Harmful Algal Blooms at Ohio Public Water Systems

OTCO 50th Anniversary Conference

August 5, 2014

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Ohio EPA

Overview

- Harmful Algal Bloom Basics
- HAB Response Strategy
- Monitoring Recommendations
- HAB Monitoring Summary
- Treatment Optimization
- Reservoir Management & Algaecide Application Issues
- Contingency Planning
- Ohio EPA Assistance

What Are Harmful Algal Blooms (HABs)?

- **Cyanobacteria (blue-green algae)**
  - Phycocyanin or phycoerythrin pigments
  - Akinetes - resting cells/spores
  - Heterocysts - fix atmospheric nitrogen
  - Aerotopes - gas vacuoles
- **A "bloom" occurs when conditions enable a rapid increase in cyanobacteria**
- **There are many different genera and species of cyanobacteria, and not all produce toxins**
- **A HAB is a bloom capable of producing toxins**

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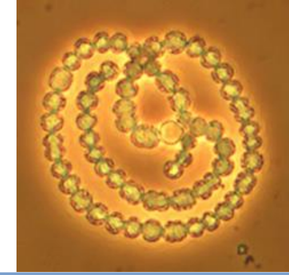
Toxin-Producing Cyanobacteria



Cyanobacteria	Cyanotoxins Produced*	Type	Geosmin	MIB
Anabaena	Anatoxins, Saxitoxins	Neurotoxin	Yes	
	Microcystins, Cylindrospermopsin	Hepatotoxin		
Aphanizomenon	Anatoxins, Saxitoxins	Neurotoxin	Yes	
	Cylindrospermopsin, Microcystins?	Hepatotoxin		
Cylindrospermopsis	Saxitoxins	Neurotoxin		
	Cylindrospermopsin	Hepatotoxin		
Microcystis	**Microcystins**	Hepatotoxin		
Planktothrix (*Oscillatoria*)	Antitoxins	Neurotoxin	Yes	Yes
	Microcystins, Cylindrospermopsin	Hepatotoxin		
Lyngbya	Saxitoxins	Neurotoxin	Yes	Yes
	Cylindrospermopsin	Hepatotoxin		

*All listed cyanobacteria produce lipopolysaccharides and *Lygnbya* and *Planktothrix* also produce Lyngbyatoxin-a and aplysiatoxins (all dermal toxins)

Cyanotoxin Sampling at Public Water Systems (PWSs)

- **Cyanotoxins are Not Regulated under the Safe Drinking Water Act & Public Water Systems are Not Required to Monitor**

- **Ohio EPA began Sampling for Cyanotoxins at PWSs in 2010**

- **Ohio EPA worked with ODNR and ODH to create a State of Ohio HAB Response Strategy in early 2011**
  - Standardized definitions, sample collection procedures, public notice language, and cyanotoxin thresholds

http://www.epa.ohio.gov/portals/28/documents/HAB/PWS-HAB-response.pdf

- **In 2012 Created Separate PWS HAB Response Strategy (updated annually)**

- **2014 Response Strategy & Policy – Responding to Comments**

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Ohio EPA Cyanotoxin Thresholds

Threshold (ug/L)	Microcystin**	Anatoxin-a	Cylindrospermopsin	Saxitoxin**
Do Not Drink- All consumers	**1 - 20**	**20 - 300**	**1 – 20**	**0.2 - 3**
Do Not Use- All consumers*	**> 20**	**> 300**	**> 20**	**> 3**
Recreation	6	80	5	0.8

* These are also the concentrations for recreational no-contact thresholds.

** Microcystin and saxitoxin thresholds are intended to be applied to total concentrations of all reported congeners of those toxins.

No National Threshold for Microcystin

- World Health Organization – 1 ug/L
- Minnesota – 0.04 ug/L
- Health Canada – 1.5 ug/L

– USEPA anticipates providing national drinking water health advisory levels for Microcystin, Anatoxin-a, and Cylindrospermopsin in early 2015

– USEPA is considering including microcystin in the Uregulated Contaminant Monitoring Rule (UCMR) 4

  - sampling would begin in 2016

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Cyanotoxin Sampling at PWSs

- **Ohio EPA will sample public water systems for toxins if there is a possibility of toxins breaking though treatment. Factors considered:**
  - Severity of bloom and extent of the reservoir/lake affected
  - Proximity of bloom to the intake, depth of the intake, and wind/weather conditions
  - Results of monitoring (algae ID, field microcystin tests, etc.)
  - Raw water quality changes
  - Type of treatment
  - History of toxin-producing blooms
  - Pre-oxidation with a strong oxidant
  - Whether an algaecide has been applied to the bloom
  - Reported human illness or animal death associated with a bloom

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Cyanotoxin Sampling at PWSs

- **Ohio EPA Sampling is Primarily Incident-Response Based**
- **Sampling Frequency:**
  - Weekly sampling until toxins are <½ threshold for two consecutive weeks and bloom has dissipated.
  - If raw water microcystin concentrations are >5 ug/L, increase sampling and analysis to 3 times/week
  - If cyanotoxins are reported in the finished water above Ohio EPA reporting limits, a repeat sample will be collected and analyzed within 24 hours. Ongoing sampling will be dependent on the results of the repeat sample and may include distribution sampling.
- **Ohio EPA Encourages PWSs with a History of Persistent HABs to Voluntarily Monitor**
- **Ohio EPA will Not Duplicate Voluntary PWS Sampling if the PWS uses a quantitative analysis method acceptable to Ohio EPA and shares data with Ohio EPA**

Additional Lake Sampling

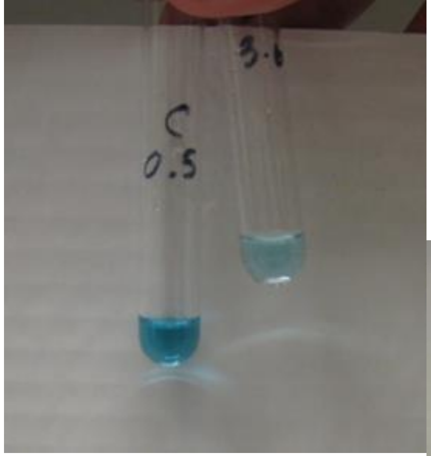
Ohio EPA Inland Lake Sampling

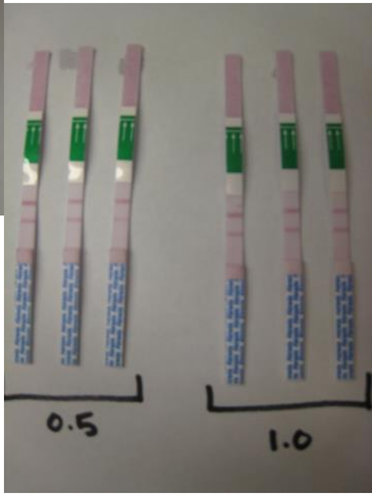
USEPA Sampling

Consider Monitoring Your Source Water

- **Routine Algae Identification & Enumeration**
- Phycocyanin Sensors
- Nutrient Monitoring (Stream & Reservoir)
- Cyanotoxin Monitoring

Toxin Testing Options





Field Test Kits

- Enzyme-linked immunosorbent assay (ELISA)
- Only available for Microcystin
- Qualitative & Semi-quantitative tests available
- Detects free microcystin (extracellular) (appropriate for finished water analysis)
- Requires lysing agent, freeze/thaw, or sonication to lyse (break open) cells if interested in total microcystin (intracellular and extracellular toxins). This is necessary for raw water analysis.

Example: Qualitubes

- Calibration Range: 0.5 to 3 ppb
- Time needed for test: 38 to 40 minutes (additional time needed to freeze/thaw if testing raw water)
- Estimated cost per test: $5-7 (<$200/kit)

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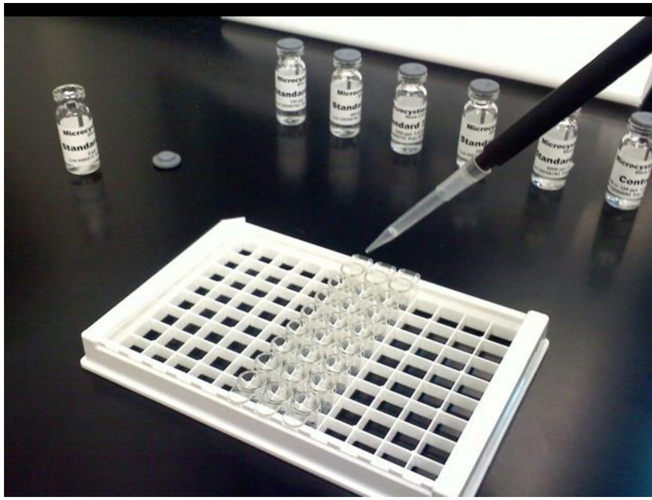
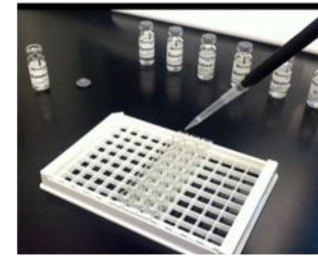
Toxin Testing Options



- **Quantitative ELISA Analysis**
  - Kits available for Microcystin, Saxitoxin, and Cylindrospermopsin
  - Same method used by Ohio EPA’s lab
  - Estimated cost per kit: $500 (~42 tests/kit)
  - Requires plate reader spectrofluorometer (~$1500)
  - Requires micropipeter
  - Improved analytical techniques provide more accurate measurements
  - Kits should be ETV certified by USEPA

- **Commercial Labs**
  - Use either ELISA, Liquid Chromatography–Mass Spectrometry (LC-MS), or High Performance Liquid Chromatography – Photo Diode Array (HPLC-PDA)
  - LC-MS can only test for up to 8 of the ~100 microcystin congeners.



Public Water System Monitoring Summary

- Ohio EPA collected 1268 raw and finished water cyanotoxin samples at 40 water systems (>1/3 surface water supplies).
- PWS submitted results for over 600 raw and finished water cyanotoxin samples.
- Cyanotoxins have been detected in the majority of the source waters sampled in Ohio.
- Two finished water detections between 0.3 ug/L and 0.6ug/L, Two public water systems with finished water detections above drinking water threshold.
- **First drinking water advisory issued in 2013.**

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Carroll Township

September 5, 2013

<u>FINISHED WATER Microcystin concentrations</u>:
1.43 ug/L (9-4-13)
3.56 ug/L (9-5-13, repeat sample)

Raw Water >5 & 12.76

<u>Do Not Drink Advisory Issued</u>

2288 People Affected

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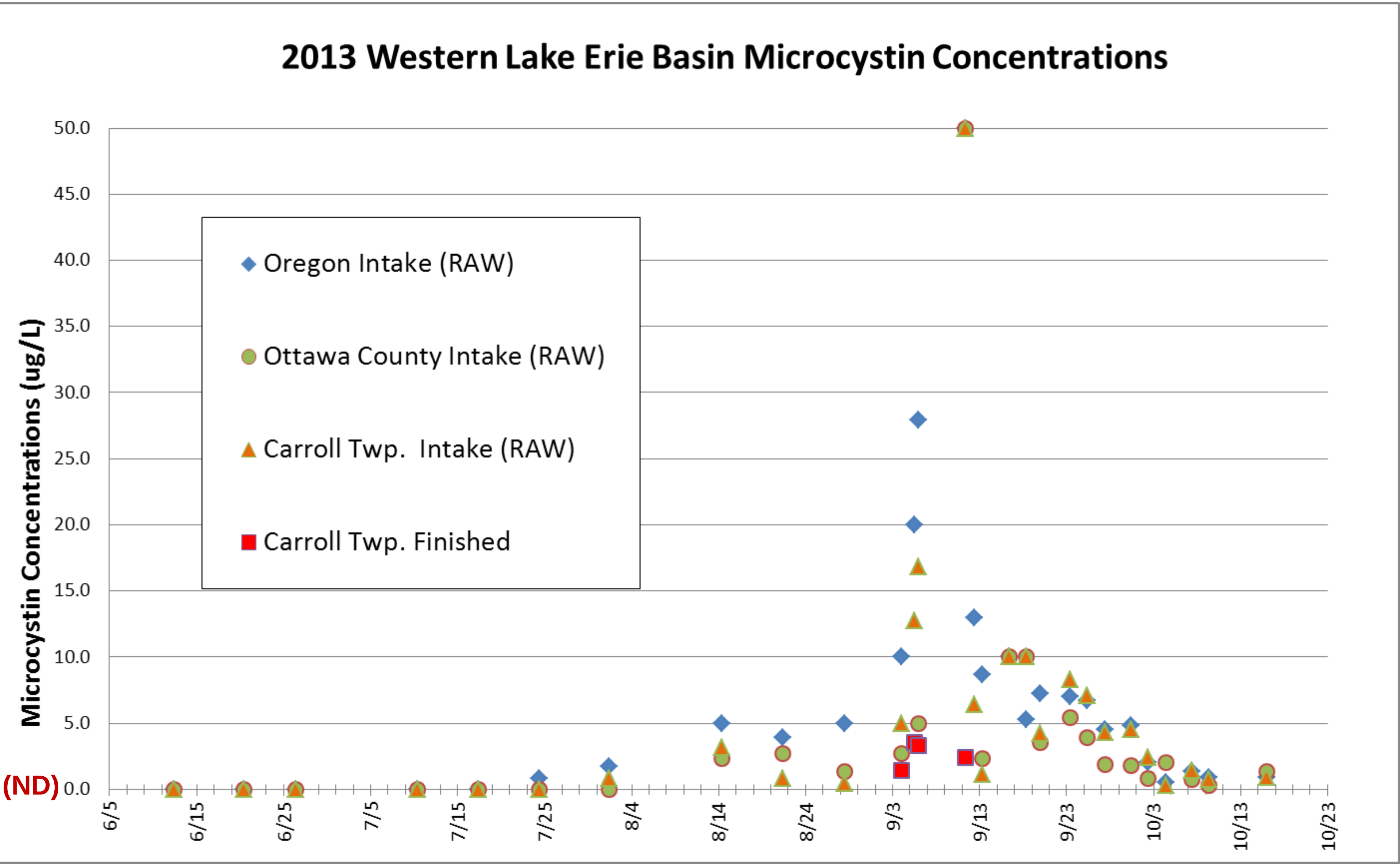
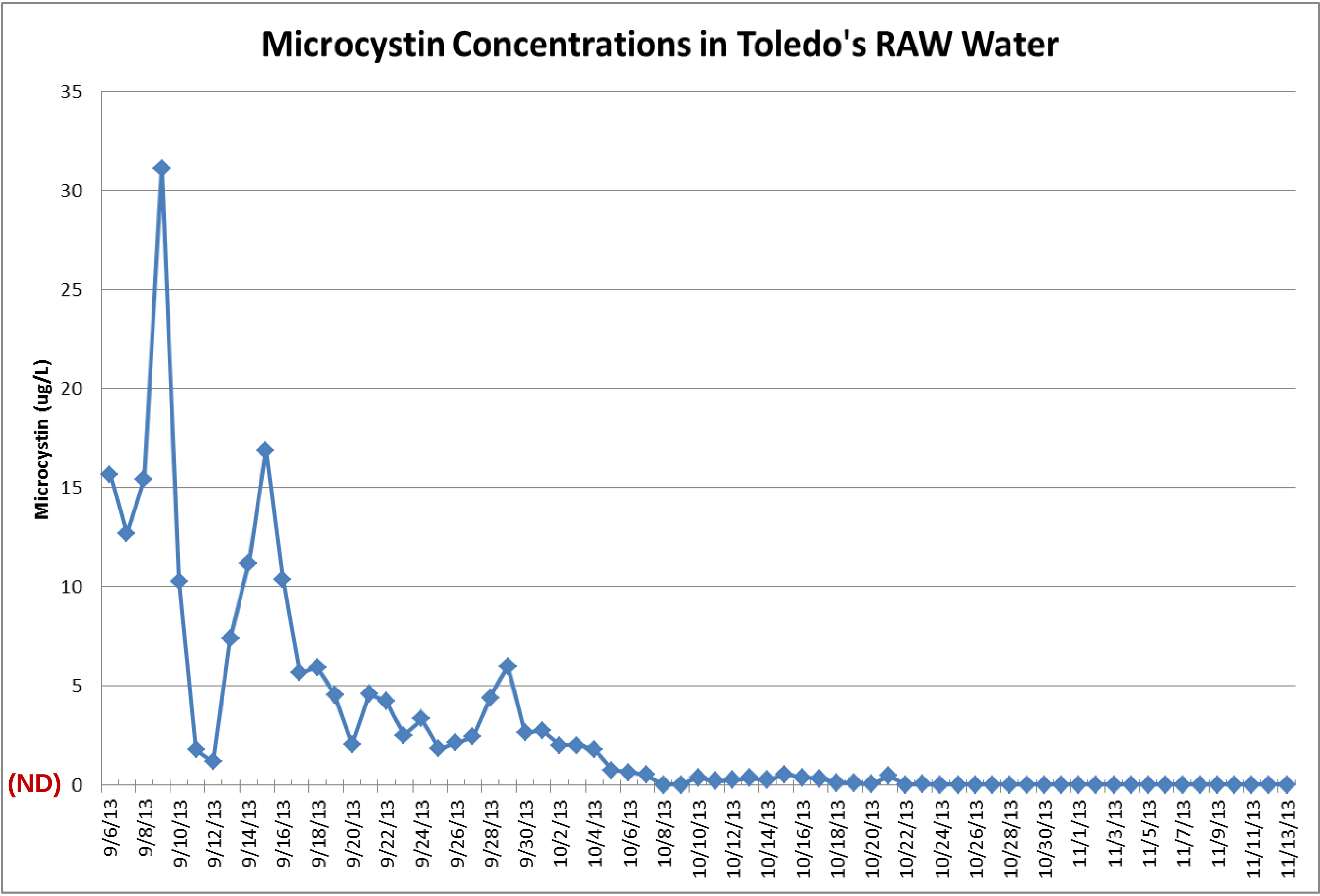
MODIS Image September 5, 2013



ND= Not Detected (Concentration <0.25)

Source: Oregon


Microcystin Concentrations in Toledo's RAW Water
Microcystin (ug/L)
35
30
25
20
15
10
5
(ND) 0
9/6/13
9/8/13
9/10/13
9/12/13
9/14/13
9/16/13
9/18/13
9/20/13
9/22/13
9/24/13
9/26/13
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11/1/13
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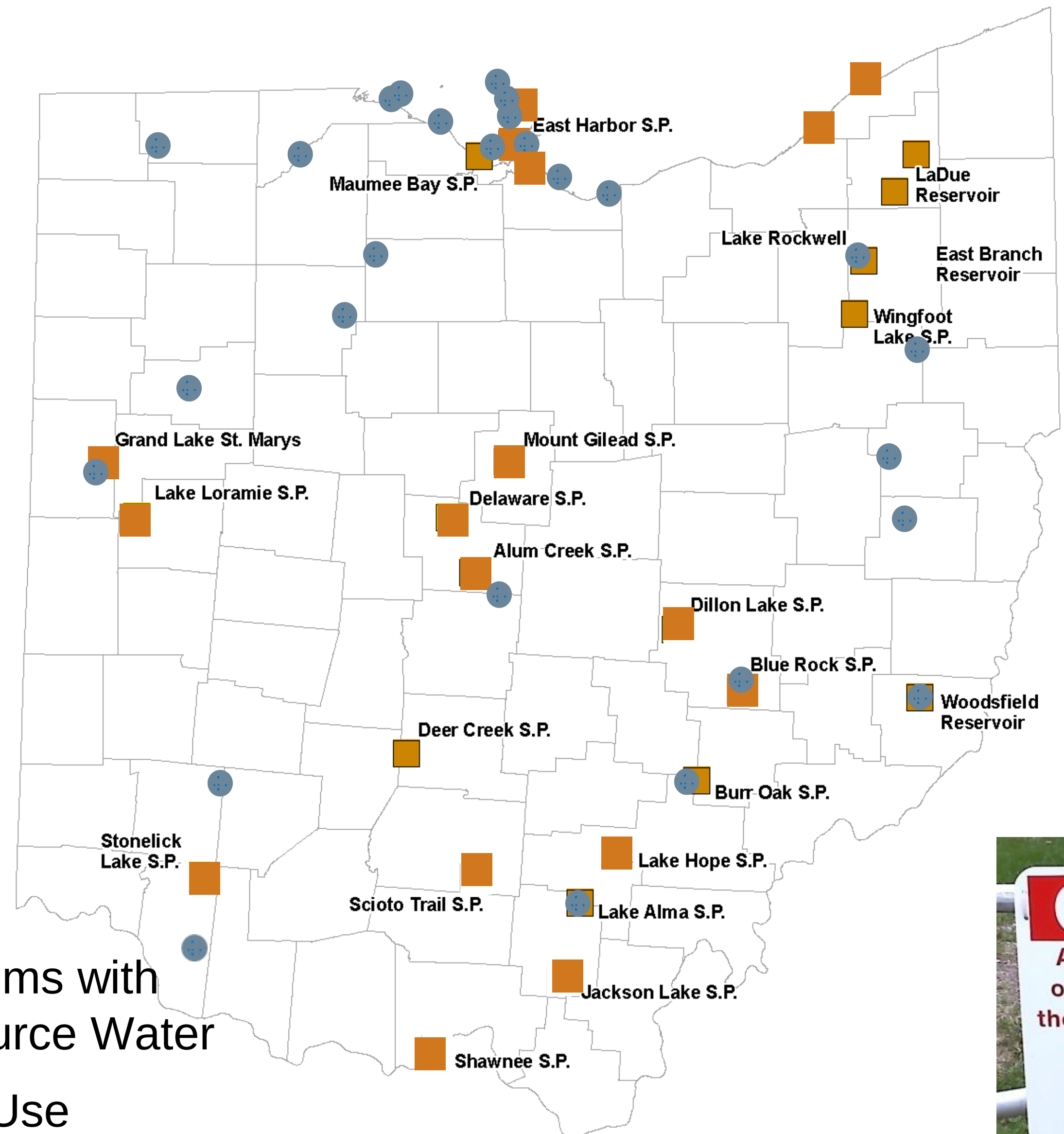
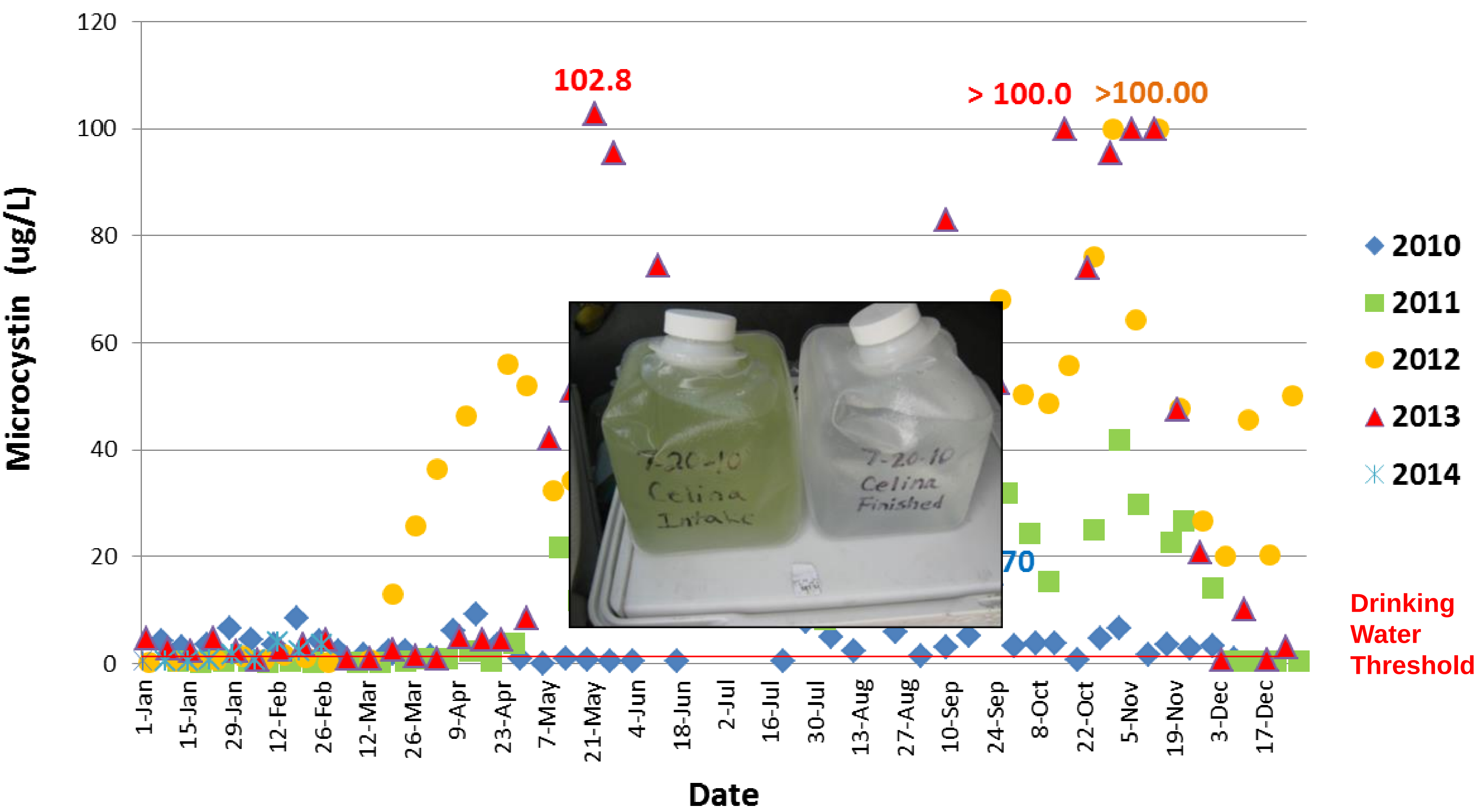
11/13/13

Ohio Harmful Algal Blooms (HABs) 2010 - 2013



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

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

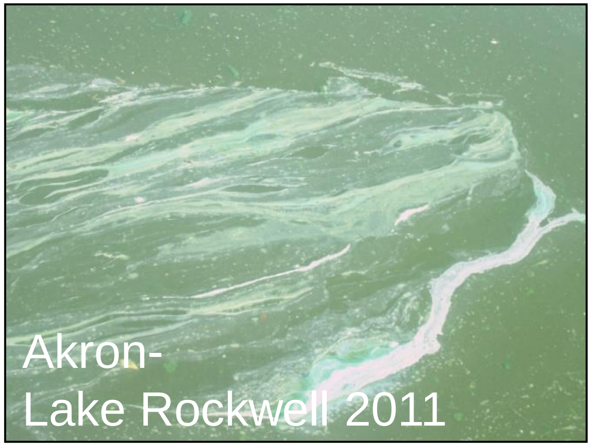


Examples of Harmful Algal Bloom on Ohio's Inland Public Water Supply Lakes and Reservoirs

Bowling Green 2013

Wilmington -Caesar Creek Lake 2011

Welston- Lake Alma 2010



Akron-
Lake Rockwell 2011

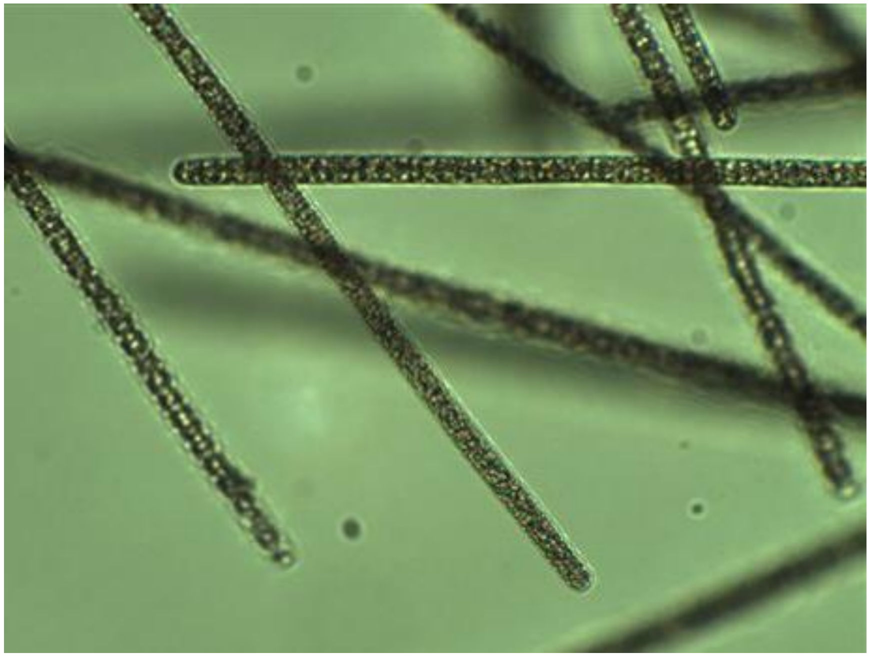
Findlay 2012

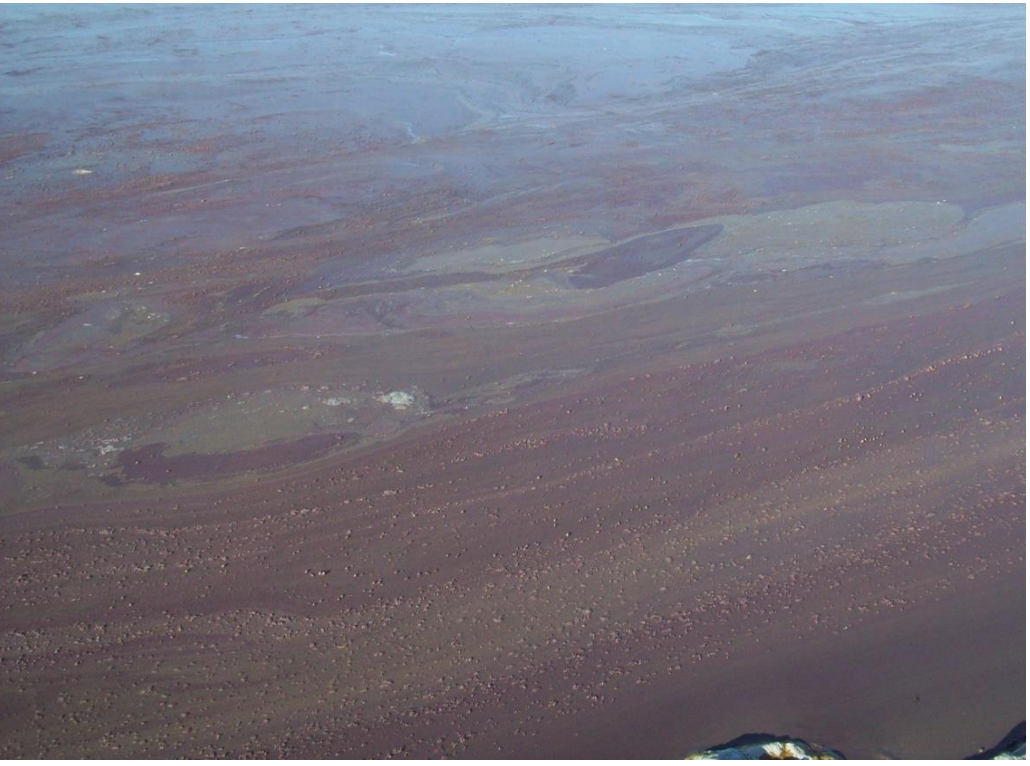
Bur Oak 2010

Lima 2011

Clermont CO-
Harsha Lake 2012

Apple Valley Lake, December, 2011





William's Reservoir
November, 2012

Microcystin
Concentration: 1400 ug/L

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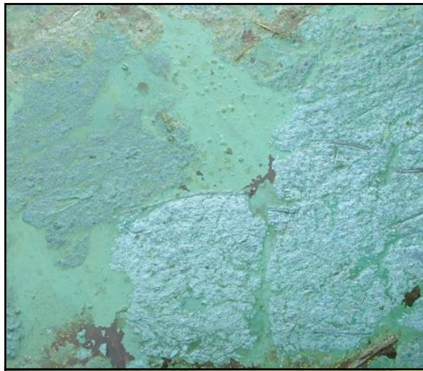
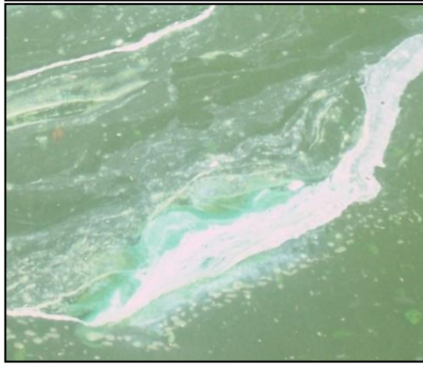
Example of Source Water With High Toxin Concentration (>100 ug/L microcystin)

Microcystin Concentrations Exceeded Drinking Water Thresholds in Raw Water at All Four Area Public Water Systems

If Cyanobacteria Scums are Present, Toxin Concentrations are Often REDUCED at the Intake.

- **Celina** Toxins concentrations at intake in 2010 when scums were present were LOWER than when scums not present (could be attributed to cyanobacteria genera change).
- **Lake Erie** Highest toxins detected at mainland intakes in extreme western basin prior to scum formation in 2011. Toxins detected at Put-in-Bay intake two weeks before scum formed, not detected after scums formed (microcystin concentration in scum was 340 ug/L).
- **Akron** Toxins not detected during scum-forming bloom, but detected months later when scum no longer present.





Planktothrix

Planktothrix blooms generally do not produce scums, but can have very high toxin concentrations at intake depths

Complicates Monitoring Programs

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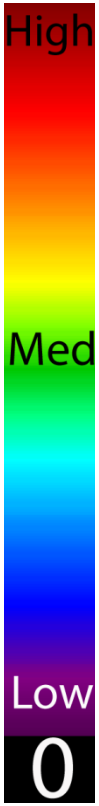
NOAA Lake Erie HAB Forecasts



Experimental
Lake Erie Harmful Algal Bloom Bulletin
2011-014
08 September 2011
National Ocean Service
Great Lakes Environmental Research Laboratory
Last bulletin: 01 September 2011

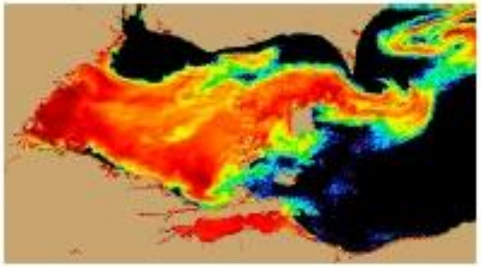


Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from September 03, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. bloom (with red being the highest concentration). *Microcystis* spp. abundance data from shown as white squares (very high), circles (high), diamonds (medium), triangles (low) , + (very low) and X (not present).

Conditions: A massive *Microcystis* bloom persists throughout most of Lake Erie's Western Basin.

Analysis: As indicated in satellite imagery from Saturday (9/3/2011), an enormous *Microcystis* bloom was present in western Lake Erie. The southern extent of the bloom was remotely observed along the coast of Ohio from Maumee Bay to Catawba Island. The northern extent of the bloom was observed to be consistent along the Michigan coast from Northern Maumee Bay to the mouth of the Detroit River. The eastern-most portion of the bloom was observed past Point Pelee and to the northeast up in to Rondeau Provincial Park.

At the mouth of the Detroit River, a five day nowcast shows a southward suppression of the western-most portions of the bloom. However, the bloom is likely to still persist in much of the Western Basin. The nowcast also suggest the bloom has spread to the east of Sandusky and into the Cleveland area. **(Note: Due to a lack of clear imagery the bloom has not been remotely observed in the Cleveland area.)** A three day forecast also suggests that the bloom will persist to the north of Cleveland through the weekend. Water temperatures remain above 20 degrees Celsius and are forecast to decrease into the weekend; however, conditions remain favorable for bloom growth.

Briggs, Wynne

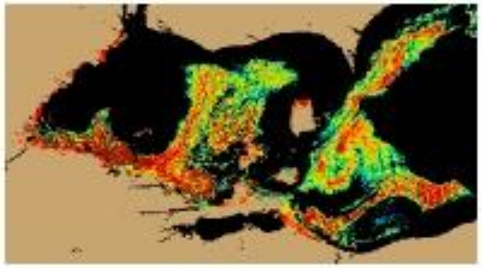


Figure 2. Nowcast position of *Microcystis* spp. bloom for September 08 using GLCFS modeled currents to move the bloom from the September 03 image.

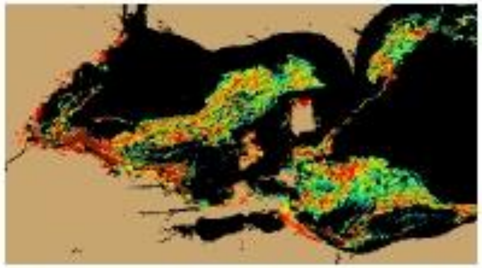
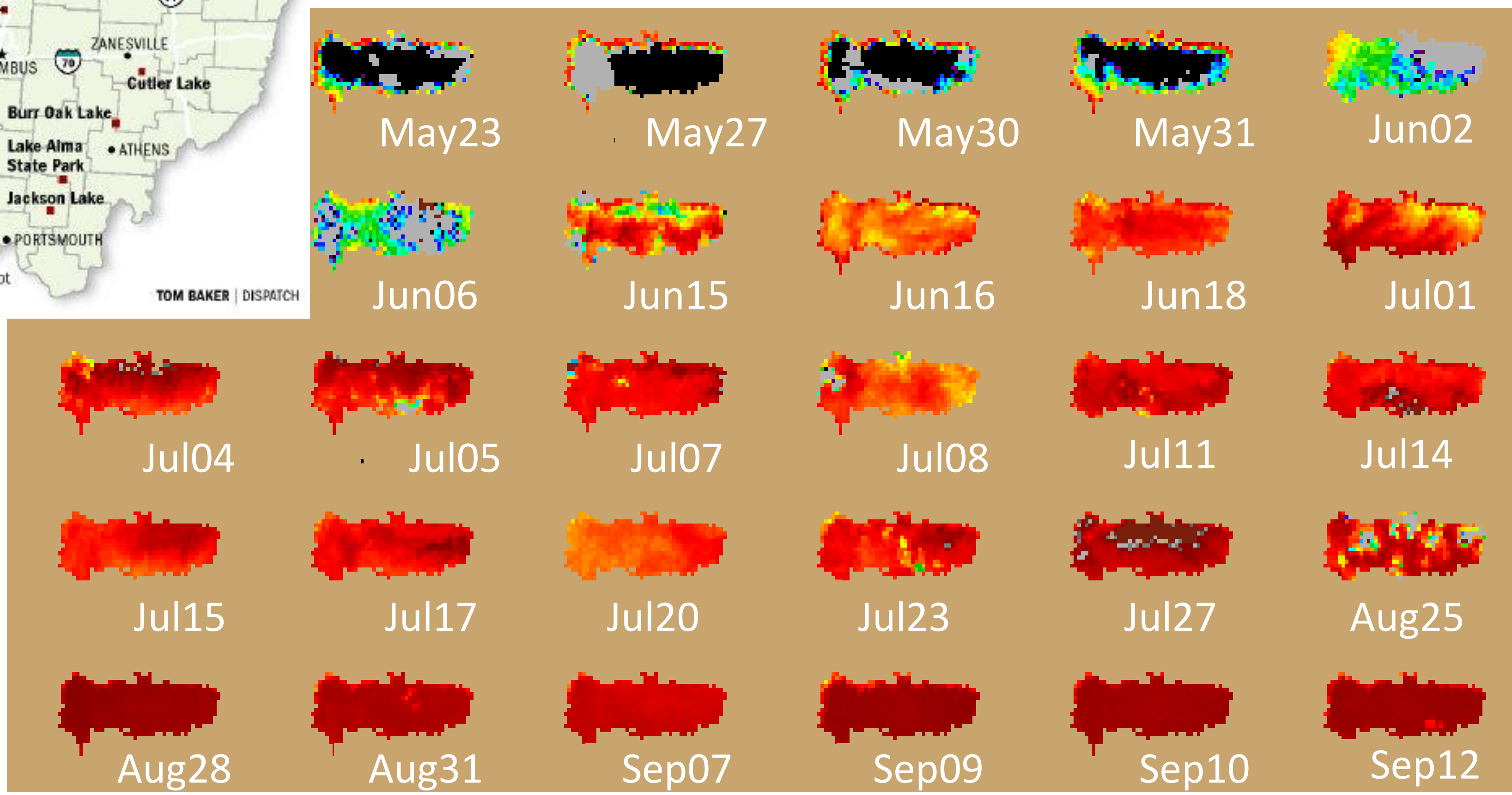


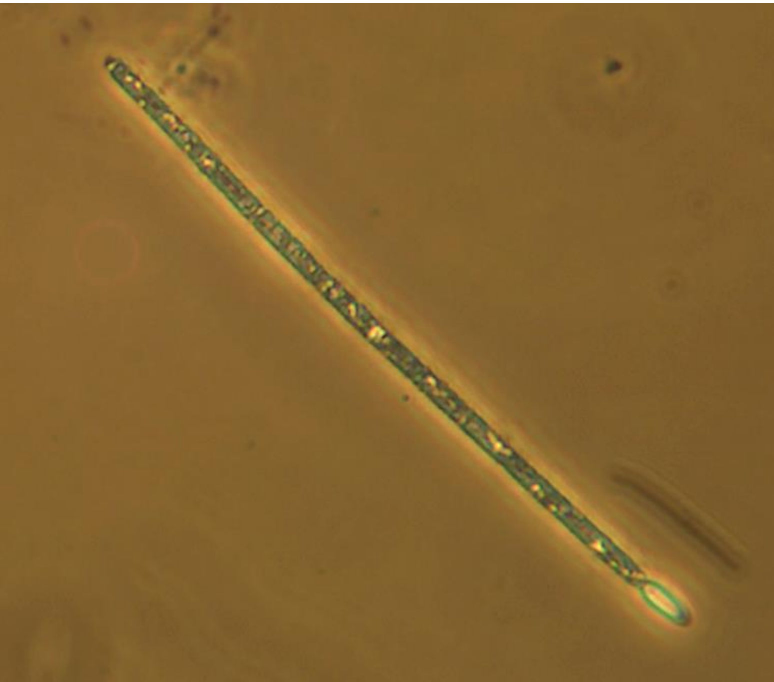
Figure 3. Forecast position of *Microcystis* spp. for September 11 using GLCFS modeled currents to move the bloom from September 03 image.

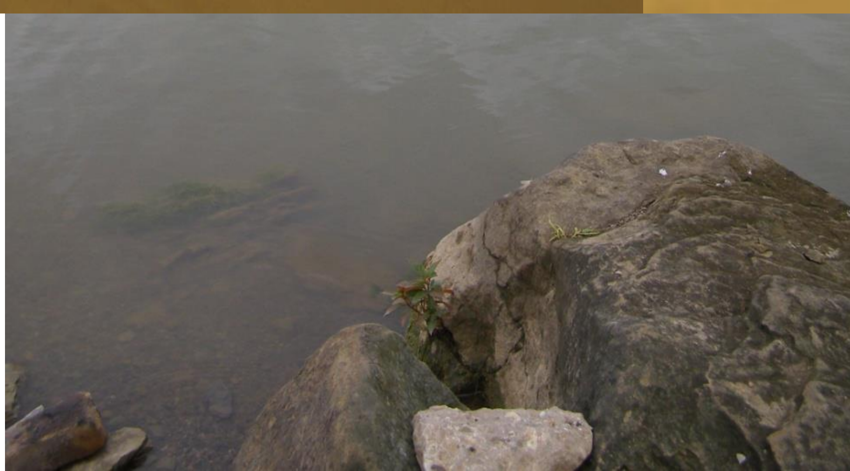
Inland Lake Satellite Data

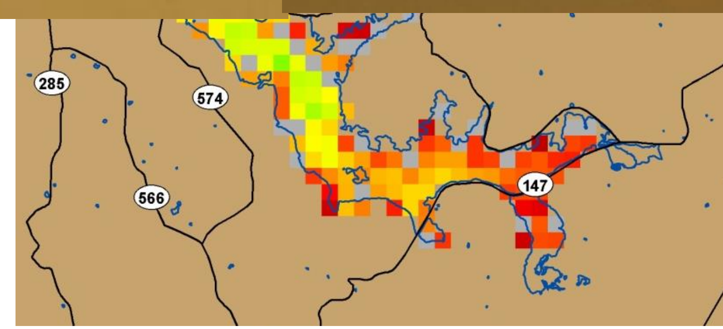
Grand Lake Saint Marys 2010



Harmful Algal Bloom? YES

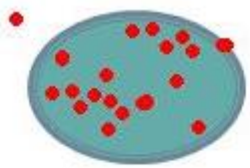




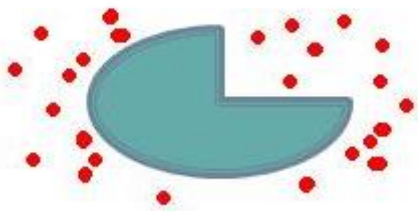


Treatment for Cyanotoxins

- **Intercellular Toxins** – toxins held within the cyanobacteria cell walls



- **Extracellular Toxins** – toxins that have been released from the cells due to cell rupture or other natural processes



- **Treatment effectiveness varies based on Toxin Location** (intercellular vs. extracellular) and **Toxin Type** (microcystin vs. saxitoxin, etc.).

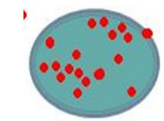
Some Slides Courtesy Dr. Hal Walker, SUNY

OhioEPA

Treatment Effectiveness- Ohio AWWA White Paper

http://www.epa.ohio.gov/portals/28/documents/HAB/AlgalToxinTreatmentWhitePaper.pdf

Intracellular Toxins/Intact Cyanobacteria Cells



– Conventional treatment is generally effective, BUT PWSs should:
  - Optimize coagulation & flocculation process
  - Monitor sedimentation sludge withdrawal cycles (increase if necessary)
  - Optimize rapid rate filtration process

– Pre-oxidation (prior to filtration) with chlorine and other oxidants may cause cell rupture and should be avoided (potassium permanganate better option, if pre-oxidation is necessary)

Extracellular/Dissolved Toxins

– Conventional treatment generally NOT effective at complete toxin removal

– Treatment effectiveness varies based on technology employed and type of algal toxin present in source water

Treatment Effectiveness- Oxidation of Extracellular Toxins

	Anatoxin-a	Cylindrospermopsin	Microcystin	Saxitoxin
Chlorine	Not Effective	Effective (at low pH)*	Effective*	Somewhat Effective
Chloramine	Not Effective	Not Effective	Not Effective at normal levels	Inadequate Information
Chlorine Dioxide	Not Effective at normal levels	Not Effective	Not Effective at normal levels	Inadequate Information
Potassium Permanganate	Effective*	Data ranges from Not Effective to Possibly Effective	Effective*	Not Effective
Ozone	Effective*	Effective*	Effective*	Not Effective
UV/advanced Oxidation	Effective*	Effective*	Not Effective	Inadequate Information

***Assumes Adequate Dose & Contact Times- Effectiveness varies based on pH, toxin concentration, and temperature**

Chlorination CT values for Microcystin-LR

Table 4
Chlorine exposure (CT values) for reducing microcystin concentration to 1 μg l^{-1} at different pH and temperature in a batch or plug-flow reactor

pH	[MC-LR]$_0$ (μg l^{-1})	CT-values (mg l^{-1} min)			
		10 °C	15 °C	20 °C	25 °C
6	50	46.6	40.2	34.8	30.3
	10	27.4	23.6	20.5	17.8
7	50	67.7	58.4	50.6	44.0
	10	39.8	34.4	29.8	25.9
8	50	187.1	161.3	139.8	121.8
	10	110.3	94.9	82.3	71.7
9	50	617.2	526.0	458.6	399.1
	10	363.3	309.6	269.8	234.9

Table 5
Chlorine exposure (CT values) for reducing microcystin concentration to 1 μg l^{-1} at different pH and temperature in a CSTR

pH	[MC-LR]$_0$ (μg l^{-1})	CT values (mg l^{-1} min)			
		10 °C	15 °C	20 °C	25 °C
6	50	583.9	503.3	436.3	380.0
	10	107.2	92.4	80.1	69.8
7	50	847.7	731.2	663.7	551.7
	10	155.7	134.3	116.4	101.3
8	50	2347.5	2020.3	1751.8	1525.9
	10	431.2	371.1	321.7	280.3
9	50	7731.1	6589.0	5740.9	4998.6
	10	1420.0	1210.2	1054.4	918.1

If initial microcystin concentration is high, pH is high, or temperatures are low total toxin destruction may not be possible.

CT values for chlorine are available in Acero et al., “Kinetics of reactions between chlorine and the cyanobacterial toxins microcystins,” Water Res., 39, 1628-1638, 2005.

Chlorine Detention Time- Effect of pH

pH = 7	**pH = 9**
Initial microcystin conc. = 50 µg/L Temp = 25 degrees Celsius BF = 0.7 CT = 44 mg/L-min Let C = 0.5 mg/L free chlorine T = 44 mg/L-min / 0.5 mg/L T = 88 min Td = 88 min/0.7 = 126 minutes	Initial microcystin conc. = 50 µg/L Temp = 25 degrees Celsius BF = 0.7 CT = 399 mg/L-min Let C = 0.5 mg/L free chlorine T = 399 mg/L-min / 0.5 mg/L T = 798 min Td = 798 min/0.7 = 1140 minutes

BF= Baffling Factor
CT values for chlorine are available in Acero et al., “Kinetics of reactions between chlorine and the cyanobacterial toxins microcystins,” Water Res., 39, 1628-1638, 2005.

Chlorination Contact Time-
Effect of Initial Concentration

Initial MC-LR conc. = 10 μg/L	**Initial MC-LR conc. = 50 μg/L**
pH = 7 Temp = 25 degrees Celsius BF = 0.7 CT = 26 mg/L-min Let C = 0.5 mg/L free chlorine T = 26 mg/L-min / 0.5 mg/L T = 52 min Td = 52 min / 0.7 = 74 minutes	pH = 7 Temp = 25 degrees Celsius BF = 0.7 CT = 44 mg/L-min Let C = 0.5 mg/L free chlorine T = 44 mg/L-min / 0.5 mg/L T = 88 min Td = 88 min / 0.7 = 126 minutes

BF = Baffling Factor

Microcystin- LR Reduction By Other Oxidants

Microcystin-LR Half-Lives at pH 8, 20 degrees C, and Constant Oxidant Dose of 1 mg/L

HOCL	**24.8 minutes**
NH_2Cl	**> 14 hours**
O_3	**0.08 seconds**
MnO_4	**5.2 minutes**
ClO_2	**13.1 hours**

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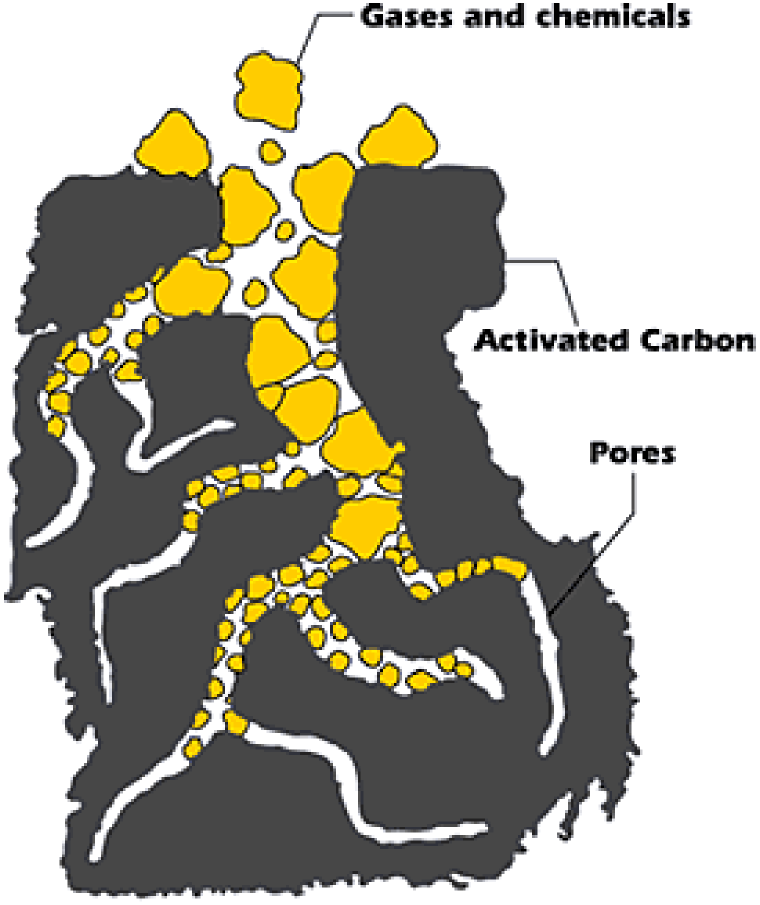
Treatment Effectiveness- PAC (Extracellular Toxins)



Micropores: d <2.0 nm
Mesopores: 2.0 nm < d < 50.0 nm
Macropores: d > 50.0 nm

Powdered Activated Carbon (PAC)

Effectiveness varies based on:

- **Type of Carbon** (size of pores)
  - **Wood Based** (mesopores) - microcystin
  - Coconut Based (micropores)- saxitoxin and taste & odor compounds
- **Dose**
- **Contact time**
- **Natural Organic Matter** (NOM) Interference

PAC dosages in excess of 20 mg/L are often necessary

Estimating Dosages of PAC

TABLE II. Comparison of Freundlich isotherm parameters of *Microcystis* and *Oscillatoria* toxins adsorbed by different kinds of activated carbons

Activated Carbon	Microcystis Toxins[a]		Oscillatoria Toxins[a]	
	K_f	$1/n$	K_f	$1/n$
Wood GAC	501.2	0.36	15.5	0.99
Calgon coal GAC	512.9	0.36	83.2	0.53
Culligon coal GAC	126	0.57	2.0	1.24
Coconut GAC	331.1	0.44	12.6	1.1
Nonactivated GC	2.1	1.3	1.48	1.4
Wood PAC	6309	0.56	1259	0.9
Calgon coal PAC	3630	0.9	955	2
Coconut PAC	1259	1	1000	1

[a] K_f, adsorption capacity in $(\mu g/g)(L/\mu g)^{1/n}$; $1/n$, adsorption intensity.

Mohamed et al., "Activated Carbon Removal Efficiency of Microcystins in an Aqueous Cell Extract of Microcystis aeruginosa and Oscillatoria tenuis Strains Isolated from Egyptian Freshwaters," Env. Tox., 15(5), 197-201, 1999.

Powered Activated Carbon

(Example-PAC dosage)

Example 1

Assume:

-Wood PAC

-Initial MC-LR conc. = 50 μg/L

-Final MC-LR conc. = 1 μg/L

-No NOM competition

$q = 6309\ Cf^{0.56} = 6309(1)^{0.56}$

$q = 6309\ \mu g/g$

Dose = (50 μg/L – 1μg/L)/6309

Dose = 0.0077 g/L = 7.7 mg/L

Example 2

Assume:

-Coconut PAC

-Initial MC-LR conc. = 50 μg/L

-Final MC-LR conc. = 1 μg/L

-No NOM competition

$q = 1259\ Cf^{1.0} = 1259(1)^{1.0}$

$q = 1259\ \mu g/g$

Dose = (50 μg/L – 1μg/L)/1259

Dose = 0.0389 g/L = 38.9 mg/L

Advanced Treatment

- Ozone – Generally effective at destroying microcystins, nodularin and anatoxin-a, but not saxitoxin.

- Membranes – RO & NF are effective at microcystin removal. MF & UF not effective at cyanotoxin removal but can remove intact cells. Cells can stick to membranes and release toxins during backwash.

- UV – Not effective at typical light intensities.

- UV-Advanced Oxidation (H2O2) – May be effective if contact time sufficient.

- GAC – Can be effective, but costly if persistent or severe blooms.

Additional Considerations

Residual Handling

- Consider discontinuing backwash and sludge recycling during harmful algal blooms
- Consider increasing the frequency with which sludge is removed from sedimentation basins during harmful algal blooms

Cost

- Akron- $100,000/month (max $212,000) for carbon treatment
- Without carbon treatment Akron had finished microcystin detection of 0.58 ug/L when concentration in raw was only 1.02 ug/L

Reservoir Management

- **Watershed Management Plan.**
- **Nutrient Reduction.** (primarily Phosphorus for cyanobacteria control)
- **Monitor**. Know Your Reservoir! Understand/predict seasonal trends.
- **Physical controls.** Manipulation of the intake location or depth, aerators, mechanical mixers, scum removal.
- **Biological controls**. Manipulation of the lake ecology to favor cyanobacteria grazers (top-down) and increased competition for nutrients (bottom up) and use of Barley Straw to inhibit cyanobacteria growth.
- **Chemical controls**
  - Phosphorus treatments (e.g. lime, aluminum sulfate, ferric chloride, and clay particles).
  - Algaecides (e.g., copper-sulfate, hydrogen peroxide).

Algaecides are an important management tool, but they should be used with caution!

Algaecide Application

Issues

- Algaecides Can Cause Cells to Lyse (rupture) and Release Toxins
- Toxins May Bypass Conventional Water Treatment

Requirements

- Meet NSF Standard 60 or 61 - OAC 3745-83-01(D)
- Monitor for Copper at Least Weekly for at Least One Month - OAC 3745-83-01
- Submit Notice Of Intent to Ohio EPA's Division of Surface Water & Obtain Coverage under NPDES General Permit for Pesticide Application

REQUIRED PRIOR TO APPLICATION

OhioEPA

Permit Requirements

Operators may not use algaecides to treat severe blooms of blue-green algae (visible scum or > 100,000 cells/mL) that cover greater than twenty percent of the reservoir or are within 500 yards of the intake, unless information is provided to Ohio EPA prior to algaecide application that confirms:

- the bloom is not currently producing toxins, or
- the surface waters will not be used as a public drinking water source until monitoring is conducted to verify the toxin concentrations are below levels of concern, or
- toxin concentrations will remain below thresholds established in the State of Ohio harmful Algal Bloom Response Strategy for treated drinking water during and following application of the algaecide.

OhioEPA

Additional Recommendations

Apply Early to Cyanobacteria Blooms

- Before Blooms are Visible or if Cyanobacteria is <10,000 cells/mL

Evaluate Threat and Consider Toxin Monitoring

- Identify cyanobacteria to genus level & estimate amount present
- If >10,000 cyanobacteria cells/mL but does not meet severe bloom algaecide restrictions in permit- consider testing for algal toxins
- Continue testing until toxins below thresholds in raw water

Report Blooms to Ohio EPA

See Ohio EPA Algaecide Application Fact Sheet for More Information!

Ohio EPA

Permit Overview

- Permit required for any algaecide application to a drinking water source (effective October 31, 2011).
- **NOIs must be submitted to Ohio EPA Division of Surface Water.**
- PWSs should include any potential algaecides they may use, to avoid needing a new permit if change type of algaecide.
- Permit will be effective for 5 years.
- For more information: **http://www.epa.ohio.gov/dsw/permits/GP_Pesticide.aspx**

Contingency Planning

- Protocol for issuing a Tier 1 Drinking Water Advisory
- Communication strategy, including 24 hour emergency contacts
- Identification of critical users/possible susceptible populations
- Consumer notification
- Alternate water sources
- Distribution sampling plan and modeling to estimate contaminant transport in the system
- Operational measures that can be taken to isolate the contamination within distribution and limit the extent of advisory
- Considerations for water restrictions at satellite systems
- Flushing lines (identify procedures and locations)
- Authorization for expenditures to implement the contingency plan

Ohio EPA

What is Ohio EPA Doing to Help?

Ohio EPA

HAB Resources

Ohio PWS Harmful Algal Bloom Website:

www.epa.ohio.gov/ddagw/hab.aspx

- **PWS HAB Response Strategy-** working with stakeholders to improve
- **Algal Toxin Treatment White Paper-** working with stakeholders to improve
- **Laboratory and Test Kit List** - working with stakeholders to improve
- Links to Additional Resources and References
- Cyanotoxin Monitoring Data
- Algaecide Application Fact Sheet
- Reservoir Management Strategies Fact Sheet
- Bloom Identification and Characterization Guide

ELISA Guidance –working with stakeholders to create

NOAA Satellite data & HAB Bulletin

http://www.glerl.noaa.gov/res/Centers/HABS/lake_erie_hab/lake_erie_hab.html

OhioEPA

Technical Assistance & Outreach

- Responded to over 700 requests for information related to HABs at public water systems
- Gave over 30 presentations on HAB impacts to water systems
- Present at the 2-day OSU Stone Lab HAB Workshop (annually since 2010)

Offered by Ohio Sea Grant, OSU & Ohio EPA

- Held at Stone Lab Campus on Gibralter Island
- Geared to Water Supplies and Lake Managers
- August 13-14 , 2014
- $325 – includes instruction (13 contact hours), lodging, & food
- Algae ID class August 11-12

http://stonelab.osu.edu/courses/noncredit/87/

Technical Assistance & Outreach

- March 28 - Lake Erie Users Group Meeting (all Lake Erie PWSs invited)
- May 1 - Western Basin HAB Meeting in NWDO
- May 29 - Lake Erie Islands HAB Meeting
- June 24 - NW Ohio PWS HAB Meeting
- July 14 - First Lake Erie PWS HAB Conference Call
- July 29 - NE Ohio PWS HAB Meeting
- July 31 - Second Lake Erie PWS HAB Conference Call

OhioEPA

Assistance & Outreach

Funding:

PWSs impacted by HABs can earn priority points for funding under the state revolving loan fund.

Federal Assistance:

Harmful Algal Bloom and Hypoxia Research and Control Act

Outreach – National Scope

- Worked with the Association of State Drinking Water Administrators to create a National HAB forum
- Invited by National Drinking Water Advisory Council and USEPA Administrators to share information on HAB impacts to Ohio PWSs
- Participated in several meetings with USEPA leadership requesting development of national cyanotoxin standards and more research on public water system treatment
- Working with USEPA research lab on cyanotoxin treatment investigations.

Ohio EPA

Public Drinking Water Supply Beneficial Use

New Impairment Criteria for 2014

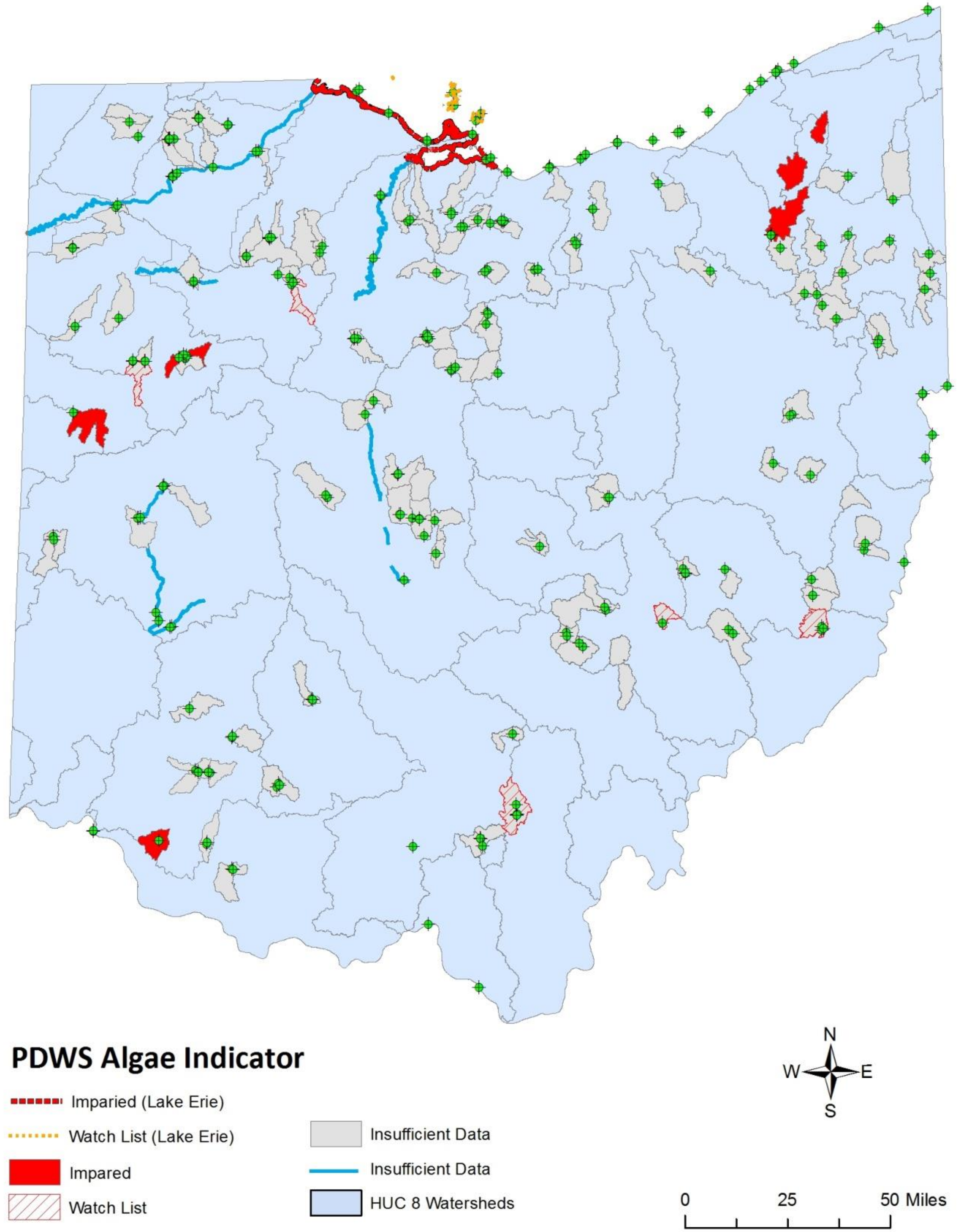
Integrated Water Quality Monitoring and Assessment Report:

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 Lake Erie Basin Shoreline and Six Watersheds are Impaired

Six Additional Public Waters Systems are on a Watch List



Support and Collaborate on HAB Research

- USEPA
- USGS
- NOAA
- Ohio State University Stone Lab
- University of Toledo Lake Erie Center
- Heidelberg Water Quality Lab

Improve understanding of bloom dynamics, triggers for toxin production, and causes. Assist with prediction modeling.

OhioEPA

Questions?

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http://www.epa.ohio.gov/ddagw/HAB.aspx