Potomac Basin Freshwater HABs: Areas of Interest and Lessons Learned

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Interstate Commission on the Potomac River Basin (ICPRB)

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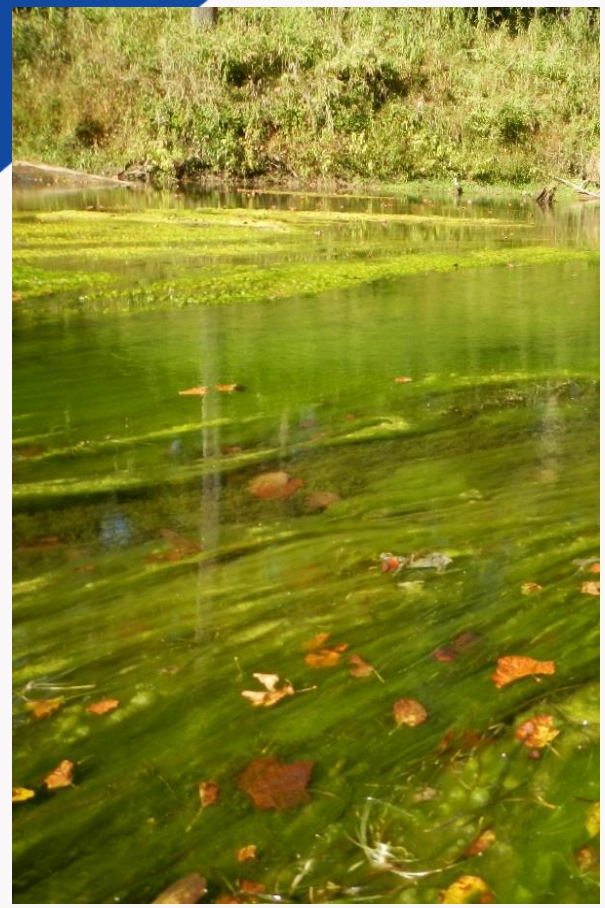
Virginia HAB Taskforce

Virginia Institute of Marine Science 2/24/2023



ICPRB: Who We Are

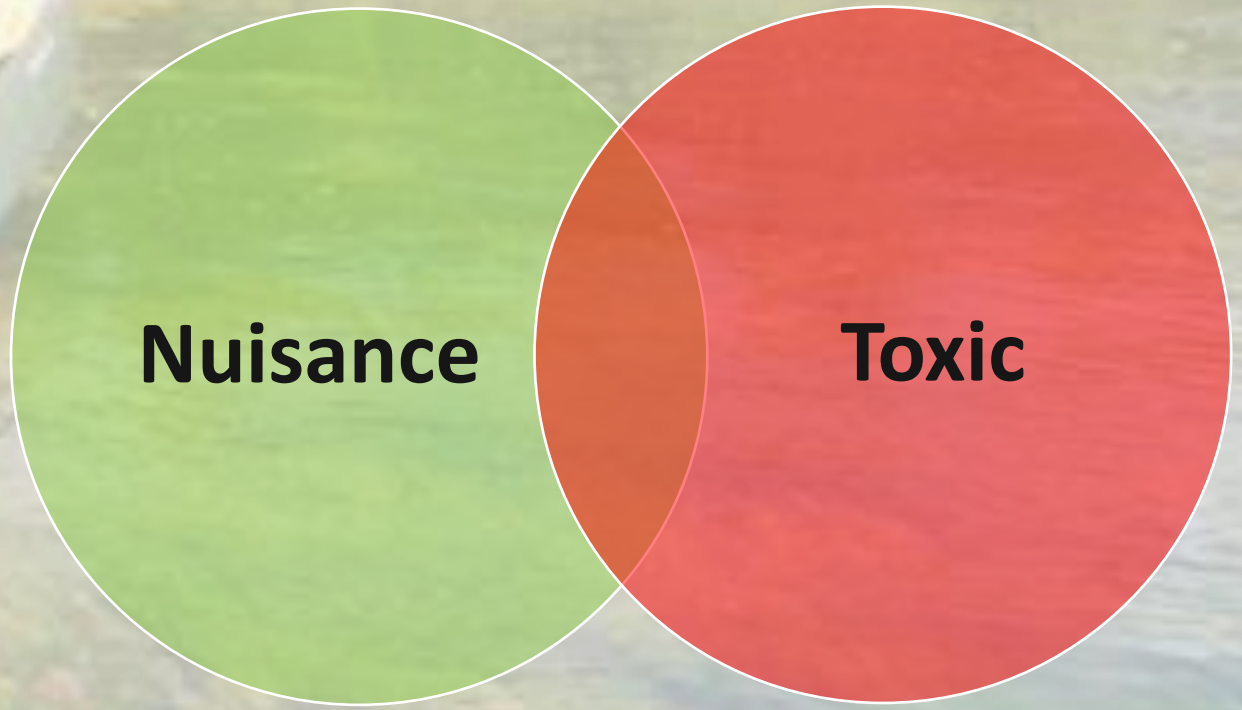
"The mission of ICPRB is to protect and enhance the waters and related resources of the Potomac River basin through science, regional cooperation, and education."

- Authorized by an Act of Congress in 1940
- Non-regulatory, research-based institution
- Methodology development, exploratory analyses, research coordination, and outreach

ICPRB's involvement in Mid-Atlantic Harmful Algal Blooms (HABs)

- 2012-Current: Algal Reporting in the South Branch Potomac and Cacapon Rivers
- 2014-2015: Longitudinal Survey Methodology Development: Shenandoah River
- 2016: Mid-Atlantic Algal Taxonomy Workshop
- 2015-Current: Nutrient/Non-Nutrient HAB Factors in Predicting Blooms
- 2020-Current: EPA Nuisance Algae Task Force
- 2021-Current: Support Virginia HAB Response Planning

Note: Until 2021, toxin analysis was not a primary objective of ICPRB work



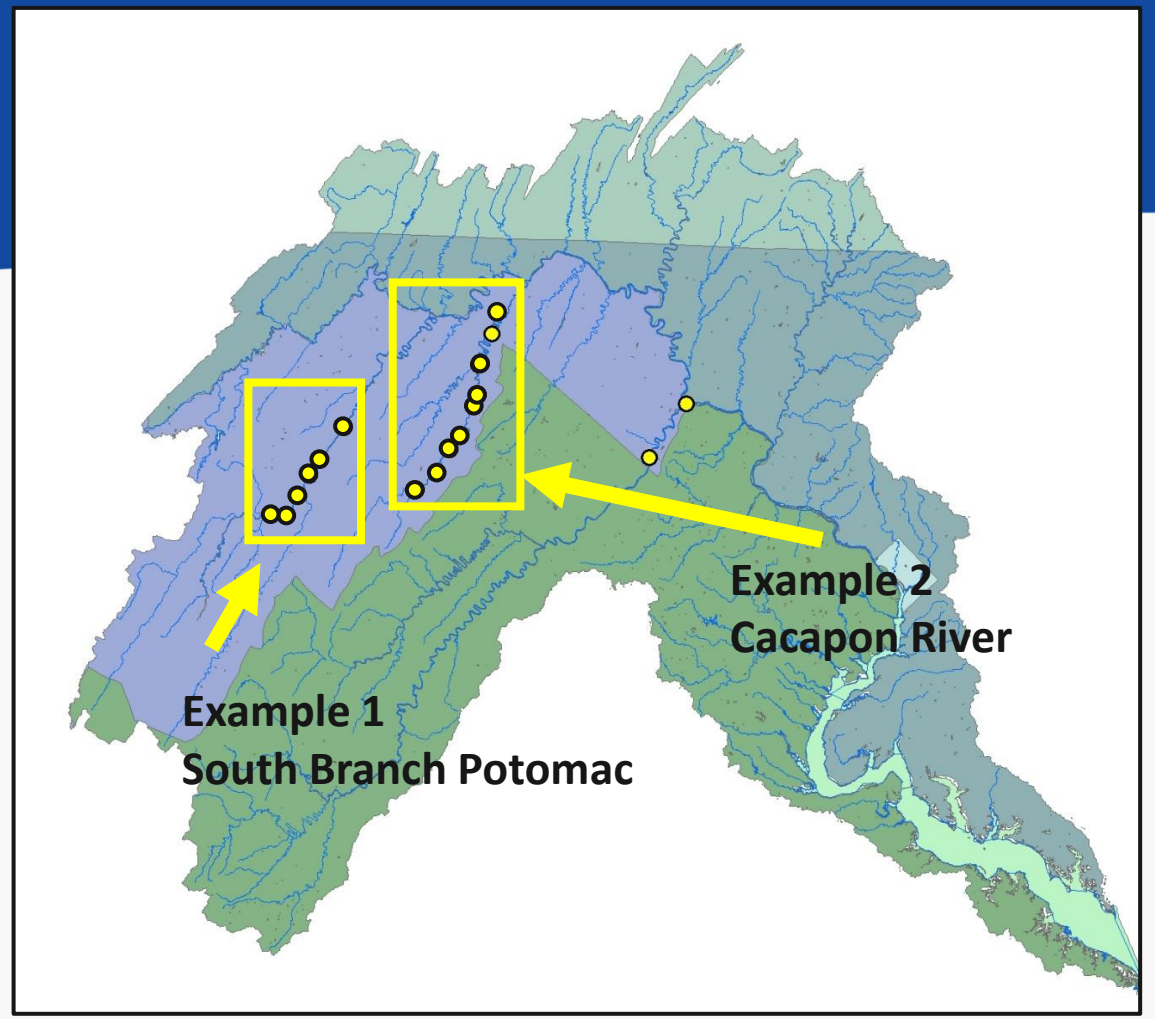
A Tale of Two Rivers

1. South Branch Potomac
2. Cacapon River

Physical qualitative habitat assessment

Visual algae transect assessments

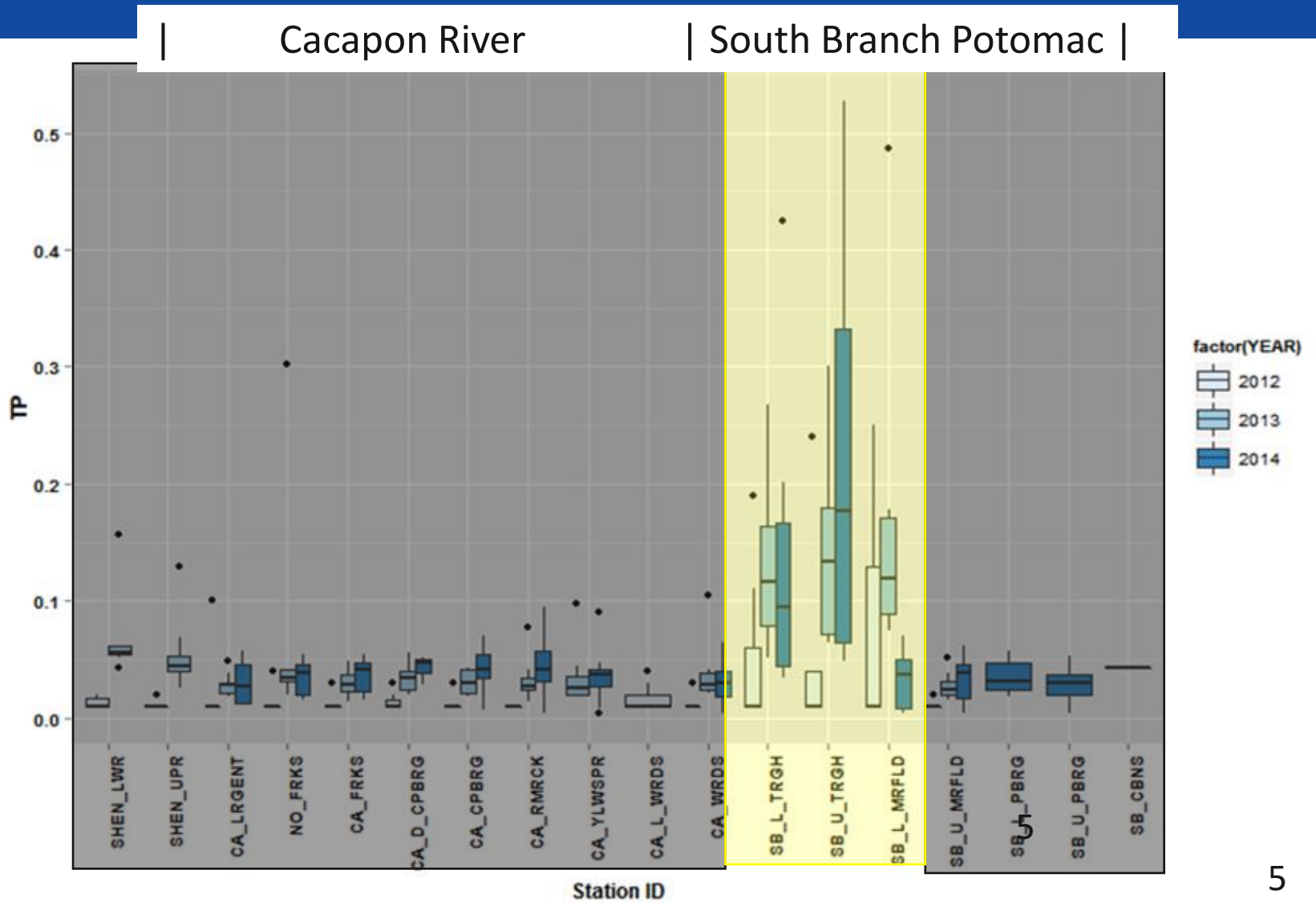
Chemistry: NO2-NO3, TKN, TP, DP, TALK, Ca, Mg, Temperature, pH, DO, TSS



South Branch Potomac

Elevated phosphorus (TP) is from **point source (**Moorefield WWTP), 2012-2013

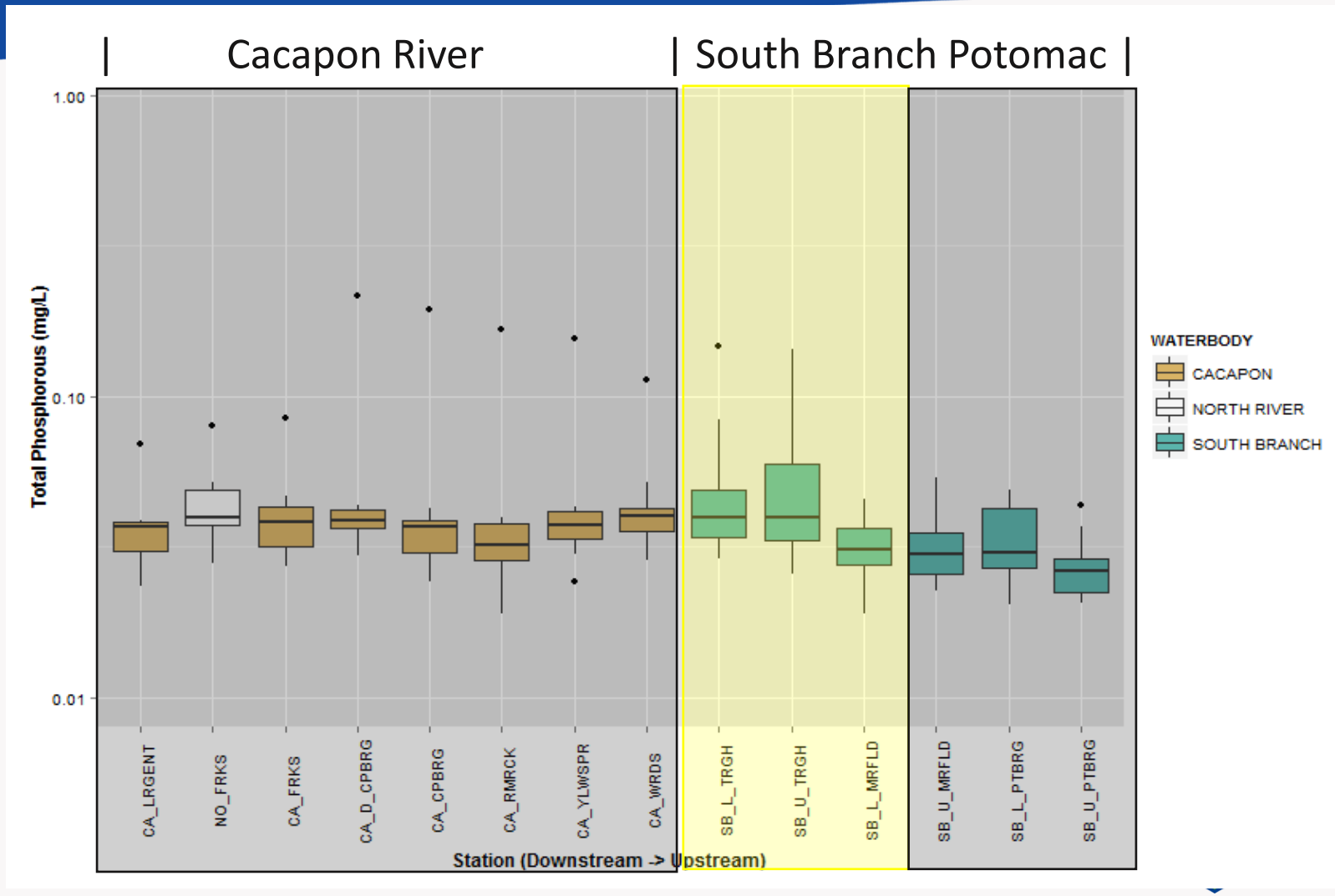
- Predictable **algal blooms**



South Branch Potomac

- WWTP upgrade 2013
- No excessive TP signal since 2014
- FGA blooms disappeared

* Still infrequent filamentous cyanobacterial blooms

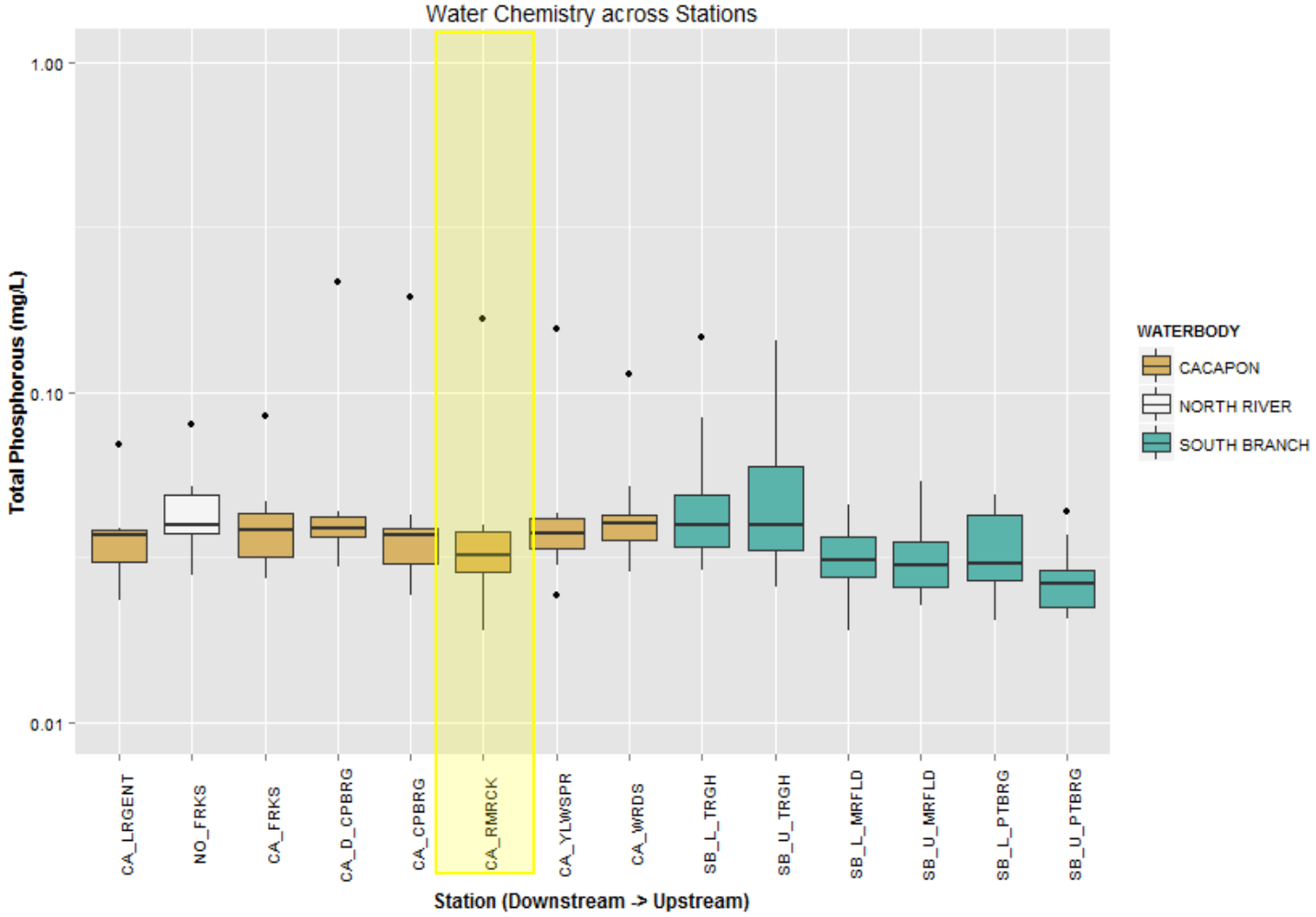


South Branch Potomac

Before

After

Cacapon River



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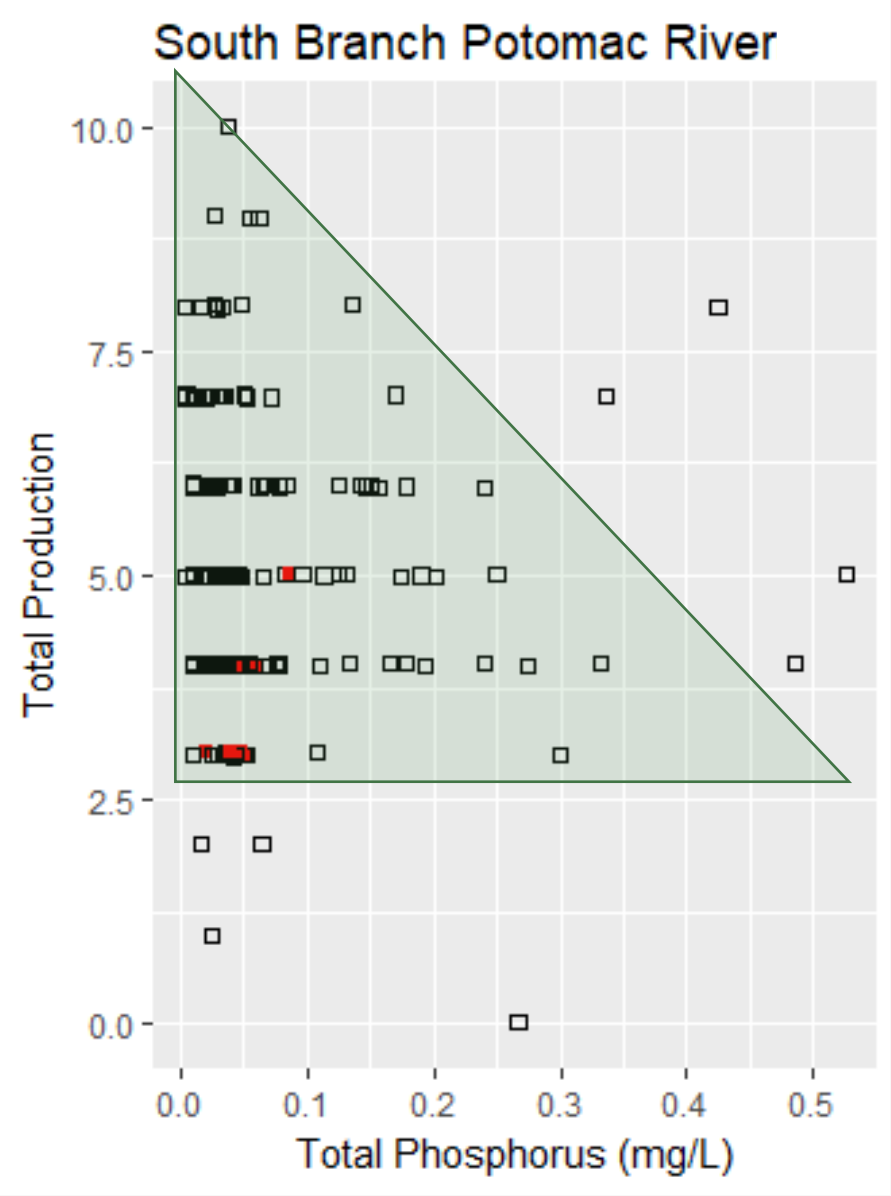
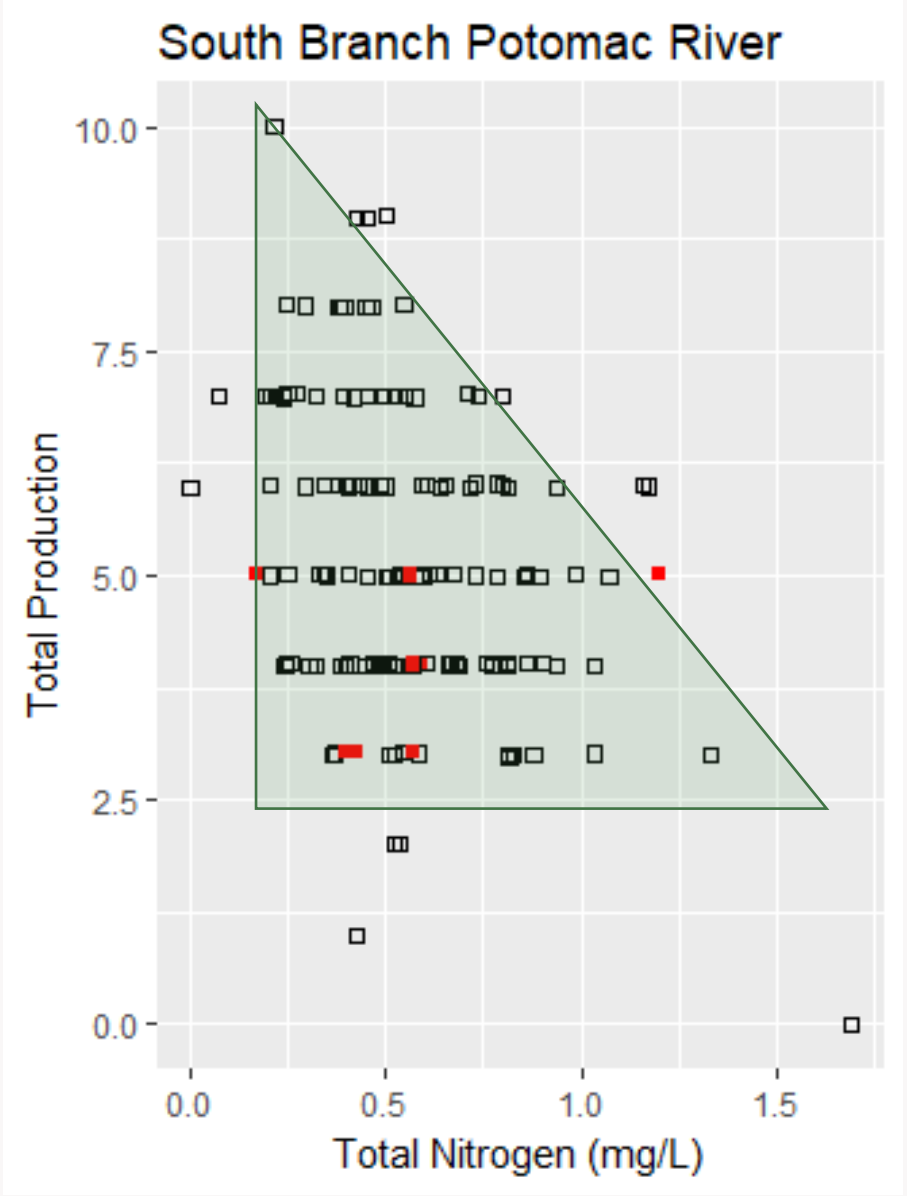
The Influence of Non-Nutrient Factors



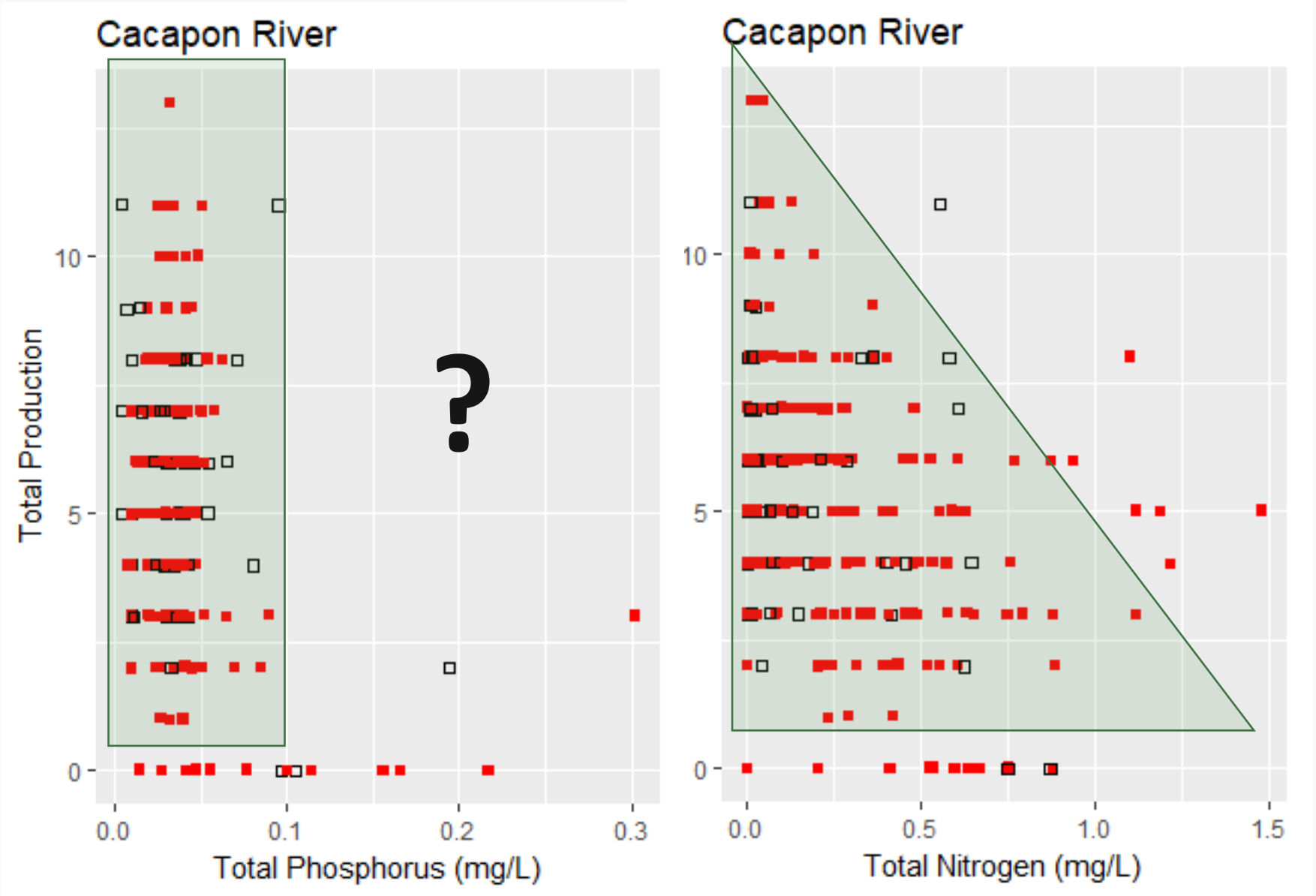


Point Source Influenced

Criteria (>40 TALK mg/liter *and* <100 HARD mg/liter)

- ☐ criteria not met (99.5%)
- ■ criteria met (0.5%)

The Influence of Non-Nutrient Factors



Non-Point Source Influenced

TALK and HARD criteria (>40 TALK mg/liter and <100 HARD mg/liter)

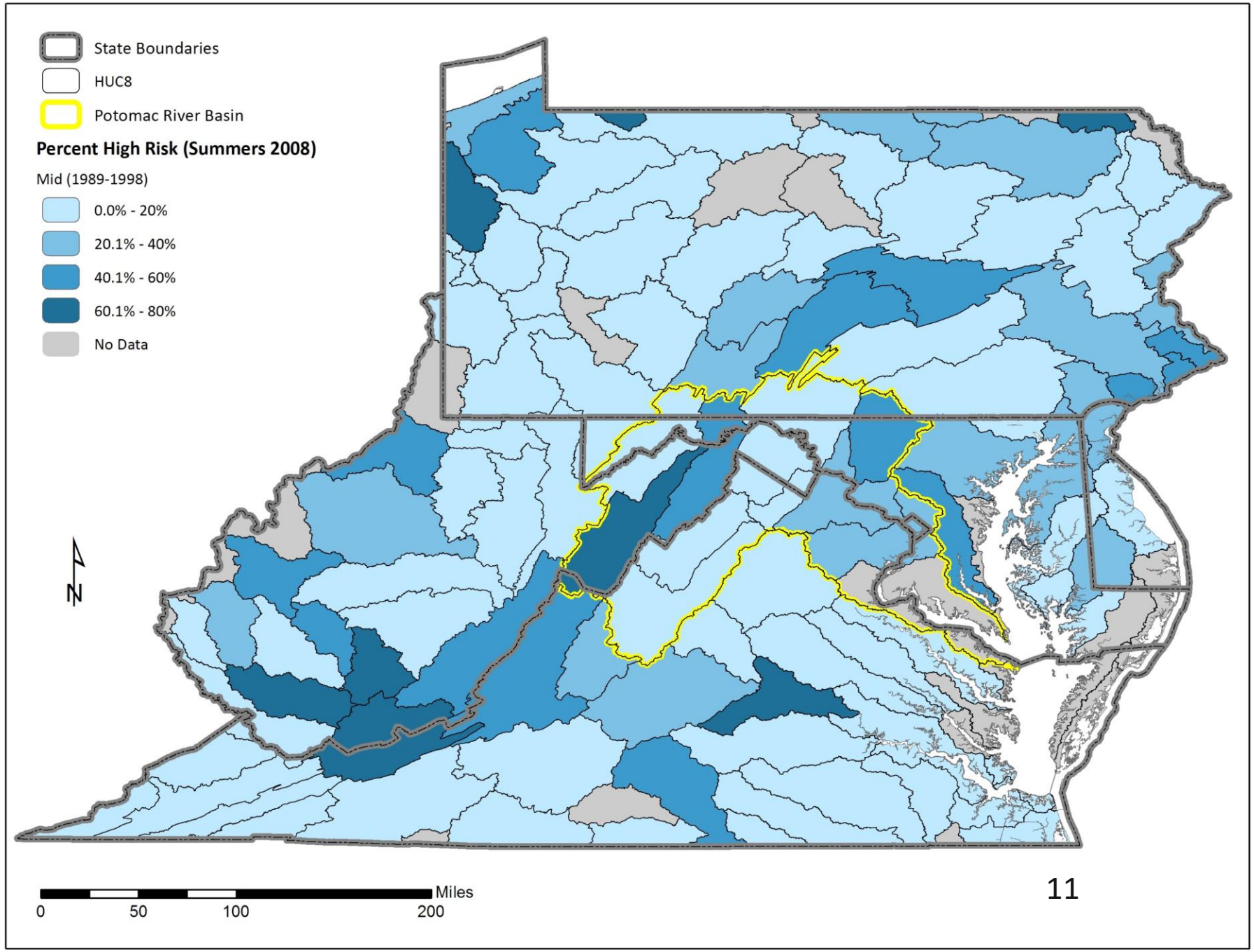
- criteria not met (22%)
- criteria met (78%)

Risk

Frequency of samples that meet criteria:

- Alkalinity > 40
- Hardness <100

1989-1998

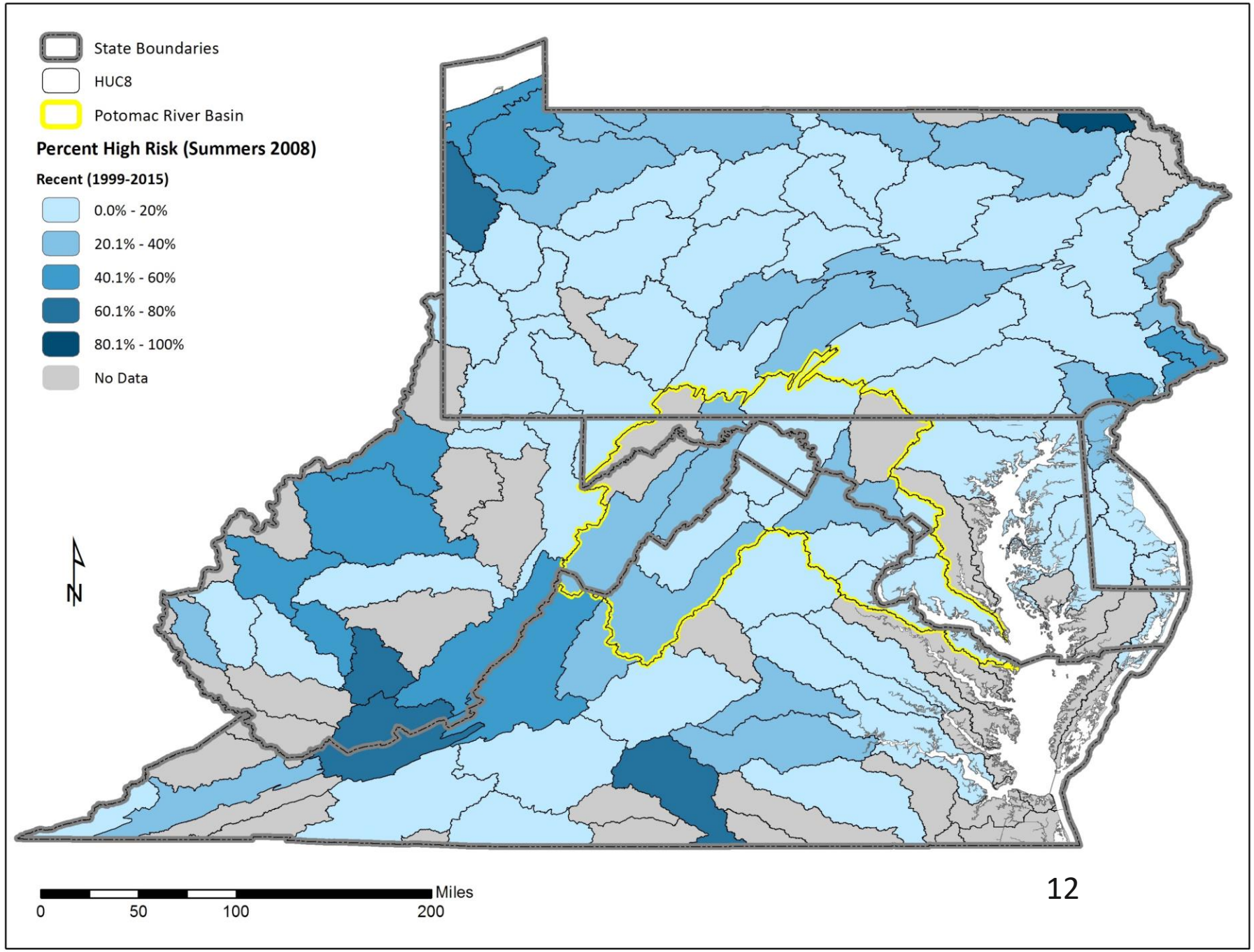


Risk

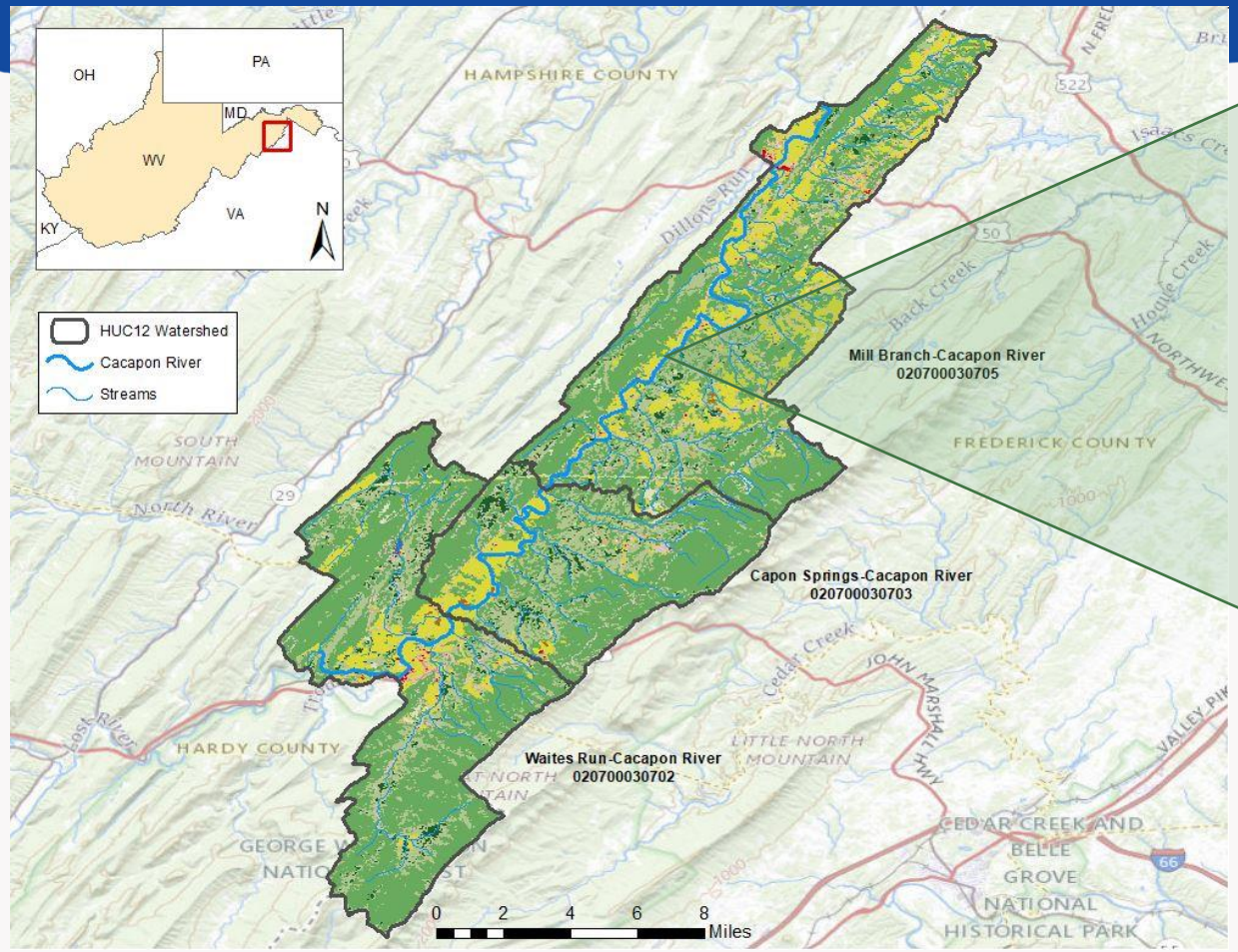
Frequency of samples that meet criteria:

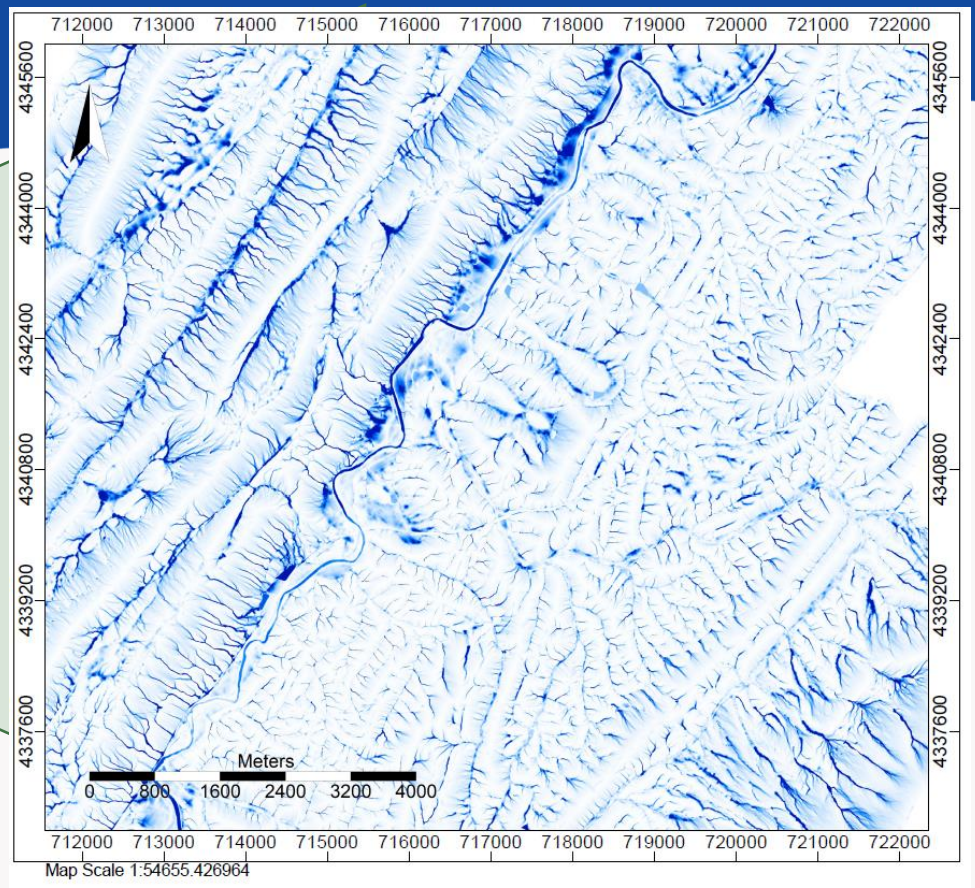
- Alkalinity > 40
- Hardness <100

1999-2015



Potential Role of Groundwater Transport





Identify potential point sources:
National Land Cover Database (NLCD 2019)
+ LiDAR/DEM flow accumulation models

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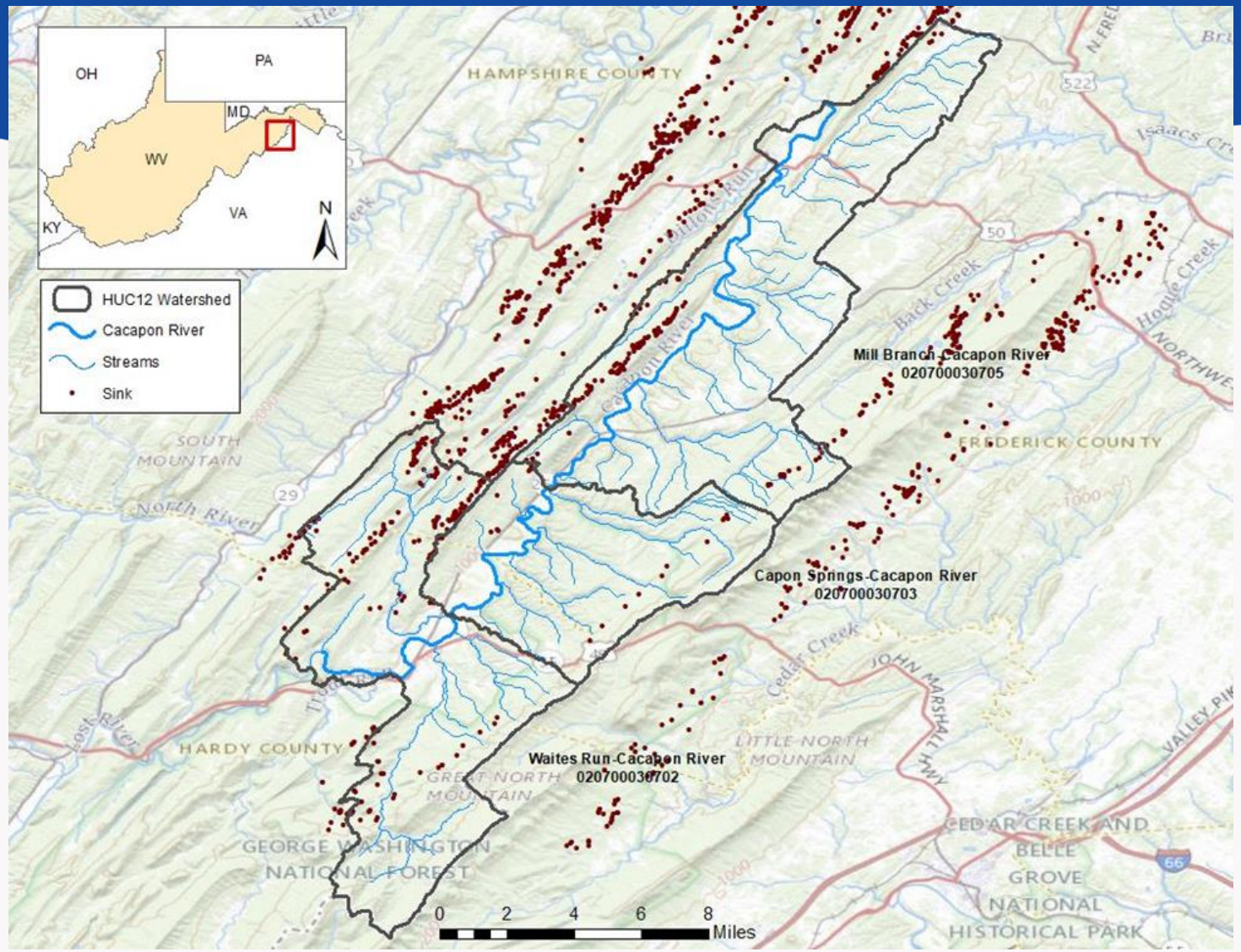
Potential Role of Groundwater Transport



- Water quality parameters vary over short distances
- Nutrient sources may not follow surface flowlines
- Karst: Ca/Mg, Alkalinity, Hardness alter nutrient binding affinity
- Other non-nutrient chemistry such as Iron may play a significant role in nutrient binding affinity

Lidar-derived closed depression density raster of karst features relative to carbonate geology of the Waites Run, Capon Springs, Mill Branch HUC12 subset of Winchester 30 x 60-minute quadrangle (USGS 2021)

Longitudinal Methodology Development: Shenandoah River

Point Surveys

WAB Field SOP 2018 Revision Date: 8/22/2018

CHAPTER 8. FILAMENTOUS ALGAE MONITORING

Overview

Since 2007, the Watershed Assessment Branch (WAB) has devoted much effort and resources to evaluating the causes, locations, and severity of filamentous algae blooms in West Virginia's streams and rivers (***see Figure 8-1 below***). As part of that effort, WAB has measured the development of filamentous algae blooms at various locations and reported the results as "percent algae cover" and occasionally "percent water column fill". Percent algae cover is the percent of the stream bottom covered by filamentous algae at a measured transect of the stream, and percent water column fill is the percent of the water column filled in a cross-sectional view of the stream at a given transect location. It should be noted that neither of these measurements have a longitudinal component; *i.e.*, these two measurements do not account for the length of stream reach impacted by filamentous algae.

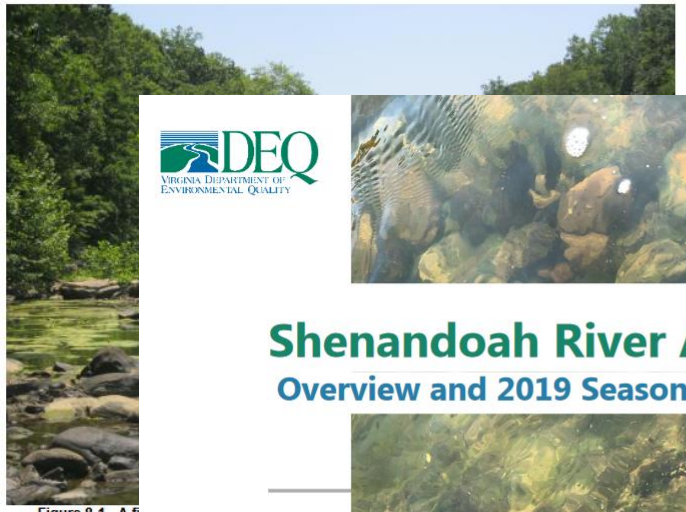


Figure 8-1. A fi

Continuous Surveys

Methods for Estimating Filamentous Algae Cover in Streams and Rivers of the Shenandoah River Basin

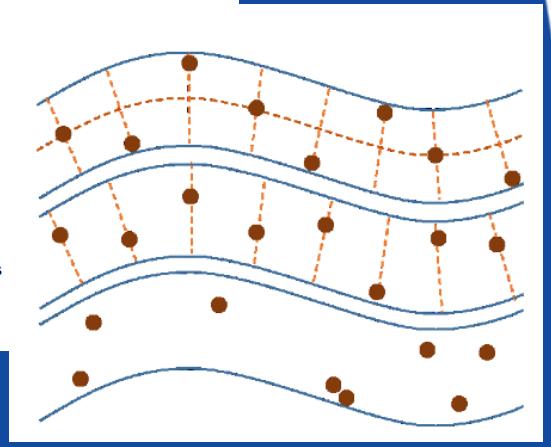
Final Report

May 20, 2015

Adam N. Griggs
Gordon Michael Selckmann
James Cummins
Claire Buchanan

Prepared for

U.S. EPA Region 3
Office of Standards, Assessment and TMDLs
Water Protection Division
1650 Arch Street, Philadelphia, PA 19103



https://www.potomacriver.org/wp-content/uploads/2015/05/ICP15-01a_Griggs.pdf

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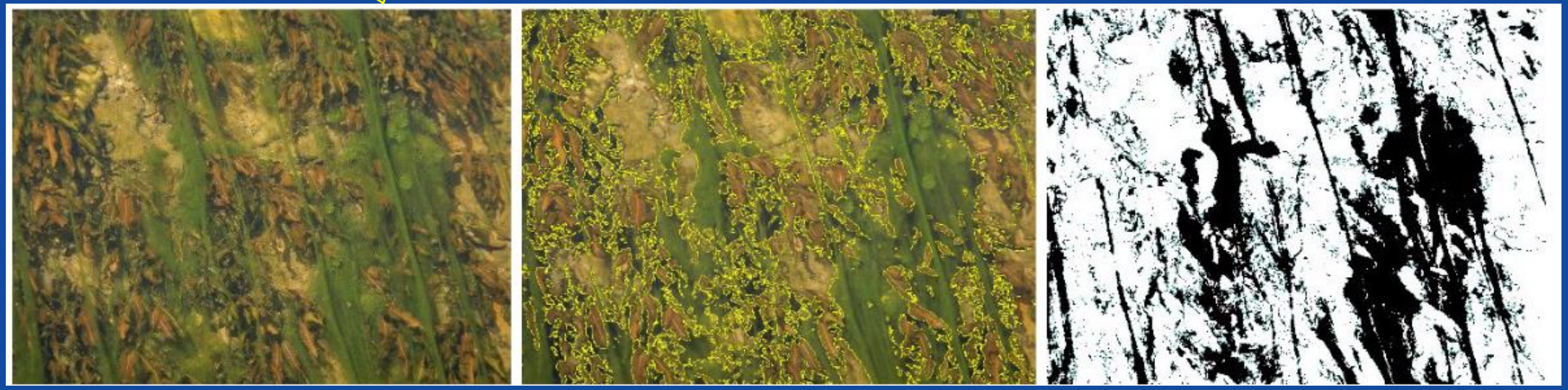
Longitudinal Methodology Development: Shenandoah River

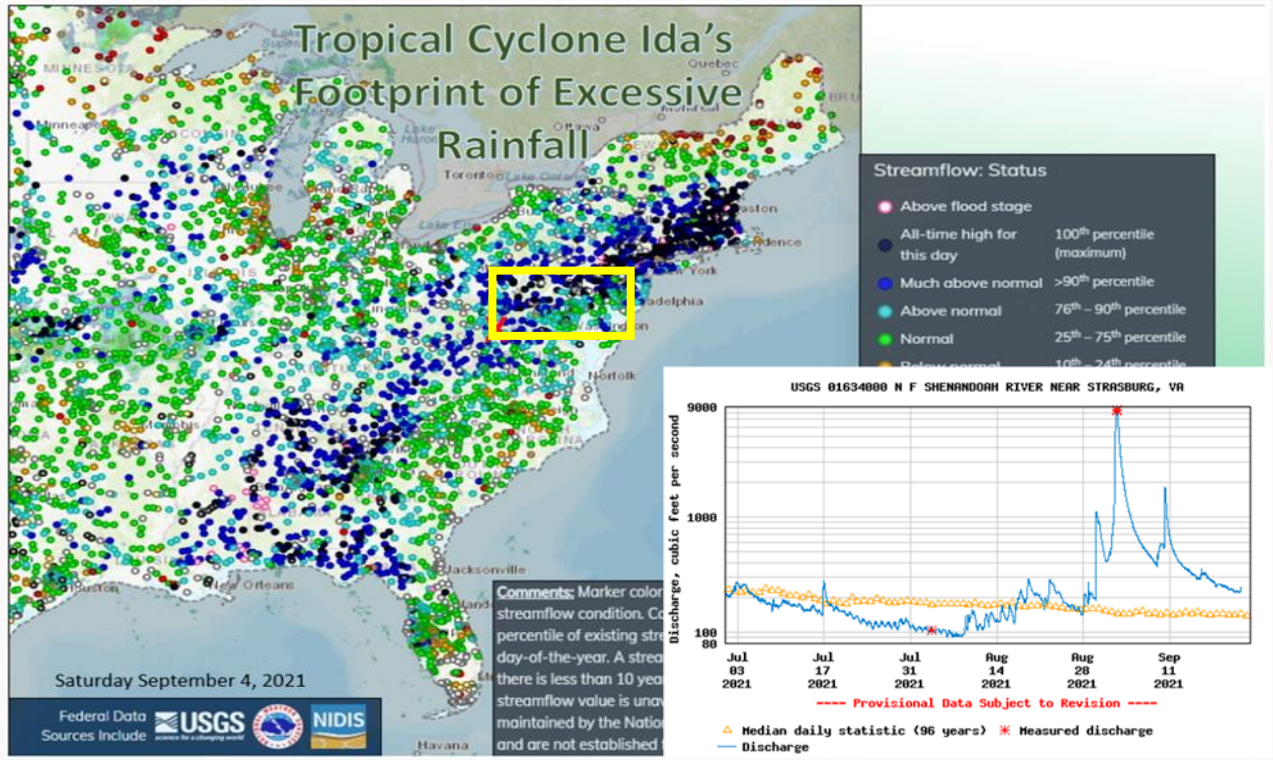
Could a digital mosaic be used to quantify coverage over large reaches?

- Methods were not feasible from *ground* level surveys
- # of samples not logistically feasible to describe clustered distributions
- Limited by speed of boat travel (~10-15miles a day)
- Conditions are too variable for pigment-taxonomic ID



2021 Shenandoah HAB event + Tropical Storm Ida

- North Fork Shenandoah emergency response halted in response to storm
- ICPRB anticipates scour of HAB and downstream impacts. Initiates self funded survey of downstream toxin movement
- ICPRB contacts drinking water utilities and regional biologists
- Tropical Storm IDA: Sept 2, 2021



ESRM Model

Potomac River Spill Model applied to estimate the leading edge of the scoured HAB.

- Intercellular toxin concentrations?
- Mechanical lysing?
- Extracellular toxin longevity?
- Dilution factor?

Potential arrival (mil time) of leading edge of scoured North Fork Shenandoah algal material at water supply intakes along the Potomac River mainstem below Harpers Ferry, WV.

	Early Arrival Time Scenario*	Late Arrival Time Scenario**
Brunswick, MD	**Thurs, Sep 02, 1900**	**Sat, Sep 04, 2330**
Frederick Co., MD	**Fri, Sep 03, 0200**	**Sun, Sep 05, 0930**
Leesburg, VA	**Fri, Sep 03, 0630**	**Sun, Sep 05, 1900**
Fairfax Water, VA	**Fri, Sep 03, 1000**	**Mon, Sep 06, 0330**
Washington Suburban San. Commission, MD	**Fri, Sep 03, 1200**	**Mon, Sep 06, 0930**
Rockville, MD	**Fri, Sep 03, 1230**	**Mon, Sep 06, 1100**
Washington Aqueduct, Great Falls	**Fri, Sep 03, 1300**	**Mon, Sep 06, 1300**
Washington Aqueduct, Little Falls	**Fri, Sep 03, 1630**	**Mon, Sep 06, 2230**

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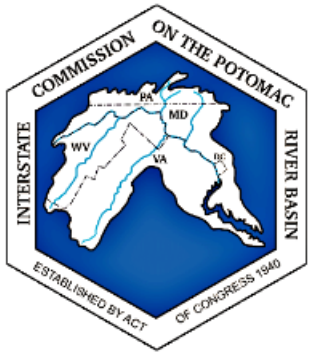
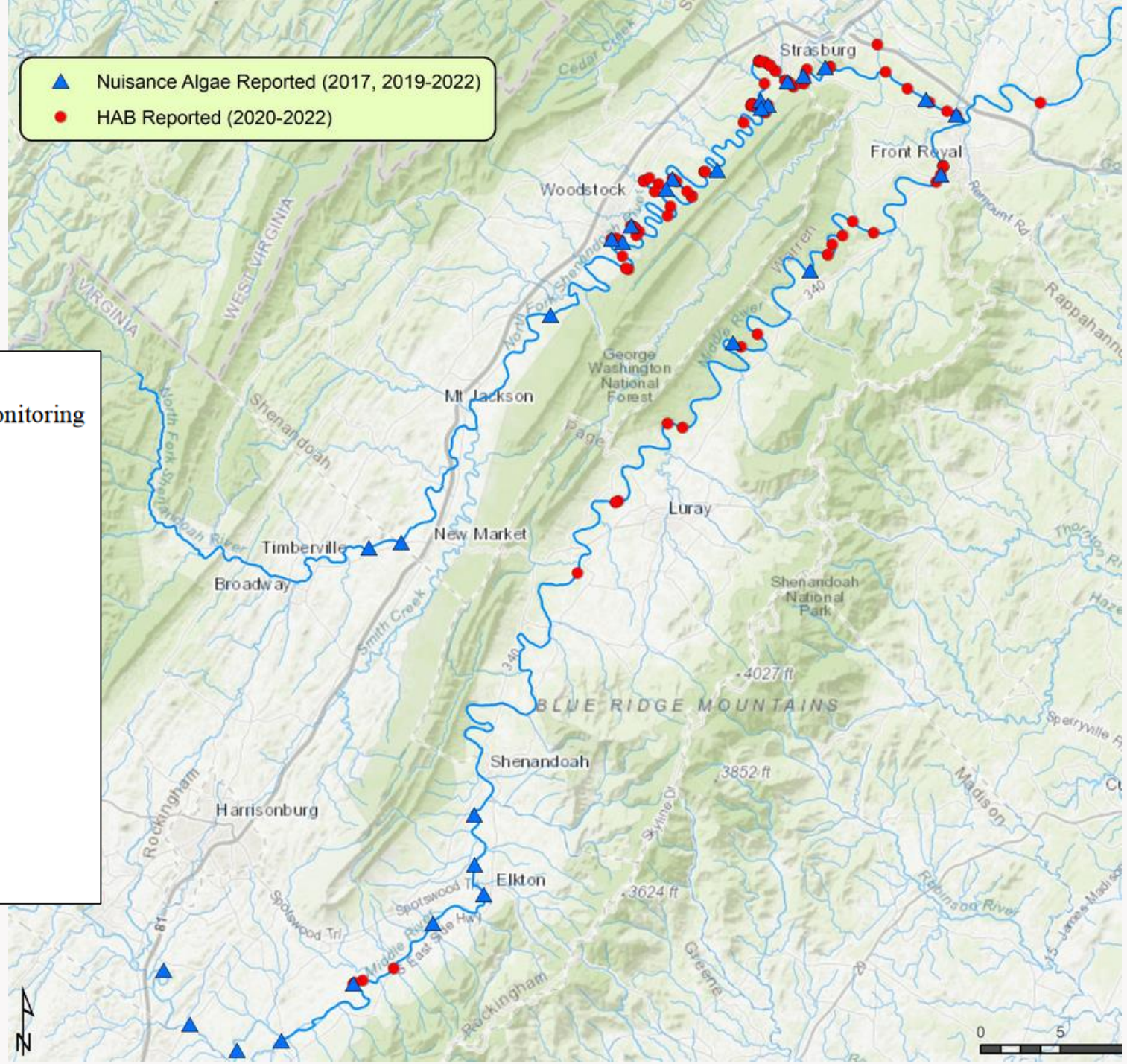
2021-Current:
Support Virginia HAB Response Planning

Considerations for Benthic Harmful Algal Bloom Detection and Monitoring in Virginia Free-flowing Freshwater Rivers

Living Document

Version: #1 (July 27, 2022)





Needs of the Potomac Basin/ Emerging Technologies

- Need: Full suite of water chemistry proximal to bloom locations
  - Issue: Bloom locations are often locally influenced*
  - Novel HAB Technologies: Thermal imaging, Groundwater transport pathways, Non-nutrient chemistry
- Need: Rapid large-scale assessment tools
  - Issue: No quantitative method to measure clustered bloom distributions over large areas
  - Novel HAB Technologies: Satellite, Drones, Orthoimages + Hyper Spectral imaging, photogrammetry
- Need: HABs in context
  - Issue: Intercellular vs extracellular toxin relationships unknown
  - Novel HAB Technologies: SPATT sampling for passive toxin monitoring, benthic algal-toxin loads

Questions?

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