A Monitoring and Early Warning System for Cyanobacteria, Algal Toxins, and Taste and Odor Compounds in the Kansas River for Public Drinking Supply

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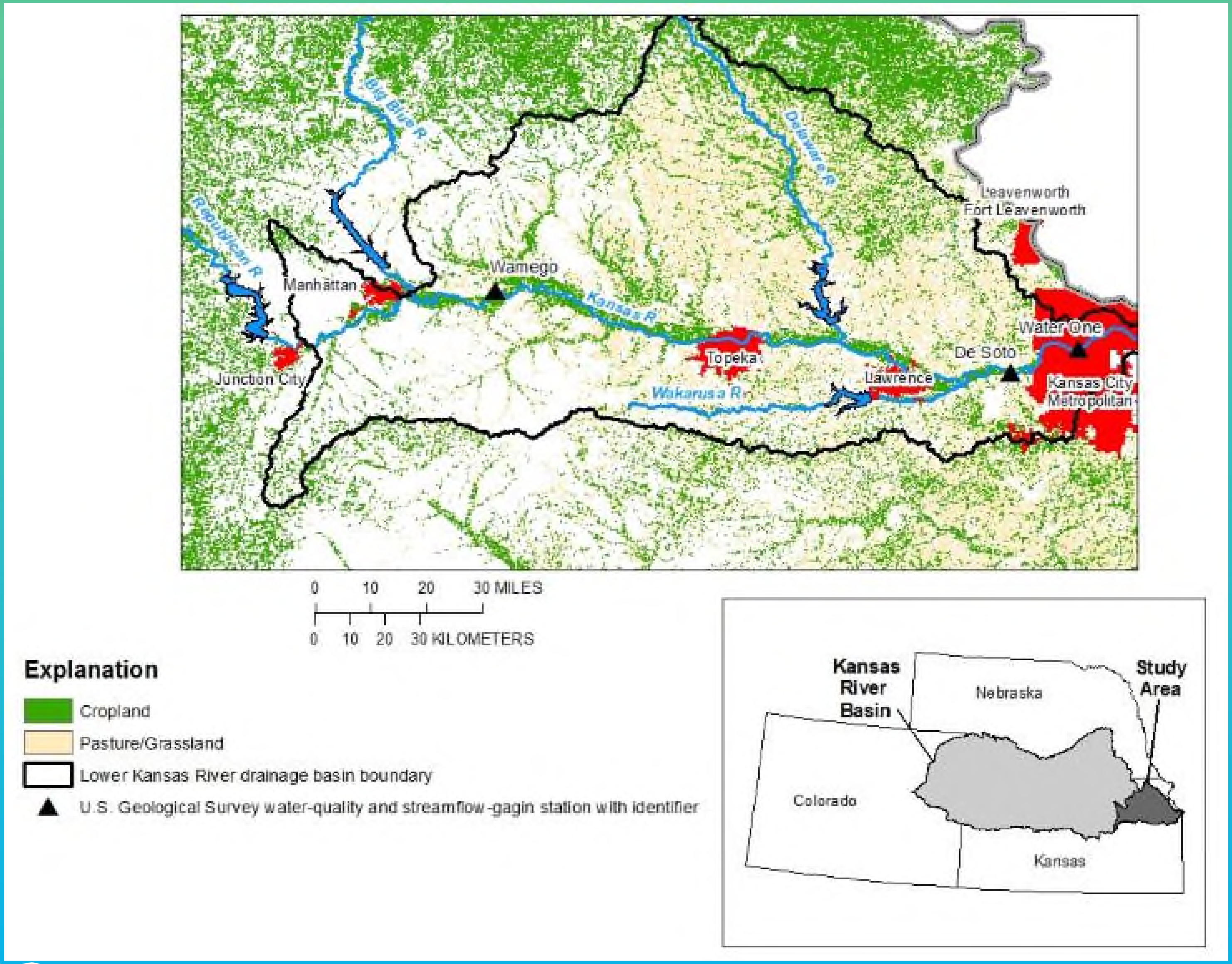
11th National Monitoring Conference
Denver, Colorado
March 25 – 29, 2019

U.S. Department of the Interior
U.S. Geological Survey

The Lower Kansas River Basin



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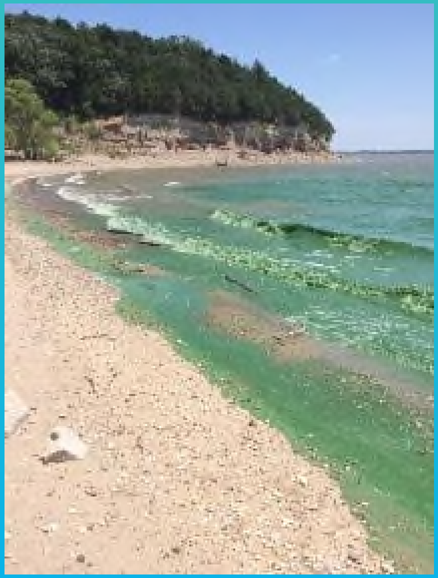
Milford Lake has Chronic, Extreme CyanoHABs with High Toxicity

2011: Missouri River Flooding + Late Summer Reservoir Releases + Harmful Algal Blooms =

Concerns About Transport of Cyanotoxins and Taste-and-Odor Compounds Potentially Affecting Drinking Water Supplies



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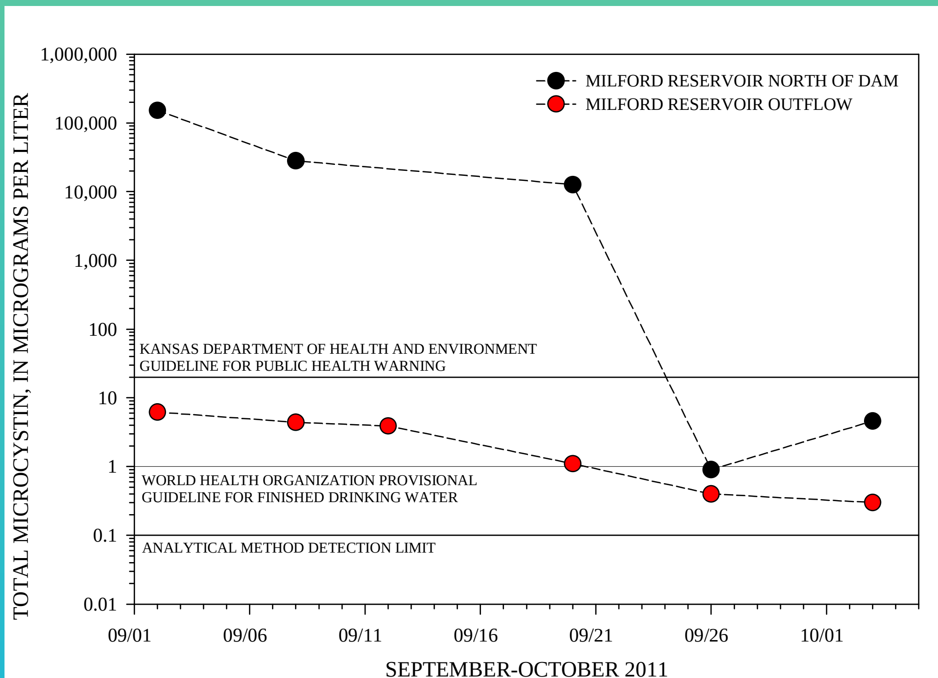
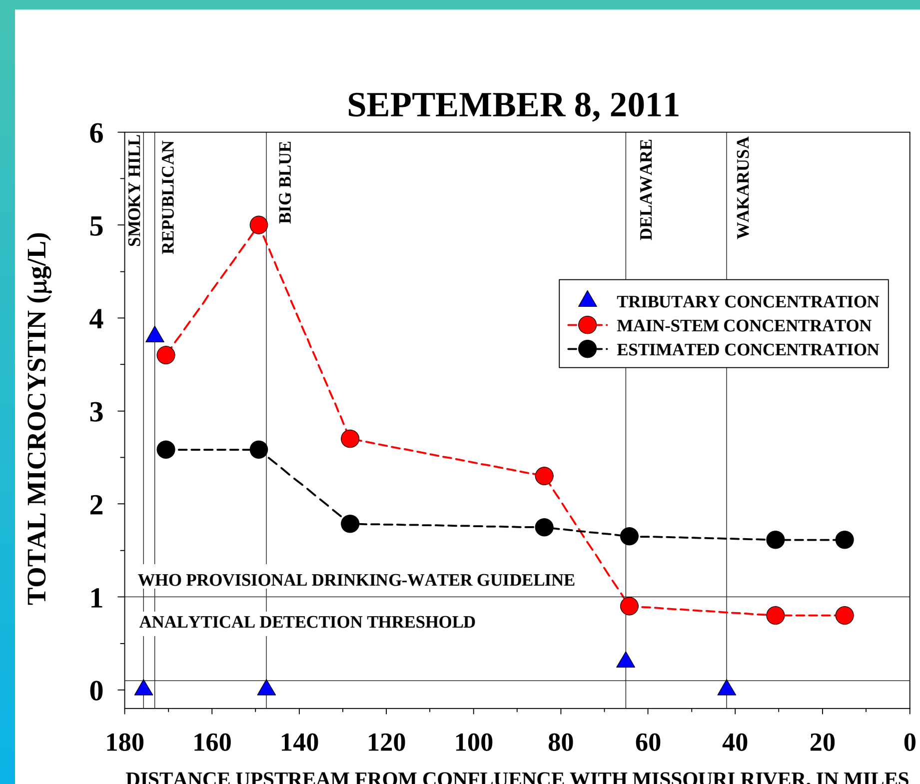
Study Results Showed: Cyanobacterial Toxins and Taste-and-Odor Compounds May Be Transported for Relatively Long Distances Downstream from Lakes and Reservoirs



Milford Lake release sends algae to Kansas River

MARIA SUDEKUM FISHER, Associated Press

Published 09:10 p.m., Wednesday, September 21, 2011



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After Graham et al., 2012, USGS SIR 2017-5016
https://pubs.usgs.gov/sir/2012/5129/

Kansas River Monitoring Objectives (July 2012 through Present)

- Characterize sources, frequency of occurrence, and potential causes of cyanobacteria and associated compounds in the Kansas River.

- Develop models to provide real-time estimates for a number of constituents, including the *potential* for cyanotoxins and taste-and-odor compounds.

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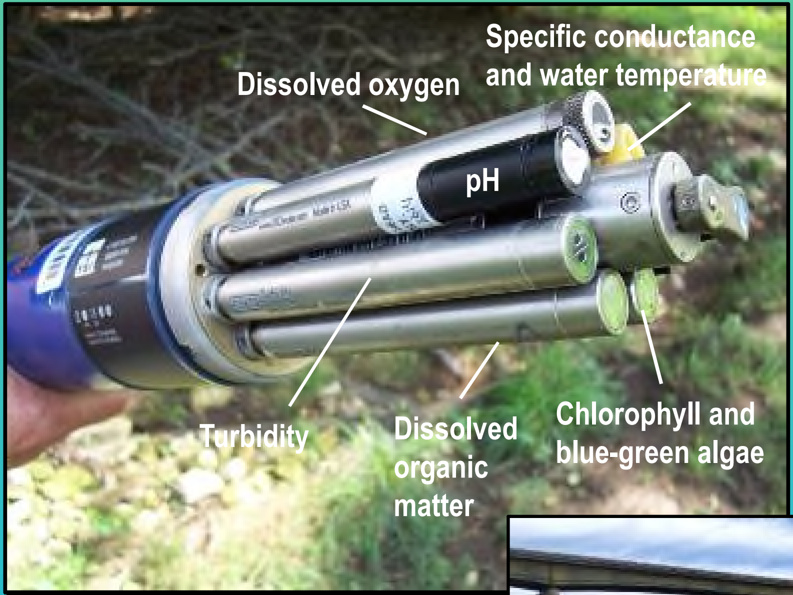
How Are the Monitoring Objectives Accomplished?

- Real-time water-quality monitors at USGS streamgages at Wamego and De Soto.
- Routine sample collection at these 2 sites about 18 times per year; reservoir outflows sampled during releases and cyanobacterial blooms.



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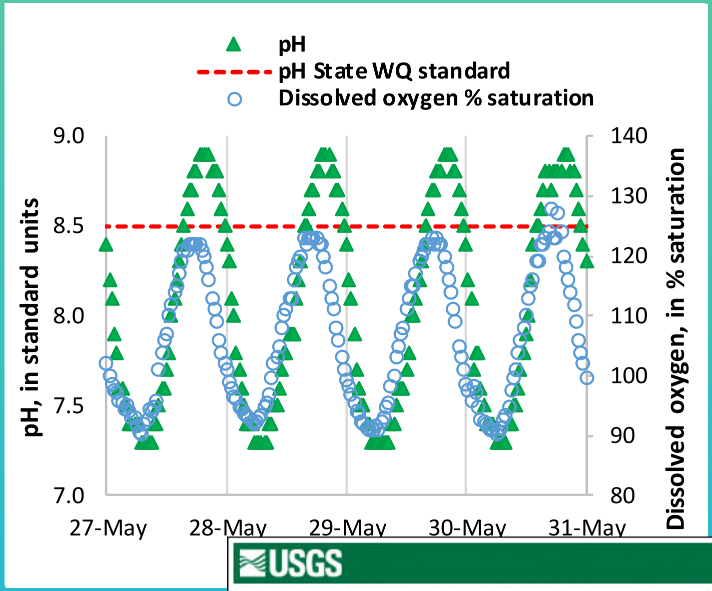
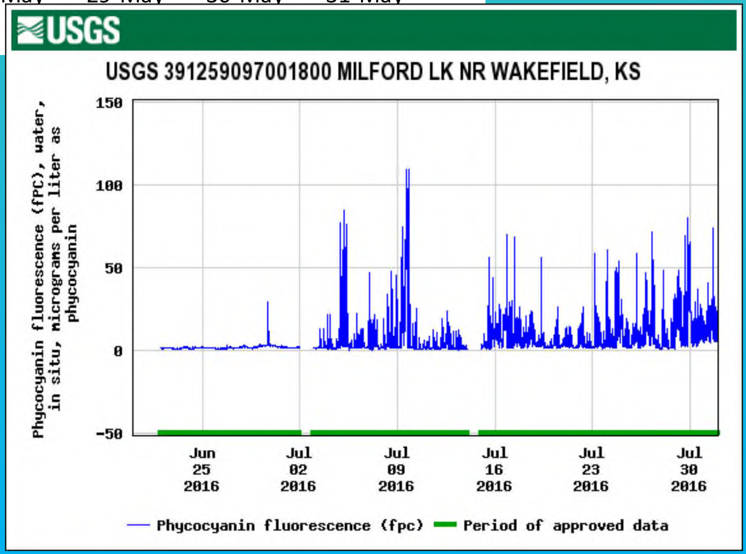
Diurnal or Noisy Patterns in Dissolved Oxygen, pH and Algal Fluorescence May Be Indicative of Potentially Harmful Algal Blooms

Courtesy of L. King





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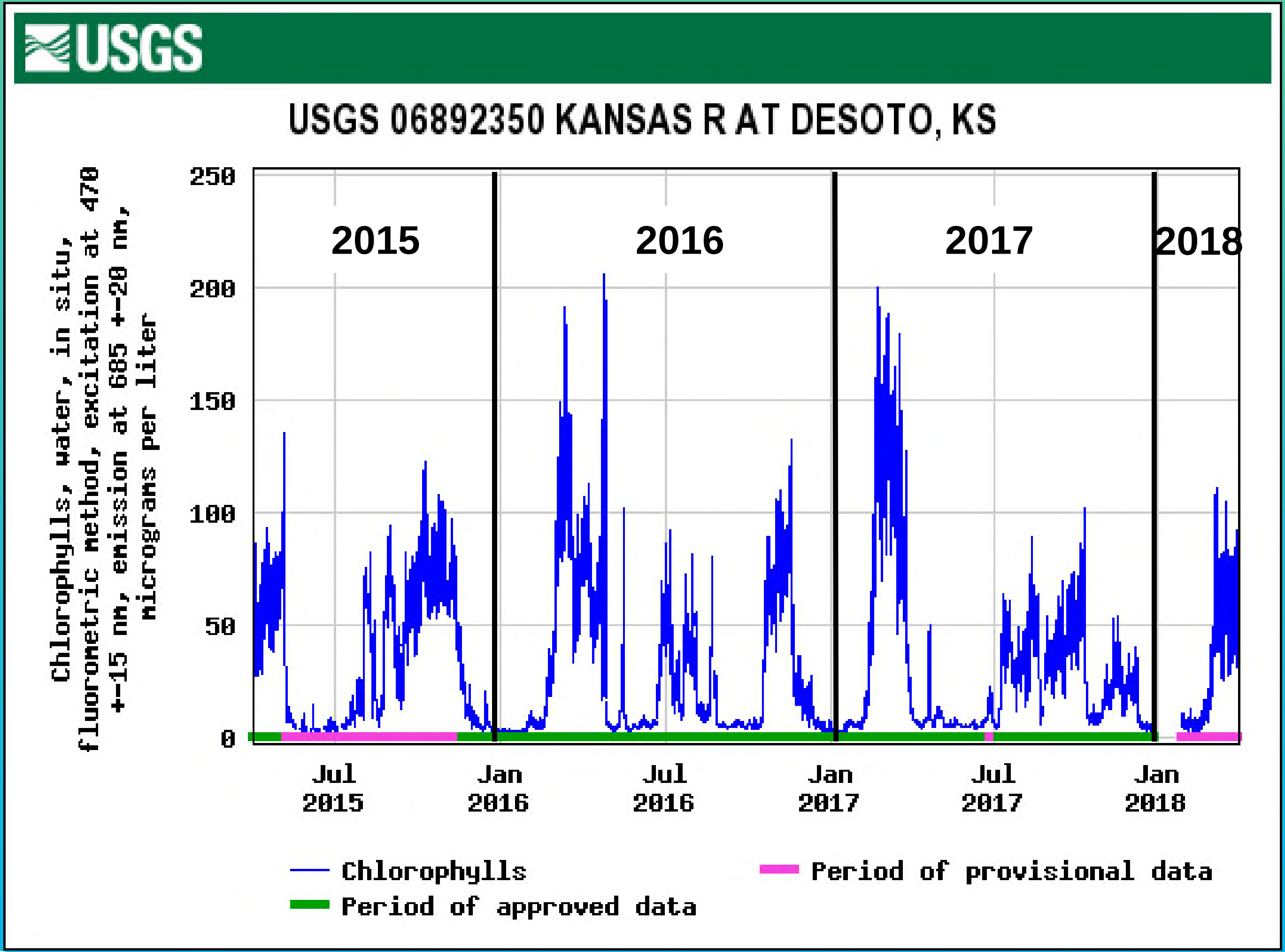
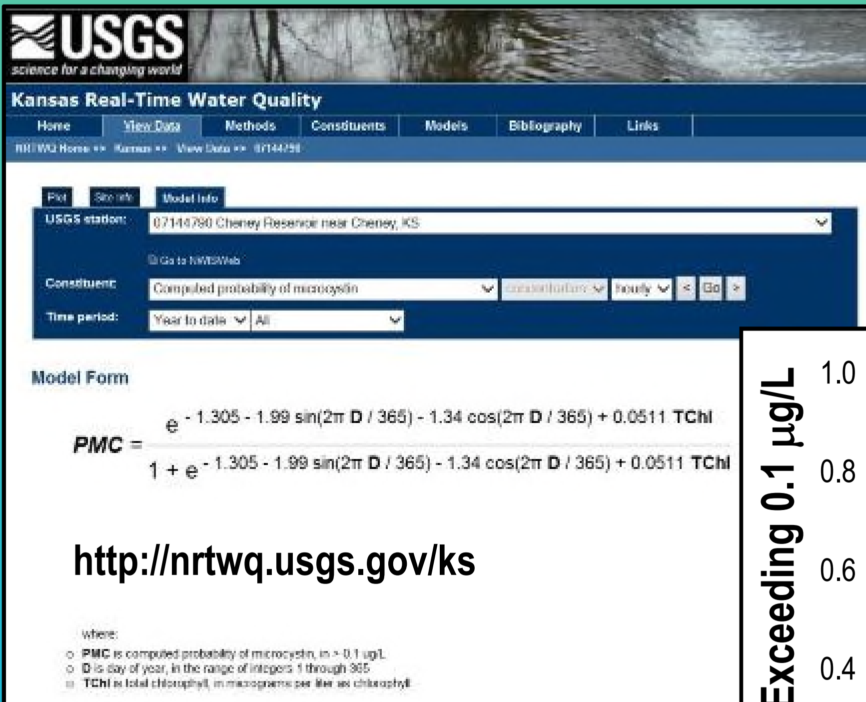
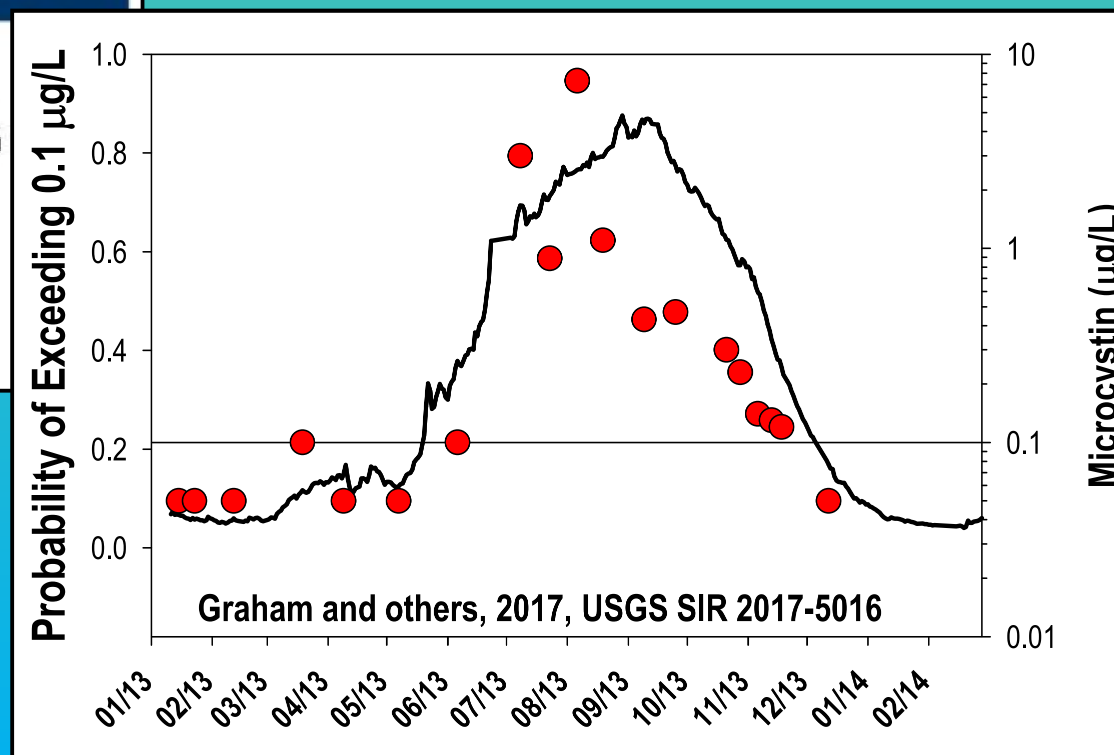
Algal Fluorescence May Be Indicative of Long-Term Patterns in Algal Activity



Continuous Water-Quality Monitors Can Be Used to Develop Models to Compute Probability of Cyanotoxin Occurrence in Real Time



http://nrtwq.usgs.gov/ks



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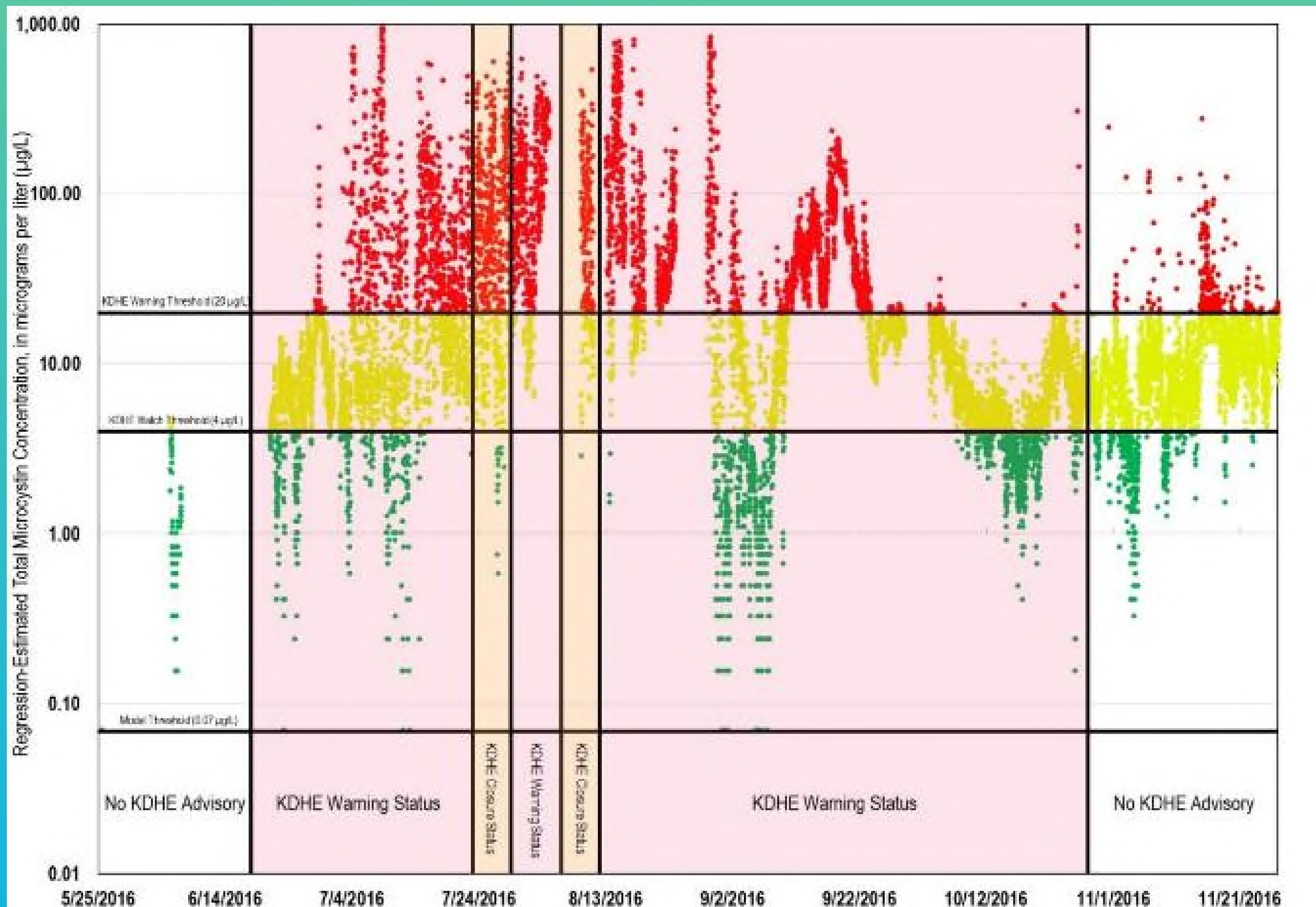
Continuous Water-Quality Monitors Can Be Used to Develop Models to Compute Cyanotoxin Concentrations in Real Time (Not Just the Probability of Occurrence)



Milford Lake at Wakefield, Data for Explanatory Variable (phycocyanin RFU) Can Be Found At: https://waterdata.usgs.gov/nwis/uv?site_no=391259097001800
Foster and others, 2018 SIR 2018-5166

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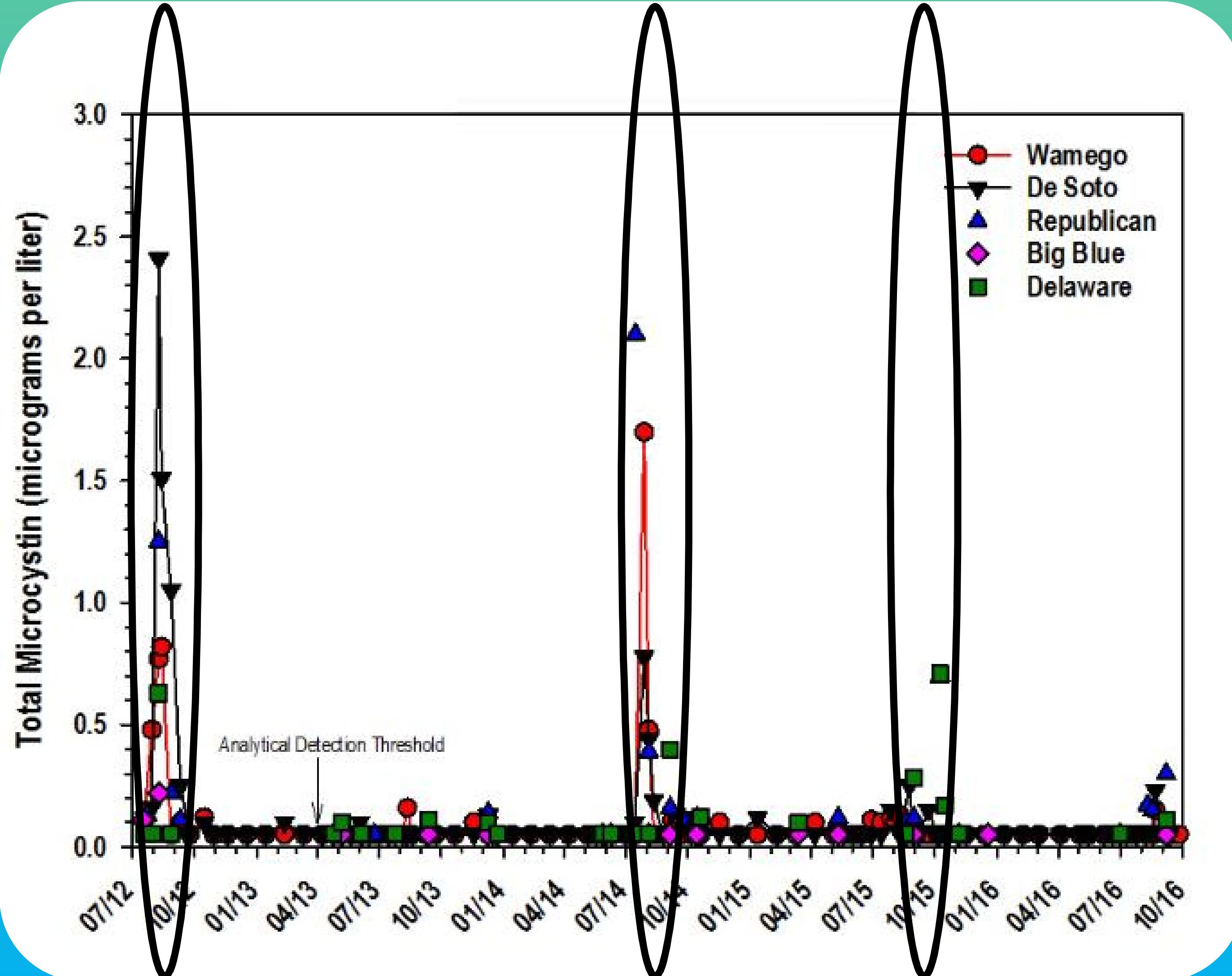
Kansas Department of Health and Environment

With the Exception of Late Summer 2011, 2012 and 2014, Microcystin Detections in the Kansas River Have Been Relatively Uncommon



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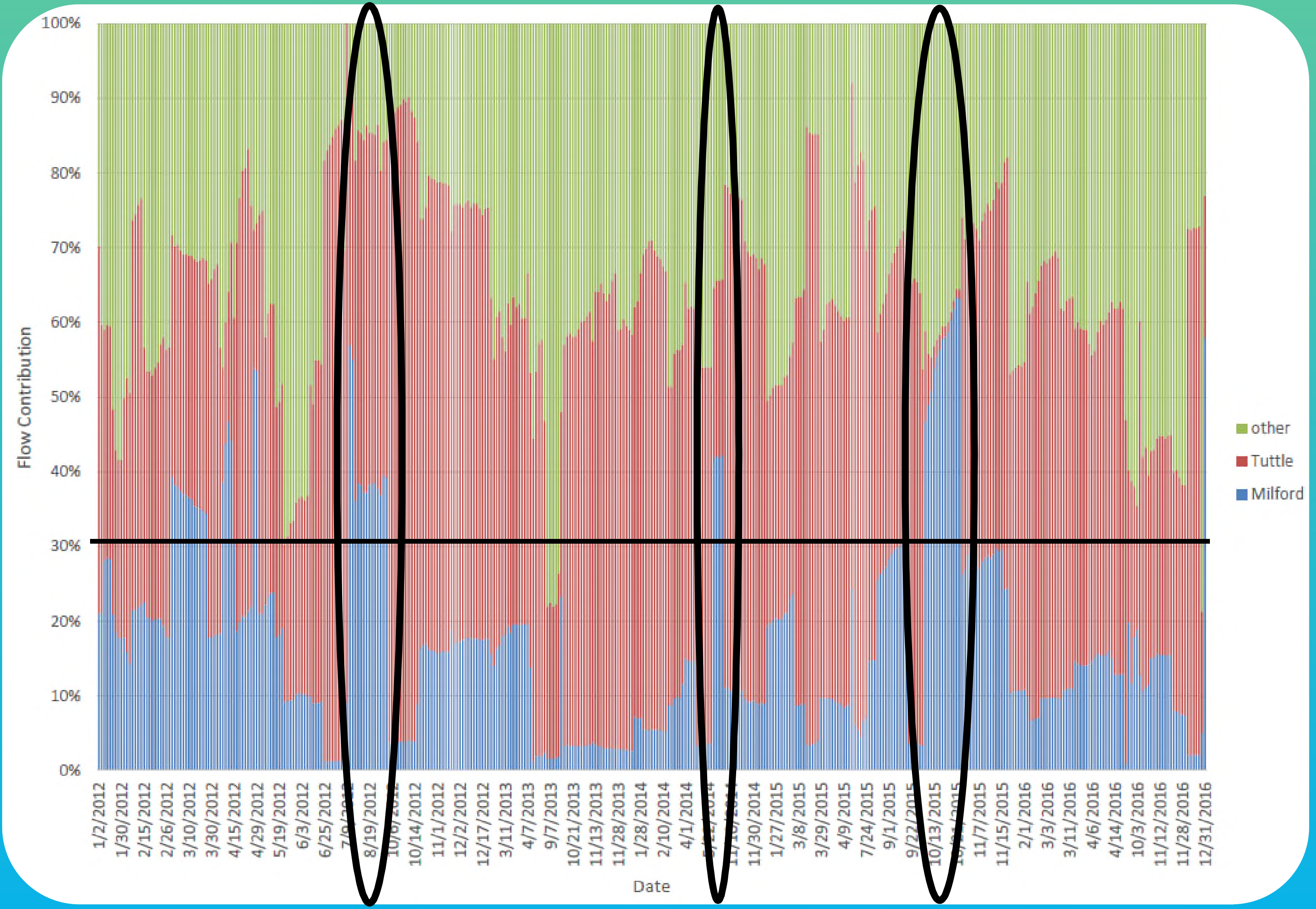
Graham and others, 2018 SIR 2018-5089

Microcystin Occurrence in the Kansas River is Associated with Streamflows less than 3,000 cfs AND Flow Contributions from Milford Reservoir Greater than 30%



Graham and others, 2018 SIR 2018-5089

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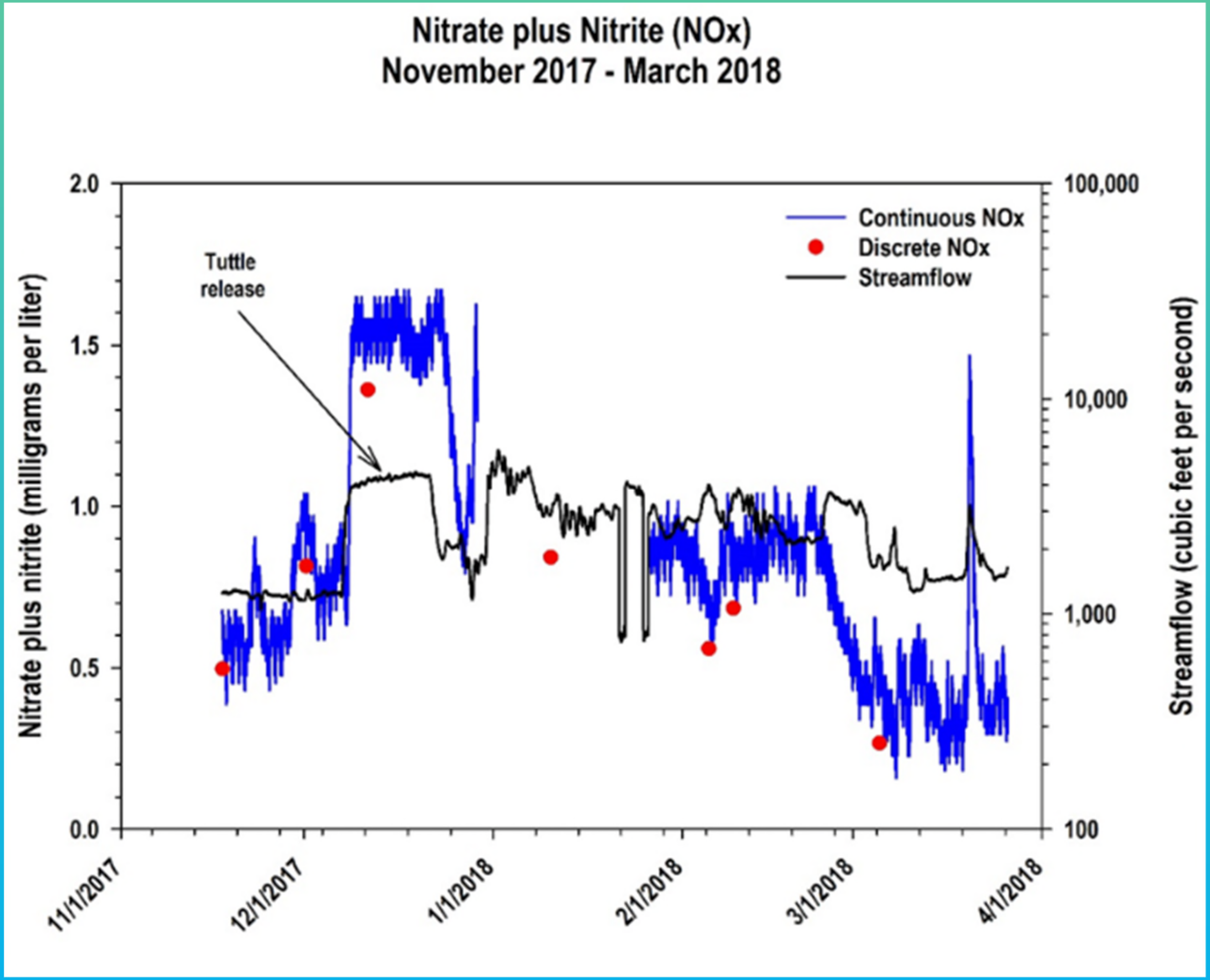
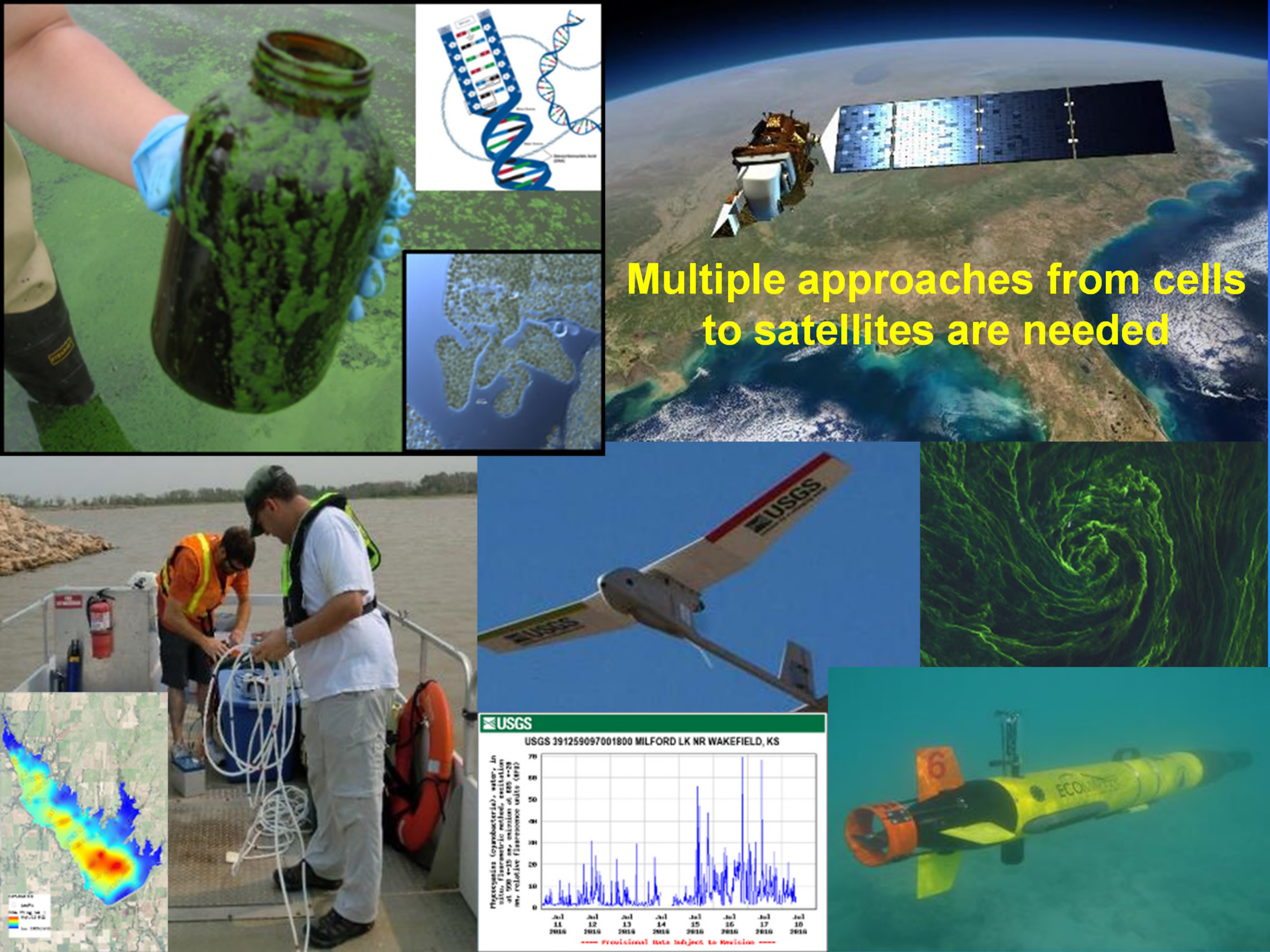
Continuous Nitrate Has Shown How Reservoir Releases Affect Nitrate Concentrations




Multiple approaches from cells to satellites are needed
USGS
USGS
USGS
USGS 391259097001800 MILFORD LK NR WAKEFIELD, KS
0
10
20
30
40
50
60
70
Jul 11 2016
Jul 12 2016
Jul 13 2016
Jul 14 2016
Jul 15 2016
Jul 16 2016
Jul 17 2016
Jul 18 2016
---- Provisional Data Subject to Revision ----
6

Aerial- and Ground-Based Cameras Show Potential as Early Warning Indicators

Courtesy of E. Emory

Courtesy of C. Smith

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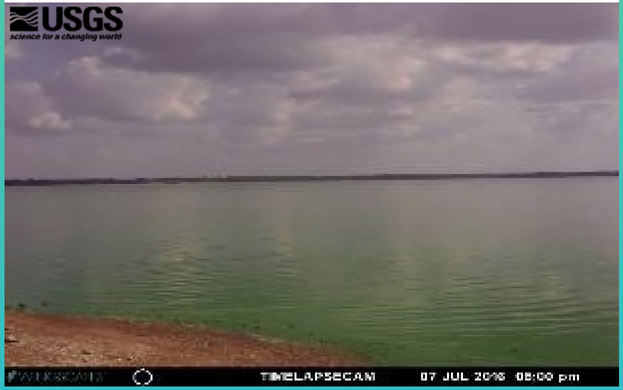
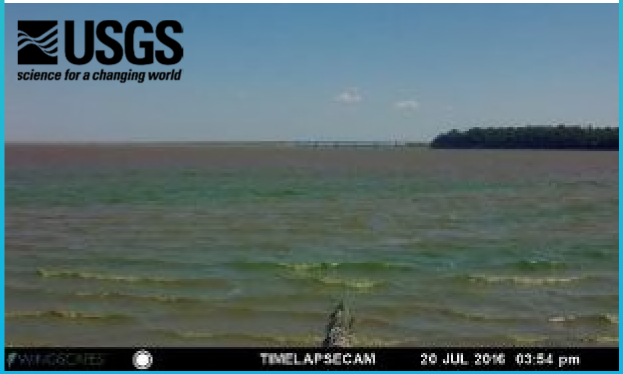
Time-Lapse Cameras Capture Temporal Variability at Sites of Interest

July 7, 2016 at 5:00 pm



July 7, 2016 at 6:00 pm

July 20, 2016 at 3:54 pm



July 20, 2016 4:09 pm

Foster and others, 2018 SIR 2018-5166

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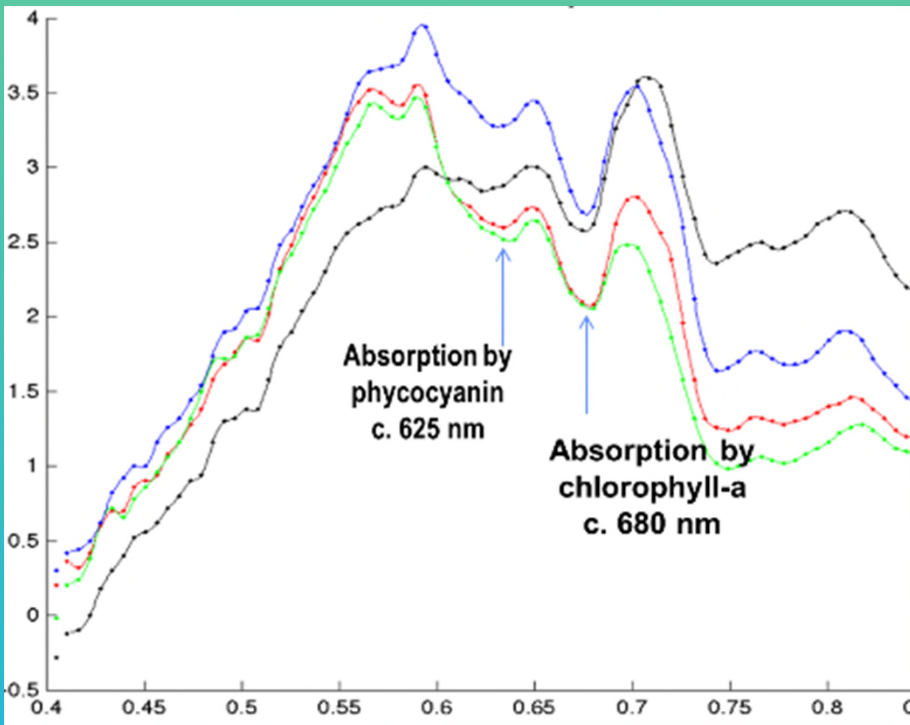
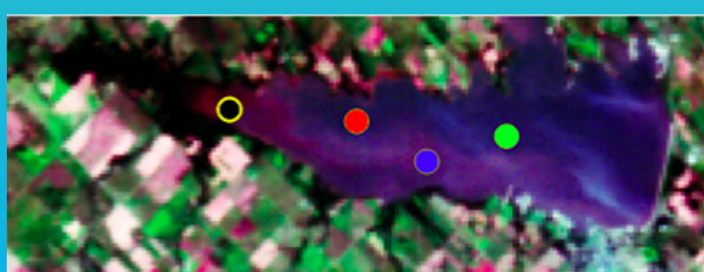
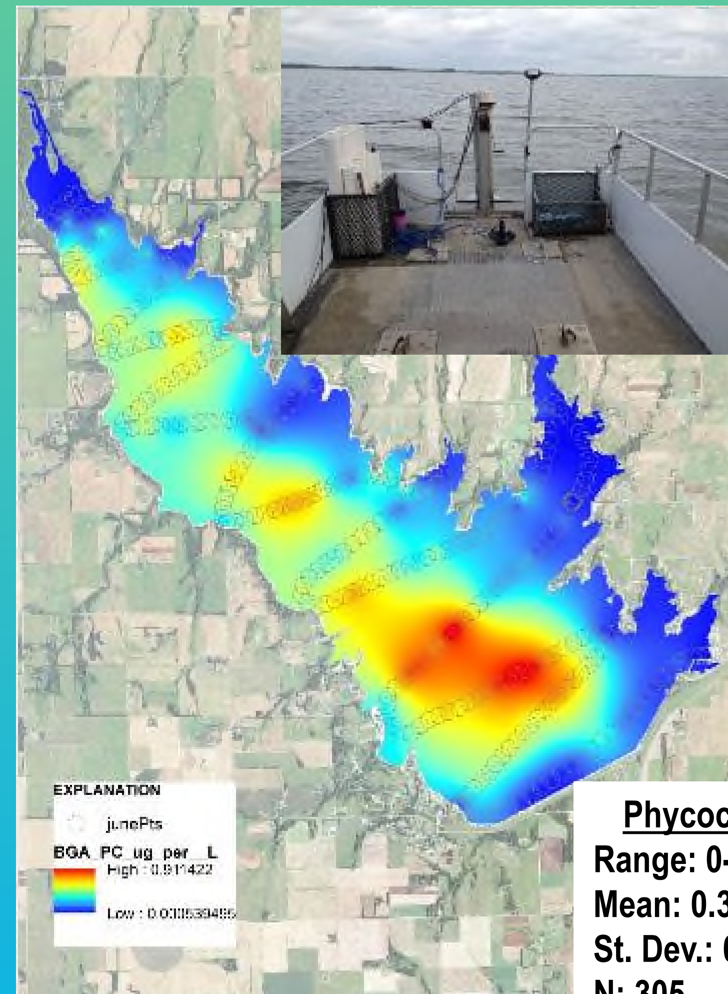
Discrete, Continuous Spatial Data Can Be Used to Validate Remotely Sensed Data







Phycocyanin
Range: 0-1 µg/L
Mean: 0.3 µg/L
St. Dev.: 0.2 µg/L
N: 305

Cheney Reservoir, KS

Integrated Approaches are Essential to Understand, Quantify, and Mitigate Harmful Algal Blooms

- Individual systems are unique.
- Spatial and temporal variability present challenges to data collection, analysis, and interpretation.
- Sensor technology and genetic approaches provide important information on spatiotemporal variability and environmental influences.
- A variety of tools for early warning and prediction are being developed and used.

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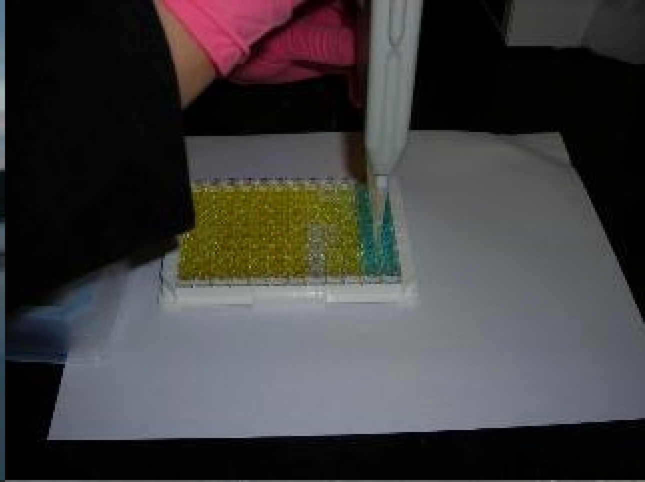
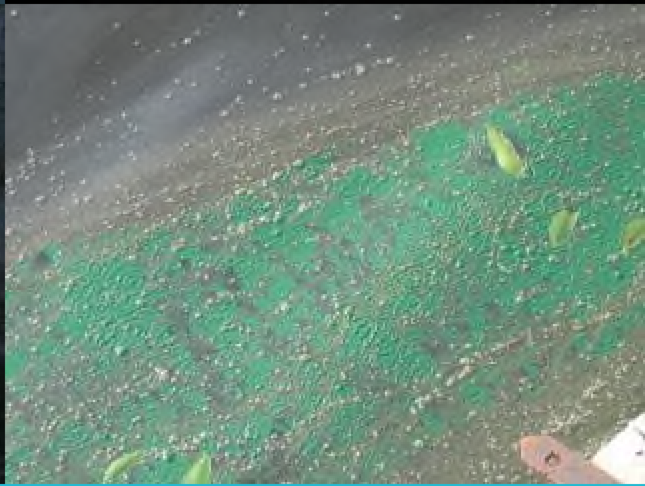
https://pubs.er.usgs.gov/publication/ofr20161174





Kansas Department of Health and Environment

Kansas Water Office

The City of TOPEKA
Transforming Topeka One Opportunity at a Time

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gfoster@usgs.gov

USGS HAB Links:

https://www.usgs.gov/news/science-harmful-algae-blooms

https://ks.water.usgs.gov/cyanobacteria

WaterOne
Water District No. 1 of Johnson County

OLATHE KANSAS

City of Lawrence