SC DEPARTMENT *of*
ENVIRONMENTAL
SERVICES

# Cyanotoxins in South Carolina

April 22, 2026

# Acknowledgement


- Emily Bores and Lindsey Lachenmyer, SCDES
- Jennifer Graham, USGS
- US EPA


# Agenda

- Cyanotoxins 101
- EPA's Criteria and State Standards
- Cyanotoxin Distribution Project
- What's Next for South Carolina?

# Cyanotoxins 101

# EPA's Criteria and State Standards

# Cyanotoxin Distribution Project

# What's Next for South Carolina?

# Cyanotoxins 101

# What are HABs?

- Algal blooms are naturally occurring events in lakes, ponds, rivers and oceans all throughout the country.
- Algal blooms are comprised of tiny plant-like organisms. **Certain species of these organisms can produce toxins** that can make people and animals sick.

# What are HABs?

- When an algal bloom **contains toxins** or is comprised of a species that **has the potential to produce toxins** that are known to affect the health of people, animals, and the environment, they are known as **harmful algal blooms (HABs)**.
- HABs are made up of algae and **cyanobacteria** (often referred to as “blue-green algae”), and under the right conditions, these organisms can overgrow in natural waterbodies.
- HABs are typically observed during the warmer and drier months, and they can persist for several weeks.

# What are HABs?

- The major factors influencing the growth and reproduction of cyanobacteria are **light**, **temperature** and **nutrients**.
- HABs tend grow well with ample sunlight, slow-moving water, excessive nutrients (nitrogen and phosphorus), and relatively warm water temperature.

# Are all Blooms Really Harmful?

- Each algal bloom is unique, and some blooms do not contain toxins. However, some HABs have the potential to produce a **variety of toxins**.
- According to USGS, **algal toxins can still be present even when a bloom is not visible**. This highlights the need for ongoing monitoring. Ingestion or contact with these toxins can lead to a range of health effects including **skin irritations** and **rashes**, **gastrointestinal symptoms**, **respiratory distress**, and **neurological effects**. Pets and livestock can also be severely affected by algal toxins, which may lead to sudden illness or death after exposure to contaminated water.

# Are all Blooms Really Harmful?

- You can't tell if a bloom is harmful just by looking at it, and not all blooms are easy to see.
- Typical pathways that put people and animals at risk of experiencing health related issues from HABs include **ingestion** and **inhalation**.

# What are Cyanotoxins?

- There are numerous cyanobacterial genera. Many cyanobacteria can produce multiple cyanotoxins.
- The four most common toxins produced by HABs in freshwater are **microcystins**, **cylindrospermopsin**, **saxitoxins**, and **anatoxins**.

# What are Cyanotoxins?

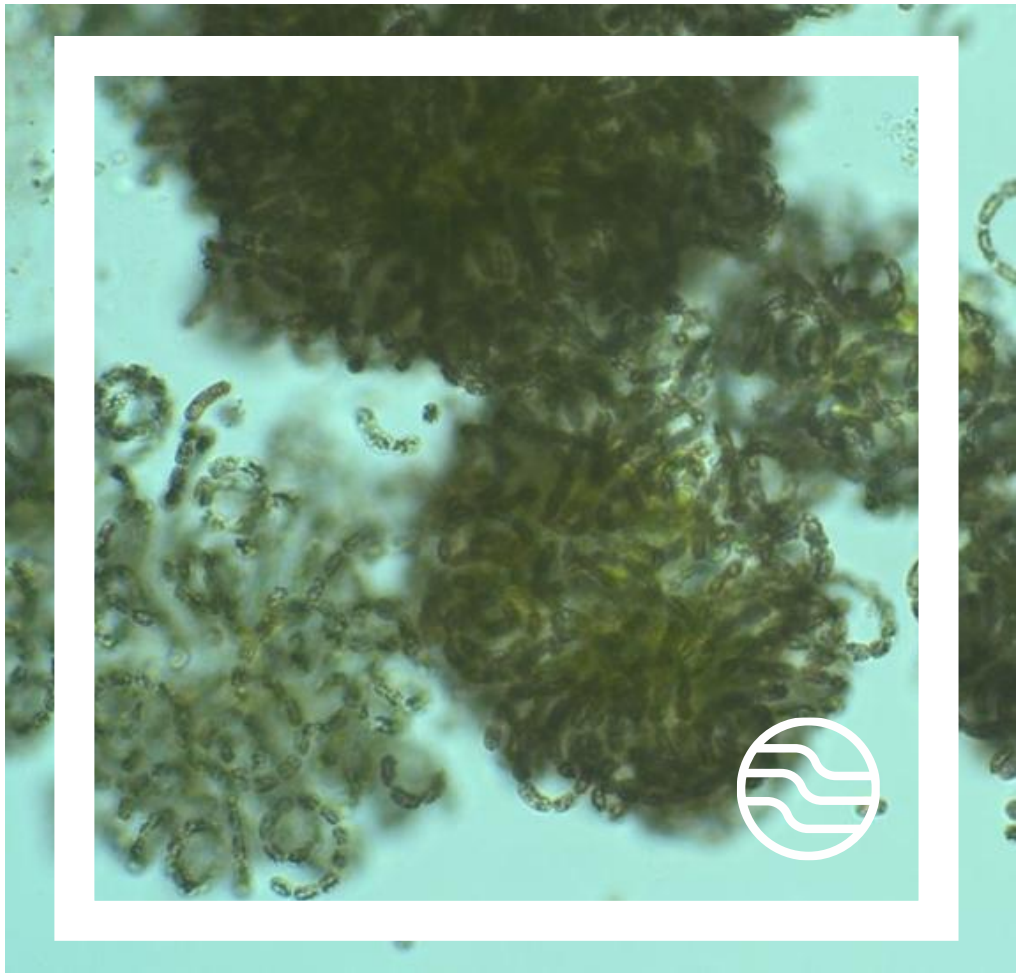
- Cylindrospermopsin and microcystins are both hepatotoxins
- Anatoxin and saxitoxins are both neurotoxins
- HABs are commonly composed of different algal species so a single bloom may contain multiple cyanobacteria producing multiple cyanotoxins.

# What are Cyanotoxins?

| Cyanobacterial Genera | Cylindrospermopsin | Microcystins | Anatoxin | Saxitoxins |
|---|---|---|---|---|
| *Anabaena/Dolichospernum* | X | X | X | X |
| *Anabaenopsis* | | X | | |
| *Aphanizomenon* | X | | X | X |
| *Aphanocapsa* | | X | | |
| *Cylindrospermopsis* | X | | | X |
| *Haplosiphon* | | X | | |
| *Lyngbya (Plectonema)* | X | | | X |
| *Microcystis* | | X | | |
| *Nostoc* | | X | | |
| *Oscillatoria (Planktothrix)* | | X | X | X |
| *Phormidium* | | | X | |
| *Pseudanabaena* | | X | | |
| *Raphidiopsis* | X | | X | |
| *Synechococcus* | | X | | |
| *Synechocystis* | | X | | |
| *Umezakia* | X | | | |

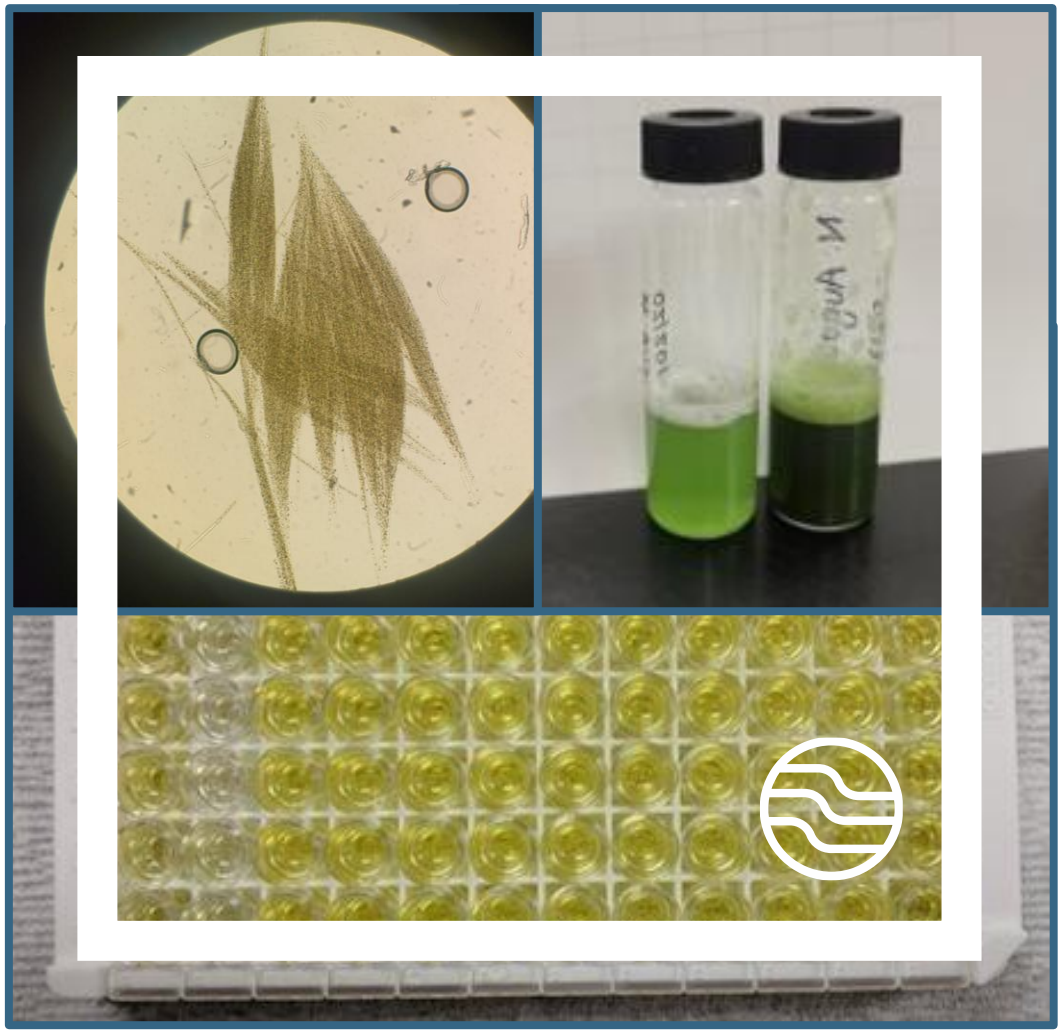
# Sampling and Analysis

- Once an algal sample is collected, it must be evaluated under a microscope to determine which algal species are present. Based on the analysis, the bloom can be identified as harmful or non-harmful.
- SCDES staff have been trained to identify toxic algae in both freshwater and saltwater.



# Sampling and Analysis

- There are two approved Enzyme Linked Immunosorbent Assay (ELISA) sampling methods for cyanotoxins
- ADDA ELISA: less sensitive detection (≥0.100 µg/L), freshwater only, less expensive
- SAES ELISA: more sensitive detection (≥0.016 µg/L), freshwater and saltwater, more expensive



# EPA's Criteria and State Standards

# EPA's Drinking Water Health Advisories

- In June 2015, the EPA developed 10-day Drinking Water Health Advisories (HA) for cylindrospermopsin and microcystins.

| Cyanotoxin | 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 |

# EPA's Human Health Recreational Swimming Advisories

- In May 2019, the EPA published swimming advisories for cylindrospermopsin and microcystins (EPA 822-R-19-001).

| Cylindrospermopsin Magnitude (µg/L) | Microcystins Magnitude (µg/L) | Duration | Frequency |
|---|---|---|---|
| 15 | 8 | One day | Not to be exceeded |

# EPA's Human Health Recreational Water Quality Criteria

- In May 2019, the EPA published **ambient water quality criteria** for cylindrospermopsin and microcystins (EPA 822-R-19-001).

| Cylindrospermopsin Magnitude (µg/L) | Microcystins Magnitude (µg/L) | Duration | Frequency |
|---|---|---|---|
| 15 | 8 | 1 in 10-day assessment period across a recreational season | Not more than 3 excursions in a recreational season or in more than one year* |

* An excursion is defined as a 10-day assessment period with any toxin concentration higher than the recommended criteria magnitude. When more than three excursions occur within a recreational season and that pattern reoccurs in more than one year, it is an indication the water quality has been or is becoming degraded and is not supporting its recreational use.

# South Carolina's Recreational Swimming Advisories

- During the 2019 triennial review, South Carolina promulgated recreational swimming advisories for cylindrospermopsin and microcystins.
- If a swimming advisory is issued, then it will remain in effect until two consecutive follow up samples show the cyanotoxin concentration has decreased below water quality standard.

| Cylindrospermopsin Magnitude (µg/L) | Microcystins Magnitude (µg/L) | Duration | Frequency |
|---|---|---|---|
| 15 | 8 | Single sample maximum | Not to be exceeded |

# South Carolina's Human Health Recreational Water Quality Criteria

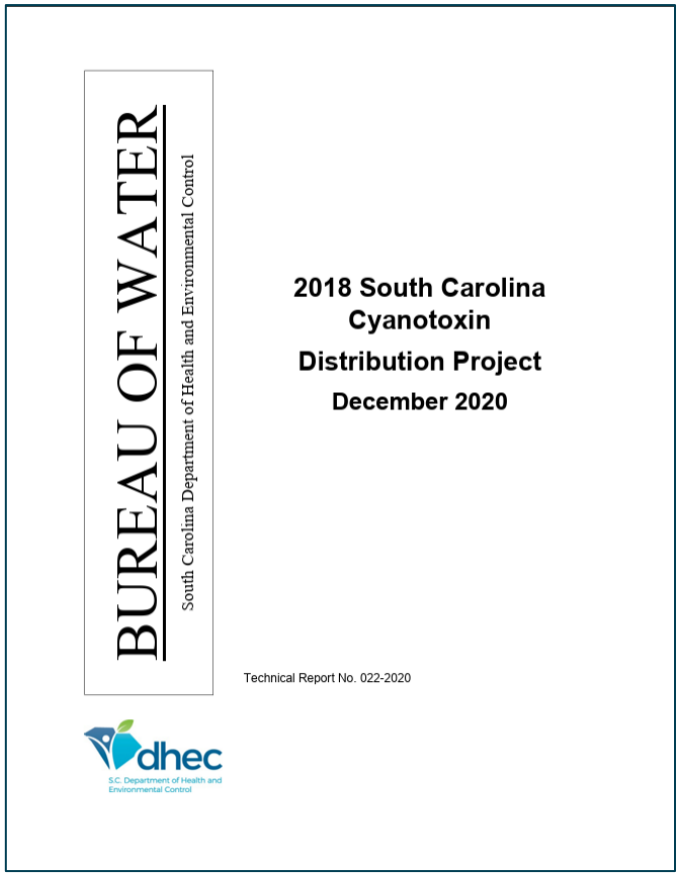
- During the 2019 triennial review, South Carolina promulgated **ambient water quality criteria** for cylindrospermopsin and microcystins.

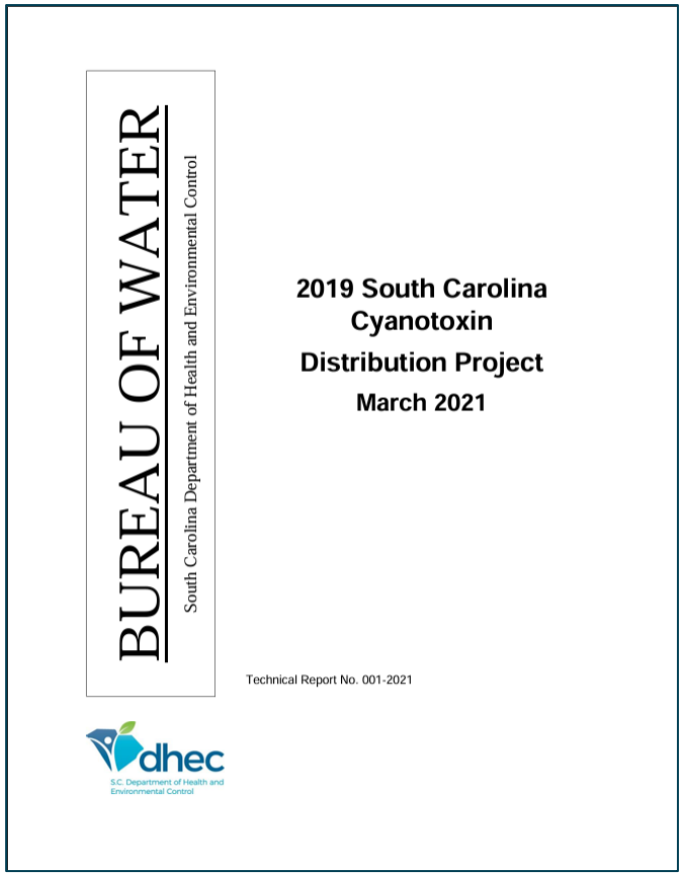
| Cylindrospermopsin Magnitude (µg/L) | Microcystins Magnitude (µg/L) | Duration | Frequency |
|---|---|---|---|
| 15 | 8 | Single sample maximum | Not more than 3 swimming advisories in a 3-year assessment period. |

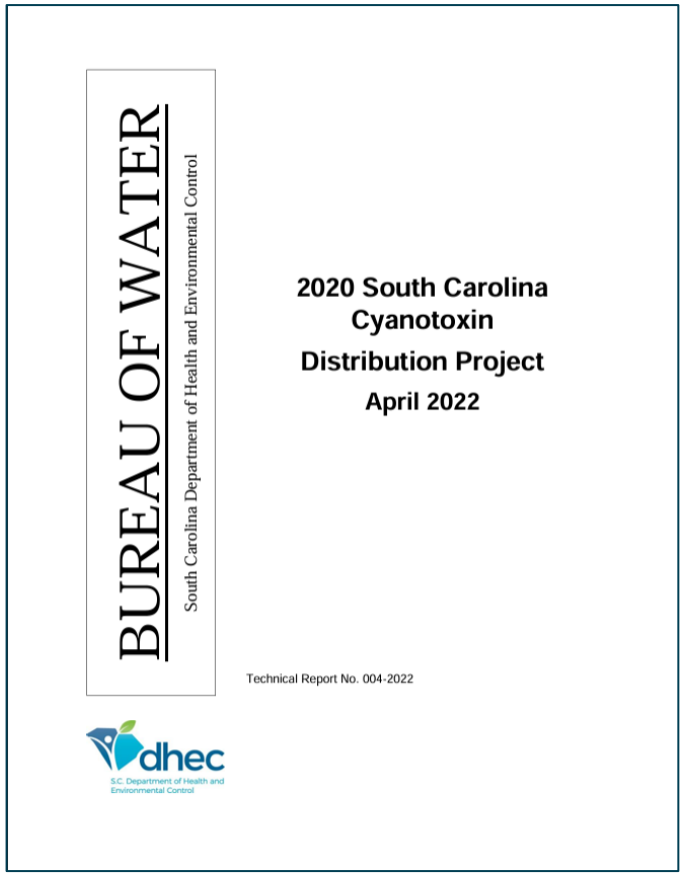
# Cyanotoxin Distribution Project

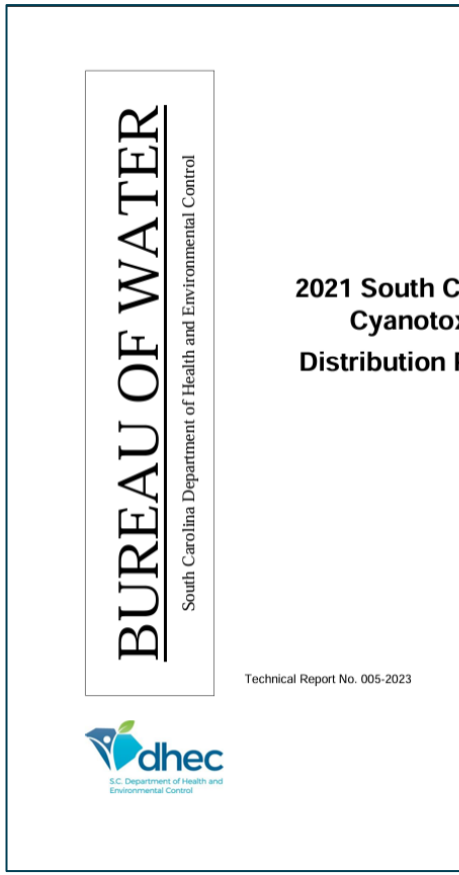
SC DES

# Distribution Project



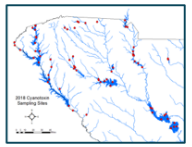



# Distribution Project Milestones

## 2018

### Project Kickoff

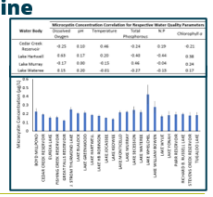
- In August **2018**, SC DHEC initiated the **HABs Monitoring Program** to investigate the effects that cyanotoxins have on human health and the environment within the State.
- Establish **baseline data** for **cyanotoxin distribution** across the state.
- Evaluate whether routine or event-driven sampling exceeded national recommendations.
- Determine if correlations exist between cyanotoxin concentrations and other water quality parameters.




## 2019

### Microcystin Baseline

- Following the **2019** sampling season, the water quality correlation analysis did not reveal any meaningful relationships between microcystin concentrations and any other parameter.
- However, after two seasons of cyanotoxin data collection a microcystin baseline showed ambient concentrations well below EPA's recreational swimming advisory of **8 µg/L**.



## 2020

### Drinking Water Intake and Estuarine Monitoring

- In **2020**, the Department increased the number of routine monitoring sites to include 6 **drinking water intake sites**.
- Additionally, 38 **estuarine sites** were added to the ambient monitoring program.

| Lake | Drinking Water Facility |
|---|---|
| Lake Bowen | Spartanburg Water System |
| Lake Greenwood | Greenwood CPW |
| Lake Murray | City of Columbia |
| Lake Murray | City of West Columbia |
| Lake Rabon | Laurens CPW |
| Lake Welchel | Gaffney BPW |

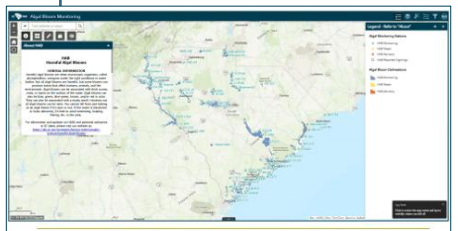
## 2021

### HAB GIS Available

- In 2021, SC DHEC released the HAB monitoring map giving the public access to updated monitoring results. The map includes all monitoring stations, watches, and advisories.
- HAB Watch: A potential toxin producing blooms has been identified but is not producing toxins that are greater than our state recreational standards or has the potential to produce toxins that are not in our state standards (i.e., saxitoxins or anatoxin-a)
- Swimming Advisory: A bloom has been identified and is producing toxins that are greater than our state recreational standards.

### Field Collection

- In **2021**, SC DHEC published the standard operating procedures for algal bloom and cyanotoxin field collection.

## 2022

### ELISA Analysis

- In **2022**, SC DHEC published the standard methodology for determining algal toxins in ambient water for ADDA ELISA and SAES ELISA.


## 2023

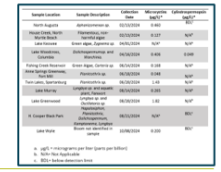
### Continued Monitoring

- The **2023** monitoring season was South Carolina's **fifth** full season for cyanotoxin monitoring in lakes and it's **fourth** full season for cyanotoxin monitoring in estuaries.
- Ambient cyanotoxin concentration baselines have been established across the state, and the monthly monitoring suggests no immediate concern for recreation activities due to the low concentrations of microcystins in open water settings.
- **Continued monitoring** is still necessary to ensure recreational and aquatic life uses are protected.

## 2024

### HAB Events Sampling

- Whenever SCDES receives reports of HABs, staff sample and analyze the algal bloom for cyanotoxins.
- During the **2024** season, there were **11** HAB events reported, resulting in HAB Watches being issued at several lakes.



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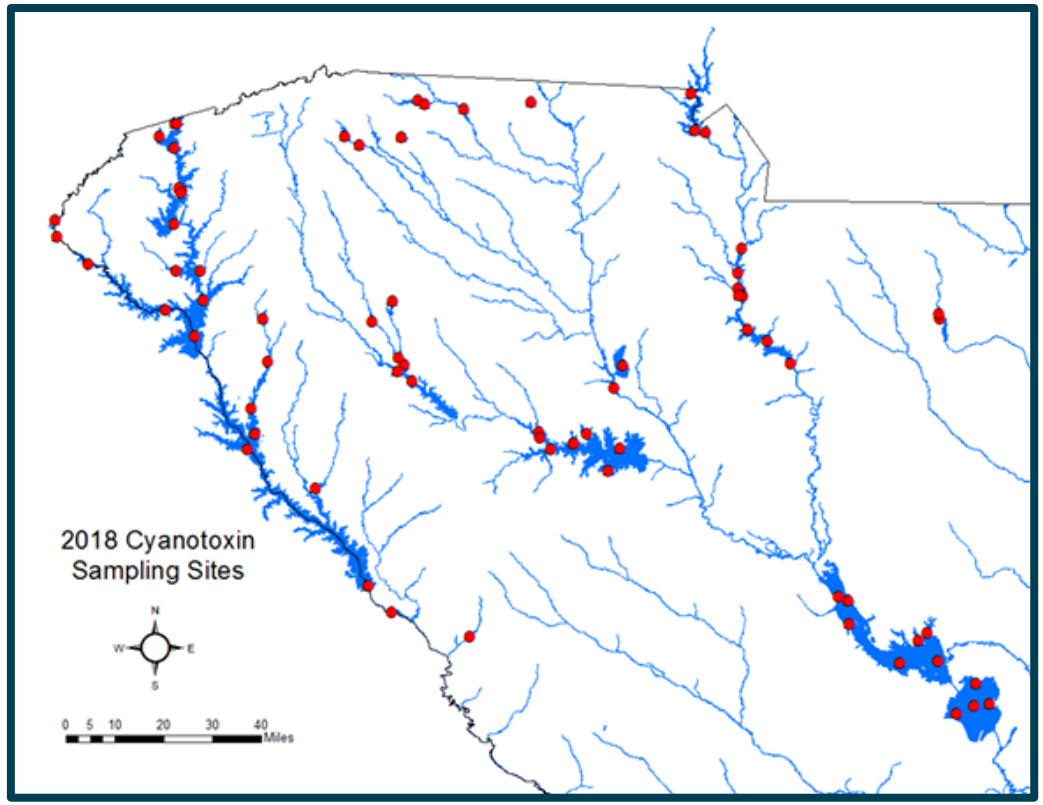

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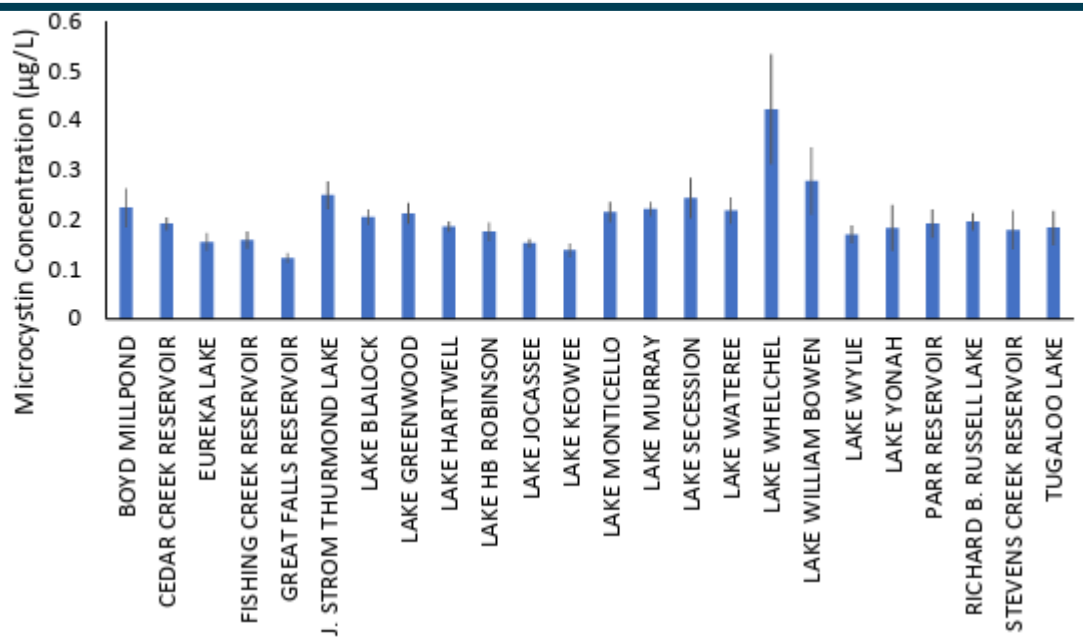
| Water Body | Microcystin Concentration Correlation for Respective Water Quality Parameters | | | | | |
|---|---|---|---|---|---|---|
| | Dissolved Oxygen | pH | Temperature | Total Phosphorous | N:P | Chlorophyll *a* |
| Cedar Creek Reservoir | -0.25 | 0.10 | 0.46 | -0.24 | 0.19 | -0.21 |
| Lake Hartwell | 0.63 | 0.17 | 0.20 | -0.40 | -0.44 | 0.38 |
| Lake Murray | -0.17 | 0.00 | -0.15 | 0.46 | -0.04 | 0.24 |
| Lake Wateree | 0.15 | 0.20 | -0.01 | -0.27 | -0.13 | 0.17 |



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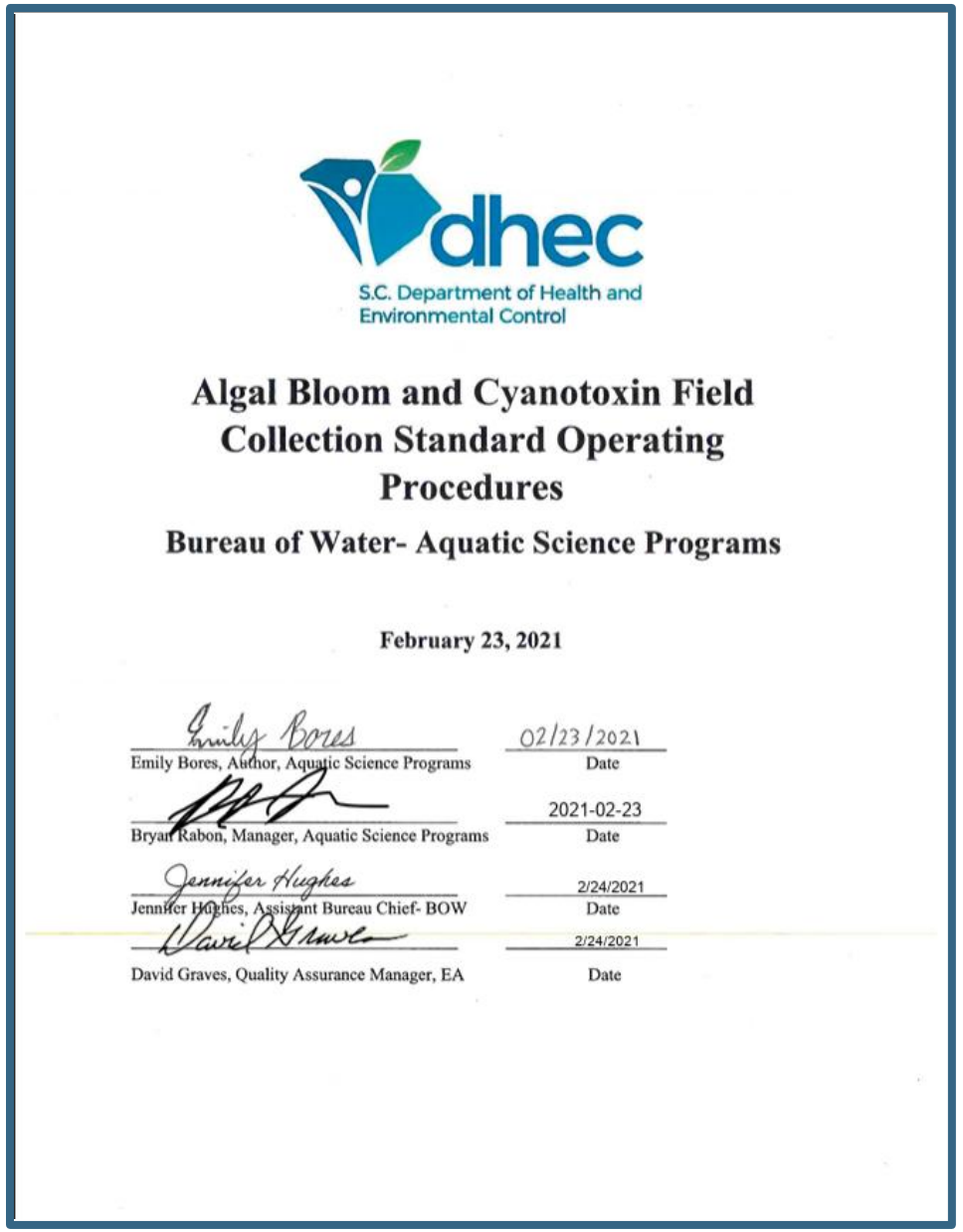

dhec
S.C. Department of Health and Environmental Control

**Algal Bloom and Cyanotoxin Field Collection Standard Operating Procedures**

**Bureau of Water- Aquatic Science Programs**

**February 23, 2021**

Emily Bores — 02/23/2021
Emily Bores, Author, Aquatic Science Programs — Date

2021-02-23
Bryan Rabon, Manager, Aquatic Science Programs — Date

Jennifer Hughes — 2/24/2021
Jennifer Hughes, Assistant Bureau Chief- BOW — Date

David Graves — 2/24/2021
David Graves, Quality Assurance Manager, EA — Date

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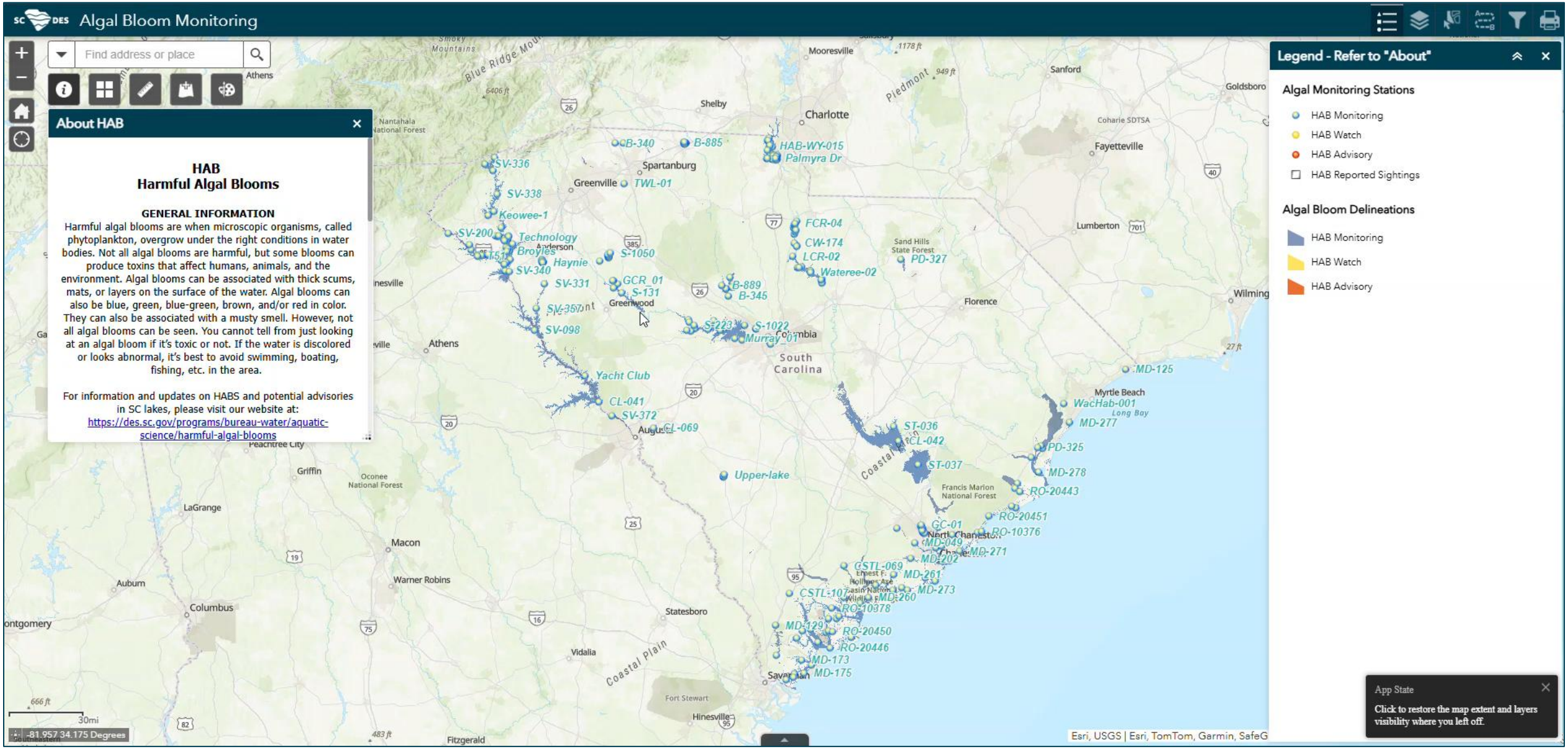
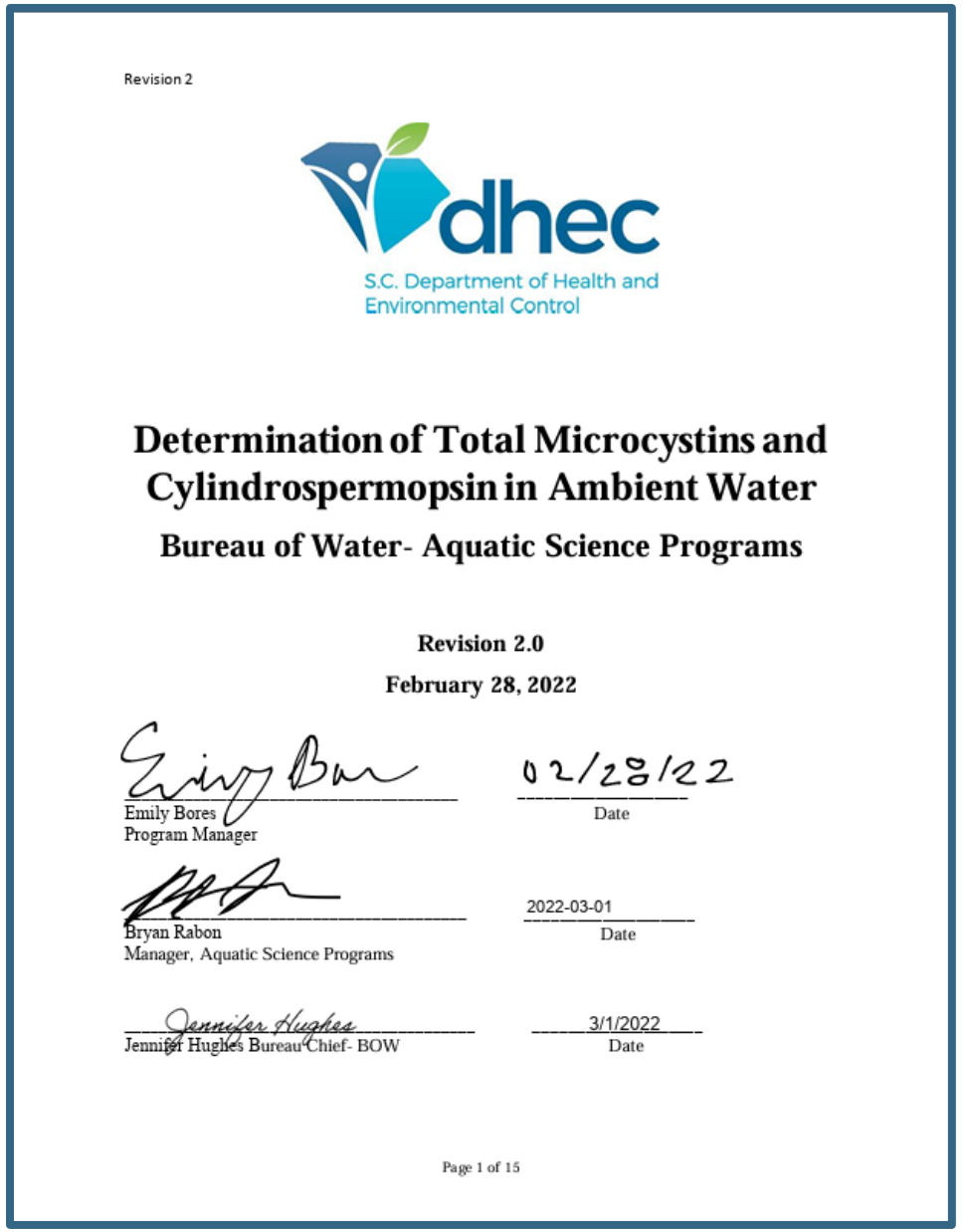

Algal Bloom Monitoring
Find address or place
About HAB
HAB
Harmful Algal Blooms
GENERAL INFORMATION
Harmful algal blooms are when microscopic organisms, called phytoplankton, overgrow under the right conditions in water bodies. Not all algal blooms are harmful, but some blooms can produce toxins that affect humans, animals, and the environment. Algal blooms can be associated with thick scums, mats, or layers on the surface of the water. Algal blooms can also be blue, green, blue-green, brown, and/or red in color. They can also be associated with a musty smell. However, not all algal blooms can be seen. You cannot tell from just looking at an algal bloom if it's toxic or not. If the water is discolored or looks abnormal, it's best to avoid swimming, boating, fishing, etc. in the area.
For information and updates on HABS and potential advisories in SC lakes, please visit our website at:
https://des.sc.gov/programs/bureau-water/aquatic-science/harmful-algal-blooms
Legend - Refer to "About"
Algal Monitoring Stations
HAB Monitoring
HAB Watch
HAB Advisory
HAB Reported Sightings
Algal Bloom Delineations
HAB Monitoring
HAB Watch
HAB Advisory
App State
Click to restore the map extent and layers visibility where you left off.
Esri, USGS | Esri, TomTom, Garmin, SafeG
-81.957 34.175 Degrees

# ELISA Analysis

- In 2022, SC DHEC published the standard methodology for determining algal toxins in ambient water for ADDA ELISA and SAES ELISA.



Revision 2

dhec
S.C. Department of Health and Environmental Control

**Determination of Total Microcystins and Cylindrospermopsin in Ambient Water**

**Bureau of Water- Aquatic Science Programs**

**Revision 2.0**

**February 28, 2022**

Emily Bores
Program Manager — 02/28/22 Date

Bryan Rabon
Manager, Aquatic Science Programs — 2022-03-01 Date

Jennifer Hughes Bureau Chief- BOW — 3/1/2022 Date

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# Continued Monitoring

- The 2023 monitoring season was South Carolina's fifth full season for cyanotoxin monitoring in lakes and it's fourth full season for cyanotoxin monitoring in estuaries.
- Ambient cyanotoxin concentration baselines have been established across the state, and the monthly monitoring suggests no immediate concern for recreation activities due to the low concentrations of microcystins in open water settings.
- Continued monitoring is still necessary to ensure recreational and aquatic life uses are protected.

# HAB Events Sampling

- Whenever SCDES receives reports of HABs, staff sample and analyze the algal bloom for cyanotoxins.
- During the 2024 season, there were 11 HAB events reported, resulting in HAB Watches being issued at several lakes.

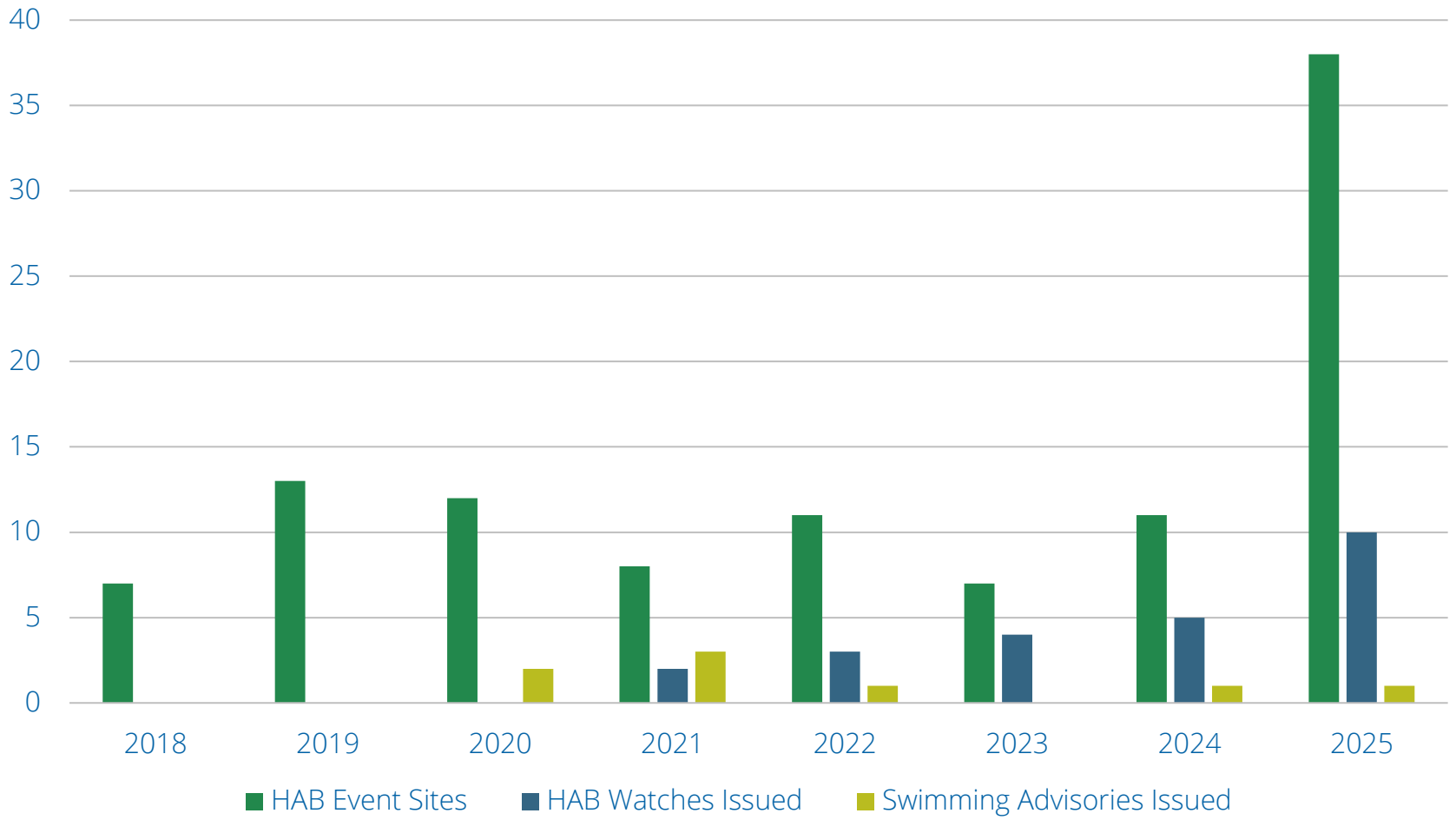
| Sample Location | Sample Description | Collection Date | Microcystins (µg/L) [a] | Cylindrospermopsin (µg/L) [a] |
|---|---|---|---|---|
| North Augusta | *Aphanizomenon sp.* | 02/13/2024 | 0.460 | BDL[c] |
| House Creek, North Myrtle Beach | Filamentous, non-harmful algae | 02/13/2024 | 0.127 | N/A[b] |
| Lake Keowee | Green algae, *Zygnema sp.* | 04/01/2024 | N/A[b] | N/A[b] |
| Lake Woodcross, Columbia | *Dolichospermumsp.* and *Worchinia.* | 04/16/2024 | 0.406 | 0.049 |
| Fishing Creek Reservoir | Green Algae, *Carteria sp.* | 06/14/2024 | 0.168 | N/A[b] |
| Anne Springs Greenway, Fort Mill | *Planktothrix sp.* | 06/18/2024 | 0.048 | N/A[b] |
| Twin Lakes, Spartanburg | *Planktothrix sp.* | 06/20/2024 | 1.43 | N/A[b] |
| Lake Murray | *Lyngbya sp.* and aquatic plant, Fanwort | 08/14/2024 | 0.265 | N/A[b] |
| Lake Greenwood | *Lyngbya sp.* and *Oscillatoria sp.* | 08/20/2024 | 1.82 | N/A[b] |
| H. Cooper Black Park | *Hapalosiphon, Planktothrix, Dolichospermum, Kamptonema, Lyngbya* | 08/21/2024 | N/A[b] | BDL[c] |
| Lake Wylie | Bloom not identified in sample | 10/08/2024 | 0.200 | BDL[c] |

a. µg/L = micrograms per liter (parts per billion)
b. N/A= Not Applicable
c. BDL= below detection limit

# Sampling Distribution

- SCDES has a network of approximately 250 fixed ambient monitoring stations.
- A subset of these base stations are selected each year for cyanotoxin analysis (monthly)
- Drinking water facility intake water sampling (monthly)
- Complaint/Event-driven sampling (as needed)

# HAB Event Trends



# Issued Swimming Advisories

- Microcystin concentrations (in µg/L) resulting in the issuance of a swimming advisory.

| Monitoring Year | Lake Edgar Brown | Lake Welchel | Lake Rabon | Lake Wylie | J. Strom Thurmond Lake |
|---|---|---|---|---|---|
| 2020 | 9.5 | > 40 | | | |
| 2021 | | 20 | 15 | 17.9 | |
| 2022 | | | | 8.88 | |
| 2023 | | | | | |
| 2024 | | | 10.2 | | |
| 2025 | | | | | 8.35 |

# Project Impact

| Monitoring Year | Number of Waters Sampled | Number of Lake Samples | Number of Estuary Samples | Number of Samples Analyzed | Ambient Monthly Monitoring Sites | Drinking Water Intake Monitoring Sites | Drinking Water Intake Samples | HAB Event Sites | Swimming Advisories Issued | HAB Watches Issued |
|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | 27 | 27 | 0 | 221 | 62 | 0 | 0 | 7 | 0 | 0 |
| 2019 | 25 | 25 | 0 | 551 | 72 | 0 | 0 | 13 | 2* | 0 |
| 2020 | 56 | 18 | 38 | 523 | 82 | 6 | 41 | 12 | 2 | 0 |
| 2021 | 58 | 19 | 39 | 595 | 101 | 6 | 24 | 8 | 3 | 2 |
| 2022 | 58 | 20 | 38 | 576 | 94 | 7 | 39 | 11 | 1 | 3 |
| 2023 | 59 | 21 | 38 | 635 | 103 | 4 | 23 | 7 | 0 | 4 |
| 2024 | 65 | 22 | 41 | 671 | 110 | 4 | 22 | 11 | 1 | 5 |
| 2025 | 64 | 23 | 40 | 817 | 109 | 6 | 46 | 38 | 1 | 10 |
| Total | 348 | 152 | 194 | 3772 | 624 | 27 | 149 | 69 | 6 | 24 |

*Samples exceeded EPA criteria, but state standards not yet promulgated so no advisory was issued.

# What's Next for South Carolina?

SC DES

# Project Trends

- Cylindrospermopsin concentrations have consistently returned below detection (i.e., 0.040 µg/L), with only a handful of samples reported above the detection limit since 2018.
- Anatoxin and saxitoxin analysis began during the 2025 monitoring season and will continue in 2026.
- Microcystin concentrations vary in freshwater but are typically not detected in saltwater.
- Estuaries will be removed from routine monthly sampling beginning in the 2026 monitoring season.
- Staff will still respond to complaints or HAB events in saltwater if they occur.
- No strong correlations between cyanotoxin concentrations and other parameters have been established so the annual correlation analysis will not continue.

SC DEPARTMENT *of*
**ENVIRONMENTAL SERVICES**

# Get in touch

Aquatic Science Program

HABs


**Drew Edwards //** Water Quality Standards Coordinator

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wqs@des.sc.gov

803.898.1271


Water Quality Standards

South Carolina Department of Environmental Services

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