

Path Forward Committee Meeting Remote Meeting, September 6, 2022



Remote Access Options

Equipment Type	Access Information	Notes
Computers with microphones and speakers	Join Microsoft Teams Meeting Please mute your microphone unless you want to provide input.	Press control and click on this link to bring up Microsoft Teams through the internet. You can view the screen share and communicate through your computer's speakers and microphone
Computers without audio capabilities, or audio that is not working	Join Microsoft Teams Meeting (888) 404-2493 Passcode: 371 817 961# Please mute your phone unless you want to provide input.	Follow instructions above Turn down your computer speakers, mute your computer microphone, and dial the toll-free number through your phone and enter the passcode
Phone only	(888) 404-2493 Passcode: 371 817 961# Please mute your phone unless you want to provide input.	Dial the toll-free number and enter the passcode

Remote Access Guidelines

- This meeting will open 30 minutes prior to the official meeting start time to allow users to **test equipment** and ensure communication methods are working
- If you dial in through your phone, mute your microphone and turn down your speakers to **avoid feedback**
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Agenda

- Opening Comments, Agenda Review/Revisions
- PFC/MRSW Meeting Time
- City of Durham Algal Floway Project
- Status of Interim Alternative Implementation Approach (IAIA) Submittal to the Environmental Management Commission (EMC)
- Modeling Status
- Status of Proposed Chlorophyll a Site-Specific Standards for High Rock Lake
- Statistical Model Development and Regulatory Options for the Chlorophyll-a Water Quality Standard
- Statistical/Bayesian/Decision Support Tool Status
- Plan for Developing the Revised Nutrient Management Strategy and Regulatory Options for the Chlorophyll-a Water Quality Standard
- Communications Support
- Other Status Items
- Closing

PFC Meeting Time

PFC Meeting Time

- A PFC member has been assigned to a standing meeting that is in conflict with the PFC meeting time
- The member request consideration of moving the day (or time?)
- The PFC will discuss

City of Durham Algal Flowway Project

City of Durham Algal Floway Project

- The City of Durham has been evaluating the use of enhanced algal growth floway technology to grow and harvest algae for reduction of nutrients within Falls Lake.
- This effort is being considered as an additional action to address nutrient reduction rules.
- Durham will present background about the City's Algal Floway Project, provide an update on site location efforts, and next steps for the project.
- Durham has identified a site adjacent to Falls Lake in Durham County on USACE land as the proposed site.
- Durham would like to discuss potential partnering with one or more UNRBA members.
- The City is also seeking endorsement of the project by the UNRBA as it proceeds with project planning and development.
- The PFC will consider this request and make a recommendation to the Board at their September 21st meeting.

Status of Interim Alternative Implementation Approach (IAIA)

Status of Interim Alternative Implementation Approach (IAIA)

- Implementation of the IAIA began July 1, 2021
- Year one of the program ended June 30, 2022
- Annual reports reflecting first-year investment commitments are due to DWR and the UNRBA Compliance Group Committee (CGC) by September 30, 2022
- The CGC will submit a joint-compliance report to DWR by November 30, 2022
- DWR is presenting the Town of Roxboro local program and the IAIA joint compliance program to the Water Quality Committee and Environmental Management Commission at the September 2022 meetings.
- DWR provided draft slides to the Executive Director for review prior to the presentations

Modeling Status

Watershed Model Report Status

- The draft WARMF watershed modeling report was distributed to the MRSW on June 30, 2022
- We have received comments from several MRSW members
- We anticipate comments from DWR soon
- Modeling team is compiling and addressing comments in a revised report to be submitted to the PFC
- Following PFC review and input, the report will be finalized for submittal to DWR for their formal review
- Delivery of the watershed model files has not yet occurred
 - The WARMF Lake model is part of the complete package and is not final
 - The new GUI (underdevelopment) will be needed to run the full model with all functionality
 - Plan to schedule a training workshop with DWR and others interested in running the model once the new GUI is ready and the lake model is calibrated (September/October)

WARMF Lake Model Status

- During the August 2nd MRSW, the modeling team presented the latest calibration of WARMF Lake
- The model was set up to allow segment-specific modeling rates to allow for unique settling, algal growth, and reaction rates
- During the MRSW discussion, the subject matter experts suggested evaluation of reaction rates that were not variable by lake segment
- The modelers tested common rates for nitrification, organic matter decay, and bed diffusion
- Next the modelers will test common rates for algal growth
- For rates where the model is improved or not negatively affected, uniform rates will be kept
- A final calibration will be presented to the MRSW at their next meeting

Potential WARMF Lake Sensitivity Analyses

- Scaling precipitation to see how sensitive the model is to hydrologic condition
- Scaling atmospheric deposition of nitrogen
- Evaluating ranges of sediment bed diffusion and algal growth rates
- Address concerns of local government with using the model to make decisions (assumptions, etc.)
- Addressing other urban sources like pet waste or sewer exfiltration
- Modeling team will work with DWR modeling staff and third-party reviewers to set the ranges and scaling factors
- MRSW will need to establish priority to stay within budget

EFDC Lake Modeling Status

- EFDC is a more complex, hydrodynamic model of Falls Lake
- The modeling team has been working with the SMEs and DWR modeling staff to discuss the challenges with the EFDC chlorophyll-a calibration with respect to the algal groups present in Falls Lake
- The modeling team has been responding to requests for additional information and meeting with these reviewers as the model development proceeds
- This input has been very helpful
- Team met with SMEs on August 30th to show revised draft calibration results for the model
- Following revisions to incorporate this input, the team will set up a meeting with DWR to review the calibration (mid to late September or next MRSW meeting)

Lake Reporting Progress

- The modeling team is continuing to draft sections and appendices of the lake modeling report.
- One of the questions that has come up regards the display of error bars around lake water quality data as shown in the watershed modeling report.
- The MRSW discussed options for visualizing uncertainty associated with lake water quality data and decided to use a simple approach to stay in scope
- Error bars are for visualization and communication purposes so a rigorous evaluation of each parameter and organization was not warranted
- The modeling team will work with the SMEs and DWR to review the assumptions for this simple approach



Status of Proposed Chlorophyll a Site-Specific Standards for High Rock Lake

July 14, 2022, EMC adopts final High Rock Lake Site-specific chlorophyll-a standards

- Previously, UNRBA Board authorized the Executive Director to submit objection letters to the EMC and, if necessary, send a letter of objection to the Rules Review Commission (RRC) if the final EMC site-specific standard for High Rock Lake failed to adequately address UNRBA's concerns.
- Some of the UNRBA concerns were addressed and others were not.
- The Yadkin coalition (members), directly affected by the site-specific standard, decided to accept the revised language and not file objection letters.
- DWR staff has informally said that the High Rock Lake site-specific standard does not directly affect the opportunities for a Falls Lake site-specific standard.
- The UNRBA Executive Director decided to not file an objection letter on behalf of the UNRBA.

Statistical/Bayesian Model Status

Falls Lake Information Overview

Inputs to Falls Lake

- Inflow volume & timing
 - USGS flow gauge data
 - Wet vs. dry conditions
 - Storm events
- Concentrations (or loads) of nutrients, sediment, organic matter in inflows
 - Local watershed and lake data collected from 1999 to 2018
 - Management scenarios based on WARMF watershed model
 - Empirical estimates using historic data
- Climate
- Atmospheric deposition
- Lake outflows and withdrawals
 - USGS flow gauge data below the dam
 - City of Raleigh withdrawal data

Water quality & processes

- Organic Carbon
 - Particulate/Dissolved
 - Watershed/Algal
- Dissolved Oxygen
 - Surface/Hypolimnetic
 - Spatial extent of anoxia
 - Percent of time or percent of volume hypoxic, anoxic
- Nitrogen
 - Inorganic/Organic
 - Sediment release
 - N-fixation, denitrification
- Phosphorus
 - Particulate/Dissolved
 - Sediment release
- Algae
 - Chlorophyll-a
 - Species Composition
 - Biomass
 - Toxin concentrations and foodweb accumulation
- pH
- Clarity (Secchi Depth)
- Residence time
- Temperature

Water Quality Standards

Designated Uses

- Safe drinking water
 - Taste, Odor
 - DBPs
 - TOC removal
 - Filter clogging
- Aquatic Life
 - Dissolved Oxygen
 - Fish Kills
- Recreation
 - Fishing (DO stress, food)
 - Swimming (pH, algal mats, T&O, clarity)
- Flood control

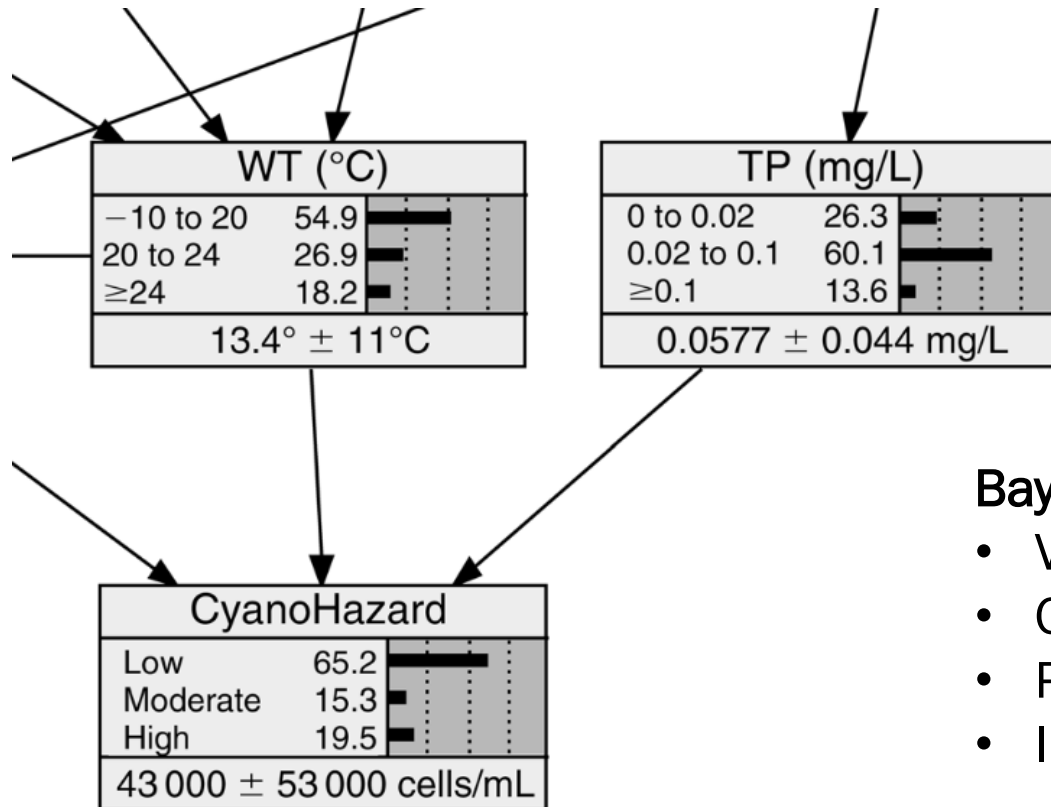
WQ Criteria

- Dissolved oxygen
- pH
- Chlorophyll-a
 - 90th percentile
 - Geomean
 - Arithmetic mean
- Total organic carbon (SDWA)

Data and WARMF/EFDC Model Driven

Probabilistic/Bayesian Predictions

Example: Cyanobacteria Risk



Bayesian Network models:

- Visual representation
- Quantitative summary of data
- Probabilistic predictions
- Interactive exploration

Categories are used to structure the model:

- Provide adequate break down of data or expectations
- Need to be relatable to each other
- Informative and useful to decision making

Statistical/Bayesian Model Status

- The team is continuing to compile data and build model
- On July 12, 2022, the Technical Advisors Workgroup (TAW) met to review some of the compiled data and to discuss potential categories to support decision making
- The TAW meeting was to ensure the team's understanding of
 - How different users and managers evaluate and apply these data
 - How potential categories may facilitate decision making (what matters to you or your organization)
- Categories are currently for discussion purposes only.
- Additional category discussions needed with topic experts
- We anticipate revisions to the categories as the model is developed

Reported Fish Kills

NCDEQ Data for Fish Kills Reported

- Statewide database of documented fish kills: 1986 - 2020
- Fish kills are rare in Falls Lake
 - 6 kills documented in 34 years, all before 1997
 - Attributed to blooms/new reservoir syndrome (1980s), post-hurricane low DO (1996), disease (2008), and cold temperatures (2018)
 - Algal composition and algal toxin data are not available at this time
- We only know if an event was reported, not if one occurred
- There are more users on the lake currently, so more opportunities exists for observations; reports of kills remain very rare.
- Types of summary statistics for reported events vary
 - Number of fish killed
 - Duration of event
 - Acreage affected

Feedback from the TAW on Reported Fish Kills

- Triangle Fly Fishers are frequently on Falls Lake
 - If a fish kill was noticed, they would notify their members and DWR
 - The group does not see fish kills on Falls Lake
- The model should consider impacts to subsistence fishers
- The species affected is important (some are more tolerant)
- Single versus multi-species is important (stressors differ)
- No bloom related fish kills have been reported on Falls Lake since the post-filling period (over 30 years ago)
- Potential categories discussed:
 - Could be species related like None, Single Species, Multi-species
 - Could be cause related like Low DO, temperature, disease, bloom

Algal Toxin Data

Data Resources for Algal Toxins

City of Raleigh – older intake measurements

- Dates: 2007 – 2012, intermittent
- Raw intake measurements

City of Raleigh – recent lake study

- Dates: 2016 – 2018, monthly multiple stations
- Also measures of environmental conditions and chlorophyll-a
- Multiple stations, multiple months
- Anatoxin-a, Cylindrospermopsin, and Microcystin
- All stations in Middle and Lower Lake

Astrid Schnetzer Lab at NCSU

- TBD, data sharing in progress, Collaboratory-funded data

US CDC : One Health Harmful Algal Bloom System (OHHABS)

- 2016 to 2020
- Voluntary reporting by some states of bloom events with health outcomes and/or blooms detected during routine algal monitoring
- Presence-only and no method to tie health outcomes to specific algal toxins or genera
- What species, in what quantity, have been documented at some blooms requiring warnings or closures
- No NC data, little SE data

Toxin Limits for Recreation (Rec) and Drinking Water (DW)

	USEPA		World Health Org.		Lowest of States	
	Rec	Adult DW	Rec	Adult DW	Human Rec	Canine Rec
Microcystin	8	1.6	10	1	0.8 (CA)	0.2 (OR)
Cylindrospermopsin	15	3	4	1	1.0 (CA)	0.4 (OR)
Anatoxin-a	None	None	60	30	1.0 (CA)	0.4 (OR)
Saxitoxin	None	None	30	3	0.8 (OH, WV, PA, IN)	0.02 (OR)

Drinking water standards apply after water has been treated.

Samples from Falls Lake are raw water.

The lowest standards from any state are chronic, long-term exposure standards (e.g., daily exposure).

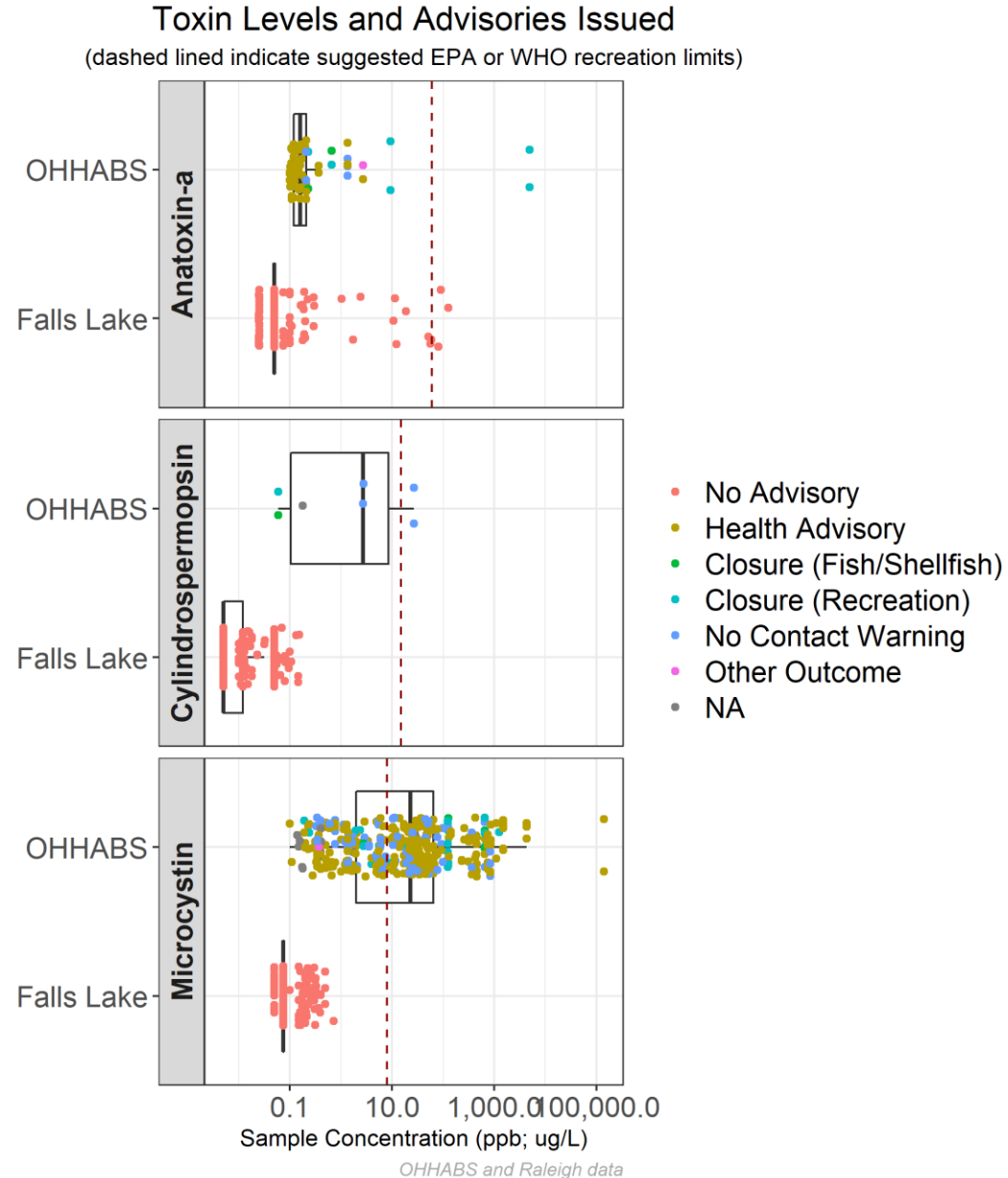
Algal Toxin Data

CDC OHHABS (national):

- Voluntary, presence only
- Majority reports associated with:
 - human or animal health event
 - high toxin levels detected during monitoring
- “Toxin levels measured” - cannot directly attribute cause
- In OHHABS data, microcystin most frequently exceeds guidelines

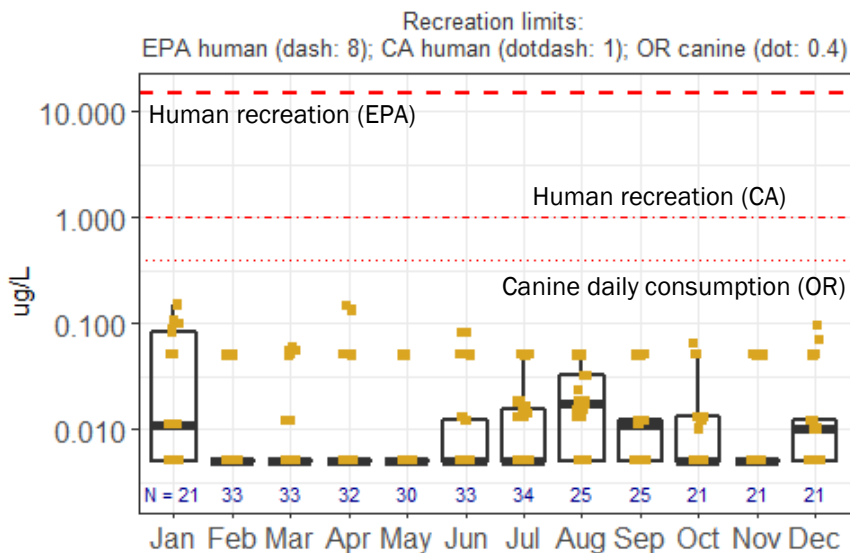
Falls Lake:

- No health advisories or closures have ever been issued due to toxins
- Anatoxin-a is the only toxin to exceed recreational guidelines (January only)
- Falls lake levels generally well below OHHABS reported levels

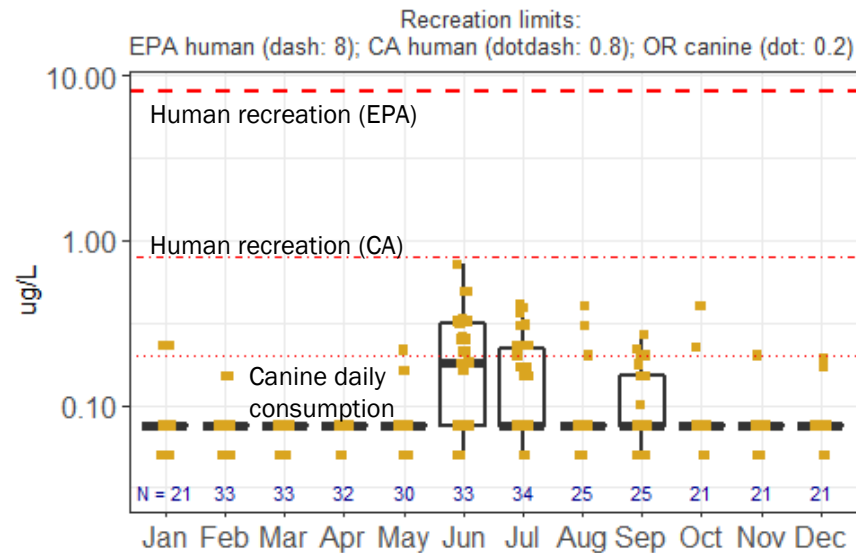


USEPA, WHO, & Other State Recreation Limits

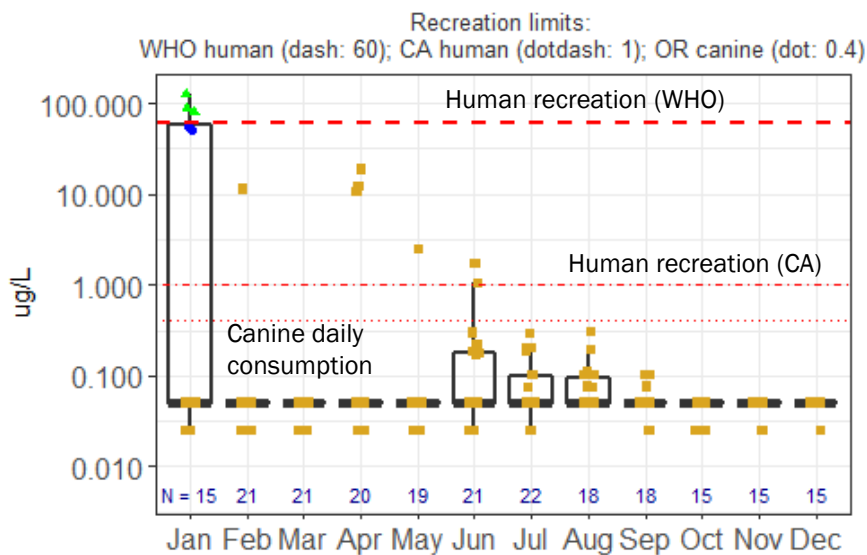
Cylindrospermopsin



Microcystin



Anatoxin-a



- Low
- Moderate
- ▲ High

Cylindrospermopsin well below strictest human and canine limits

Microcystin below strictest human limits; occasionally above Oregon canine limits (daily consumption)

Anatoxin-a usually below limits; has exceeded canine and human limits. High values have only occurred in January when swimming would be limited.

Potential Categories for Algal Toxins

Microcystin ($\mu\text{g/L}$)¹

Low	ND to 1.6:	Below standards for drinking water and recreation
Moderate	1.6 to 8:	Below standards for recreation, but not drinking
High	> 8:	Higher than both standards

Cylindrospermopsin ($\mu\text{g/L}$)¹

Low	ND to 3:	Below standards for drinking water and recreation
Moderate	3 to 15:	Below standards for recreation, but not drinking
High	> 15 :	Higher than both standards

Anatoxin-a ($\mu\text{g/L}$)²

Low	ND to 30:	Below standards for drinking water and recreation
Moderate	30 to 60:	Below standards for recreation, but not drinking
High	> 60 :	Higher than both standards

1. USEPA Adult Standards
2. World Health Organization (WHO)

Additional categories could be included based on the lowest standards of any state associated with chronic exposure (i.e., daily consumption, daily swimming, canines, etc.)

Feedback from the TAW on Algal Toxins

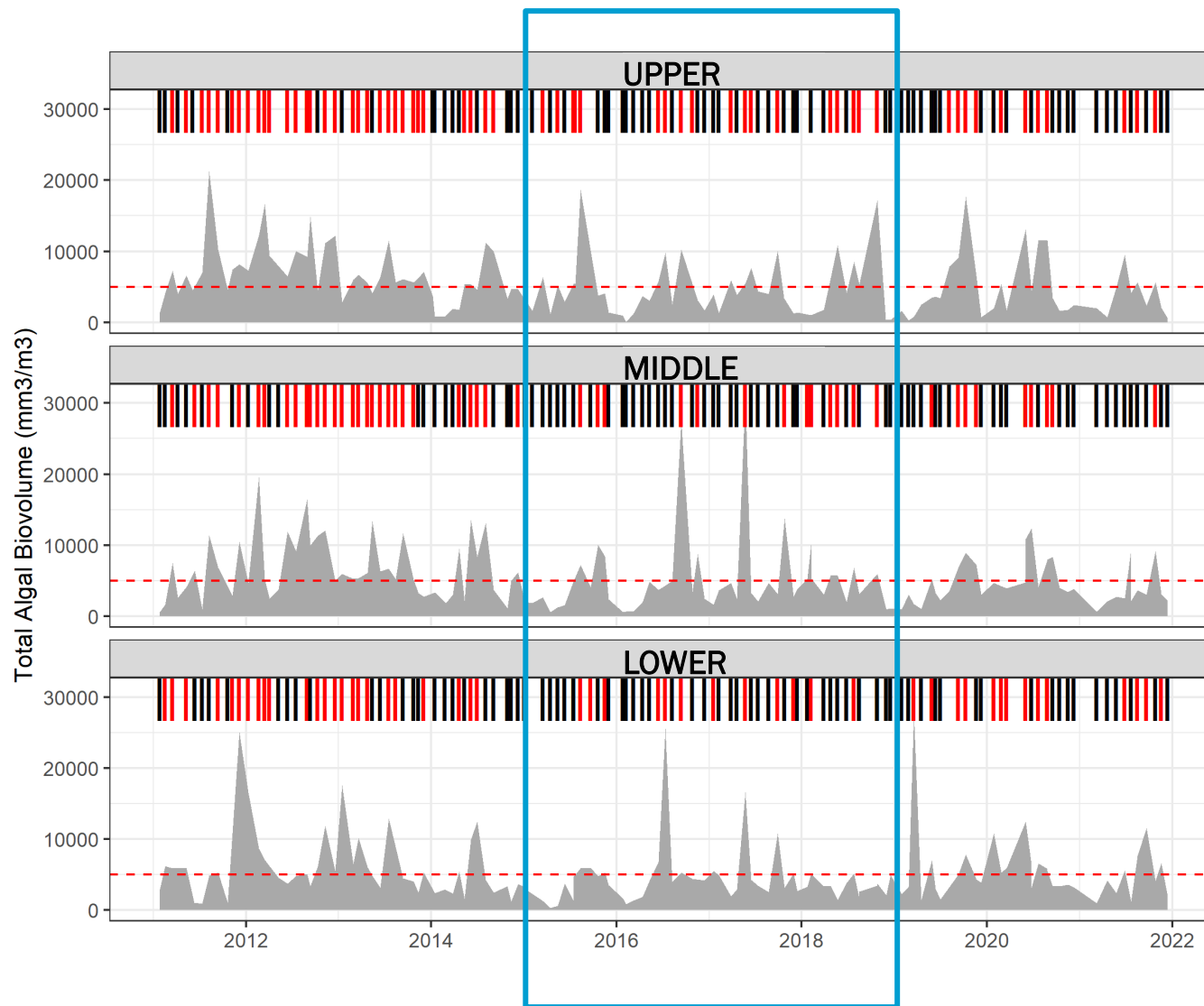
- Triangle Fly Fishers does not track algal toxin data in Falls Lake because toxins are consistently low;
 - If a swimming beach closure occurred due to high toxin levels they would alert the group and that may affect their decision on where to fish.
 - The group is not concerned about exposure to algal toxins on Falls Lake (either environmental or consumptive)
- Wake County has a response plan that includes coordination with DEQ, signage, etc. if DEQ confirms toxin exposure led to an adverse event
- City of Raleigh drinking water staff track toxin levels; not a concern in Falls Lake due to consistently low levels.
 - If toxin levels were found to be high in their terminal ponds, they can use granulated active carbon to remove these.
 - There is not a concern that toxin levels could not be addressed at the water treatment plant.
- Food web accumulation is a potential exposure pathway but there is no data from Falls Lake to include in the model (potential future study)

Algal Communities

Data Resources for Algal Communities

- DEQ (Contact: D. Wiltsie)
 - Dates: 2001 to 2022
 - Report Cell Density, Unit Density, and Biovolume by genera
 - DEQ threshold for a bloom:
 - >10,000 algal units/mL (unit density) or
 - >5,000 mm³/m³ (biovolume)
 - These are thresholds and not indicative of a specific use impairment
 - Algal genera grouped as Diatoms, Green, Blue-Green, Euglenophyta, Prymnesiophyceae, and Other
- Astrid Schnetzer's lab
 - TBD, expected soon
- OHHABS
 - Algal data are less useful than toxin data because generally presence-only
- City of Durham (upper lake samples when DO and pH values indicate a bloom)

Total Algal Biovolume (DWR Data, 3 stations, monthly)

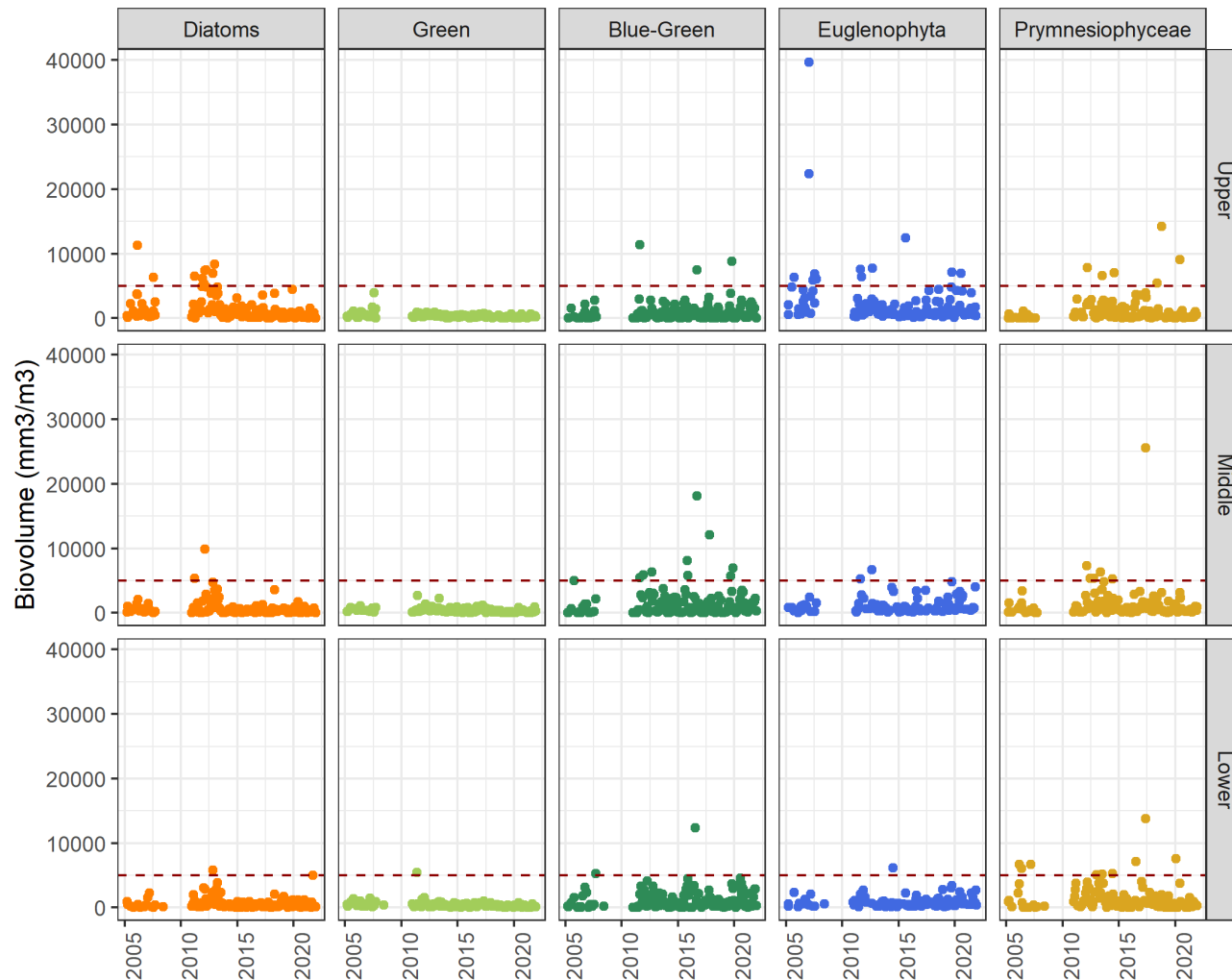


■ Not Bloom
■ Bloom

- DWR threshold for “bloom” is total biovolume of 5000 mm³/m³
- Total biovolume at any given station frequently exceeds 5000 mm³/m³
- Longer-duration bloom events appear less frequent in recent years

UNRBA Study Period

Algal Biovolume by Type



- All except Green periodically exceed 5000 mm^3/m^3 level
- Fewer blooms documented as move downstream
- Euglenophyta have largest documented events based on biovolume

Potential Algae Biovolume Categories

- **Total biovolume**
 - Clogging filters
 - Surface scum and water discoloration
 - Too little would be bad for fish health
- **Biovolume by algal group**
 - Toxin producing genera (blue-greens)
 - Filter clogging genera (diatoms)

Potential Categories:

Total Biovolume:

Not Bloom: $< 5000 \text{ mm}^3/\text{m}^3$

Bloom: $\geq 5000 \text{ mm}^3/\text{m}^3$

Group Biovolume:

Not Bloom: $< 5000 \text{ mm}^3/\text{m}^3$

Bloom: $\geq 5000 \text{ mm}^3/\text{m}^3$

Feedback from the TAW on Algal Communities

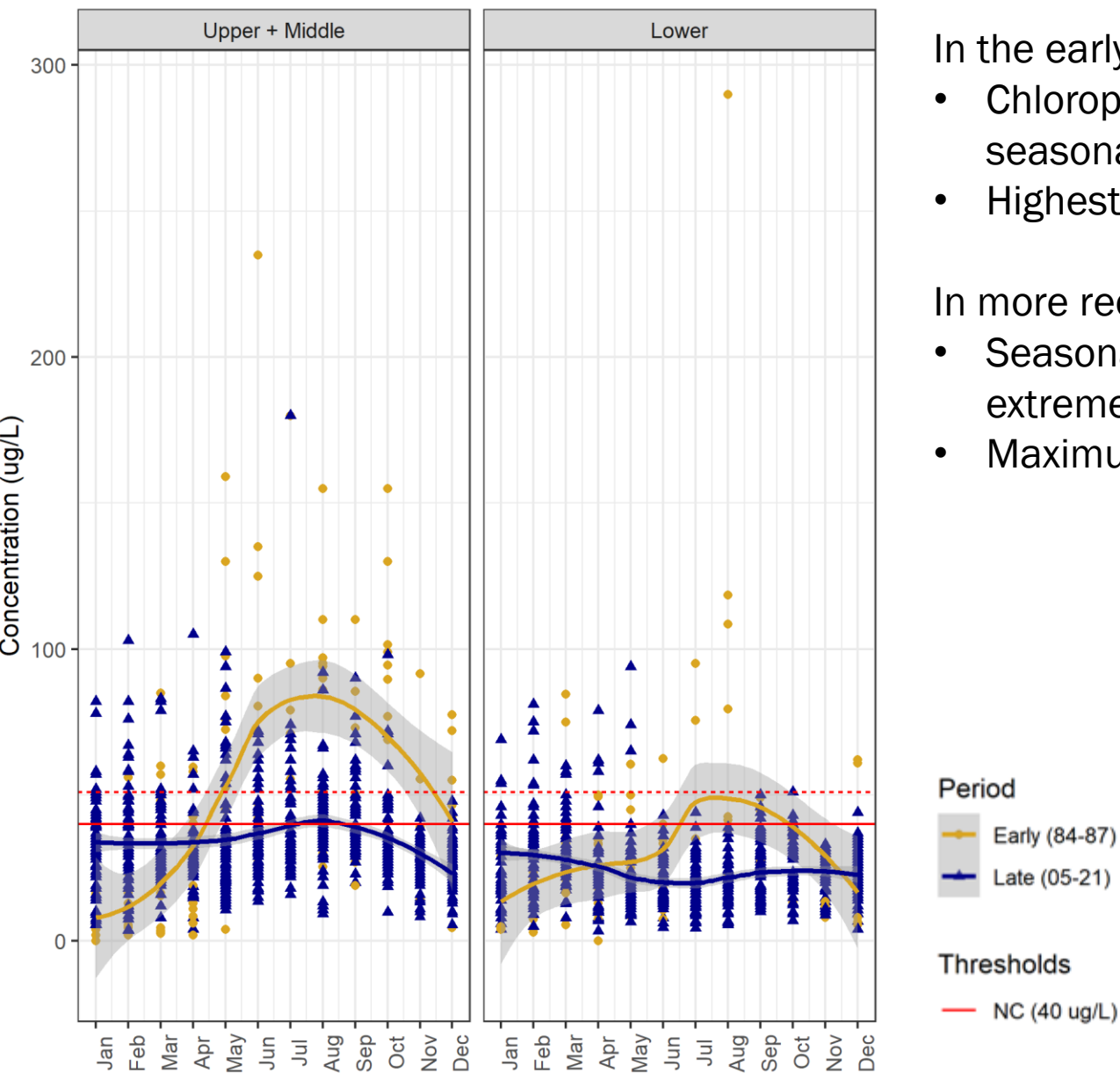
- Need to include City of Durham data (in progress)
- The City of Raleigh has two terminal reservoirs that are used for treatment of diatoms when needed
 - The City's biological laboratory handles these evaluations once a month with the Falls Lake intake sample
 - They had one issue about seven years ago that required treatment
- Neither Triangle Fly Fishers nor Wake County track algal community data in Falls Lake

Chlorophyll-a Data

Data Resources for Chlorophyll-a

- DWR Data (STORET)
 - Dates: 1984 to 1994, 2001, 2005-07, 2010-17
 - Fifteen locations
- NC DEQ Algal Group (contact: D. Wiltsie)
 - Dates: 2006 & 2007, 2010-2022
 - Eight locations, but most samples from three
- City of Raleigh (contact: E. Buchan)
 - Dates: 2017 & 2018
 - Six locations
- City of Durham
 - Dates: 2002 to 2018
 - Two locations
- CAEE data
 - Dates: 2014/2016 to 2018 (depending on station and parameter)
 - Seventeen locations

Chlorophyll-a



In the early data (84-87):

- Chlorophyll-a has a strong seasonal pattern
- Highest values in Summer

In more recent years (05-21):

- Seasonal changes are less extreme
- Maximum values are lower

Chlorophyll-a: Key Insights

- As predicted and expected for a Piedmont reservoir, chlorophyll-a regularly exceeds the 40 µg/L limit
- Chlorophyll-a levels decrease from upper to lower lake
 - Highest where tributaries enter the shallow part of the lake
 - Generally lower towards the dam
- Where the chlorophyll is highest:
 - We have the least algal toxin and community data
 - We have the least ability to discern trends in time
- Seasonal chlorophyll-a patterns may have shifted since the 1980s:
 - Seasonal changes are less extreme
 - Maximum values are lower

Feedback from the TAW on Chlorophyll-a Data

- The 1980's chl-a data in Falls Lake are higher than recent. While the analytical method has changed since then, the results should be generally comparable.
- The lack of chl-a data from 1987 to 2004 is due to
 - The lake not being sampled, or
 - Omission of data by DEQ due to laboratory issues
- Potential categories
 - Regulatory
 - Not Exceed = $< 40 \mu\text{g/L}$
 - Exceed = $>40 \mu\text{g/L}$
 - Ecological (placeholder)
 - $< 30 \mu\text{g/L}$
 - $30 \mu\text{g/L}$ to $60 \mu\text{g/L}$
 - $> 60 \mu\text{g/L}$

Next Steps

- Follow-up discussions with topic experts
- Integrate category inputs from TAW and topic experts
- Continue building model
- Follow-up discussions with topic experts
- Return to TAW to discuss model structure and review/edit categories for designated use satisfaction
- Share with MRSW and PFC

Ongoing Development of the Revised Nutrient Management Strategy and Regulatory Options for the Chlorophyll-a Water Quality Standard

Ongoing Development of the Revised Nutrient Management Strategy and Regulatory Options for the Chlorophyll-a Water Quality Standard

- The Executive Director met with the DWR Director on June 17th
- The Executive Director and UNRBA subject matter experts met with the DWR Director and the leadership team on July 25th
- Both meetings discussed a collaborative approach to
 - Finalize the models
 - Develop a revised nutrient management strategy
 - Develop a petition for site specific criteria
- DWR will identify a contact for standards development
- The UNRBA will continue to work with other stakeholders on these items as well
- The subject matter experts continue to evaluate other State's site-specific standards for chlorophyll-a and nutrient-related standards
- Coordinate with Dr. Marty Lebo to integrate his work into the statistical modeling and regulatory support efforts

Communications Outreach and Preparation

Communications Outreach and Preparation

- Continued engagement with DWR
- Planned workshops and symposia
 - UNRBA Technical Stakeholder Workshop (see next slides)
 - Fall
 - Workshop with local government communications staff
 - Winter
 - Workshop with DWR/NC Policy Collaboratory/NGOs
 - Spring
 - Joint symposium with NC Policy Collaboratory
 - Summer
- Recent staff changes at member local governments highlight the need for UNRBA engagement from multiple staff across the levels of each local government.
- The Executive Director will continue to reach out to local government staff to identify needs and support staff with implementation of the IAIA Program and participation in developing the revised nutrient management strategy.

Planning for the UNRBA Technical Stakeholder Workshop

- Potential modeling topics
 - Watershed model
 - Overview of inputs and model development
 - Model performance (summary table)
 - Nutrient loading summaries to Falls Lake by source
 - Lake models
 - Overview of development
 - Model performance (summary table)
 - Water quality trends
 - Scenario Evaluation
 - Scenario selection process and status
 - Results of “all forest/unmanaged land uses”
(not yet run, but important for understanding constraints)
- Preliminary concepts for revised nutrient management strategy including input from the joint symposium with the NC Policy Collaboratory (April 2022)

Planning for the UNRBA Technical Stakeholder Workshop

- Small group discussions and stakeholder feedback
 - Did anything you hear today surprise you?
 - How should new findings be incorporated into a revised nutrient management strategy for Falls Lake?
 - What preliminary concepts for a revised strategy do you like? Which concepts would you change and how?
 - What additional concepts for the revised strategy should be considered?
 - What level of engagement, if any, would you like to have in the development of the strategy? Please include your name, organization, and email address:
 - Active participant (attends work sessions, reviews draft products)
 - End-product reviewer (reviews near-final products)
 - Other (please describe other levels of engagement you are interested in)

PFC Discussion – UNRBA Technical Stakeholder Workshop

- Potential dates
 - November 1, 2022
 - December 6, 2022
 - January 3, 2022
- Options for workshop length and number of meetings
 - Multiple shorter meetings
 - Full day
- Food
- Meeting materials
 - Handouts and slides
 - Potential distribution of executive summary of the watershed modeling report and/or draft report depending on timing

Future Meeting Protocols

Future Meeting Protocols

- The Executive Director will continue to track conditions and coordinate changes as needed.

Other Status Items

Ongoing Items

- Intensive workgroup activity and management of expectations and resources—A lot to do between now and recommendations in 2023
- Ongoing DEQ/DWR Items
 - MOA
 - Neuse Watershed Model Information Session – Delivery Factors for WWTP

Future Meetings as Currently Scheduled:

Next BOD Meeting: September 21, 2022, 9:30 AM to Noon

Next MRSW or PFC Meeting: October 4, 2022, 9:30 AM to Noon

Closing Comments

Additional Discussion