



Public Water Supply - HAB Monitoring Program
First Kansas PWS Harmful Algal Toxin Breakthrough
Rob Gavin, P.G. | April 17, 2024



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Today's Topics

- Brief Review of PWS HAB Monitoring Program
- Program Numbers
 - Public Water Systems Participating
 - Testing Results
- Discussion of first Toxin exceeding Health Advisory in Kansas Drinking Water and process to clear toxin from drinking water system.
- Questions and Answers





KDHE HAB Monitoring Program

1. Voluntary program for Surface and GUI Public Water Supply System
2. Provides consistent proactive monitoring for potential toxins through the HAB bloom season (Weekly tests May 1- Oct. 31)
3. Intended to provide water systems with important information, so that treatment processes can be modified, or other measures taken to assure safe drinking water is provided to their customer
4. Early detection will also allow for timely notification to customers should an event occur.



KDHE HAB Monitoring Program

5. Monitoring Season will run annually May 1 through October 31
6. HAB test Bottles will be sent to PWS from KHEL at the beginning of season and additional bottles sent when/if needed
7. PWS will conduct initial microcystins monitoring for both raw and finished water during the first two weeks of May. PWS Ships samples back to KHEL
8. If no microcystins are detected, the PWS would begin weekly monitoring of raw water at water intake only (i.e. the same location as LT2 Samples are collected or water intake structure)



KDHE HAB Monitoring Program

9. If microcystins are detected in the raw water over $0.3 \mu\text{g/L}$, Contact KDHE PWS-Section immediately (contact information listed below). PWS will then collect a paired raw and finished water microcystins samples within 24 hours of receiving the positive results and complete analysis within five days.
10. Depending on the microcystins levels detected, KDHE may instruct PWS to continue weekly monitoring or request increased testing of raw and/or finished water. Modifications to water treatment process may be required to remove toxins.
11. PWS will continue with weekly paired raw and finished water microcystins monitoring until results are non-detect for at least two consecutive weeks or as directed by KDHE.



EPA Numerical Cyanotoxin Thresholds for 10-Day Drinking Water Health Advisories

Cyanotoxin	Drinking Water Health Advisory (10-day)	Drinking Water Health Advisory (10-day)
	Bottle-fed infants and pre-school children	School-age children and adults
Microcystins	0.3 µg/L	1.6 µg/L
Cylindrospermopsin	0.7 µg/L	3 µg/L
Anatoxin-A	*	*
Saxitoxin	*	*

- Exposure Pathway – Oral Ingestion of Drinking Water
- Health Advisory Value – 10 Day Exposure

KDHE HAB Monitoring Program Lab and HAB Sample Kit Costs

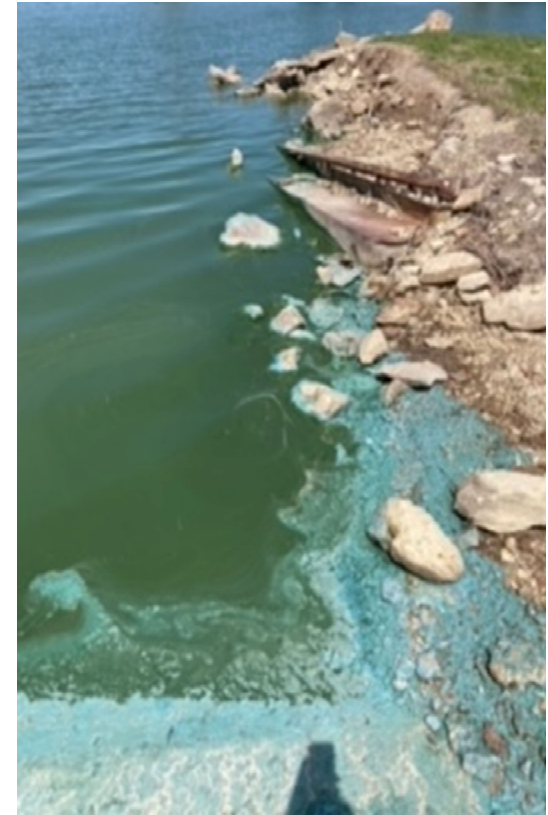
1. Testing Costs will depend on how many Systems that Participate
2. Test Kits are approx. \$400 per tray -30 tests per tray, but tray cannot be reused if all tests not filled
3. PWS will pay for shipping
4. Current estimated test cost without KHEL Staff time is just over \$125/test
5. KDHE will underwrite a portion of testing costs
6. Estimated Cost per test to PWS \$25 each





Public Notification Procedure

- Should an exceedance of the EPA Health Advisory (0.3ug/L) occur in the finish water or distribution system samples, Contact KDHE PWS-Section immediately.
- KDHE will assist the PWS to issue an immediate Tier-1 **do not drink public advisory** (24-hour notification) informing all customers of the situation. Water System to provide alternate drinking water source.
- If requested, a public advisory template will be provided by KDHE containing the appropriate health effects language and use restrictions depending on tested levels vs. health advisories.





PWS Contingency Planning

- KDHE encourages public water systems to work with KDHE, their local emergency management agency, and local health departments to develop a coordinated response to cyanotoxin detections in finished water above EPA designated health advisory levels.
- A detailed response protocol should be included in the Emergency Operations Plans of those PWSs using surface water sources susceptible to a harmful algal bloom.



Additional items the water system should address in their contingency plan include:

- A communication strategy, including 24-hour emergency contacts, identification of critical users/possible susceptible populations.
- Alternate bottled water supply plan.
- Considerations for water restrictions or connections to a backup water supply.
- KDHE can provide additional guidance as requested.



2023 KDHE HAB Monitoring Program

- **29**-surface water and **1** GUI systems are participating in voluntary monitoring program.
- **4**-additional PWSS are doing own testing.
- **719**-samples run by KHEL to date.
- **576**-raw water samples.
- **143**-finish water samples.
- **12**-systems had toxin detects in raw water at intake.
- **63**-raw samples were above health advisory at PWS intake.
- **4**-systems had detects in finish water.
- **1** system had finish water test results above the HA of 0.3ug/L.
- **0** qPCR samples have been taken this season.



Some things were learned from Program:

- Microcystin toxin detects have been observed in raw water tests without a visual bloom being identified in the water source.
- Mis-information from media and social media can cause undue concern for the public and extra work for water systems and KDHE.
- KDHE would still like to do qPCR testing earlier in season to fully use its potential for predicting toxins but since COVID no qPCR testing on water samples.
- Raw water toxin levels can fluctuate widely from day to day due to weather, wind and currents – Marion and Hillsboro use same lake intake structure yet have significant difference in results.

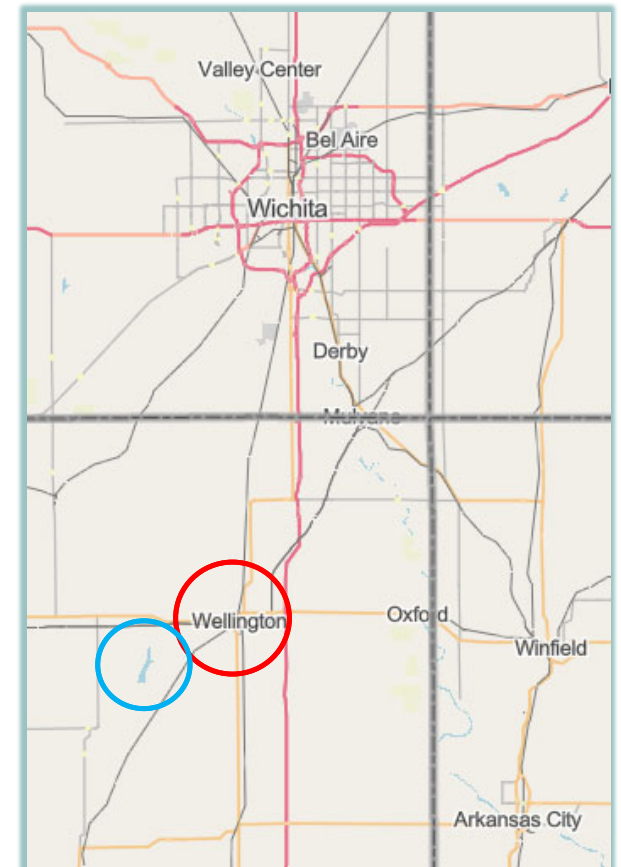


Wellington, KS Public Water System

First Kansas Toxin Breakthrough above HA

Special Acknowledgements

- **City of Wellington Staff** for enduring the onslaught, understanding the health risks and spending numerous hours sampling, flushing and answering public concerns.
- **SCDO Inspector Staff** – Kari Goldston, Sabrina Cantrell and Amanda Smythe for being onsite to evaluate conditions, collecting samples, photos and participating in HAB sample relays.
- **KHEL** – Laboratory staff worked late nights and weekend to process samples to get data for PWS to make health decisions. Lab staff also made numerous trips participating in sample relays.



Wellington City Lake

- Surface area of approximately 674 acres.
- Old and new sections of lake.
- Approximately ten miles of shoreline.
- HAB Bloom in June has dissipated.
- Heavy Rain and then high temps in late July and August 2023.



Wellington WTP

- Average production: 1.5 MGD.
- Peak day about 2.1 MGD.
- 420 MGY of treated water.
- Tri-level intake structure.



2023 NAIP Image from KDHE PWS Web-Mapper



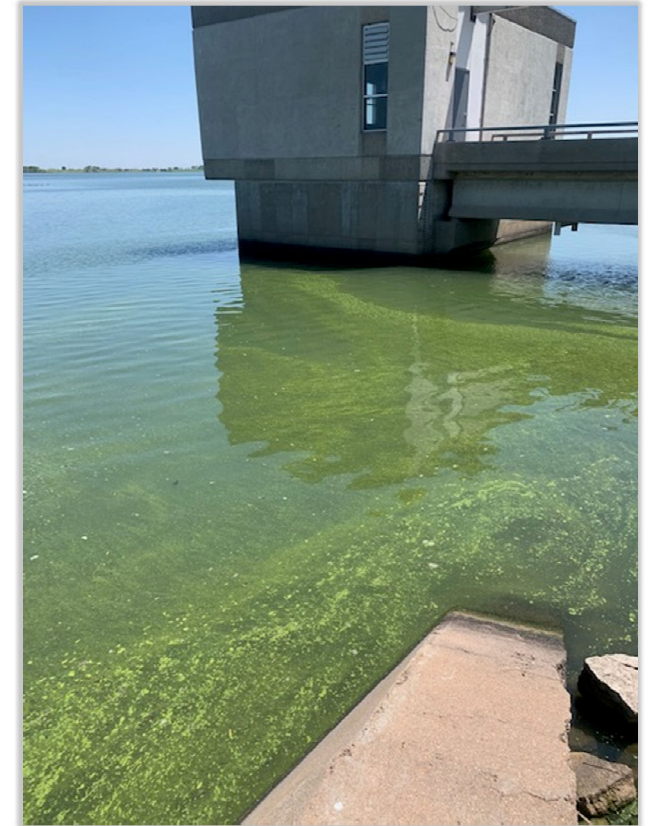
Wellington WTP Treatment Processes

Unit Type	Unit Name	Pri. Ind.	Objective Code	Objective Name	Process Code	Process Name
<u>CF</u>	<u>CORROSION</u>		<u>C</u>	<u>CORROSION CONTROL</u>	<u>447</u>	<u>INHIBITOR, POLYPHOSPHATE</u>
<u>DI</u>	<u>DISINFECTION</u>	<u>N</u>	<u>D</u>	<u>DISINFECTION</u>	<u>200</u>	<u>CHLORAMINES</u>
<u>FI</u>	<u>FILTER</u>	<u>N</u>	<u>P</u>	<u>PARTICULATE REMOVAL</u>	<u>345</u>	<u>FILTRATION, RAPID SAND</u>
<u>FL</u>	<u>FLOCCULATION</u>		<u>O</u>	<u>ORGANICS REMOVAL</u>	<u>360</u>	<u>FLOCCULATION</u>
<u>DS</u>	<u>FLUORIDATION</u>		<u>Z</u>	<u>OTHER</u>	<u>380</u>	<u>FLUORIDATION</u>
<u>SE</u>	<u>SEDIMENTATION</u>	<u>N</u>	<u>P</u>	<u>PARTICULATE REMOVAL</u>	<u>660</u>	<u>SEDIMENTATION</u>
<u>CF</u>	<u>SOFTENING</u>		<u>S</u>	<u>SOFTENING (HARDNESS REMOVAL)</u>	<u>240</u>	<u>COAGULATION</u>
<u>CF</u>	<u>SOFTENING</u>		<u>S</u>	<u>SOFTENING (HARDNESS REMOVAL)</u>	<u>500</u>	<u>LIME - SODA ASH ADDITION</u>
<u>CF</u>	<u>TASTE AND ODOR</u>		<u>T</u>	<u>TASTE / ODOR CONTROL</u>	<u>125</u>	<u>ACTIVATED CARBON, POWDERED</u>
<u>CF</u>	<u>TASTE AND ODOR</u>		<u>T</u>	<u>TASTE / ODOR CONTROL</u>	<u>560</u>	<u>PERMANGANATE</u>

From KDHE SDWIS Database

WTP - Intake Structure

- The city lake intake is a concrete structure with 3 sluice gate openings that are located at 6.8ft, 13.3ft and 19.8ft levels in the lake.
- The bottom intake pipe was in operation for this event.
- Possible, but unlikely that intake would support or house benthic algae due to insufficient sunlight.



Photos by Amanda Smyth – KDHE SCDO

June BGA Bloom:

- June 8, 2023 - HAB Bloom on Wellington City Lake detected



Photos by Amanda Smyth – KDHE SCDO



KDHE Recreation Program Threshold Levels

Indicator	Watch	Warning	Hazard
Blue-green cell counts (cells/mL)	80,000	250,000	10,000,000
Microcystin toxin level (µg/L)	4	8	2,000
Visual identification	Visual confirmation	Significant blue-green algae surface scum	N/A

June 2023 Scenario:

- CyAN imagery Est: 2,451,884 cells

KDHE HAB Samples;

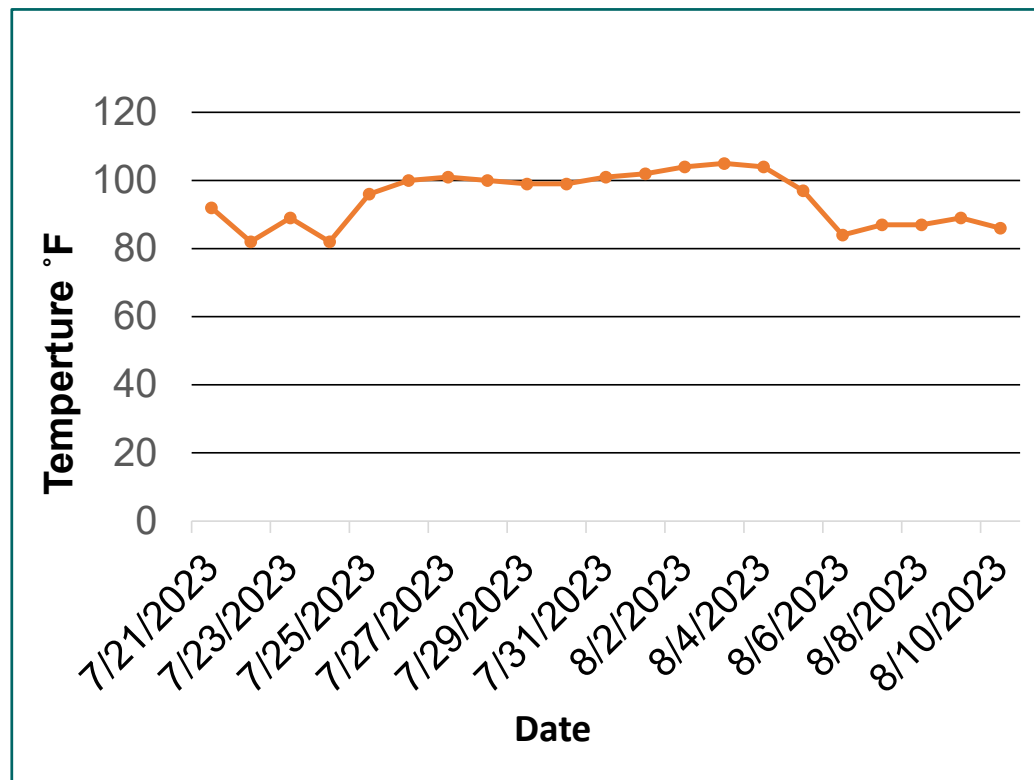
- Warning for Cells Total Cells: 254,642, Dolichospermum: 168,056, Psuedanabaena: 11,151, Aphanocapsa: 75,453 // Toxin: Non-Detect < 0.15
- Bloom Ran it's course and lifted by end of June



Photo by Amanda Smyth – KDHE SCDO



July 21 – August 10, 2023, Temperatures



To protect and improve the health and environment of all Kansans



Scenario- HAB PWS Monitoring Test Result Reports

July 27, 2023

2535558 Wellington Raw is **0.518 ppb**

Collected: 07/18/2023

Collection site: 80000921

- 2535559 Wellington Raw is <RDL
Collected: 07/18/2023
Collection site: 80000938
- 2535557 Wellington Raw is <RDL
Collected: 07/18/2023
Collection site: 00134859
No Finished Water Collected

August 3, 2023

2539420 Wellington Raw is **4.839 ppb**

Collected: 07/31/2023

Collection site: 80000921

- 2539421 Wellington Raw is <RDL
 - Collected: 07/31/2023
 - Collection site: 80000938
- **2539419 Wellington Finished is 0.954 ppb**
Collected: 07/31/2023
Collection site: 00134859



What is Happening?

- KDHE Lake Monitoring Program sampled Wellington City Lake on the morning of 8/2/2023 @ 0755. No active bloom perceived at that time.
- Notes indicated: below normal pool level; slight green cast. The sampling was done from a boat and near the dam (~300 ft). Normal water quality samples were taken; however, no toxin analysis.
- There was no algal scum/foam or perceived bloom at boat ramp area – located in the old lake area.
- CyAN imagery did not indicate a bloom was occurring in the lake

Treatment Adjustments

KDHE-PWS asked City:

- To boost powdered activated carbon feed and
- Reduce pre-oxidation with permanganate to prevent lysing of cells
- Increase Testing at Intake, POE and Distribution System

Note: There is no visible bloom on the lake at this time.



Photo by Kari Goldston – KDHE SCDO



Response

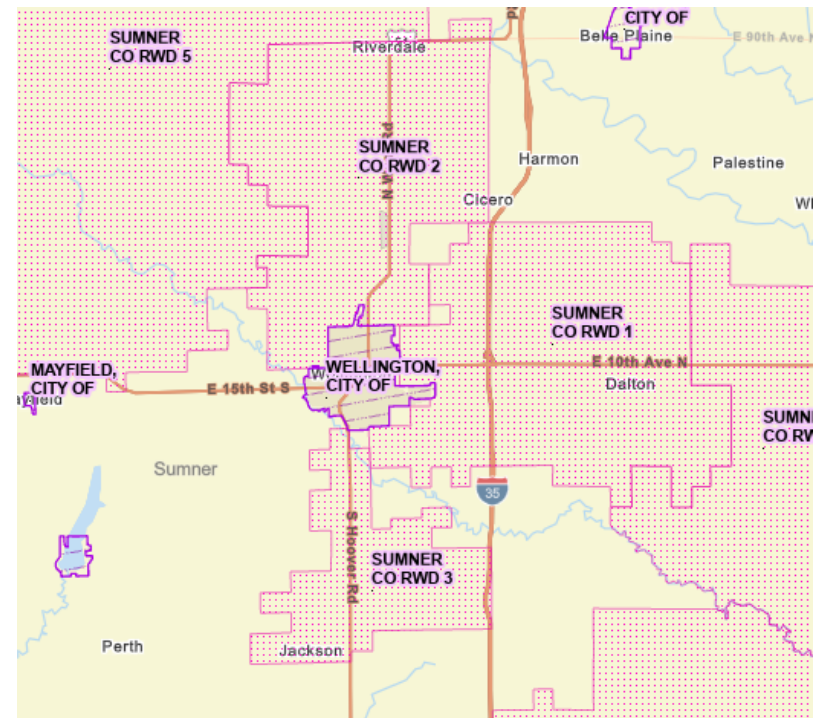
- This is the first time Kansas had a finished water test above the Health Advisory
- Cyanotoxins have a Health Advisory of 0.3 parts per billion for infants and children under 6 years old for a 10 -day exposure.
- EPA's policy is to ask the PWS to issue a **“Do Not Drink Advisory”**. (Non-regulated)
- KDHE provided a sample public notice that can be used by water systems.
- KDHE expected this to be a “big deal” with lots of press. “Toxin” in the drinking water tends to cause concern.

City of Wellington sells water to four other public water systems

Purchasing Systems and Populations

- City of Mayfield - 74
- Sumner Co. RWD 1 - 280
- Sumner Co. RWD 2 - 490
- Sumner Co. RWD 3 - 80

(Approximately 10-miles in all directions)





Response:

- Sumner County Emergency Management is contacted to provide bottled water and logistic support.
- Daily re-sampling daily starting on August 3, 2023
- KDHE-PWS coordinated sampling with the City, KHEL Laboratory, KDHE - South Central Office, Emergency Management to get samples transported to/from Wellington.
- City operators and officials under assault to resign. KDHE PWS staff prepares document supporting the City of Wellington's response.



Aug 4th – Distribution System Test Results

- Seven out of 9 tests were above the HA in Distribution system
- Raw water sample at intake was 1.033

HSN	Analysis Date	Raw/Finished	Microcystins Result (ug/L)		Sample Point	Collection Date
2549453	8/5/2023	Finished	0.27	Zone 1	1400 E 16th ST	8/4/2023
2549454	8/5/2023	Finished	0.55	Zone 2	501 N Washington	8/4/2023
2549459	8/5/2023	Finished	0.8	Zone 3	19 Industrial Ave	8/4/2023
2549458	8/5/2023	Finished	0.62	Zone 4	1601 W 16th	8/4/2023
2549457	8/5/2023	Finished	0.66	Zone 5	218 S High	8/4/2023
2549452	8/5/2023	Finished	0.54	Zone 6	102 W Botkin	8/4/2023
2549451	8/5/2023	Finished	0.36	Zone 7	1015 E 16th	8/4/2023
2549456	8/5/2023	Finished	0.58	Zone 8	911 W 8th	8/4/2023
2549455	8/5/2023	Finished	0.59	Zone 9	317 S Washington	8/4/2023
1388744	8/5/2023	Finished	0.26	TP003	Water Treatment Plant	8/4/2023
1388748	8/5/2023	Raw	1.033	Intake 999	Wellington City Lake	8/4/2023



Aug 5th – Raw and Finished Water Test Results

- Toxin level (0.12) in finished water dropped below HA at point of entry
- Raw water sample at intake was 0.493

2549528	8/5/2023	Finished	0.12	TP003	Water Treatment Plant	8/5/2023
2549209	8/5/2023	Raw	0.493	Intake 999	Wellington City Lake	8/5/2023

Sunday Aug 6th – Raw and Finished Water Test Results

2549531	8/6/2023	Finished	0.134	TP003	Water Treatment Plant	8/6/2023
2549208	8/6/2023	Raw	0.377	Intake 999	Wellington City Lake	8/6/2023

Aug 6th – Response

- City operators and officials under continued assault to resign.
- KDHE issues official statement supporting the City of Wellington’s response.
- Assuring public that the situation could not reasonably be predicted or prevented.



Aug 8th – Distribution System Test Results

- Two of the Wellington samples (zones 3 and 4) are still above the EPA Health Advisory
- Taking considerable time for the water to move through the distribution system. Any result lower than 0.15 ug/L is considered non-detect. Note that zones 2, 5, 6, 8 and at the POE are all below 0.15.

2550231	8/7/2023	Finished	0.258	Zone 1	1400 E 16th	8/7/2023
2550230	8/7/2023	Finished	0.088	Zone 2	501 N Washington	8/7/2023
2550225	8/7/2023	Finished	0.533	Zone 3	19 Industrial Ave	8/7/2023
2550229	8/7/2023	Finished	0.474	Zone 4	1601 W 16th St	8/7/2023
2549205	8/7/2023	Finished	0.072	Zone 5	218 S High	8/7/2023
2550228	8/7/2023	Finished	0.133	Zone 6	102 W Botkin	8/7/2023
2550226	8/7/2023	Finished	0.151	Zone 7	1015 E 16th	8/7/2023
2550227	8/7/2023	Finished	0.105	Zone 8	911 W 8th	8/7/2023
2546600	8/7/2023	Finished	0.252	Zone 9	317 S Washington	8/7/2023
2550232	8/7/2023	Finished	0.032	TP003	Water Treatment Plant	8/7/2023
2549206	8/7/2023	Raw	0.372	Intake 999	Wellington City Lake	8/7/2023



Aug 8 – Response

- No samples taken today. City conducted distribution system flushing to move contaminated water out of the distribution system.
- KDHE – PWS contacted Jennifer Graham from USGS to help determine the source of the toxin. She inquired about the intake structure to see if it could support benthic algae.
- KDHE-PWS requested the lab test for anatoxin, saxitoxin, cylindro and microcystin on a raw water sample provided by the lake monitoring program to help determine extent of toxins.



Aug 10 – Distribution System Test Results

- All finished water sample locations were non-detect in Wellington.
- The purchasing systems are still under the do not drink advisory.

2550729	8/9/2023	Finished	0.113	Zone 1	1400 E 16th	8/9/2023
2550718	8/9/2023	Finished	0.005	Zone 2	501 N Washington	8/9/2023
2550719	8/9/2023	Finished	0.122	Zone 3	19 Industrial Ave	8/9/2023
2550734	8/9/2023	Finished	0.096	Zone 4	1601 W 16th St	8/9/2023
2550735	8/9/2023	Finished	0.008	Zone 5	218 S High	8/9/2023
2550725	8/9/2023	Finished	0.072	Zone 6	102 W Botkin	8/9/2023
2550737	8/9/2023	Finished	0.083	Zone 7	1015 E 16th	8/9/2023
2550738	8/9/2023	Finished	0.043	Zone 8	911 W 8th	8/9/2023
2550724	8/9/2023	Finished	0.046	Zone 9	317 S Washington	8/9/2023
2550730	8/9/2023	Finished	0.03	TP003	Water Treatment Plant	8/9/2023
2549376	8/9/2023	Raw	0.304	Intake 999	Wellington City Lake	8/9/2023
2546602	8/9/2023	Raw	0.058	Intake 998	Chikaskia River Intake 998	8/9/2023



August 10 Advisory Rescinded For Wellington Only

Remains in affect for:

- City of Mayfield
- Sumner Co. RWD-1
- Sumner Co. RWD-2
- Sumner Co. RWD-3

Drinking Water Advisory Rescinded for the City of Wellington, Drinking Water Advisory Remains in Effect for the City of Mayfield and Sumner County Rural Water Districts 1, 2 and 3

TOPEKA – The Kansas Department of Health and Environment (KDHE) is rescinding a drinking water advisory for the City of Wellington in Sumner County. Laboratory testing indicates the cyanotoxin concentration is below the U.S. Environmental Protection Agency's (EPA) 10-day Health Advisory levels of 0.3 micrograms per liter of microcystins for bottle fed infants and children under 6 years old.

The advisory remains in effect for the City of Mayfield and Sumner County Rural Water Districts 1, 2 and 3 until laboratory testing indicates the cyanotoxin concentration is below the EPA 10-day Health Advisory levels. It may take several days for water containing cyanotoxin to pass through each system's water mains and distribution system piping. Customers of these public water systems should continue to observe the following precautions until further notice:

- Bottle fed infants and children under 6 years old should not consume the water. For children over 6-years and adults the water remains acceptable for drinking, food preparation and all household use.
- **Do not boil the water before use as boiling concentrates the microcystins.**

Microcystins entered Wellington's public water supply system due to cyanobacteria, also known as blue-green algae, occurring in Wellington City Lake, which is the source water for the [City](#). The City of Mayfield and Sumner County Rural Water Districts 1, 2 and 3 purchase [water](#) from the City of Wellington.

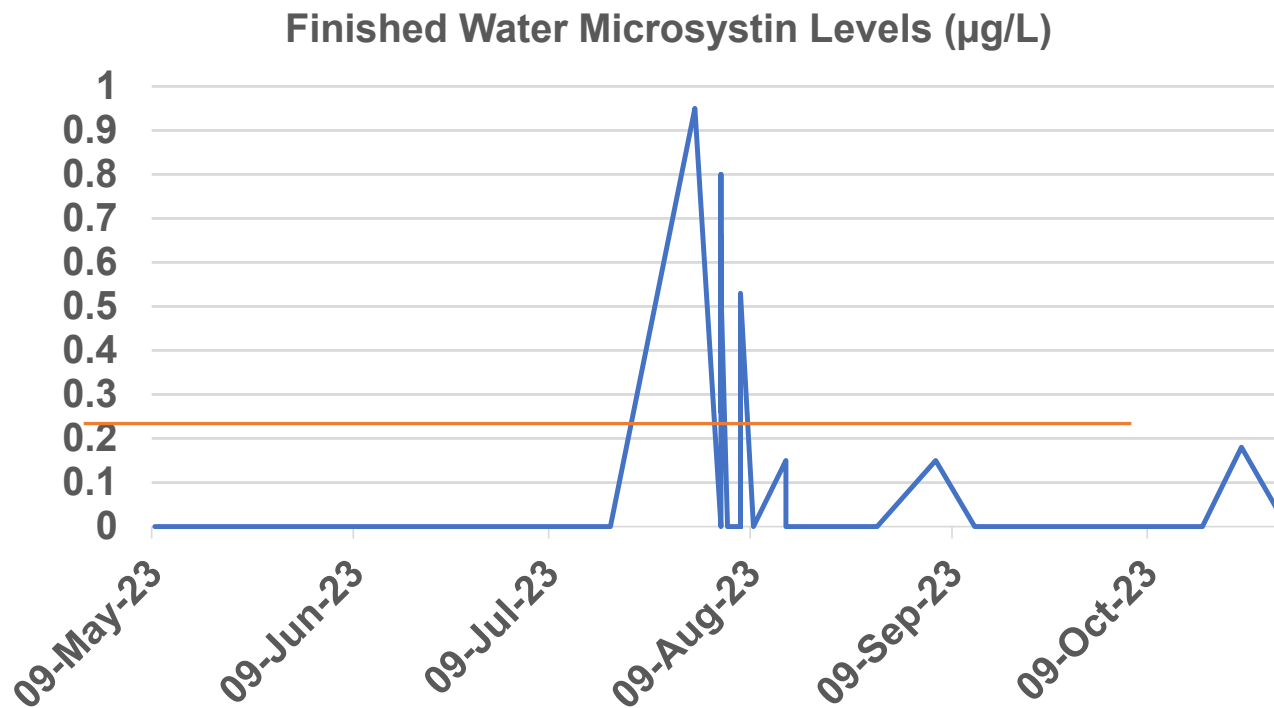
The City of Wellington, the City of Mayfield, and Sumner County Rural Water Districts 1, 2 and 3 are working with KDHE and will continue to monitor their public water supply systems. Additional samples will be collected and sent to the laboratory for analysis to confirm the microcystins levels consistently remain below the EPA 10-day Health Advisory level of 0.3 micrograms per liter for bottle fed infants and children under 6 years old in drinking water delivered to consumers.

People and animals should always take steps to stay away from any blooms in surface waters because contact can make people and animals sick.

###



Finished Water Sample Results for Event





Purchasing Systems – Estimated Time to Clear Toxin

Calculate volume of a water in 8-inch main per mile in gallons?

Volume of Pipe Formula is $V = \pi r^2 \times L$

V = volume

Cross Sectional Area of pipe = πr^2 (ft²)

r = radius of the pipe (ft) or $8''/2=4''/12''= 0.33\text{ft}$.

$\pi = 3.14$

L = length of the pipe (ft) – 5280ft/mile

Gallons of water in one cubic foot = 7.48 gals/ft³



Purchasing Systems – Time to Clear Toxin

Calculate gallons of water in 2-miles of 8" water main?

$$A = \pi r^2 \text{ or } A = 3.14(0.33 \times 0.33) = 0.349 \text{ ft}^2$$

$$(0.349 \text{ ft}^2)(5280 \text{ ft/mile}) = 1842 \text{ ft}^3$$

$$1842 \text{ ft}^3 (7.48 \text{ gals/ft}^3) = 13,784 \text{ gallons per mile of 8-inch pipe or approx. 2.6 gals/ft}$$

Population of Mayfield is 74 persons. Estimate 100 gals/day/person or 740 gpd

How many Days to clear 2-miles of 8-inch pipeline. $2.6 \text{ gals /ft (10560ft.)} = 27,456 \text{ gpd}$

$$27,456 \text{ gpd} / 740 \text{ gpd use} = 37 \text{ days...they may want to flush???$$



Purchasing Systems

- KDHE calculated the volume of the pipelines serving the purchasing systems.
- Pipeline lengths and diameters were obtained from the system operators.
- Water usage was based on 100-gallons per day/per person since they didn't know actual daily usage.
- Calculations were used to determine when tests would be run.
- Testing results were all non-detect.

- City of Mayfield – Rescinded August 15
- Sumner Co. RWD 1 – Rescinded August 15
- Sumner Co. RWD 2 – Rescinded August 15
- Sumner Co. RWD 3 – Rescinded August 15

Identification of Blue Green Algae (The Perp)

- KDHE-PWS requested the lab test for anatoxin, saxitoxin, cylindro and microcystin on a raw water sample provided by the lake monitoring program
- The bloom in June when Wellington was on advisory status was predominantly composed of Dolichospermum (Anabaena).
- The samples in early August were a mix of several Blue-Green Algae species, however dominant species were Dolichospermum (Anabaena) and Pseudanabaena w/smaller amounts of Aphanizomenon and Raphidiopsis.

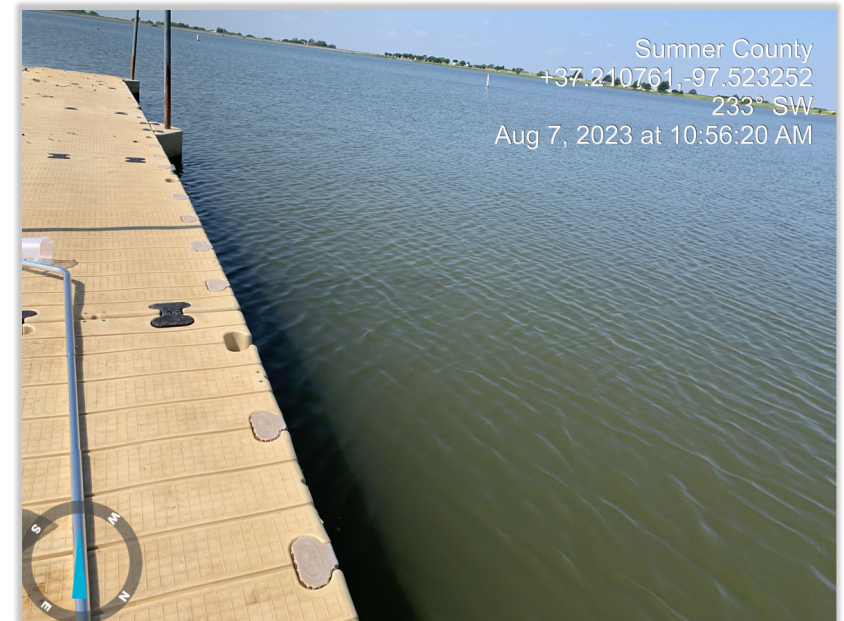


Photo by Kari Goldston – KDHE SCDO



Theory of Sources of Toxin ???

- Dolichospermum (Anabaena) was suspended in water column so went undetected and excess nutrients from heavy rains and heat stress caused die-off and/or toxin release.
- Earlier die-off of bloom settled to lake bottom and did not release toxins until extreme conditions of late July.



What we learned:

- Many of our standard prediction indicators do not necessarily indicate when a algal toxin release may be occurring in lakes.
- Algal toxin does not degrade rapidly in distribution systems
- Clearing toxin contaminated water from system piping takes considerable time even with flushing
- After years of study, the conditions that trigger a bloom and/or toxin release are hard to predict.



Contact Information

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To protect and improve the health and environment of all Kansans



Questions and Comments