



Becoming More Together

Cora Bartlett, Ryan Fullerton, Jacob Hanna, Aidan Leon, Isaac Stanton



@ClimateMHS



# Cheney Reservoir Cheney, KS



Cheney Reservoir

# Cheney Reservoir gets algal blooms in hot summers.



Not all algae is harmful, but some of it is.



# What makes it a “harmful algal bloom (HAB)”?

Algae  
+  
Cyanobacteria



# Purpose

- To develop a **historical** and **predictive data model** of when, where, and how harmful algal blooms (HABs) occur in Cheney Reservoir.
- To learn how to use **data science** to solve this real-world problem in our community and in others.

MHS Biology Students looked for  
**PATTERNS** in 20 Years of USGS Data.

# Cause and Effect

Patterns

Structure and  
Function

Systems

Scale

Change and  
Stability

Matter and  
Energy



National Water Information System: Web Interface

[USGS Water Resources](#)

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## USGS Water Data for the Nation

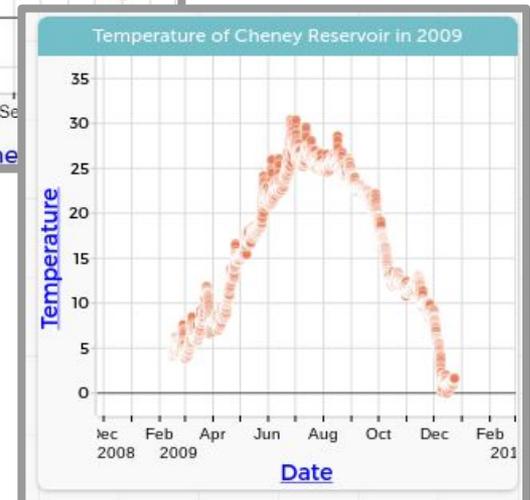
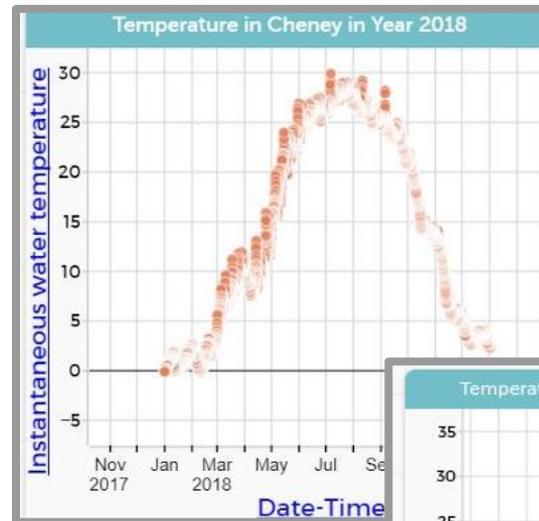
Search for Sites With Data

# TREND PATTERNS

August is the hottest month.

It is also “algae primetime”.

## 20 Years of Data: Water Temperature

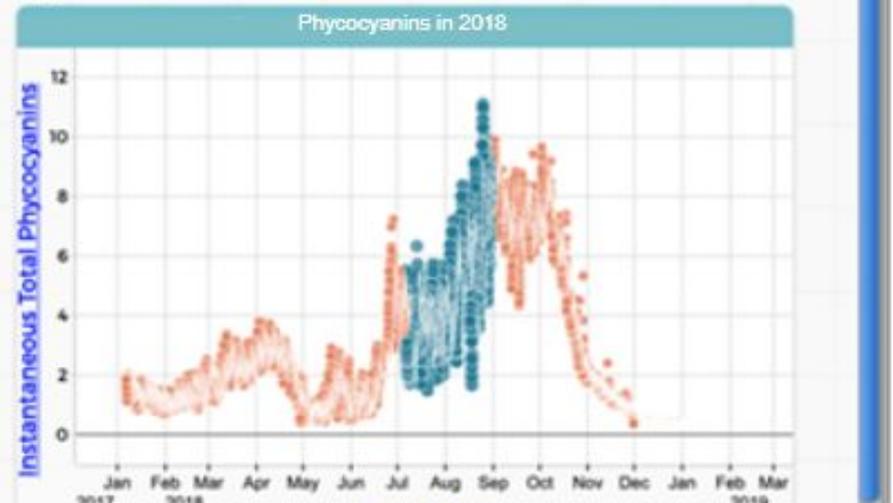
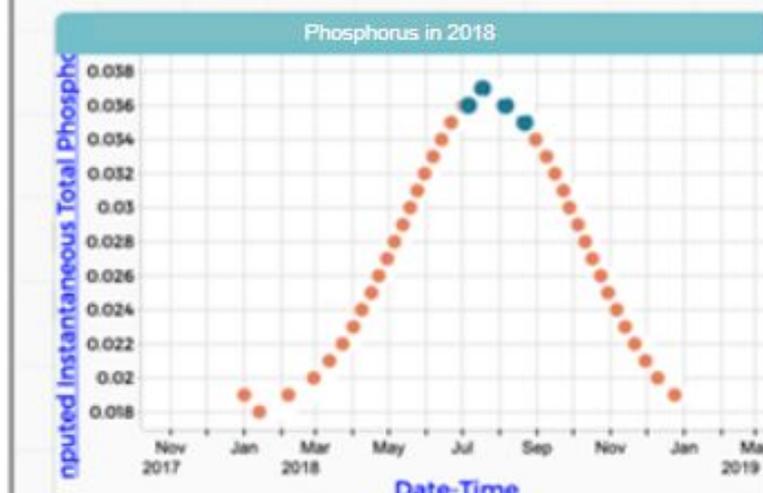


Look at July / August. Highlighted in **BLUE** are **Phosphorus-** and **Phycocyanin-**Levels.

USGS - Cheney Reservoir - 2018 Aggregated Data

Cases (8723 cases)

index	Date-Time	latitude	longitud	Instanta.. nperature	Instanta.. cocyannins	Comput.. osphorus	Dissolve.. d Oxygen
2964	8/30/18	37.73	-97.79	24.9	9.01	0.04	12
2965	8/30/18	37.73	-97.79	24.9	8.74	0.04	12
2966	8/30/18	37.73	-97.79	24.9	8.56	0.04	12
2967	8/30/18	37.73	-97.79	24.9	8.26	0.04	12
2968	8/30/18	37.73	-97.79	24.9	8.36	0.04	12
2969	8/30/18	37.73	-97.79	24.9	8.8	0.04	11.9
2970	8/30/18	37.73	-97.79	24.9	8.14	0.04	11.9
2971	8/30/18	37.73	-97.79	24.9	7.19	0.04	11.9
2972	8/29/18	37.73	-97.79	24.9	5.8	0.04	11.9
2973	8/29/18	37.73	-97.79	24.9	5.81	0.04	11.9
2974	8/29/18	37.73	-97.79	24.9	6.23	0.04	11.9
2975	8/29/18	37.73	-97.79	24.9	5.64	0.04	11.9
2976	8/29/18	37.73	-97.79	24.9	6.55	0.04	11.9





National Water Information System: Web Interface

USGS Water Resources

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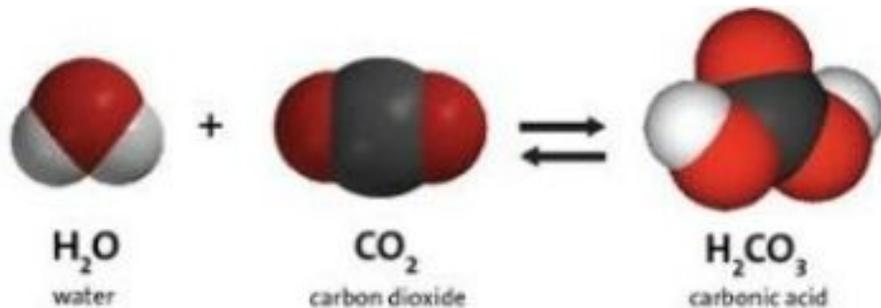
- [Introducing The Next Generation of USGS Water Data for the Nation](#)
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## USGS Water Data for the Nation

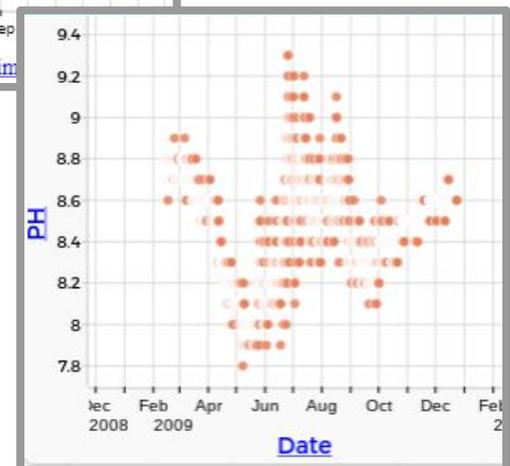
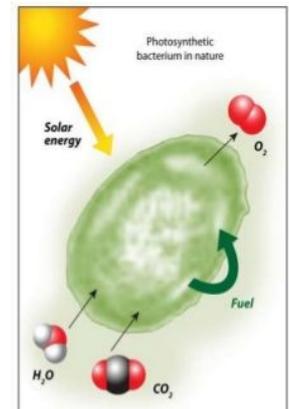
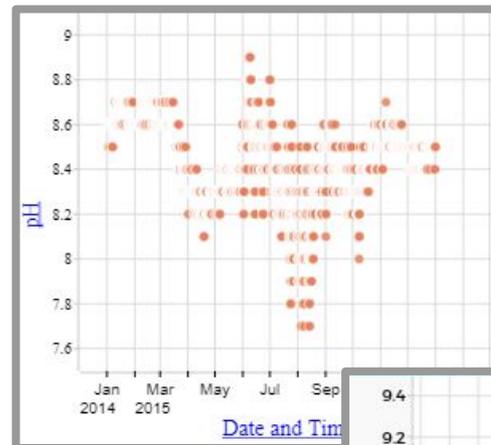
Search for Sites With Data

# TREND PATTERNS

### pH rises during an algal bloom.



# 20 Years of Data: pH





National Water Information System: Web Interface

[USGS Water Resources](#)

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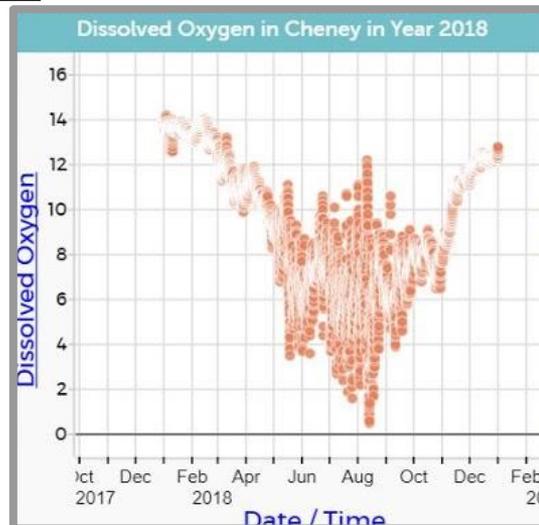
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## USGS Water Data for the Nation

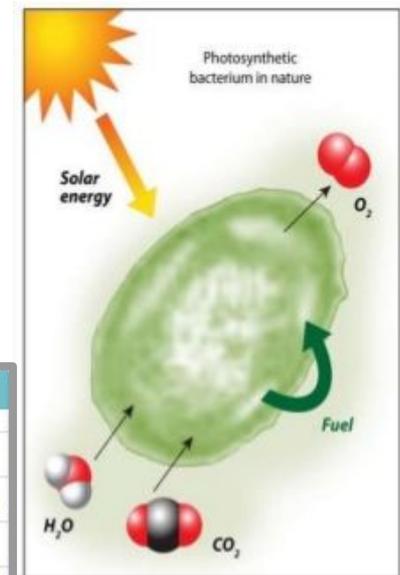
Search for Sites With Data

# TREND PATTERNS

**Dissolved oxygen increases during an algal bloom, then it decreases when the bloom dies.**

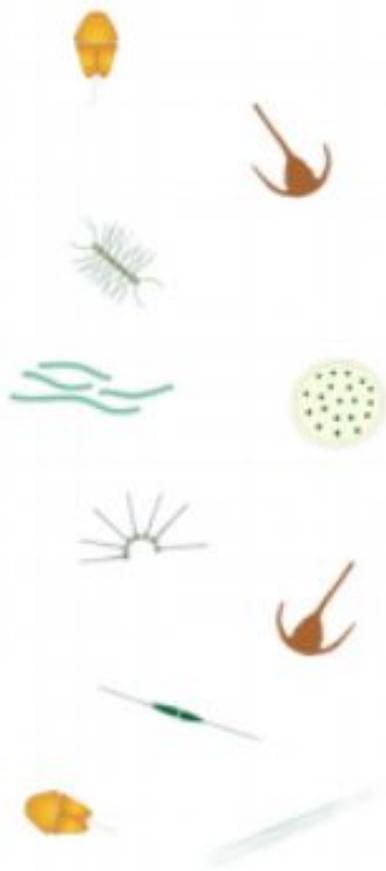


# 20 Years of Data: Dissolved Oxygen

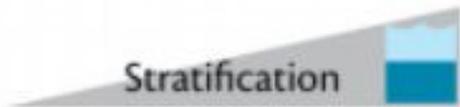
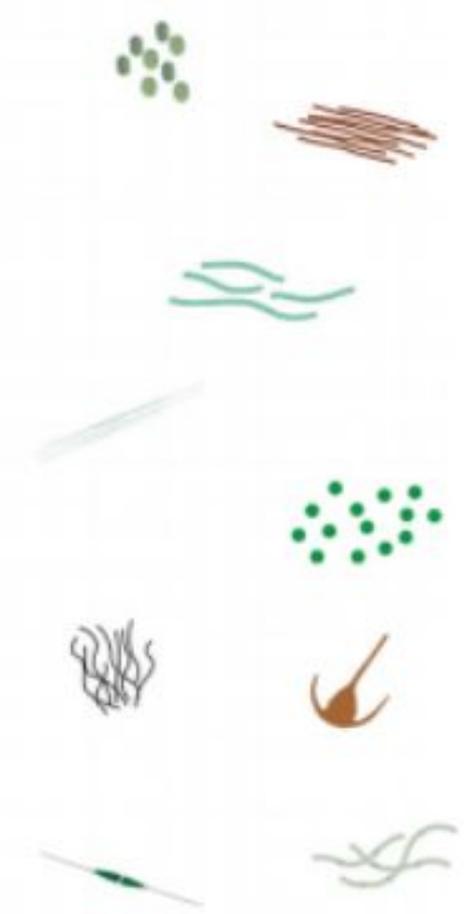


# Climate and eutrophication effects

Less CHABs



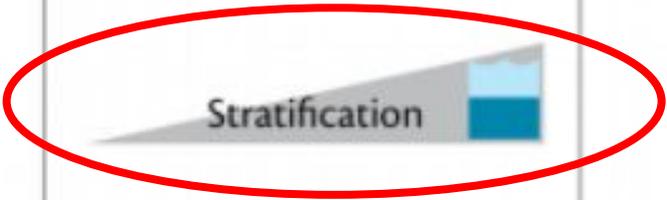
More CHABs



# Climate and eutrophication effects

Less CHABs

More CHABs



# USGS Thermistor

- Mrs. Hammett talked to Dr. Ted Harris at Kansas Biological Survey about these patterns, and he recommended we check whether Cheney micro-stratifies in the topmost layer, and with USGS's design & assembly help, our group set up a thermistor chain at the end of last school year.
- USGS let us set up our thermistor on their locked dam site, with some of their data probes in parallel so that we could verify a few of our own data points.





Amy Hammett, Maize High School Climate Club  
C/o Maize Unified School District  
905 W. Academy Ave.  
Maize, KS 67101

March 7, 2019

Dear Mrs. Hammett, and distinct members of the Maize High School Climate Club:

Thank you for all of the information that you've provided to the City of Wichita. The City takes great interest in the Maize High School Climate Club's project involving Cheney Reservoir. As you know, Wichita is the largest populated city in the state of Kansas and Cheney Reservoir provides half of the City's drinking water supply. Wichita is a regional supplier of water, and provides service to a number of cities, towns and rural water districts in the metropolitan area. The City's water utility serves half a million people with a seasonal average production rate of 55,000,000 to 60,000,000 gallons of water each day. Summertime hourly peaks can eclipse 120,000,000 gallons in finished water production. Critical customers include McConnell Air Force Base and Spirit Aerosystems. McConnell, home of the 22<sup>nd</sup> Air Refueling Wing, is critical to the nation's defense. Spirit is the largest private employer in the metropolitan statistical area. Preservation of Cheney Reservoir is critical in ensuring a healthy and reliable water supply for all of the City's residential, commercial, industrial and wholesale customers.



The U.S. Environmental Protection Agency  
Commends

**Maize High School Climate Club**

for outstanding achievement in  
environmental protection services

A handwritten signature in black ink, which appears to read "Hiram Lee Tanner III".

Hiram Lee Tanner III  
Acting Chief of Staff, Office of Public Engagement and Environmental Education

President's Environmental Youth Awards  
United States Environmental Protection Agency

- All 11th graders, Interested in Limnology/Environmental Science or Health Sciences

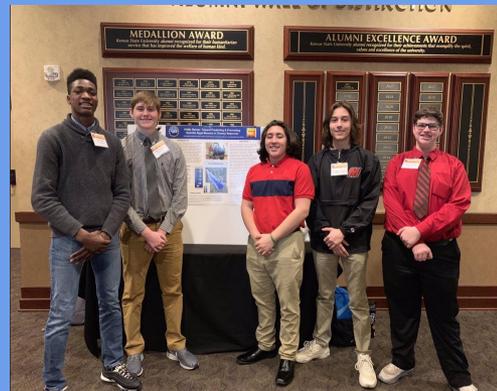
- Isaac, the founder

- Supporters:

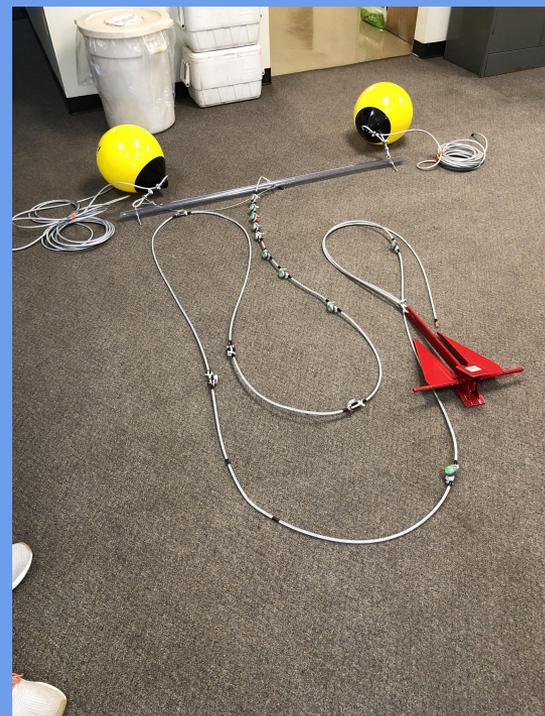
- Ted Harris-KBS

- USGS

- ROSS Project



# USGS



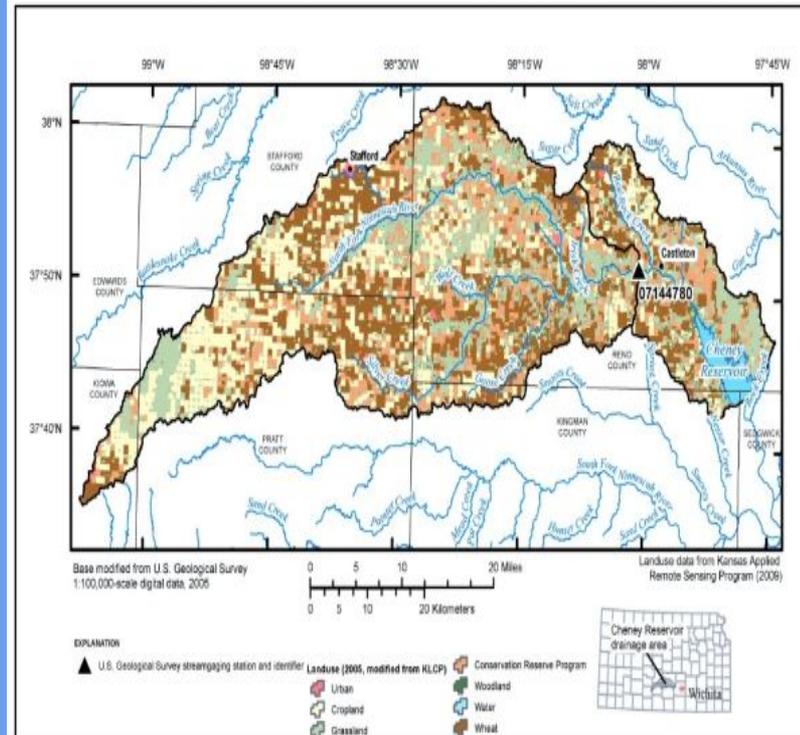


# Dr. Ted Harris



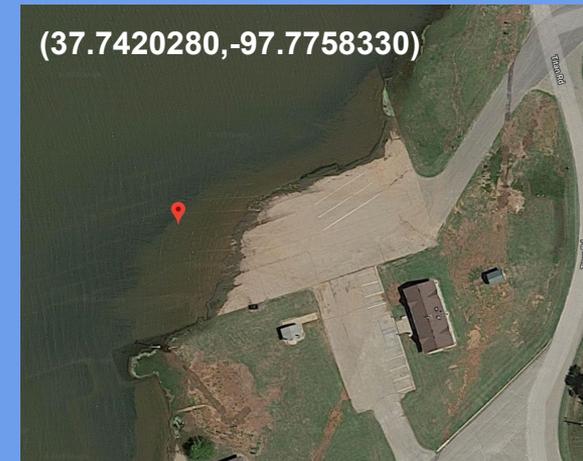
# Kansas and HABS

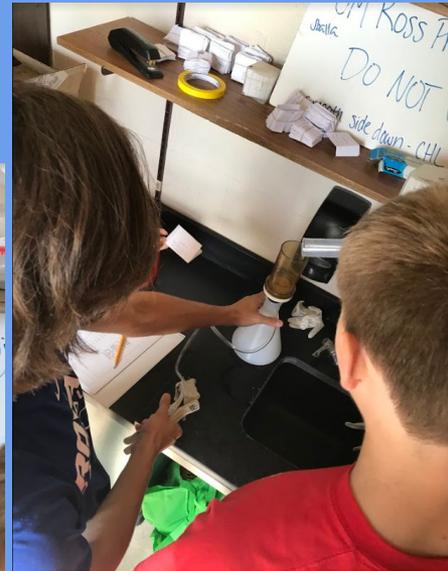
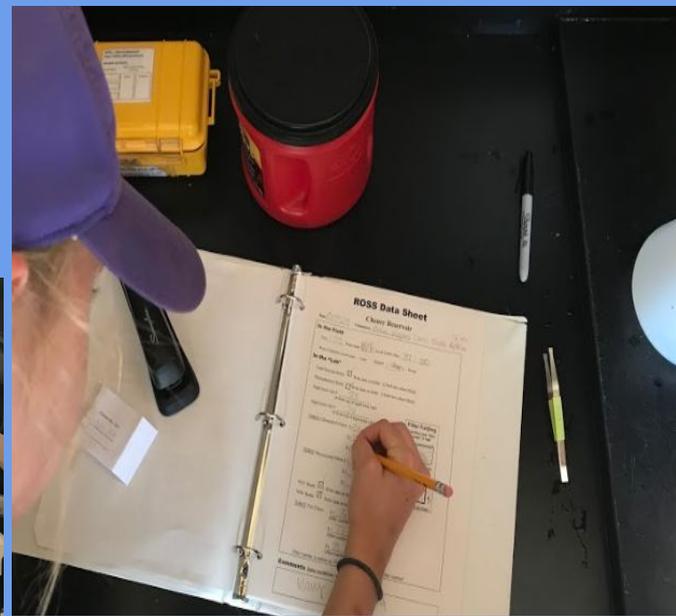
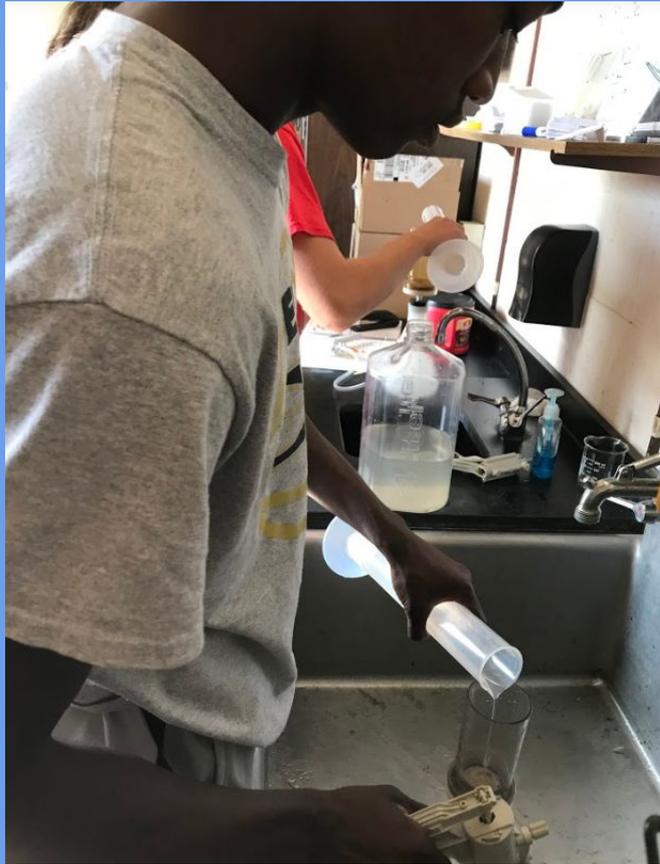
- The water we test (Cheney) supplies our drinking water and all of Wichita
- Affects the largest city in Kansas
- Taste and Odor problems since 1990
- Huge watershed, Farmland
- Why do we care?
  - It's our water.

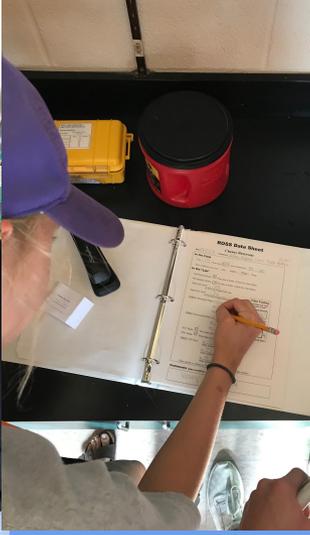


# Sampling Protocol

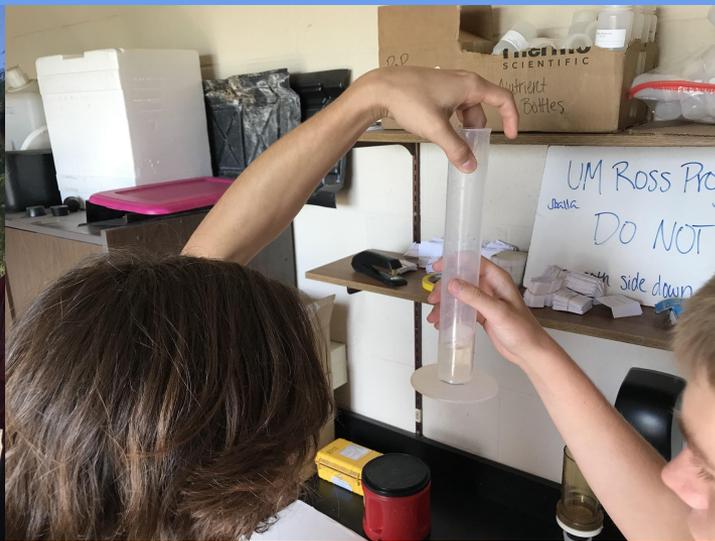
- Cheney trips bi-weekly
- Record Temperature & Transparency
  - Secchi Disk
- Collect Sample; Tested in Lab
  - TSS, CHL, Phycocyanin, Phytoplankton, Algal toxins, Nutrients
- Filters sent to U. of Missouri
- Procedure verified by Emily, ROSS



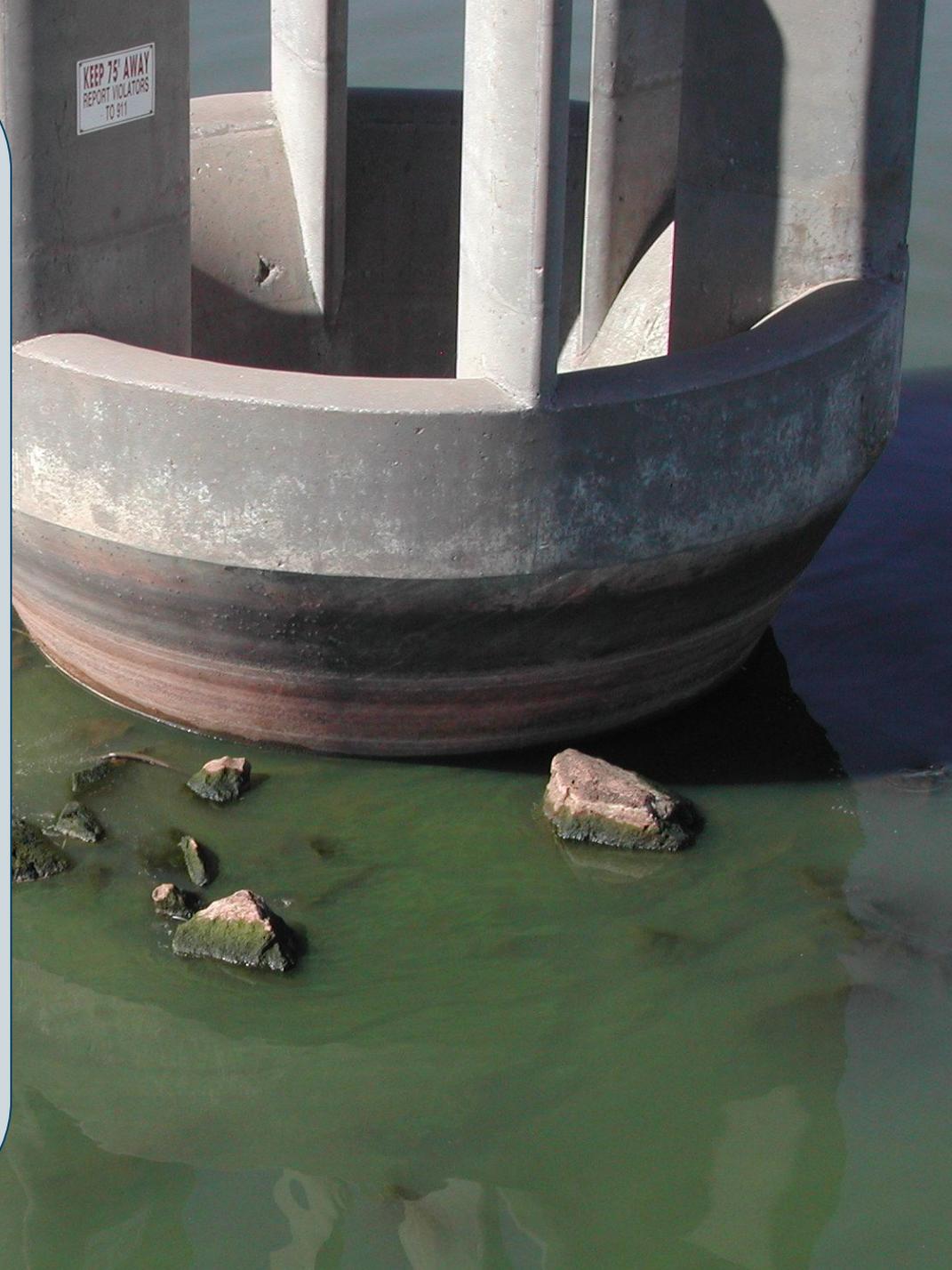




# ROSS Project



- The Army Corps of Engineers drained the top layer of Cheney's water (pictured here next to Cheney's drinking water intake) through the dam to eliminate flood water, which also drained the top layer of algae and sediment this year (2019).
- Took water down into Gulf causing dead zone & death in fish.
- The draining of the top layer resulted in significantly less algae & cyanobacteria in our Summer 2019 Cheney data, which was great!
- HAB toxins still increased, though.



# EPA Drinking Water Health Advisories for Cyanotoxins

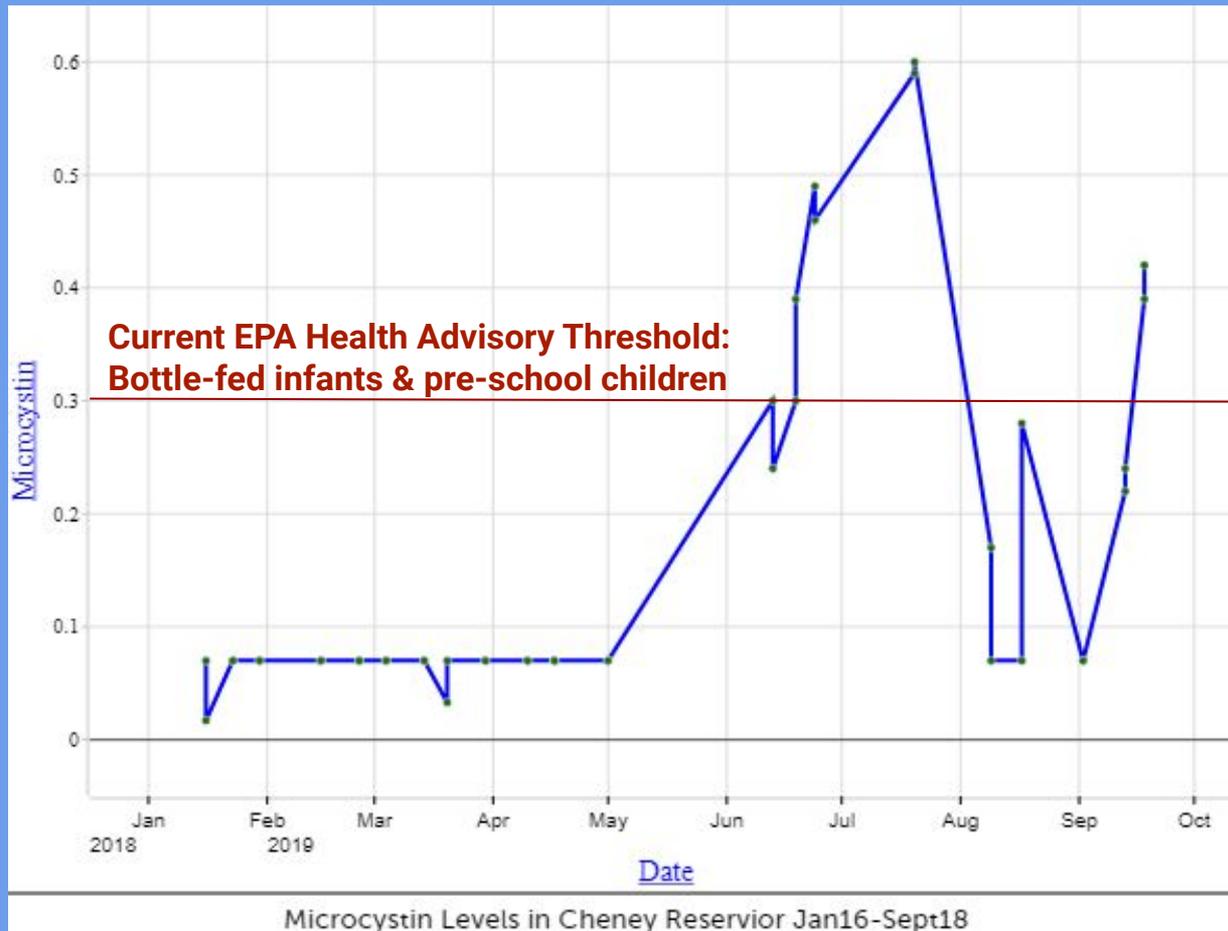
Cyanotoxin	Drinking Water Health Advisory (10-day)	
	Bottle-fed infants and pre-school children	School-age children and adults
Cylindrospermopsin	0.7 µg/L	3.0 µg/L
Microcystins	0.3 µg/L	1.6 µg/L

In 2015, EPA developed Health Advisories (HAs) for cylindrospermopsin and microcystins. These are not regulations and should not be construed as legally-enforceable federal standards.

HAs may change as new information becomes available.

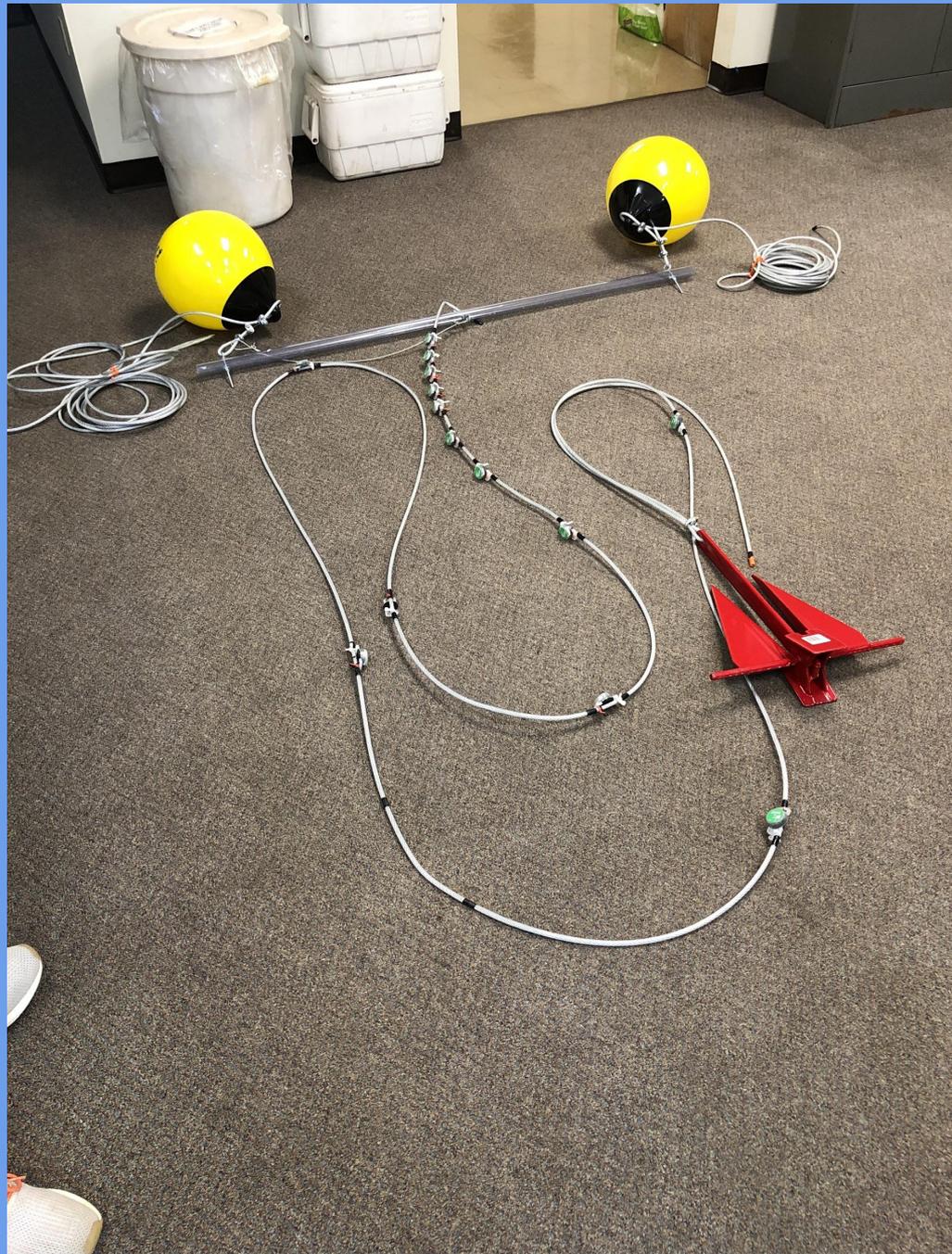


# ROSS Project: 2019 Microcystins in Cheney



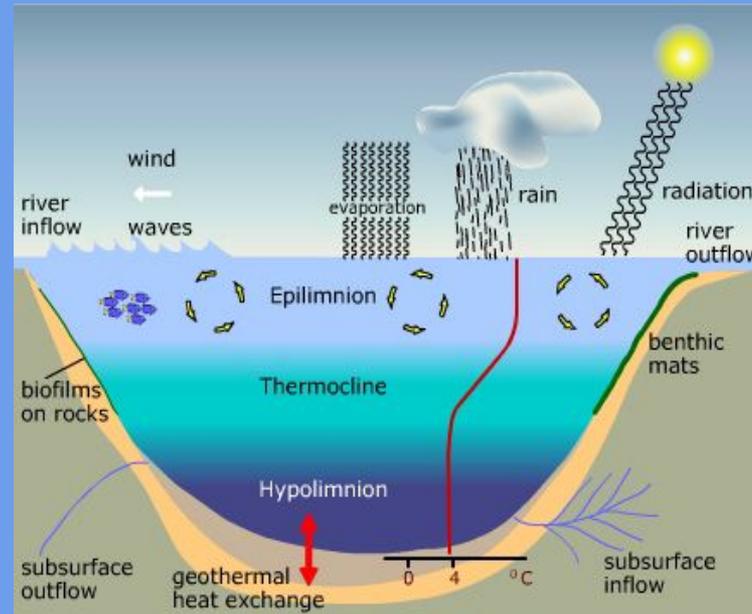
NOTE: 2019 USGS-measured microcystin levels provisionally show higher levels, likely due to electric-powered vacuum filtration processes (as opposed to our “hand-powered” vacuum filtration process) or due to differences in sampling site and/or the migration of HABs or cyanotoxins.

Designed by:  
Trudy  
Bennett  
(USGS)

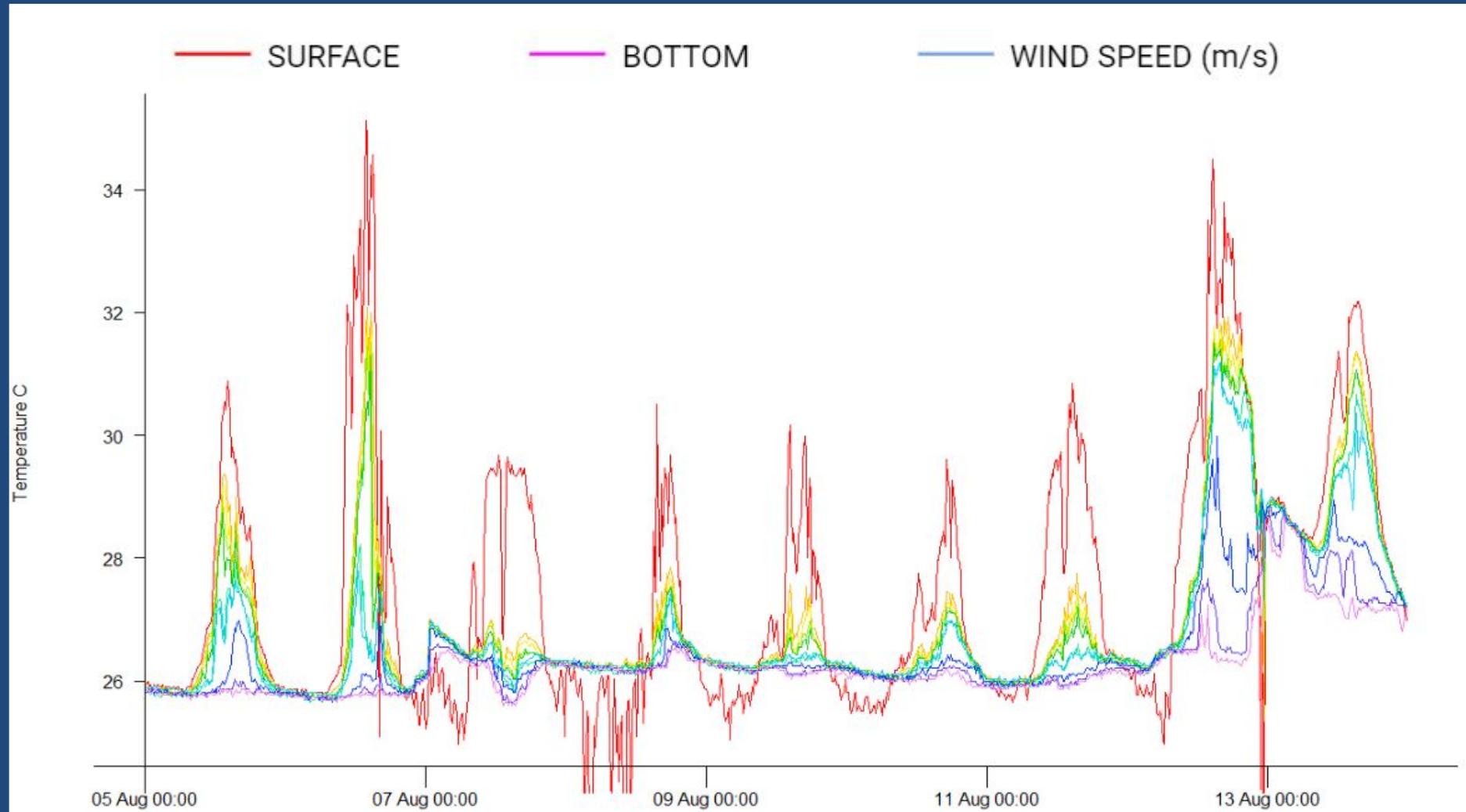


# Cheney's Micro-stratification

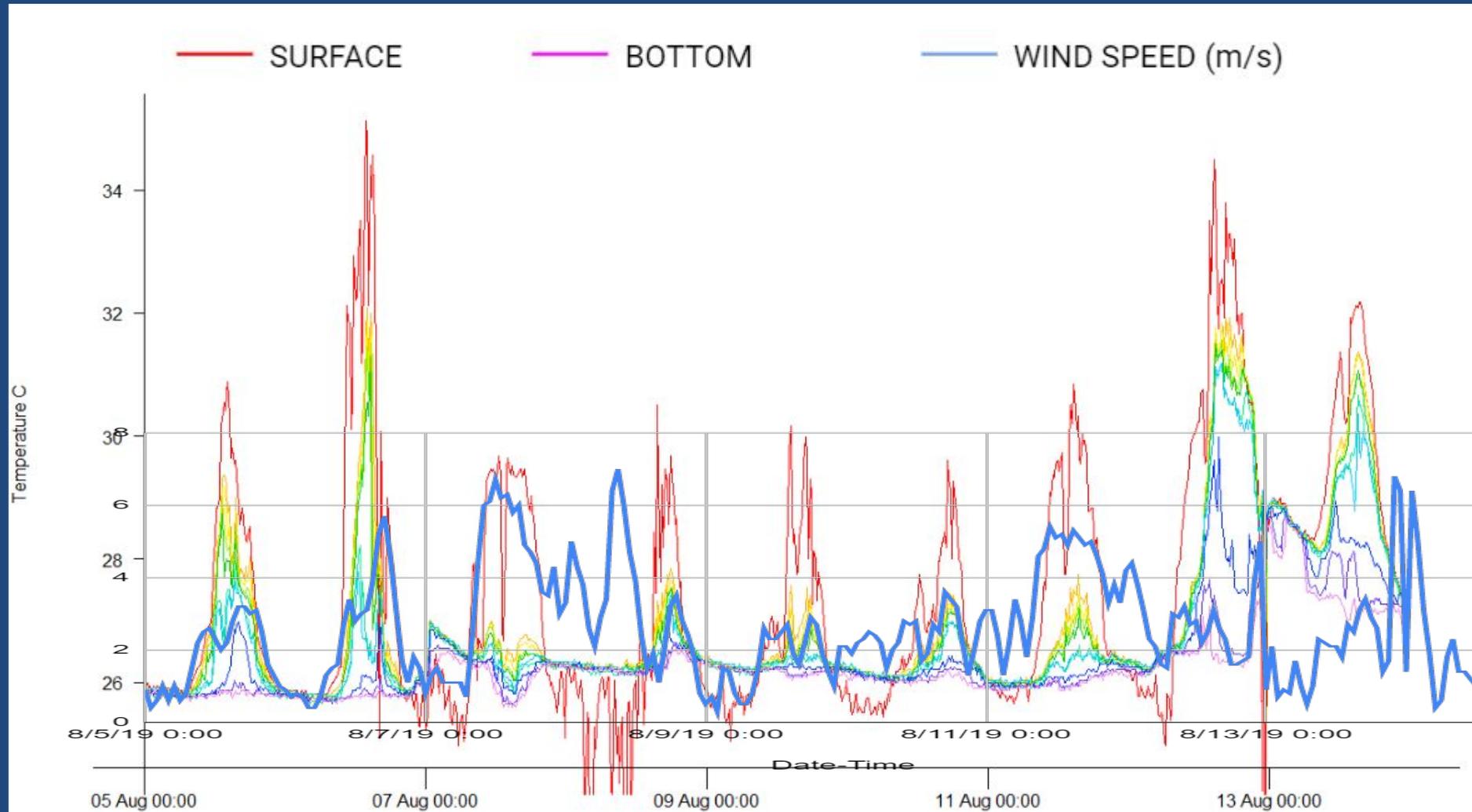
- We believe that Cheney stratifies in polymictic pattern.
- When the lake mixes, the nutrients from the bottom of the lake move to the top of the surface.
- This can make a perfect mix of nutrients and high amounts of sunlight that can cause an algal bloom.



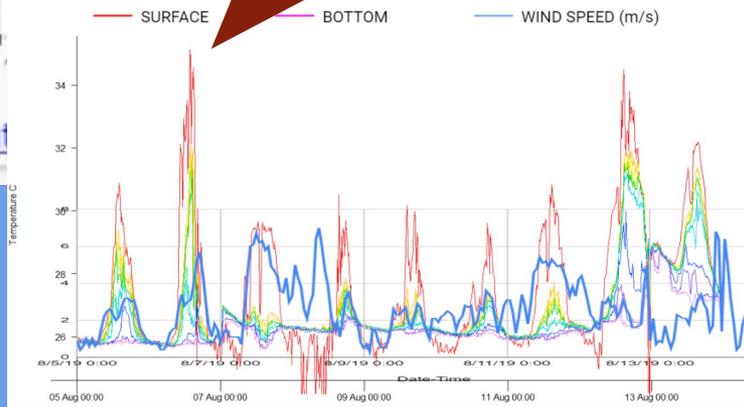
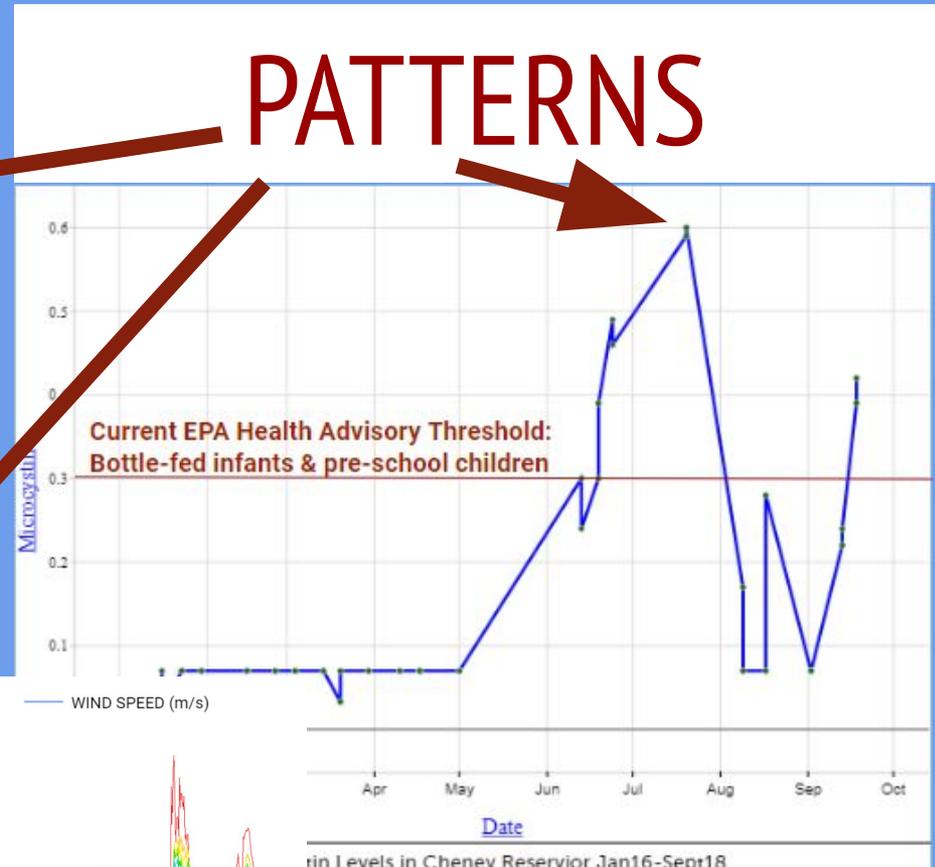
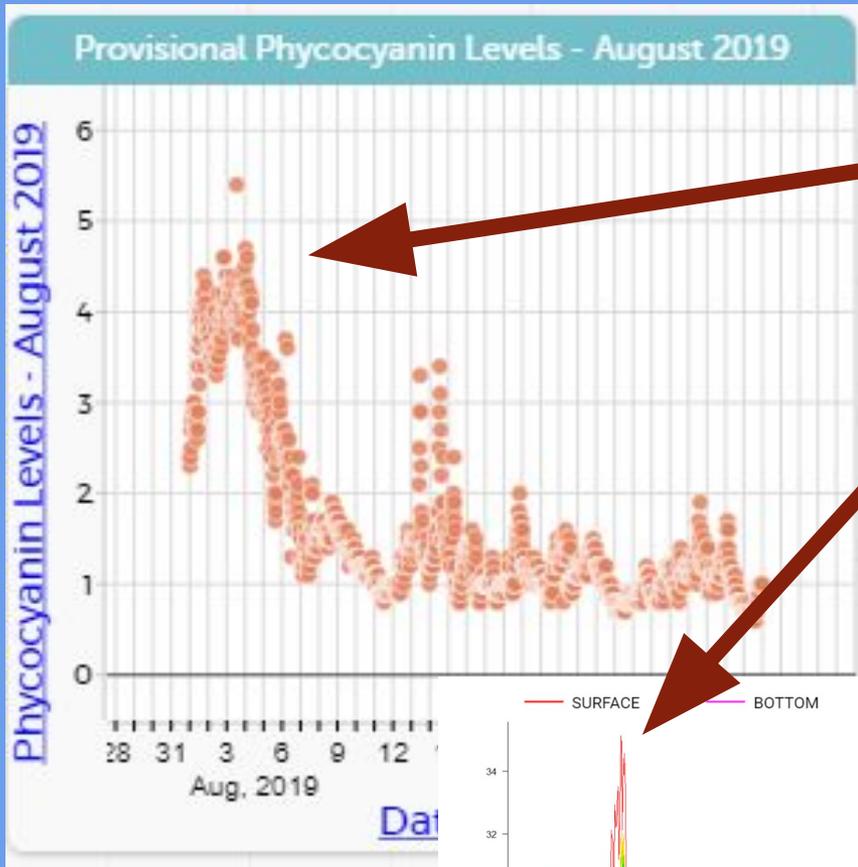
# Micro-Stratifications & Wind Speeds (Aug 5 - 13)



# Micro-Stratifications & Wind Speeds (Aug 5 - 13)



# Phycocyanin-Levels, Microcystin-Levels, Micro-stratifications



**PATTERNS**



# Biggest Take-Away

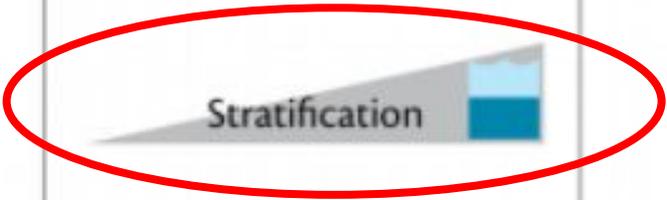
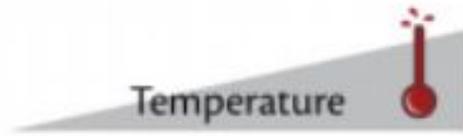
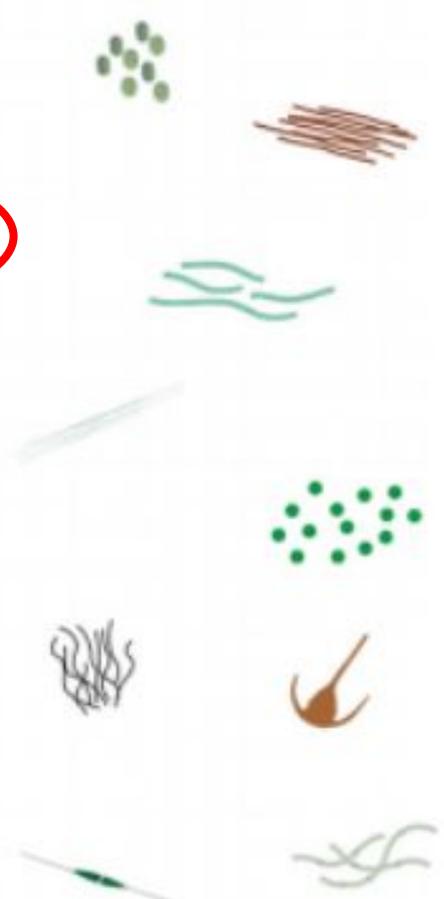
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- Cheney was believed to not stratify due to high winds.
- Based on our data, though, Cheney does have low/no wind periods of micro-stratification.
- This allows for nutrients that were once at the bottom of the reservoir (and unobtainable for use by organisms at the surface) to be moved up to the surface of the reservoir.
- This favors the formation of HABs.

# Climate and eutrophication effects

Less CHABs

More CHABs



# Closing

## Possible Solutions

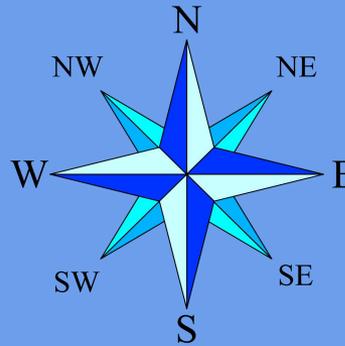
HAB predictions with models like rLakeAnalyzer

Outreach - farmers, policy makers

## Next step?

Till vs. no till, prairie grass

East vs. West - rains more in the east, more sediment inflow



# Cheney Lake Watershed, Inc.'s Agriculture Specialists Came to Teach Us About Till vs. Low Till vs. No Till Farming

Cora, who is becoming a plant and soil specialist, will lead the demonstration that they have loaned to us.



# Low-Till & No-Till Benefits WATER

## UNTILLED SOIL

Water is able to sink in



## TILLED SOIL

MOST RUNS OFF

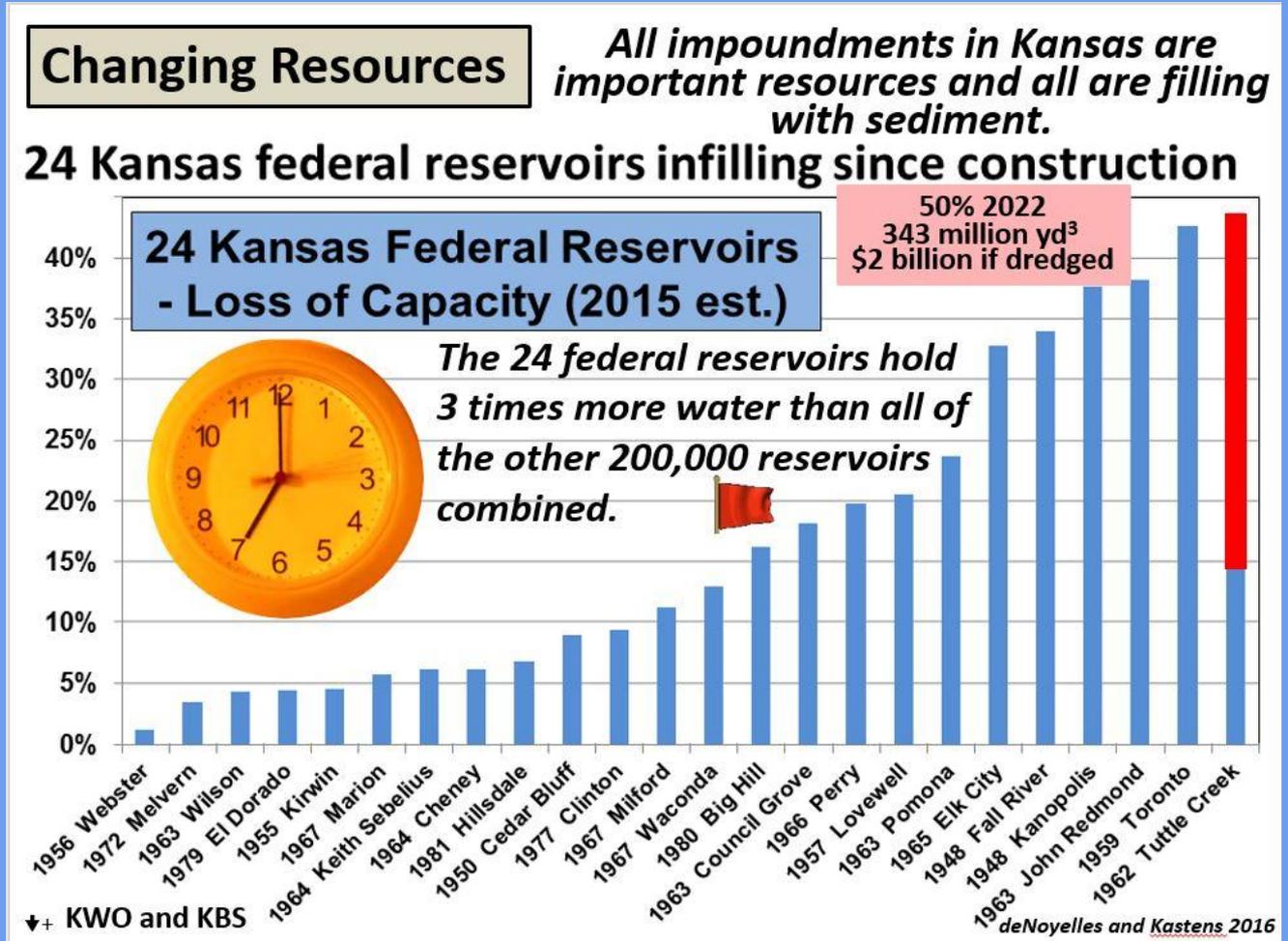


**UNTILLED SOIL PREVENTS  
DAMAGE FROM FLOODING,  
WHICH IS EXPENSIVE**

# Economics Graph

We lose a lot of money to dredge reservoirs!

This graph speaks to policy makers!



If you gain anything from this, we charge everyone in attendance to do something like Ted, Emily, and Mrs. Hammett have. Help high schoolers mitigate HABs and let them learn the accompanying science.

**What kinds of PATTERNS do you think you will find to solve the puzzle in the other reservoirs?**



We are the next generation of scientists and leaders. Find a local high school; we are ready and able to help them!



**Amy Hammett** @LadyHammett · Sep 3



Real science is unsolved detective work, so give Ss real-world unsolved problems. "The principal goal of education is to create men and women who are capable of doing new things, not simply repeating what other generations have done." -Jean Piaget #FiguringOut #PBL #NGSSchat



Thank you to all of these supporters!

# Real-World Education that Serves Kansas by Kansans

Thank you for listening!

