North Fork Shenandoah River Benthic Cyanobacteria Event - 2021

Friday February 25, 2022
Virginia Annual HAB Task Force Meeting

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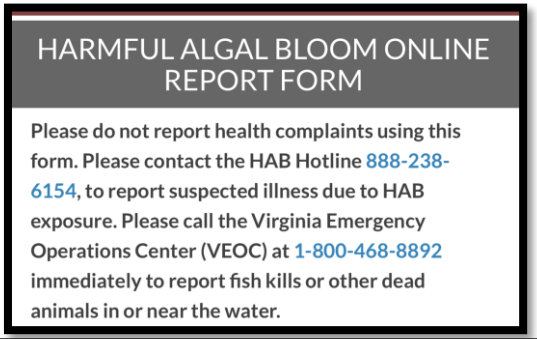
VDH VIRGINIA DEPARTMENT OF HEALTH
To protect the health and promote the well-being of all people in Virginia.


North Fork Shenandoah River Bethel Rd. 7/12/21: by DEQ

Harmful Algae Blooms (HABs) and Advisory Management in Virginia

- Historically the HAB program (VA HAB Task Force) focused on **planktonic** marine bloom toxin-producers capable of impacting seafood and public health along the VA coast
- Expansion in the 2010s to include response for **planktonic** freshwater blooms primarily in lakes and reservoirs, and ponds, which posed a health risk to recreational water users and drinking water intakes
- HAB hotline for illness complaints, online HAB report form, HAB toolkit, HAB response plan document (2018), Advisory guidance (2011, 2021)



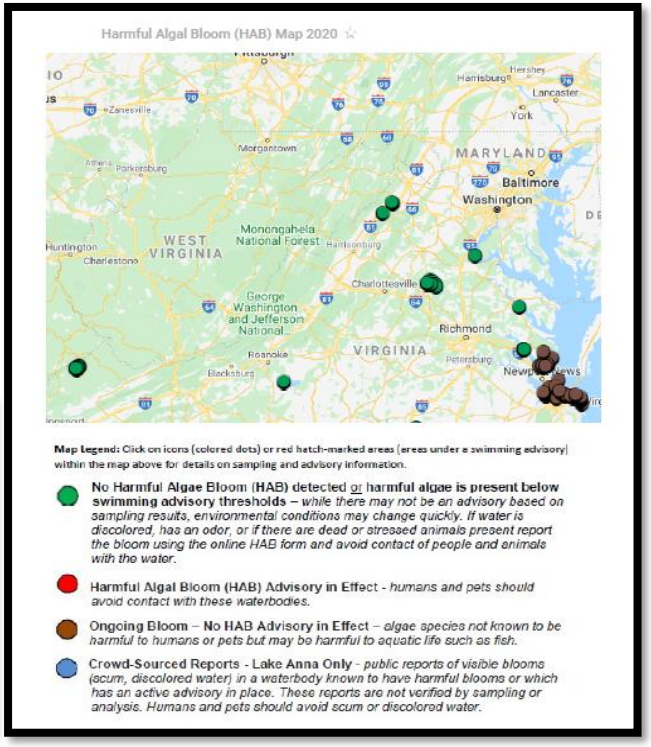
HARMFUL ALGAL BLOOM ONLINE REPORT FORM

Please do not report health complaints using this form. Please contact the HAB Hotline 888-238-6154, to report suspected illness due to HAB exposure. Please call the Virginia Emergency Operations Center (VEOC) at 1-800-468-8892 immediately to report fish kills or other dead animals in or near the water.

Is your report concerning a public or private body of water? *

Public

The HAB Task Force does not currently have the resources to respond to reports of possible algae blooms in private bodies of water. Please contact a private consultant for assistance with private waterbodies. The Department of Game and Inland Fisheries maintains a consultant list for such services at: https://www.dgif.virginia.gov/fishing/private-pond-management/private-consultants/



www.SwimHealthyVA.com

Benthic Blooms:

- Concentrated material/ potential toxins
  - Surface scums/mats
  - Mats attached to river/lake bottom
- Exposure:
  - Ingestion (pets/ livestock/ children)
  - Skin contact
  - Release of toxins into water column
- Sampling and analyses:
  - Solid material and water collections
  - Field observations of spatial coverage
  - Results/units not comparible to those of co-located water column samples

Planktonic blooms:

- Throughout water column
  - More homogenous
  - Can concentrate at surface or near
- Exposure:
  - Accidental ingestion
  - Drinking water
  - Skin contact or breathing in droplets
- Sampling and analyses: water column
- Results/unites comparible to advisory thresh

Solid material

- Dominance of potentially toxic cyanobacteria (PTOX taxa)
- Presence of cyanotoxins
- Widespread extent of material, that cannot be avoided during water recreation activities and likely to result in accidental ingestion.

Guidance for Cyanobacteria Bloom Recreational Advisory Management: 2021

Water column thresholds for cell count densities and toxins:

Table 1: Hybrid advisory approach: Cyanobacteria bloom recreational advisory thresholds using cell densities and toxin concentrations for targeted cyanotoxins.

Metric	Concentration
Microcystis species	≥40,000 (total cells/mL)
total potentially toxigenic (PTOX) cyanobacteria taxa*	≥100,000 (total cells/mL)
microcystin toxin	≥8 µg/L
cylindrospermopsin toxin	≥15 µg/L
anatoxin-a toxin	≥8 µg/L
saxitoxin toxin	≥4 µg/L

**PTOX taxa list is subject to change based on most recent research and is available upon request. Current list is included in Appendix B.*

Assessing Cyanobacteria Exposure Risk of Scums or Floating/Benthic Mats Should field staff judge that conditions warrant, investigations may also include collection of "solid material" samples (i.e. algal scums or mats that are suspended in the water column, on the surface, or on the bottom). Sampling of solid material is warranted when algal growth at the surface or on the bottom is spatially extensive, such that it cannot easily be avoided when accessing a water body for recreation. When warranted, samples containing solid material that does not disperse into the water column sample will be collected to provide supplemental information to the public and stakeholders on the bloom compositions. These samples will be evaluated in the laboratory to determine if algal toxins are detectable or not and to determine the proportion of potentially toxic cyanobacteria present in the sample, relative to non-toxigenic algae. Neither cell densities (algal cells per unit volume) nor toxin concentrations (mass toxin per unit volume) will be reported from solid material samples. Because there are currently no accepted nor published advisory thresholds for solid materials for Virginia waters, information from solid materials will not be used as grounds alone for issuance of advisories. Exceptions to this are cases where water column thresholds are exceeded, or when solid material at the surface with confirmed toxins and/or potentially toxigenic species is extensive and widespread in the waterbody, such that it cannot be avoided during water recreation activities and is therefore likely to result in accidental ingestion.

PTOX = Potentially toxigenic cyanobacteria (taxa)

https://www.vdh.virginia.gov/content/uploads/sites/178/2022/01/FINAL_SIGNED_Guidance_for_Cyanobacteria_Recreational_Advisory_Mgt.5Aug2021-1.pdf

Benthic/Mat-forming Cyanobacteria in Virginia

- VA/NC - Lake Gaston - 2020 *Microseira wollei* (Lyngbya) Investigation
    - *M. wollei* is a mat-forming algae capable of producing toxins
    - Aug 2020 - VA collab with NC partners due to public health concerns → brochure produced
    - First VA cyanobacteria “benthic mat” investigation
    - Inspired the method development for toxin testing of benthic mat samples by ODU Phytoplankton Analysis Lab
    - No health complaints received by VA to-date for Lake Gaston

https://www.vdh.virginia.gov/content/uploads/sites/178/2021/04/Lake-Gaston-and-Lyngbya-wollei-Factsheet-210222.pdf

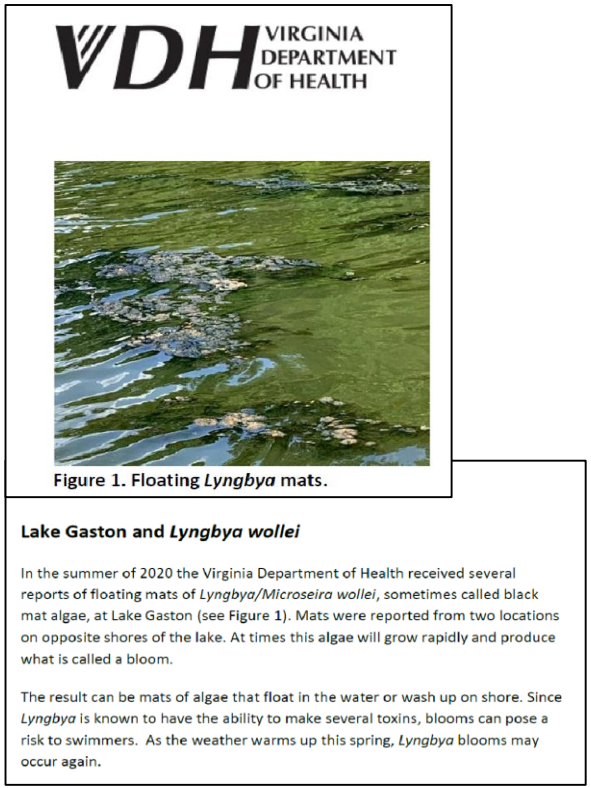


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Figure 1. Floating *Lyngbya* mats.

Lake Gaston and *Lyngbya wollei*

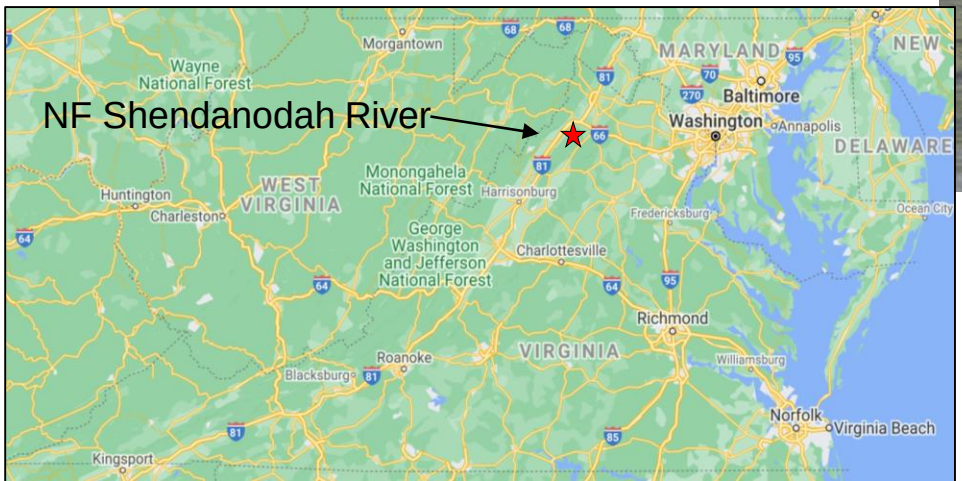
In the summer of 2020 the Virginia Department of Health received several reports of floating mats of *Lyngbya/Microseira wollei*, sometimes called black mat algae, at Lake Gaston (see Figure 1). Mats were reported from two locations on opposite shores of the lake. At times this algae will grow rapidly and produce what is called a bloom.

The result can be mats of algae that float in the water or wash up on shore. Since *Lyngbya* is known to have the ability to make several toxins, blooms can pose a risk to swimmers. As the weather warms up this spring, *Lyngbya* blooms may occur again.

HAB response NF Shenandoah River <u>prior to 2021</u>:

Filamentous algae reports to DEQ and the HAB report form

- NF Shenandoah River complaints submitted via the HAB report form ~20% of all complaints (2018-2020)
- Investigations for these complaints were negative for PTOX in water samples



The NF and SF Shenandoah confluence to form the Shenandoah River, which confluences with the Potomac River at Harpers Ferry along the Maryland Border west of D.C.

Cyanobacteria mat cyanotoxin analysis method: (2021)

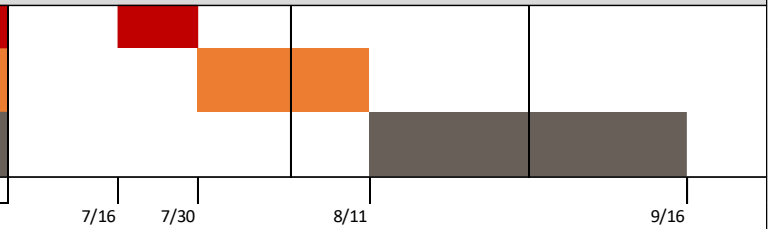
ODU Phytoplankton Analysis Laboratory

- Preparation of material
  - Analyses: Eurofins/Abraxis ELISA kits (microcystin, cylindrospermopsin, anatoxin-a, saxitoxin)
- Summary of toxin extraction method
  - Centrifuge excess water from algae mat
  - Weigh aliquot of algae mat (~50cc)
  - Freeze/lyse in -80 freezer
  - Thaw, combine Milli-Q water (1ml:1g of mat)
  - Homogenate mixture w/ mini-food processor
  - Freeze/thaw lyse 2 more times (3x total)
  - Centrifuge
  - ELISA analyses on supernatant
- PPE
  - Fume hood, gloves, lab coat, face shield

In Spring of 2021 method for mat collection & analysis was developed with co-located water column samples →mat analysis includes PTOX ID and enumeration as well as toxin assays (MCY, CYL, ATX-A, SAX)

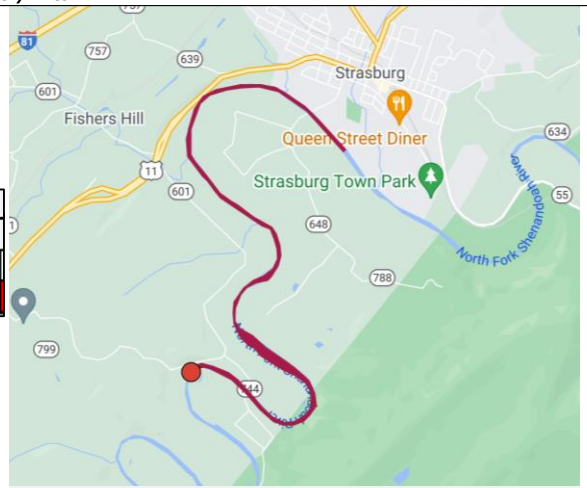
Highlights of the Recreational Water Response
Bethel Road - July 2021

River Segment	Advisory Miles
Bethel Road	3
Lower River Road to Strasburg	5
Chapman Landing to Riverton	45
TOTAL MILES	53

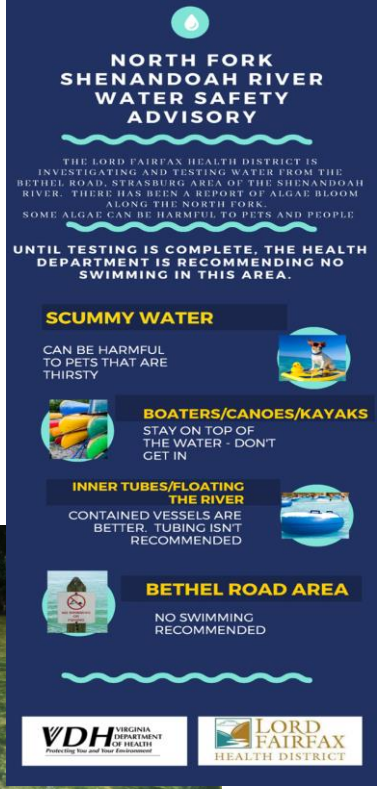


Each advisory segment adds the segment prior for total ~53 advisory miles

	12-Jul	13-Jul
6-Bethel Rd		
water		-PTOX, tox BDL
benthic mat		+PTOX



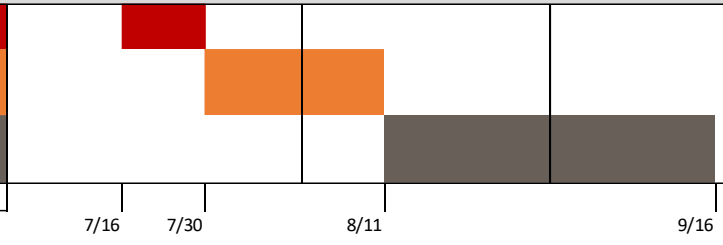
● toxins present ● toxins absent



Highlights of the Recreational Water Response

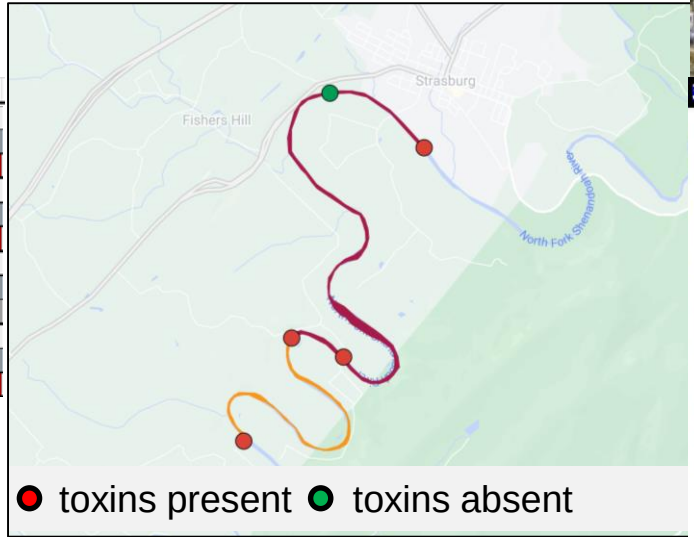
Lower River Road

River Segment	Advisory Miles
Bethel Road	3
Lower River Road to Strasburg	5
Chapman Landing to Riverton	45
TOTAL MILES	53



Each advisory segment adds the segment prior for total ~53 advisory miles

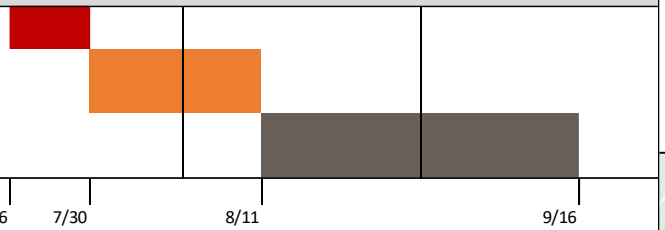
	12-Jul	13-Jul	19-Jul	26-Jul
5-Lower River Rd				
water				PTOX<100k, tox BDL
benthic mat				+PTOX, +Mc,+Ana,+Sax
6-Bethel Rd				
water		-PTOX, tox BDL		-PTOX, tox BDL
benthic mat		+PTOX	+PTOX, +Mc,+Ana	+PTOX, +Mc,+Ana
7-Low-head dam				
water			-PTOX, tox BDL	
benthic mat				
8-Strasburg				
water			PTOX<100k, tox BDL	PTOX<100k, Ana0.67
benthic mat			+PTOX	+PTOX, +Mc,+Ana



Highlights of the Recreational Water Response

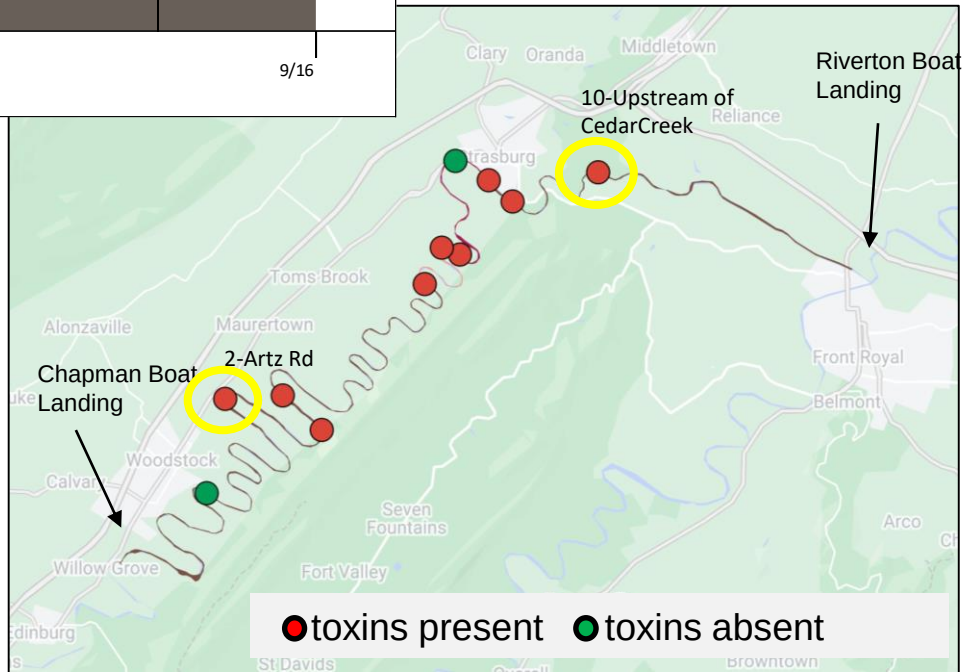
Chapman Landing to Riverton

River Segment	Advisory Miles
Bethel Road	3
Lower River Road to Strasburg	5
Chapman Landing to Riverton	45
TOTAL MILES	53



Each advisory segment adds the segment prior for total ~53 advisory miles

	29-Jul	2-Aug
2-Artz Rd		
water		-PTOX, Ana 0.16
benthic mat		+PTOX
10- Upstream of CedarCreek		
water	-PTOX, Ana 1.77	
benthic mat	+PTOX	



Cyanotoxin range summary for water and mats:

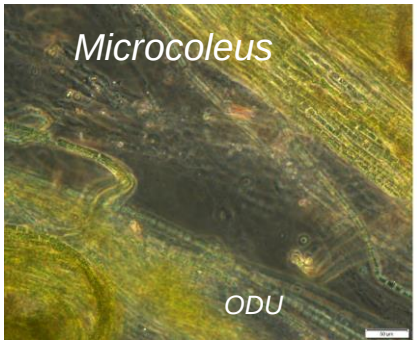
	Water samples	Cyanobacteria mats
microcystin	BDL (<0.15)	1.69 - 4.31
cylindrospermopsin	<0.05 - 0.05	0.07 - 0.15
saxitoxin	<0.02 - 0.02	0.01 - 2.45
anatoxin-a	<0.02 - 1.77	64.45 - 2804
		(mat results not for comparison with the water advisory thresholds)
UNITS:	quantitative ppb (µg/L) toxin within water	presence/absence; semi-quantitative ppb within lab sample

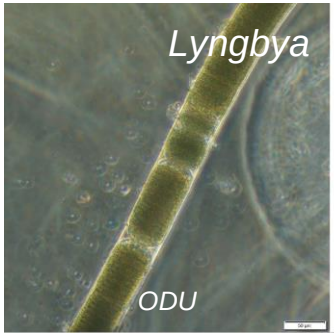
VA Advisory Thresholds (water)

Metric	Concentration
Microcystis species	≥40,000 (total cells/mL)
total potentially toxigenic (PTOX) cyanobacteria taxa*	≥100,000 (total cells/mL)
microcystin toxin	≥8 µg/L
cylindrospermopsin toxin	≥15 µg/L
anatoxin-a toxin	≥8 µg/L
saxitoxin toxin	≥4 µg/L

PTOX taxa ID'd in mats:

- *Microcoleus*
- *Planktothrix*
- *Phormidium*
- *Oscillatoria*
- *Lyngbya*





Highlights of the Recreational Water Response

Lifting the advisory (~10 weeks)

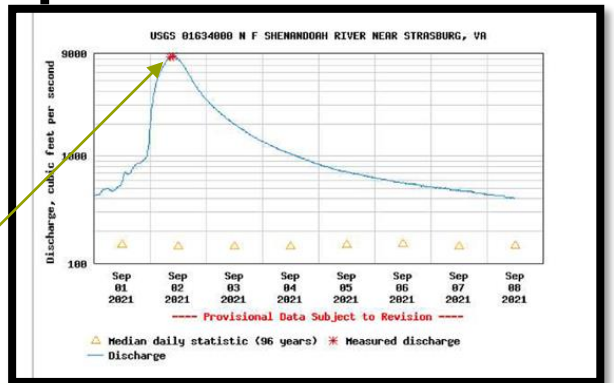
River Segment	Advisory Miles
Bethel Road	3
Lower River Road to Strasburg	5
Chapman Landing to Riverton	45
TOTAL MILES	53

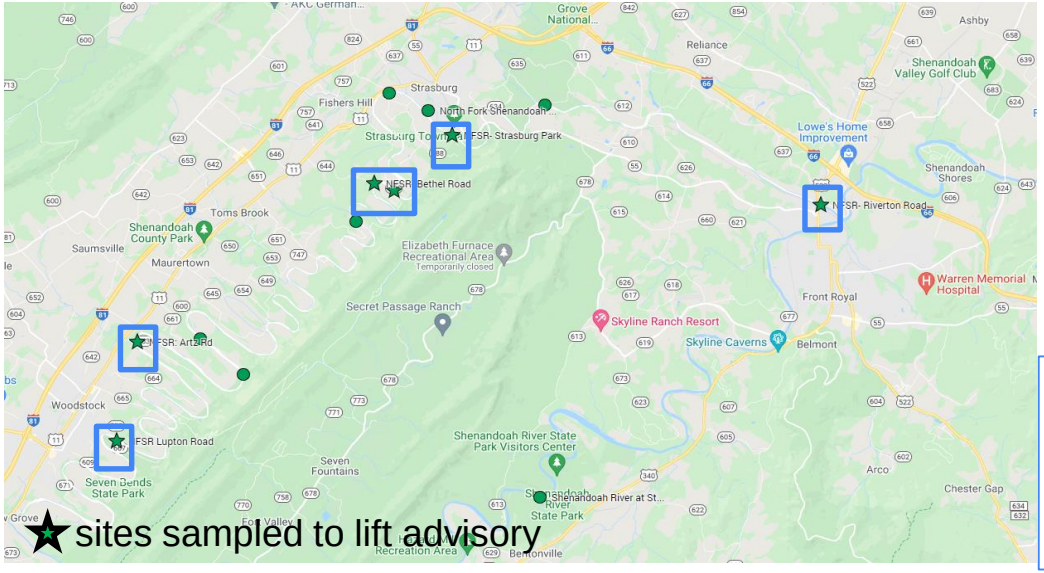
July | August | September

7/16 | 7/30 | 8/11 | 9/2 | 9/16

Each advisory segment adds the segment prior for total ~53 advisory miles

Trop storm IDA

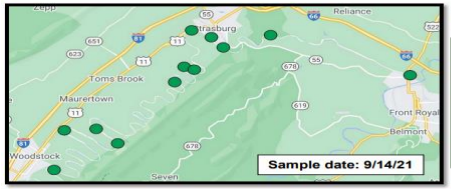




★ sites sampled to lift advisory

NF Shenandoah River - Harmful Algae Bloom (HAB) Status Report

Issued: Friday 9/16/2021



No harmful algal mats detected

HELPFUL TIP:

Visit www.SwimHealthyVa.com and click on the Harmful Algae Bloom Map to review sample results near you!

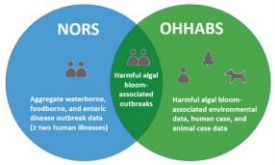
Expand the map using the symbol in the upper right hand map title bar, then click on the magnifying glass. You can search my location name or address!

The advisory for the North Fork Shenandoah River has been lifted due to weekly observations at sites along the river since mid-August which indicate the dissipation of algal mats, in addition to water samples at 6 sites (Deer Rapids, Lupton Rd, Artz Rd Strasburg Park, and Riverton Rd) on Sept 14 which indicated cyanobacteria and toxins were at acceptable contact levels. Weather and other environmental factors can cause rapid changes in the water quality and algal mats which have dissipated can return if conditions are favorable to support algal growth. People and pets should avoid contact and accidental ingestion of algal mats (should they reappear) within this area of the river.

Drinking water remains safe to drink and use in Woodstock, Strasburg, and Winchester.

ICPRB study using the Emergency Spill Model and storm sampling to evaluate high storm flow impacts to down-river drinking water intakes: https://www.potomacriver.org/publications/rapid-response-survey-of-cyanobacteria-toxin-levels-downstream-of-north-fork-shenandoah-river-algal-bloom-after-tropical-storm-ida-2021/

Health Complaints



OHHABS
ONE HEALTH Harmful Algal Bloom System

- 8/2/21 person reported suspected health effects from multiple exposures while recreating along ~1 mile stretch of the NF Shenandoah River at Seven Bends State Park between 6/29 – 7/8/21
  - Exposure = inhalation & skin contact; taught fly fishing ~6hrs day (no waders)
  - Symptom onset = 7/9/21
  - Symptoms = cough, congestion, sore throat, and post nasal drip
  - Skin rash onset was 20 days after the last exposure

- 8/3/21 ODU reports 3 lab staff members experienced health effects while processing HAB samples (*2 participated in epi-interview*)
  - Exposure = inhalation and skin contact *(occupational)*
  - Duration of exposure ranged from 30 min to ~ 7 hours
  - Symptom onset varied from 15 minutes to 4 hours after exposure
  - Symptoms = neurologic and respiratory
    - Dizzy, oral & tongue numbness, muscle weakness, headache, and generalized numbness
    - Respiratory symptoms = wheezing and shortness of breath
    - Nausea and skin irritation also reported

Symptoms disappeared within 15 minutes after staff left the area where mat samples were located

Recreational Water – Lessons learned and 2022 ideas:

- Continue collaboration with DEQ on options to visually evaluate benthic HABs in the NFSR and utilize water column sample and analysis ***(pause the collection of benthic mat sample/analysis)***
  - *Develop a VDH Job Aide for Cyanobacteria Advisory Guidance – specific to benthic HAB response advisories in 2022*
  - *ITRC Benthic Guidance recommendations*
- Utilize existing resources to enhance surveillance
  - DEQ weekly surveys for filamentous algae – ***additional discussions necessary based on staff availability***
  - Friends of Shenandoah River Algae Watch Map
- Identify and establish relationships with commercial labs to process benthic mat material
- Explore “out-of-the-box” options that enhance field identification and presence/absence and foster alternative cyanotoxin collection methods to evaluate public health risk
- Build on the efforts with local health and TF partners - continue developing stakeholder lists, gain insight on how we can more effectively communicate risks of HAB exposure to the public
- Raise public awareness for the potential of cyanobacteria benthic mats:
  - Social media ads to include benthic mat visuals, HSSW campaign, consider permanent signage (Be Aware of Algae Blooms) at public access points where prior bloom events have occurred
  - Share (Virtual HAB Toolkit) more broadly with watershed groups (HOAs, community bulletins, libraries

Special thanks to ODU, DEQ Central and Valley Regional Office, Lord Fairfax Health Department, CA Water Board, EPA, CDC, and USGS staff for all efforts to support this event response in 2021.

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