Webinar Outline

- HAB Rules Overview
- 2016 Results
- 2017 Monitoring Schedules
- Response Strategies
- Contingency Planning and Preparedness
- Q & A
2016 Highlights

- 100% compliance with new monitoring requirements!
- No microcystin in finished water.
HAB Rules - Overview

- PWS requirements - OAC Chapter 3745-90
  - Microcystins action levels in drinking water
  - Monitoring requirements
  - Treatment technique requirements
  - Public notification and Consumer Confidence Report (CCR) requirements
  - Recordkeeping requirements

- Laboratory Certification requirements – new OAC rule 3745-90-04 and amended rules in Chapter 3745-89
  - Laboratory certification
  - Analytical techniques
  - Reporting deadlines
Applicability

- **Surface water systems**
  - All requirements apply

- **Consecutive (purchased) surface water systems from out-of-state sources**
  - Finished water microcystins monitoring only

- **In-State consecutive (purchased) surface water systems**
  - Routine monitoring and treatment technique requirements do not apply; However, if wholesale system has action level exceedance then monitor at distribution sampling points.

- **Ground water systems**
  - Routine monitoring requirements do not apply
Ohio Numerical Cyanotoxin Thresholds for Drinking Water

<table>
<thead>
<tr>
<th>Drinking Water Thresholds</th>
<th>Microcystins (μg/L)</th>
<th>Anatoxin-a (μg/L)</th>
<th>Cylindrospermopsin (μg/L)</th>
<th>Saxitoxins (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do Not Drink – children under 6 and sensitive populations</td>
<td>0.3</td>
<td>20</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Do Not Drink – children 6 and older and adults</td>
<td>1.6</td>
<td>20</td>
<td>3.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Do Not Use*</td>
<td>20</td>
<td>300</td>
<td>20</td>
<td>3</td>
</tr>
</tbody>
</table>

*Microcystins = Action Level in Ohio Rule
Other cyanotoxins = Threshold in PWS Response Strategy
Current Monitoring Requirements

Total Microcystins
- May-October *(new reduced options)*
  - Weekly raw/finished water
- November-April
  - Biweekly raw water only
- If purchasing SW from out of state
  - Weekly finished water microcystins monitoring required (year round)

Cyanobacteria Screening (qPCR)
- Biweekly raw water
- Triggers follow up sampling by Ohio EPA for other cyanotoxins
Cyanobacteria Screening: qPCR
(Quantitative polymerase chain reaction)

- Identify total cyanobacteria and cyanotoxin producing genes
  - Ohio EPA conduct analysis and follow up
    - Cyanobacteria (16S rDNA)
    - Microcystin, Cylindrospermopsin, and Saxitoxin production
  - Lab certification in 2017
  - Biweekly sampling at all PWS

- May - December 2017 all samples analysis will continue at Ohio EPA’s lab
  - Containers and analysis provided at no cost
  - OEPA continuing to cover shipping fees from regional hubs
## NWDO Shipping Hubs

<table>
<thead>
<tr>
<th>Hub</th>
<th>Sample Receipt Day &amp; Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archbold WTP</td>
<td>Tuesday by 10:00 AM</td>
</tr>
<tr>
<td>Celina WTP</td>
<td>Tuesday by 12:00 noon</td>
</tr>
<tr>
<td>Findlay WTP</td>
<td>Wednesday by 8:00 AM (transported to Oregon)</td>
</tr>
<tr>
<td>Oregon WTP</td>
<td>Wednesday by 10:00 AM</td>
</tr>
<tr>
<td>Willard WTP</td>
<td>Tuesday by 12:00 noon</td>
</tr>
<tr>
<td>Ohio EPA NWDO</td>
<td>Call for availability</td>
</tr>
</tbody>
</table>
NEDO Shipping HUBS

Hub #1 – Lorain Co. (Avon Lake WTP)
- Avon Lake City PWS
- Elyria Water Dept PWS
- Lorain City PWS
- Oberlin Water Dept PWS
- Wellington Village PWS

Hub #2 – Cuyahoga Co. (Cleveland-Morgan WTP)
- Cleveland PWS (all 4 plants)
- Berea City PWS

Hub #3 – Lake Co. (Painesville WTP)
- Painesville City PWS
- Lake County West PWS
- Lake County East PWS
- Aqua Ohio Mentor PWS
- Fairport Harbor Village PWS
- Aqua Ohio Ashtabula PWS
- Conneaut PWS

Hub #4 – Trumbull & Mahoning Co. (Warren WTP)
- Aqua Ohio Struthers PWS
- Campbell City PWS
- Warren City PWS
- Newton Falls City PWS
- Mahoning Valley Sanitary District PWS
- West Farmington Village PWS

Hub #5 – Stark, Mahoning, Columbiana Co. (Salem WTP)
- Salem City PWS
- Sebring Village PWS
- Alliance City PWS
- East Liverpool City PWS
- Buckeye Water District – Ohio River PWS
- MWCD Atwood Park PWS

Hub #6 (Akron WTP)
- Akron City PWS
- Barberton City PWS
- ODNR West Branch Tower PWS
- Ravenna City PWS

Ohio Environmental Protection Agency
Response to Microcystin Detections

- **Raw water > 5 \( \text{ug/L} \) = increase monitoring to 3 days/week**
- **Finished water detect = increase to daily monitoring**
  - Ohio EPA initiate immediate response with PWS
- **Finished water detect exceeds Action Level = Resample and Repeat Sample**
  - Notification to state agencies (Ohio EMA Watch Desk)
- **Resample.** Collect raw/finished resample asap but no later than 24 hours after notified of exceedance. Analysis w/in 24 hours of collection.
- **Repeat.** Collect raw/finished repeat samples within 24 hours of collecting the resample. Analysis w/in 24 hrs of collection.
Resample and Repeat Sample Exceeds Action Level

- If any finished water Resample or Repeat samples exceed the action level:
  - Notify any consecutive systems (w/in 3hrs of receiving resample or repeat results that exceed Action Level)
  - Collect distribution samples (including consecutive systems, w/in 24 hrs of receiving the resample or repeat results that exceed Action Level)

- If finished water Repeat samples exceed the action level:
  - Conduct public notification

Quick treatment optimization and source management are critical and can prevent advisories.
Treatment Technique Requirements

- Treatment Optimization Protocol *(short term)*
- Cyanotoxin General Plan *(long term)*
Treatment Technique Requirement –

**Treatment Optimization Protocol**

- Required if microcystins are detected in raw or finished samples
  - Due within 30 days of detection (unless previously required)
- Describe treatment adjustments that will be made under various raw and finished water conditions
- Main components
  - PWS Summary information
  - Raw/finished water triggers for optimization
  - Source water management strategies
  - Treatment plant optimization strategies
  - Response to raw/finished water detections
Treatment Technique Requirement – *Cyanotoxin General Plan*

- Required if microcystins detected in finished water or in raw water > 1.6 µg/L (2X within one year)
- Due within 120 days
  - $150 fee for general plan and P.E. stamp required
- Include one or a combination of source water protection and avoidance strategies, reservoir management, and in-plant treatment technologies
  - Must include implementation schedule; or
  - Document existing treatment is sufficient for cyanotoxin destruction or removal
Treatment Technique Requirements

- 52 PWS triggered Treatment Optimization Protocols (TOPs)
- 6 PWS triggered Cyanotoxin General Plans

Guidance available on OEPA webpage
Tier 1 Public Notification

- Repeat finished water sample exceeds an action level
  - unless Director approves extension or waiver based on extenuating circumstances
- Based on the results of resamples or distribution system samples, if required by the Director
- Failure to collect repeat samples
- May limit distribution of public notice
  - Demonstrate cyanotoxins remain below the action level in portions of the distribution system which would not be included
  - Include procedures for making this demonstration in Contingency Plan
  - Obtain written permission (email is acceptable)
Tiers 2 & 3 PN, CCR and Recordkeeping

- Tier 2 PN
  - Failure to submit treatment optimization protocols
  - Failure to submit or implement cyanotoxin general plan

- Tier 3 PN
  - Failure to monitor or report

- CCR
  - Include any finished water action level exceedance (including distribution sites)

- Recordkeeping
  - Keep records for 10 years
Certified Laboratory Requirements

- Analytical method “Ohio EPA Total (Extracellular and Intracellular) Microcystins - ADDA by ELISA Analytical Methodology” version 2.2 (August 2015)
- Extending acceptance for all labs that have a current acceptance letter and submitted an acceptable application for certification prior to the current letter expiration (5/31/17)
  - DES performing surveys for certification starting the second week of April 2017.
  - Some surveys may be scheduled until June or July.
  - Laboratories’ acceptance will be extended until the on-site laboratory survey is conducted.
  - Contact DES if survey needed sooner.
Reporting Deadlines

- Report by the end of the next business day to OEPA and PWS
  - all detections of microcystins in finished water samples
  - all results above 5 µg/L microcystins in raw water samples
  - all daily, resamples and repeat samples
- All others, report by the 10th day following the month in which the sample was collected.
PWS HAB Response Strategy

- Monitoring strategy
  - Ohio EPA response to qPCR screening
  - New reduced monitoring options
- Drinking water thresholds
- Response to finished water exceedances
- Updated annually since 2011

What did we learn in 2016?
Preliminary Findings: Microcystins

- 100% compliance with rules
- Microcystins detected in raw water at 41 PWS (33% of surface water systems)
- Nearly all Lake Erie PWSs had microcystins detections and all had gene detections
- No finished water microcystins detections
- Still dealing with microcystins at PWSs into March
- Some PWSs had first microcystins detection in “off-season”
Source Water Microcystins Detections at Ohio PWSs

Data Available for 119 Public Water System Source Waters

(includes ~2000 compliance samples collected in 2016)
Maximum Microcystins Detection By Month

Based on Microcystins Detections at 62 Public Water Systems (2010 - 2016)
Comparison of Maximum Microcystins Detection at Lake Erie Public Water Systems by Year (2010 to 2016)

Microcystins Concentration (µg/L)

- 2011
- 2012
- 2013
- 2014
- 2015
- 2016

* Microcystins not detected at Cleveland Intakes
Comparison of 2015 and 2016 Lake Erie HAB using Satellite Imagery (NOAA data)

Was 2016 a good year to benchmark?
Lake Erie Central Basin

![Graph showing mcyE and Microcystins Trends in Lake Erie Central Basin]

- **Y-axis**: Microcystins (µg/L), mcyE (GC/µL)
- **X-axis**: Dates from 5/30/2016 to 11/6/2016

Legend:
- Green circle: PWS1 mcyE
- Red circle: PWS2 mcyE
- Green cross: PWS1 Microcystins
- Red plus: PWS2 Microcystins

Note: ND indicates not determined.
Raw Water Microcystins at an Inland PWS – Microcystins Do Not Always Peak in Summer

No Samples Collected

Microcystins (ug/L)
qPCR as Screening Tool for Microcystins

- Out of 1850 paired PWS samples:
  - 100% of microcystins detections greater than 1.6 ug/L had paired mcyE gene detections.
  - Only 2% of samples had microcystins detections without corresponding gene detections:
    - 22 PWSs had at least one MC detection without corresponding mcyE detection, BUT
    - 19 of the 22 had gene detections in either prior or post sampling events
    - The remaining three PWSs had only one low level (0.35 – 0.44 ug/L) microcystins detection this season. Two of those systems had trace mcyE gene copies (detected, but below DES reporting limit)

- Overall, qPCR is a reliable screen for Microcystins
qPCR mcyE Correlation with Microcystins

Correlations

<table>
<thead>
<tr>
<th>Spearman</th>
<th>Kendall</th>
</tr>
</thead>
<tbody>
<tr>
<td>rho = 0.62</td>
<td>tau = 0.59</td>
</tr>
<tr>
<td>p &lt;&lt; 0.001</td>
<td>p &lt;&lt; 0.001</td>
</tr>
</tbody>
</table>

- 100% of microcystins detections >5 ug/L had mcyE detections > 5gc/uL
- 90% of microcystins detections >1.6 ug/L had mcyE detections > 5 gc/uL

*excludes 7 data points >100 mcyE
# qPCR Screen for Microcystins

<table>
<thead>
<tr>
<th>Microcystins (µg/L)</th>
<th># samples, (# PWS)</th>
<th>mcyE %, range (Gene Copies/µL)</th>
<th>16S, Total Cyanobacteria range (Gene Copies/µL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.3</td>
<td>1705 (120)</td>
<td>5% ND – 29</td>
<td>ND – 67K</td>
</tr>
<tr>
<td>0.3–1.6</td>
<td>116 (40)</td>
<td>66% ND – 29</td>
<td>8 – 59K</td>
</tr>
<tr>
<td>&gt;1.6</td>
<td>22 (9)</td>
<td>100% 0.45 – 4K</td>
<td>1.4K – 300K</td>
</tr>
</tbody>
</table>
Microcystins and qPCR Trends

Microcystins (µg/L) vs. mcyE gene (gc/µL) over time from 5/30/2016 to 12/16/2016.

- Blue dots represent the mcyE gene concentration (gc/µL).
- Red line represents the Microcystins concentration (µg/L).

The graph shows a trend analysis for Microcystins and their corresponding mcyE gene concentrations.
Microcystins and qPCR Trends

- Microcystins trend with mcyE genes
- Non-toxic cyanobacteria bloom in August
Late Fall-Winter Microcystins and qPCR Trends

- Microcystins, mcyE (µg/L)
- Total Cyanobacteria qPCR (GC/µL)
- Total Cyanobacteria count (cells/µL)

Graph showing trends from 5/30/16 to 12/16/16.
Preliminary Findings: Saxitoxins & Cylindrospermopsin

- **Saxitoxins**
  - 33 PWSs detected saxitoxin genes in source water (27%)
  - 15 of those PWSs detected saxitoxins in raw water (12%)
  - 6 PWSs detected saxitoxins in finished water; No detections above Ohio EPA thresholds (5%)

- **Cylindrospermopsin**
  - 1 PWS detected cylindrospermopsin gene in source water
  - No raw or finished water detections
qPCR as Screening Tool for Saxitoxins and Cylindrospermopsin

- Saxitoxin gene detections triggered response sampling at 33 PWSs
  - <1% percent of samples had saxitoxins detections without corresponding gene detections
- Cylindrospermopsin - Not enough occurrence to determine screening effectiveness
- Overall, qPCR is a reliable screen for Saxitoxins
Multiplex Assay Works: Microcystin (mcyE) genes and microcystins also detected; Cylindrospermopsin (cyrA) genes also detected (cylindrospermopsin was not detected)
Ongoing qPCR Evaluation

- Ohio EPA will continue to provide qPCR analysis to PWSs at no cost through December 31, 2017
- Split samples extracts with USEPA:
  - Interlab validation of qPCR method
  - Evaluating enhanced sample clean-up methods
  - Sequencing samples for 16s
  - Develop national guidance
- Split sample extracts with NOAA
  - Sequencing samples for mcyE and sxtA
- Publish Manuscript with Results
- Finalize Ohio EPA qPCR Method
Joint OEPA/USEPA Comprehensive Performance Evaluation (CPE) Effort

- Project to expand the national CPE program to optimization of cyanobacteria and cyanotoxins
  - Developmental effort to establish a CPE protocol incorporating HABs
  - Evaluate HAB related performance factors to assess the WTP’s ability to address cyanobacteria and cyanotoxins
  - Four Ohio surface water PWS will be involved in the project
Where are we going in 2017?
Unchanged from 2016 HAB Season

- Biweekly Cyanobacteria Screening (qPCR)
  - PWS will remain on same week of the biweekly scheduling provided in their monitoring requirements mailed in December.
  - Ohio EPA will conduct follow up monitoring for other cyanotoxins based on gene detections.

- PWS response and additional monitoring requirements:
  - raw water microcystins > 5 ug/L
  - any finished water microcystins detection
New Microcystins Monitoring Schedules starting May 1, 2017

- Based on occurrence and treatment risk
  - Are we likely to have HABs in source water?
  - How capable is the WTP of removing cyanotoxin?
- Feedback from OAWWA Tech Committee
- Developed 3 Monitoring Schedules
- PWS will be notified and OEPA will maintain list of current schedules online
<table>
<thead>
<tr>
<th>Schedule</th>
<th>PWS Criteria</th>
<th>2017 Season Monitoring Requirements (starting 5/1/17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Historic microcystins detections in finished drinking water; OR &lt;br&gt; • PWS has a high source water susceptibility (more than two historic microcystins detections greater than 1.6 ug/L in raw water since 6/15/15) and either: &lt;br&gt;   o Pre-oxidizes with chlorine or chlorine dioxide and has limited down-stream processes to address extracellular microcystins OR &lt;br&gt;   o Has no advanced treatment processes in place</td>
<td>All year &lt;br&gt; Biweekly qPCR screening &lt;br&gt; 5/1/17-10/31/17 &lt;br&gt; Weekly raw/finished microcystins (paired with screening sample)</td>
</tr>
<tr>
<td>2</td>
<td>• PWSs do not meet the criteria for Schedule 1 or 3</td>
<td>All year &lt;br&gt; Biweekly qPCR screening &lt;br&gt; 5/1/17-10/31/17 &lt;br&gt; Biweekly raw water microcystins (collected on alternate week as screening sample, not paired)</td>
</tr>
<tr>
<td>3</td>
<td>• PWS with well source considered ground water under the influence of surface water with no historic microcystins or saxitoxins detections, no sxtA or mcyE detections, and low 16s</td>
<td>All year &lt;br&gt; Biweekly qPCR screening</td>
</tr>
</tbody>
</table>
Monitoring Schedules

**Schedule 1**: Toledo, Cadiz, Kelleys Island, PIB, Campbell’s Soup, Camp Patmos, Lake Erie Utilities, Mansfield

**Schedule 2**: All other PWS

**Schedule 3**: Bellaire, Byesville, Dayton, Wellston South
Schedule 2- Implementation Notes

- If microcystins are detected in the raw water:
  - PWS must collect raw/finished water sample within 24 hours of receiving the result and complete analysis within five days.
  - If PWS collected a paired finished water sample with their initial raw water sample, an additional raw and finished sample is not required until the following week (unless raw water was > 5ug/L or any finished water detection).
  - PWS will be changed to Schedule 1 requirements for remainder of the season (though 10/31/2017).
Schedule 2- Implementation Notes

- If mycE genes are detected at high levels in the raw water (> 5 gene counts per uL):
  - PWS collect raw/finished water microcystins sample within 24 hrs of receiving the result and complete analysis within five days.
    - Any microcystins detections in finished water or raw water > 5 ug/L will trigger additional monitoring requirements as specified in OAC Chapter 3745-90.
    - If microcystins are not detected the PWS will remain on Schedule 2 monitoring requirements.
    - If microcystins are detected in either the raw or finished water, the PWS will be changed to Schedule 1 monitoring requirements for the remainder of the season.
All Schedules

- If data from source water monitoring or satellite data indicate that a HAB is present, Ohio EPA can request or require (depending on HAB severity and proximity to intake) the PWS conduct sampling for microcystins.
  - Based on results could be switched to schedule 1
- Ohio EPA considering monitoring options starting Nov. 1 and will notify PWS by the end of September 2017.
If positive mcyE gene detection:

- PWS must collect raw/finished water microcystins sample within 24 hours and complete analysis within five days.
  - Any microcystins detections in finished water or raw water > 5 ug/L will trigger additional monitoring requirements as specified in OAC Chapter 3745-90.
  - Any microcystins detected in the raw or finished water, the PWS will switch to Schedule 1 monitoring for remainder of the season (through 10/31/2017).
  - If only mcyE genes are detected, PWS transitions to Schedule 2 monitoring.
Contingency Plans for Public Water Systems

- Required in Ohio Administrative Code 3745-85-01
- Identify risk (TEN most likely emergencies)
- Define response for each incident type
- Select alternate sources of water
- Provide notice when service restored

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

- Public water systems
- Local EMAs, health districts, government officials
- Technical assistance
- Website: www.ohioalgaeinfo.com
HAB Monitoring and Equipment Grants and HAB Infrastructure Loans

- WSRLA HAB Infrastructure Loans (0% Interest/20 yrs)
- Monitoring Equipment Grants – additional funds available after (up to $30K per PWS, lifetime max).
  - ELISA Microcystins Testing Equipment and Training
  - Microscopes, datasondes, phyto identification

Funding is still available!
Ohio EPA District HAB Coordinators

Central District
Tya Darden 614-728-3866

Northeast District
Chris Maslo 330-963-1164

Northwest District
Kimberly Burnham 419-373-3102
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Questions?

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http://epa.ohio.gov/ddagw/HAB.aspx
www.ohioalgaeinfo.com
• Low mcyE genes detected 1 week prior to MC
• MC detection triggers change to Schedule 1
Change in schedule – Example 2

- Greater than 5 mcyE requires resample within 24 h
- Resample MC detection triggers change to Schedule 1
- In 2016, only 3 PWS would require resample