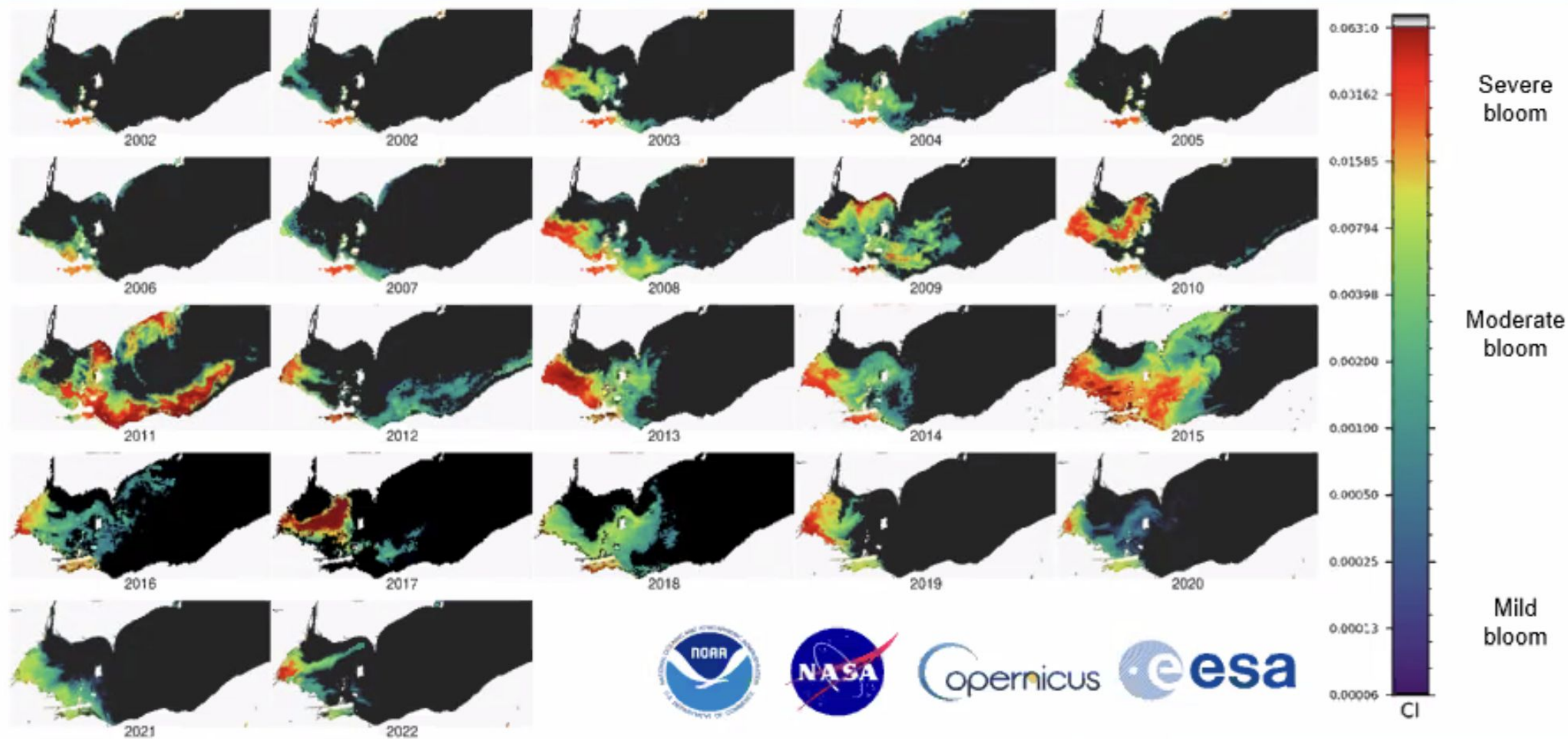
Problems With Ohio's Proposed Total Maximum Daily Load (TMDL) Plan

- Doesn't focus on DRP.**
- Doesn't prevent over-application of P**
- Doesn't try to identify legacy or problem fields, e.g., fields with high Soil Test Phosphorus (STP) levels.**
- Doesn't limit additional animals to the watershed.**
- Is deceiving because it is measuring and reporting only positive changes in watershed.**
- Doesn't track negative impacts of more animals and more manure.**
- Margin of safety is much too low—3%**

Great Lakes Tributary Total Phosphorus Loads (MTA) 2008



2002-2022 Bloom Peak



Lake Erie: Poster Child for Pollution Problems

- 1969: Cuyahoga River burns (13th time since 1868)
- 1970: USEPA, NOAA, and 1st Earth Day
- 1971: Predecessor, Environment & Climate Change Canada
- 1972 (April): Great Lakes Water Quality Agreement
 - Provided phosphorus targets (11,000 MTA TP – ~60% reduction)
- 1972 (Oct): Clean Water Act (Over Pres. Nixon's Veto)
 - Allowed us to regulate point sources
 - 70% of P coming from point sources—improve sewage treatment, reduce TP load by 60% by 1981, and lake becomes "Walleye Capital of World"
 - Since mid-90s, TP is still on target but DRP loads have returned to 1970s levels and over 85% comes from agricultural runoff (not a point source)

What brought about the rebirth from dead lake to Walleye Capital?

- Improved fisheries management
- 62% Phosphorus reduction (29,000 MT to 11,000)
 - New TP load for lake = <7,000 MT vs. 11,000 in 1972
- In those days 2/3 of phosphorus from sewage treatment plants, no reductions were voluntary, reached target in 9 yrs
- Today, more than 85% is non-point source loading from agriculture, all meaningful actions are voluntary, no progress in 14 years.
- HABs are back