Nutrient Impacts on Ohio's Drinking Water Quality

Nutrient TAG Meeting

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Akron's Drinking Water Supply, 2011

Presentation Outline

- Overview of Nutrients Impacts on Public Water Systems
- Impairments to the Public Drinking Water Supply Beneficial Use
  - Background
  - Methods & Sampling (for Nitrate & Algae)
  - 2014 Impairment Listings
- TIC Comparison
- Downstream Impacts

Nutrient Impacts to Drinking Water

- **Nitrogen:**
  - **<u>Nitrate</u>** – Regulated under the Safe Drinking Water Act (SDWA). ACUTE exposure based MCLs.
  - Ammonia
- **Phosphorus- Linked to Algae Blooms:**
  - **<u>Cyanotoxins</u>** - ACUTE exposure based Thresholds
  - Taste and Odor Compounds
  - Total Organic Carbon Loads
  - Disinfection Byproducts – Regulated under the SDWA. Chronic exposure based MCLs.

Drinking Water Treatment Issues

- **Conventional Drinking Water Treatment**
  - Does Not Remove Nitrates or Taste and Odor Compounds
  - Does Not Remove High Concentrations of Cyanotoxins
- **Advanced Carbon Treatment**
  - Does Not Remove Nitrates
  - Granular Activated Carbon Quickly Exhausted During Algae Blooms
  - High Doses of Powdered Activated Carbon often Required for Complete Cyanotoxin and Taste and Odor Compound Removal
  - Expensive
- **Reverse Osmosis & Ion Exchange**
  - Removes Nitrates, but Generally Cost-prohibitive on Large Scale
  - Algae Blooms Can Cause Membranes to Foul
  - Issues with Residual Handling

Examples of Economic Impacts of High Nitrate Levels to Surface Water Systems

- Fremont. Population = 19,500. Spending $60 million for upground reservoir due to high nitrates in the Sandusky River.
- Monroeville. Population = 1400. Spent over $2 million on upground reservior due to high nitrates.
- Columbus. Population >1,150,000. Monitors source water daily and avoids pumping from Scioto River when nitrate levels are >MCL. Considering multi-million dollar plant upgrades to reduce nitrate levels. Determined reverse osmosis plant would not be cost effective (spent millions just on pilot study).

Examples of Harmful Algal Blooms on Ohio's Inland Public Water Supply Lakes and Reservoirs

Celina- GLSM 2010

Wilmington -Caesar Creek Lake 2011

Wellston- Lake Alma 2010

Akron-
Lake Rockwell 2011

Findlay 2012

Bur Oak 2010

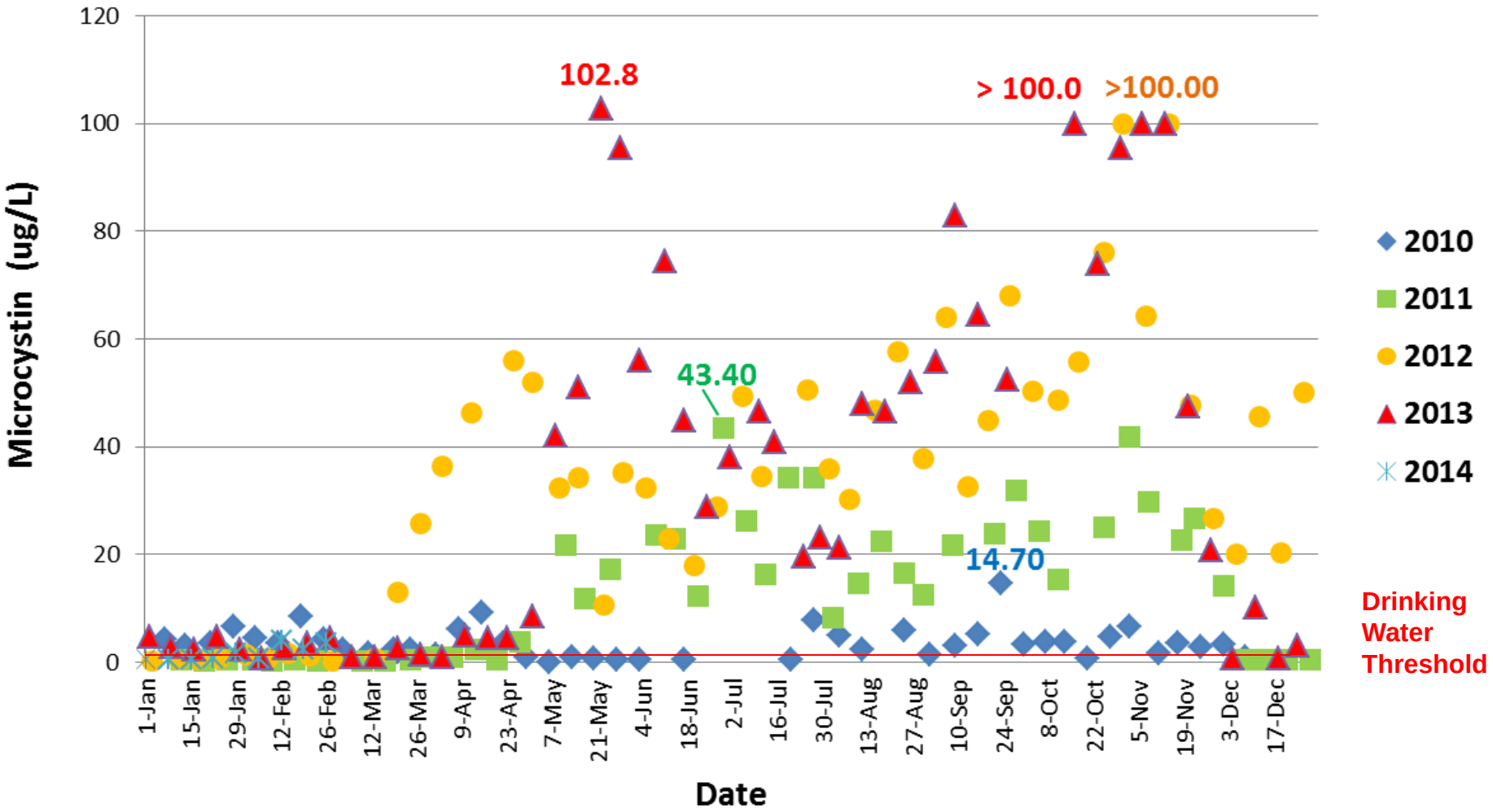
Lima 2012

Clermont CO-
Harsha Lake 2012

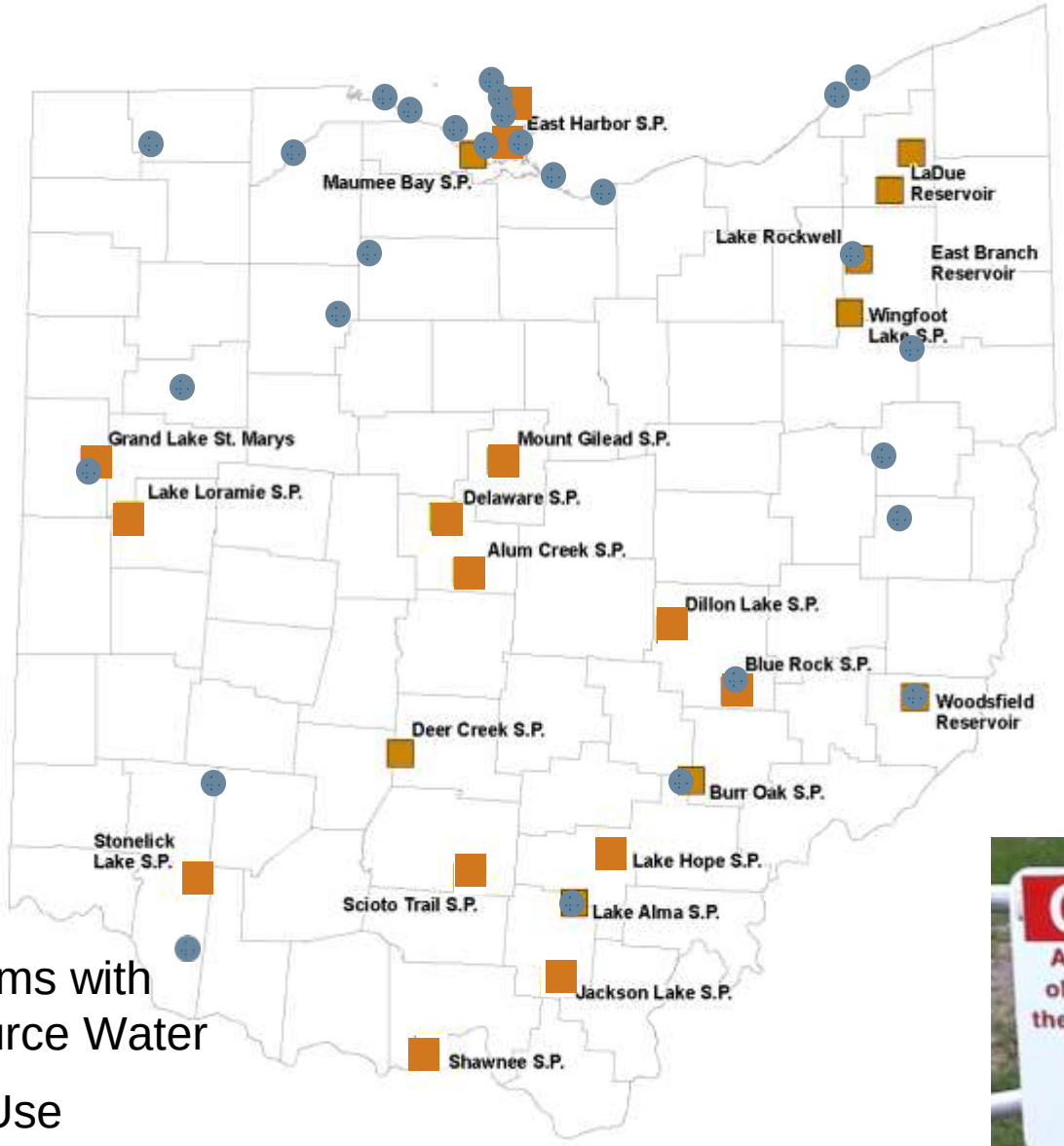
Examples of Economic Impacts of HABs to Surface Water Systems

- Toledo. Population 450,000. Spends up to $200,000/month on carbon to address Algae/HABs. Many Lake Erie water systems routinely add carbon to address HABs.
- Clermont County. Population 117,000. In response to increasing THM levels/Algae, spent approximately $6 million in capital costs for new GAC facility and anticipates spending $660,000/year on GAC filter media.
- Akron. Population 333,000. Spent over $200,000 in one month on carbon to treat an algae bloom that was causing taste and odor impacts.
- Columbus. Population >1,150,000. Spent an extra $10,000/day for PAC in response to algae-related taste and odor event.
- Carroll Township. Population 2288. Installing upgraded $125,000 ozone treatment in response to finished water microcystin detections.
- Celina. Population 11,700. Spent $7.2 million in capital costs for new GAC facility and spends ~$500,000/year on GAC filter media & ozone annual expenses to address disinfection byproducts and HAB concerns.

Grand Lake St. Marys Microcystin Concentrations at City of Celina Intake (Raw Water)



Ohio Harmful Algal Blooms (HABs) 2010 - 2013



- Water Systems with HABs in Source Water
- Recreation Use Advisories

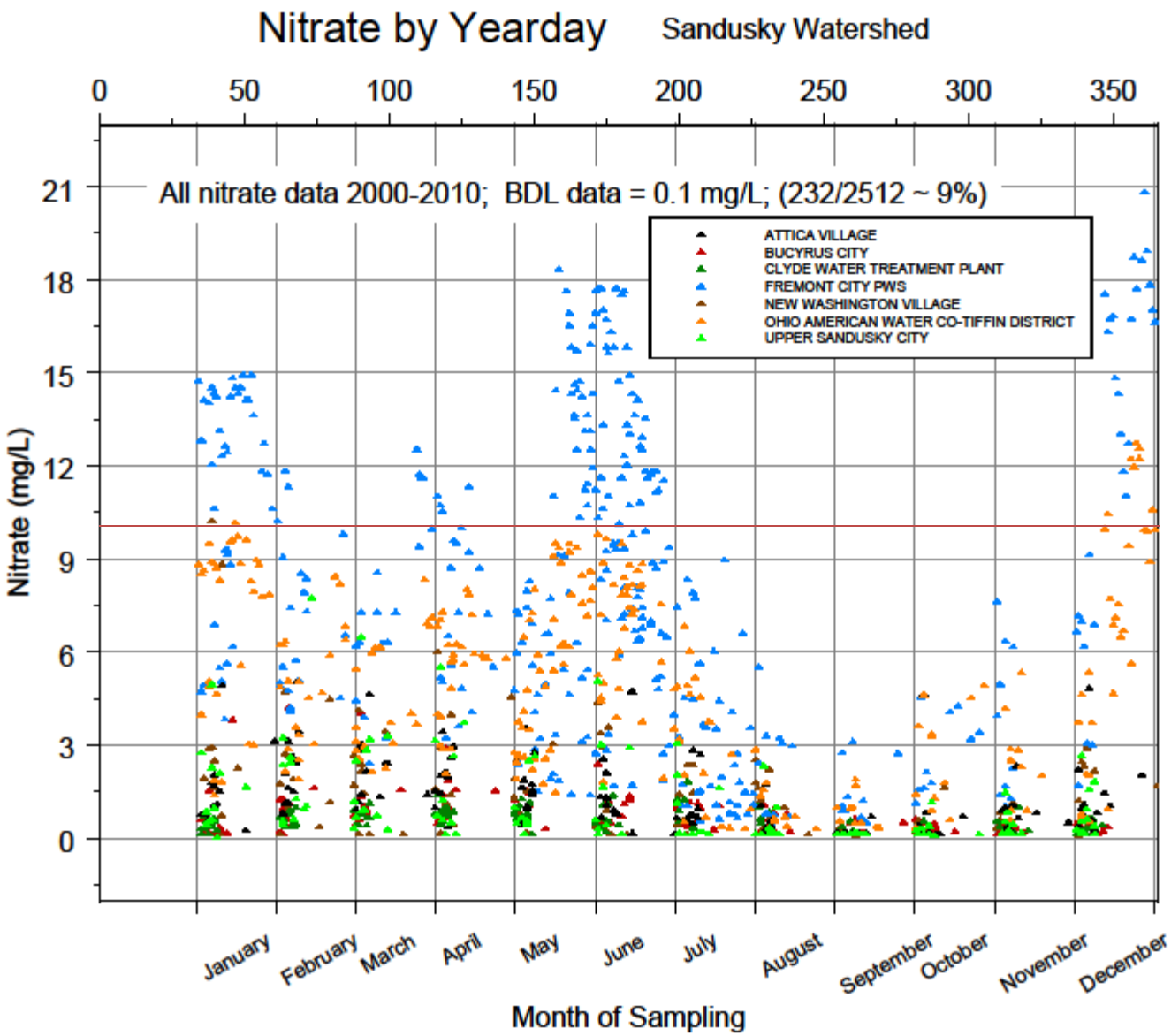
Clean Water Act

"Fishable, Swimmable, Drinkable"

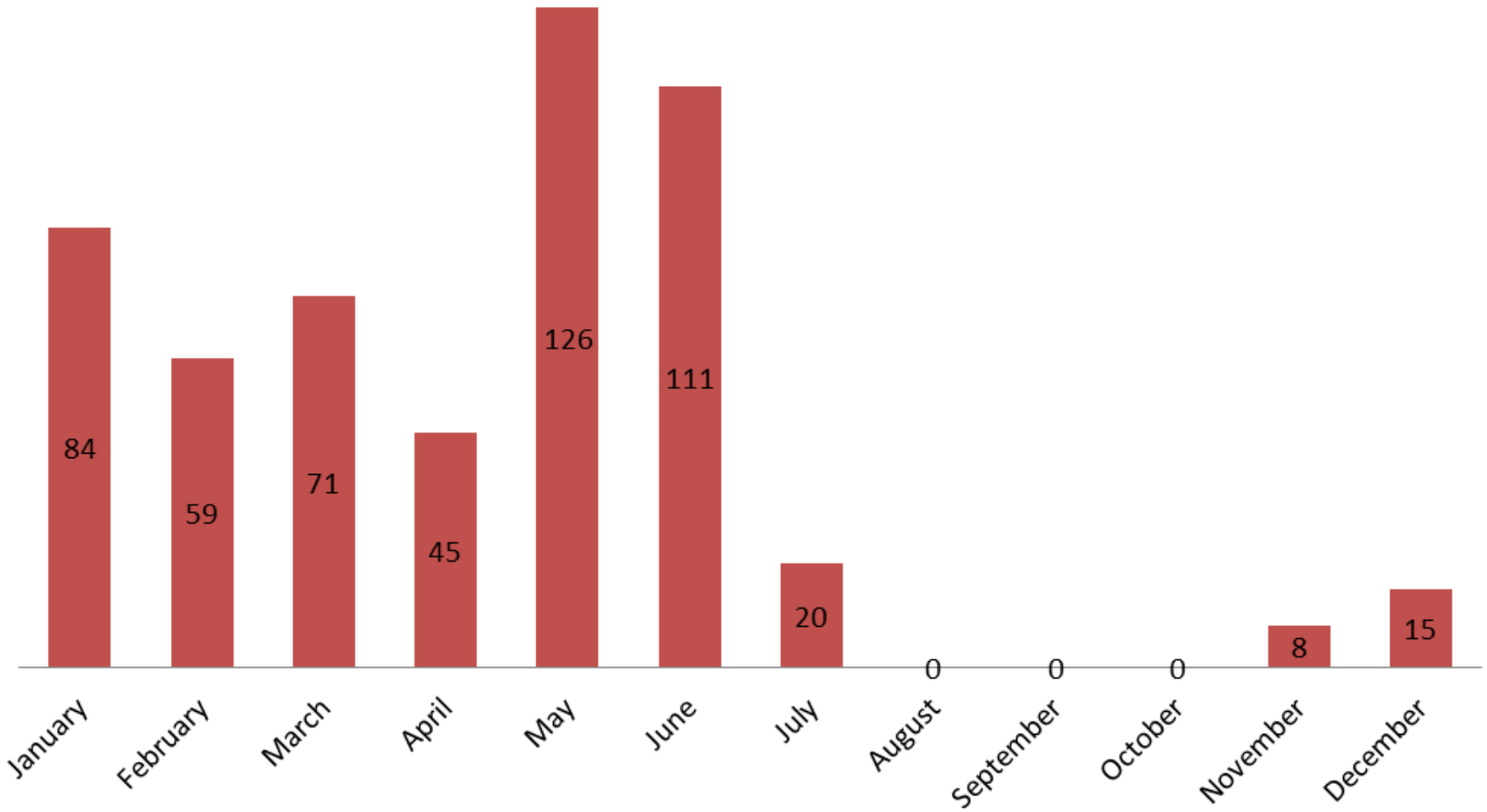
Goal for water quality criterion is that water systems will be able to produce safe water using "conventional treatment" only.

A brief history…

- Public Drinking Water Supply (PDWS) has been a beneficial use since beginning of CWA, but...
- Ohio's initial approach assumed if a stream was meeting its aquatic life use, then was meeting the PDWS use.
- 2002 Ohio began development of new criteria just for PDWS after disconnect was discovered (Monroeville example)
- 2006 IR – Methodology presented
- 2008 IR – 1st formal assessments and listings on 303(d)
  - Focused on Nitrate and Pesticide indicators
- 2010 IR – 2nd Listing USEPA: "*OEPA should be commended for being a leader in drinking water use assessments*."
- 2014 IR – Began assessing impairments due to algae (cyanotoxins)


Nitrate by Yearday
Sandusky Watershed
All nitrate data 2000-2010; BDL data = 0.1 mg/L; (232/2512 ~ 9%)
ATTICA VILLAGE
BUCYRUS CITY
CLYDE WATER TREATMENT PLANT
FREMONT CITY PWS
NEW WASHINGTON VILLAGE
OHIO AMERICAN WATER CO-TIFFIN DISTRICT
UPPER SANDUSKY CITY
Nitrate (mg/L)
0
3
6
9
12
15
18
21
0
50
100
150
200
250
300
350
January
February
March
April
May
June
July
August
September
October
November
December
Month of Sampling

Occurance of Elevated Nitrate (>10 mg/L) in Maumee River from January 1990 to September 2012



Data Source: Heidelburg Water Qulaity Lab

Nitrate Sampling

- Use treated water data (12-52 samples) if source avoidance strategies or advanced treatment are not used.
- Recommend 20 raw water samples at intake over at least two year period. Minimum of five samples collected during period when contaminant is typically detected at highest concentrations: winter/spring high-flow.

Nitrate Impacts to Surface Water Sources of Drinking Water

2014 Integrated Water Quality Report

Impaired waters:

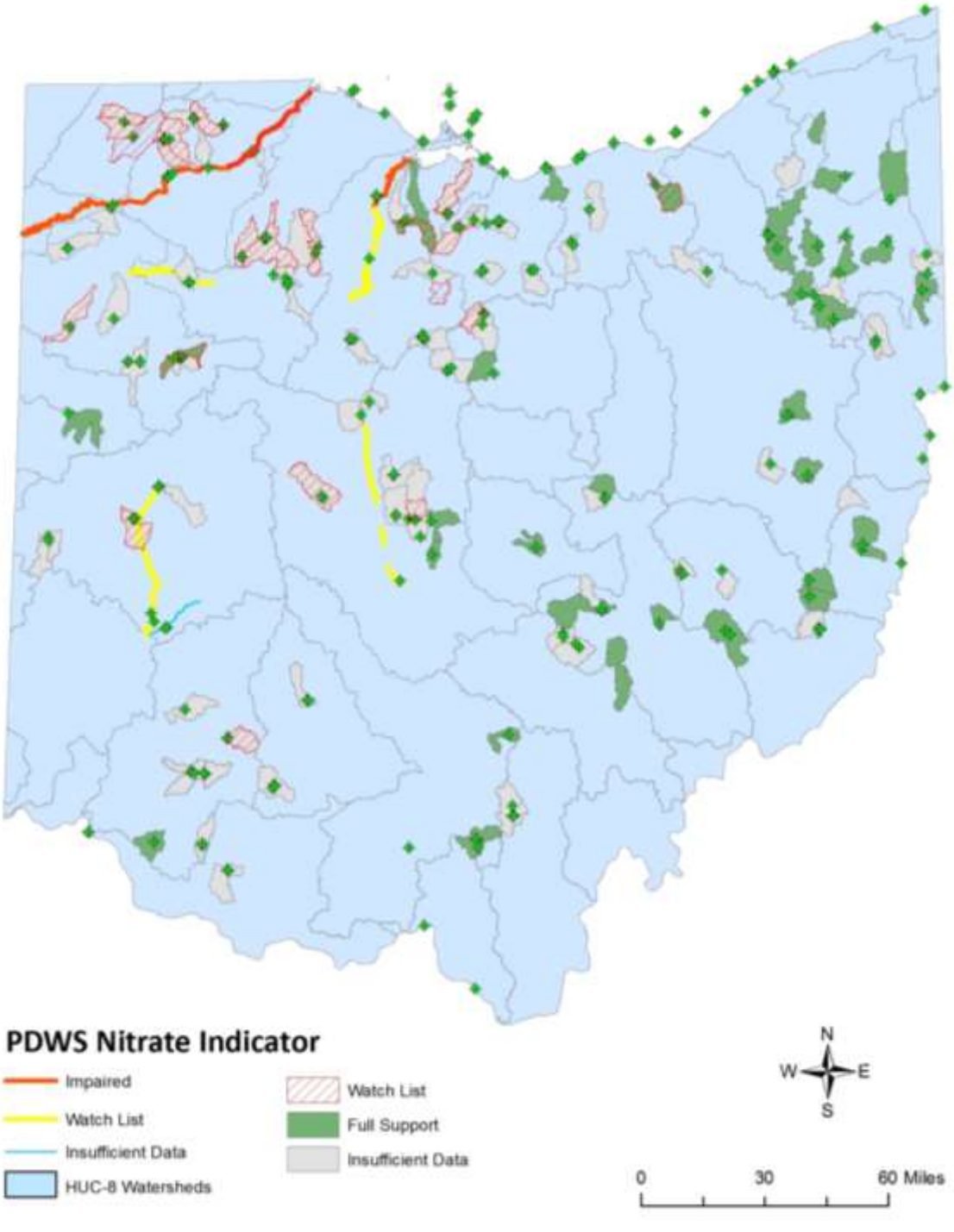
Maumee and Sandusky Rivers
Impaired = 2 or more detections >10 mg/L (MCL)

Watch List waters:

29 Source Streams
"watch list" = at least 1 detection >8 mg/L

100% of assessed Large River Assessment Units are either impaired or on the watch list.

Maumee River TMDL will address nitrate impairments.



New Impairment Methodology for Algae

- Initial 2006 PDWS Use methodology indicated that algae and taste and odor would be considered supplemental indicators using the aesthetic narrative criteria described in OAC rule 3745-1-07.
- Numeric cyanotoxin thresholds were established in 2011 (Ohio Harmful Algal Bloom Response Strategy).
- Algae impacts were mentioned in the 2010 and 2012 IR, but first impairment listings occurred in 2014.
- 2014 Impairments based solely on source water exceedances of cyanotoxin drinking water thresholds (at least 2 exceedances, greater than 30 days apart).
- Future listings may consider other algae impacts: Total Trihalomethane or Haloacetic Acids MCL violations, elevated TOC, taste and odor (Geosmin/MIB) events, etc.

Sampling

- Cyanotoxin sampling is incident response based and occurs when contaminant is most likely to be present
- Ohio EPA recommends routine sampling at PWSs with persistent problems
- Lake sampling in 2014
- Currently evaluating additional sampling options

Algae Impacts to Drinking Water Quality

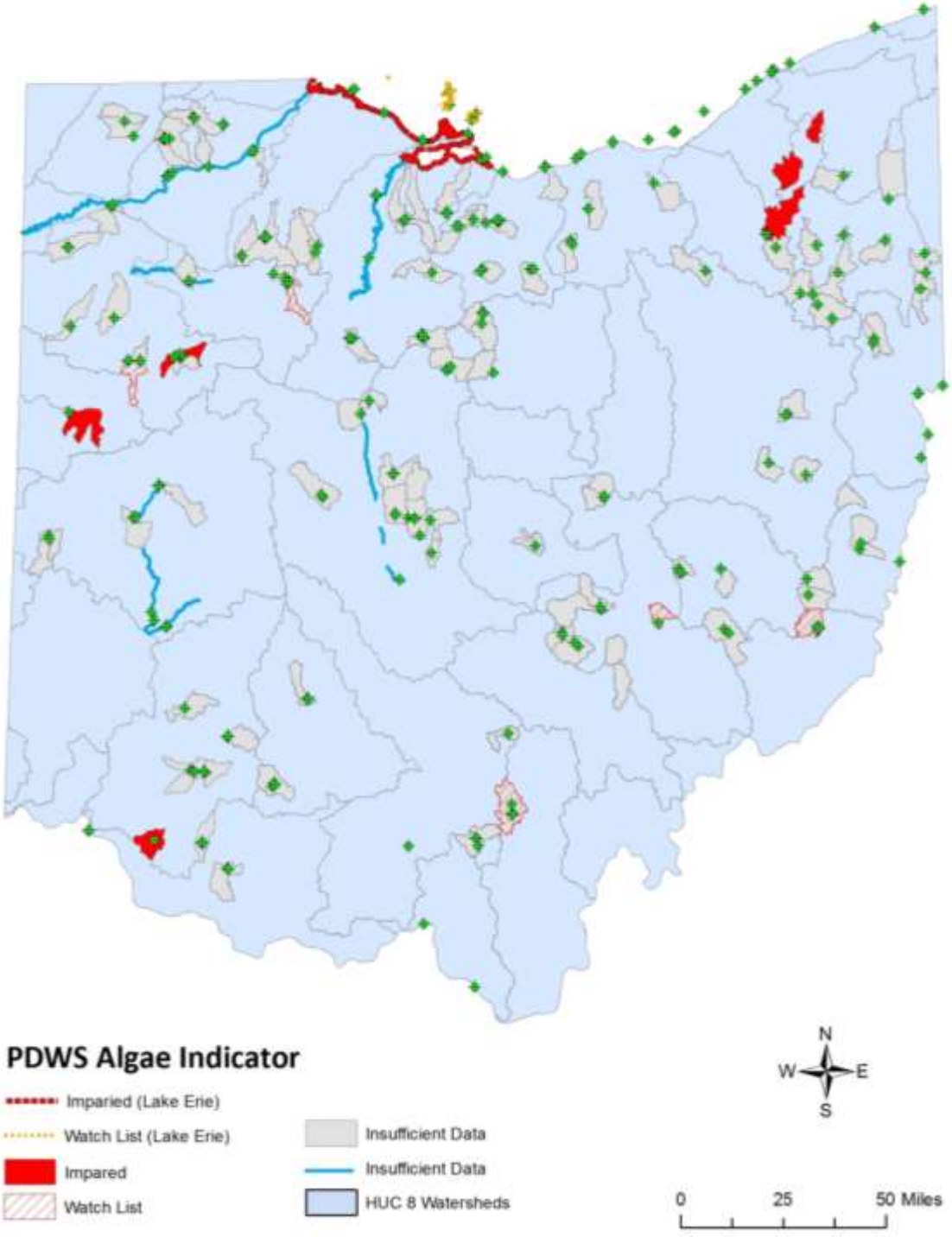
New Impairment Criteria for 2014 Integrated Report:

Impaired = at least 2 cyanotoxin detections above drinking water thresholds at least 30 days apart.

Nine Public Water Systems Triggered Impairment Listings: Toledo, Oregon, Carroll Township, Ottawa County, Marblehead, Lima, Akron, Clermont County, and Celina

The Western Basin of Lake Erie and Six Watersheds are Impaired

Six Additional Public Waters Systems are on a Watch List



TIC Scores

- Nitrogen is a component of TIC score
  - If DIN > 6.7, nutrient score=0
  - There were 38 occurrences when the nutrient score = 0, but only 9 of those reaches had an overall impaired TIC rating (24%)
  - Relatively low weighting
- Cyanotoxins are not a component of TIC score
- Chlorophyll is a component of TIC score
  - There were 20 occurrences when chlorophyll score =0, but only 5 of those reaches had an overall impaired TIC rating (25%)
  - Focus on benthic algae?

TIC Score Comparison

Algae Impairment: Ottawa River – Lima

Data from 2 stations within HUC 12:

TIC Score 27 (Acceptable)

TIC Score 16 (Threatened)

Nitrate Impairment: Maumee River (entire LRAU)

Data from 7 stations:

Acceptable (TIC Scores: 29, 31)

Threatened (TIC Scores: 15, 19)

Impaired (TIC Scores: 9, 10, 11)

Implications

- Assessment units with acceptable TIC scores could be listed as impaired for the PDWS use based on nitrate or algae. PDWS Use impairments will trigger nutrient TMDL development.

- Assessment units upstream of waters with PDWS nutrient impairments may be contributing to the PDWS use impairment, but TIC score for upstream waters may be acceptable.

- May have a similar issue with recreation impairments, if cyanotoxin impacts are assessed.

Thank You!

Please contact me if you have any additional questions:

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