

CHLOROPHYLL A CONSIDERATIONS

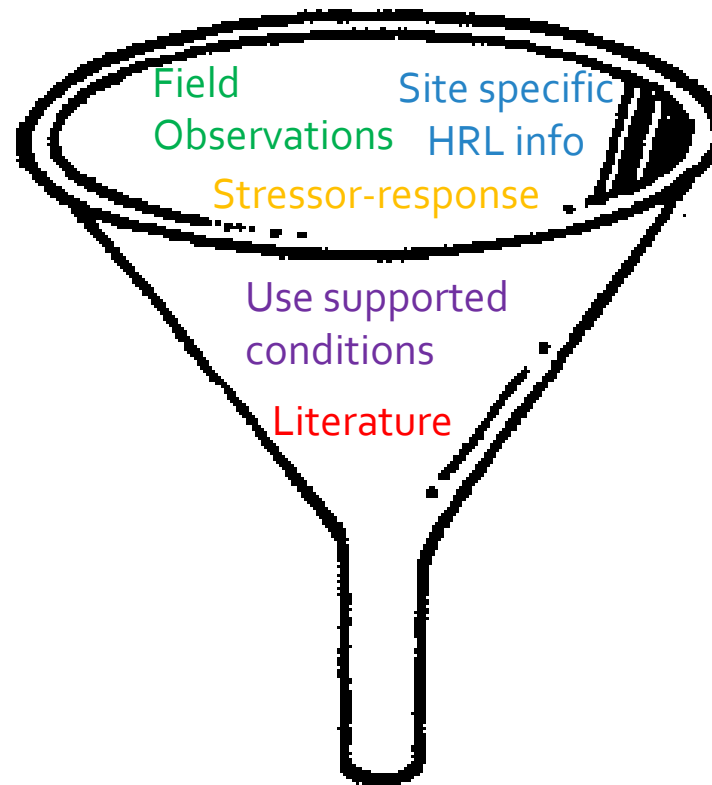
Lauren Petter

July 12, 2017 SAC Meeting

Refresher: What are the water quality goals?

Water Quality Goal(s) as Defined in Rule	Refined WQ Goal(s)
AQUATIC LIFE	
HRL should support a healthy and diverse population of fish, benthos, and wildlife.	<p>HRL should support a Healthy and Diverse population of fish and benthos that are safe for Human Consumption</p> <p>Diverse biological population that is safe for human consumption</p>
Protection of HRL to allow for the safe consumption of fish species	
HRL should maintain an aesthetic quality that does not interfere with any of the above uses.	
WATER SUPPLY	
HRL should be suitable for use as a water supply source	<p>HRL should be free from cyanotoxins and excessive algal growth</p> <p>Potentially harmful (toxic or excessive) algal bloom prevention</p>
HRL should not contain substances that cause taste and odor issues that are untreatable	
RECREATION	
Protection of HRL to allow for full-body contact recreation including swimming	<p>HRL should provide water of adequate clarity that is free from excessive algae and algal toxins and is desirable for recreation</p> <p>Waters desirable and safe for recreation</p>
Protection of HRL to allow for incidental or infrequent body contact recreation through boating, wading, or other activities	
HRL should maintain an aesthetic quality that does not interfere with any of the above uses	

Lines of Evidence + Best Professional Judgement



Chlorophyll *a* Criterion

DOCUMENTATION & DETAILS

- Member papers are starting points for discussion
- Color coding in my paper can be changed with group consensus.
 - Green = positive endpoints for given designated use
 - Red = negative endpoints for given designated use
- Documenting the SAC's decisions is important for the record.
 - After two years of discussions, important to keep track of information sources.
- All vales for chlorophyll *a* are given in $\mu\text{g/L}$.

MAGNITUDE – AQUATIC LIFE ENDPOINTS

- 5-24 → adopted lake criteria in Alabama, Florida, and Georgia lakes/reservoirs that have considered fishery resource or have general fish and wildlife designated use (most of which have chlorophyll in the 15-20 µg/L range)
- 10-15/10-15/20/20 → healthy fish population/ not necessarily detrimental to black bass and crappie/ black crappie fisheries peak/growth of crappie and largemouth increased
 - 25/25/35 → Nevada growing season average/warmwater fisheries only (Dillon)/VA warmwater lake high end adopted, shares ecoregion with North Carolina
 - 40-60/40/40 → fertilization to achieve chlorophyll *a* for production of bass and sunfish/trophy fish more abundant in eutrophic lakes/South Carolina and Nevada instantaneous chlorophyll
 - 60/60 → VA fertilized lakes adopted value/white crappie fisheries peak
 - 60-70 → ponds managed for fishing not recreation

MAGNITUDE – AQUATIC LIFE SUMMARY

- Chlorophyll *a* values between 15-35 µg/L were consistently determined to represent positive endpoints for aquatic life
- The value of 40 µg/L represented a mix of positive and negative endpoints.
- The range between 40 and 70 was generally determined to be negative because it represented fertilized, or more narrowly managed, waterbodies.
- For this analysis, the decision to include categories related to sport or trophy fish related endpoints as positive, when not otherwise characterized as managed or fertilized, was done to give consideration to warmwater fish species that occur in the reservoir.

AQUATIC LIFE – FOLLOW UP QUESTIONS

- Coldwater aquatic life endpoints from previous presentations were not included
 - Is the SAC comfortable with that decision or should those values be inserted into the analysis? Some or all species?

MAGNITUDE – WATER SUPPLY ENDPOINTS

- 5-20/0-30 → adopted drinking water use lake criteria in Alabama, Colorado, and Georgia/
chlorophyll *a* in this range was associated with a 9.3% dominance of blue greens
- 9-10/10 → taste and odor problems become noticeable/low probability of adverse health effects
 - 15 → to keep geosmin <5 ng/L
 - 15-20 → water supply use impaired
- 30/30/30-40 → represents shift in average unit density of blue greens/ increased risk of
algae related health problems/ chlorophyll *a* in this range was associated with a 46.4%
dominance of blue greens
 - >40/50 → (61.5% blue greens dominate)/moderate risk of health effects
 - 20-80 → consumptive uses severely impaired in Kansas lakes

MAGNITUDE – WATER SUPPLY SUMMARY

- Chlorophyll *a* values between 5-20 µg/L were determined to represent positive endpoints for water supply.
- Negative endpoints within that range, were more subjective
- Limited information for concentrations of 20 and 30 µg/L
 - Jing's August 2015 presentation provides potentially positive endpoint information
- Chlorophyll *a* concentrations of ≥ 30 µg/L tended to be more consistently negative

WATER SUPPLY – FOLLOW UP QUESTIONS

- Should we incorporate the April 2016 information on probability of exceeding microcystin-LR concentrations?
- Should the 9.3% blue greens information be characterized as a positive or negative endpoint?
 - Would it be one characterization for water supply and a different characterization for recreation? In this analysis, it was chosen to be positive for both uses because it seemed like the change point based on the information provided for HRL and has relevance to both designated uses.

MAGNITUDE – RECREATION ENDPOINTS

- 0-10/0-25/14/<1-10/10/0-30 → no problems/clear no blooms/excellent to good/excellent to good/mild-low probability of health effects/ chlorophyll *a* in this range was associated with a 9.3% dominance of blue greens
 - 5-24 → adopted recreation use lake criteria in Alabama, Florida, Georgia, and Colorado
 - 10-15/6-15/10-20/15-20/20 → fair/ noticeable and observable levels to moderate/scums/ considered impaired for contact recreation/recreation based low levels found with levels of algal toxin
- 15/25-100/20-25/20-30/32/30/30/30 → poor / no swimming due to concerns for human health/ represents shift in average unit density of blue greens/ good to acceptable/nuisance/acceptable to marginal/moderate blooms
- >30/30-40 → very poor/chlorophyll *a* in this range was associated with a 46.4% dominance of blue greens
 - >40/50 → chlorophyll *a* in this range was associated with a 61.5% dominance of blue greens/moderate probability of short term health effects
- >30/30-80/100-200/5,000/40-60 and 20-80 → severe nuisance/severe algal scums and uses impaired/dense colonies and scums/high risk of long term health effects/ nuisance to severe nuisance

MAGNITUDE – RECREATION SUMMARY

- Chlorophyll *a* values up to 15 µg/L represent generally positive endpoints for recreation.
- There is a mix of positive and negative endpoints between 15 and 30 µg/L.
- Chlorophyll *a* concentrations >30 µg/L tended to be more consistently negative

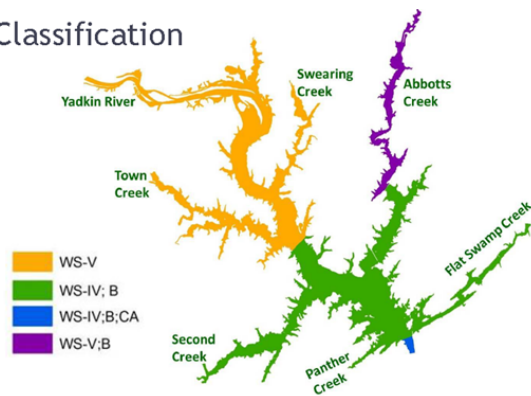
FINAL MAGNITUDE SUMMARY

Designated Use	Chlorophyll a Concentrations
Aquatic Life	15-35 µg/L
Water Supply	5-20 µg/L
Recreation	15-30 µg/L

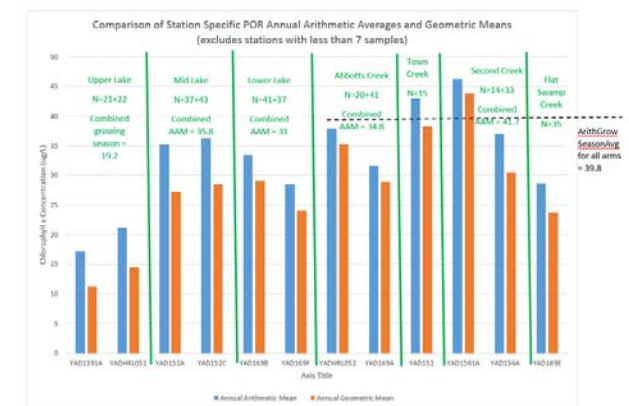
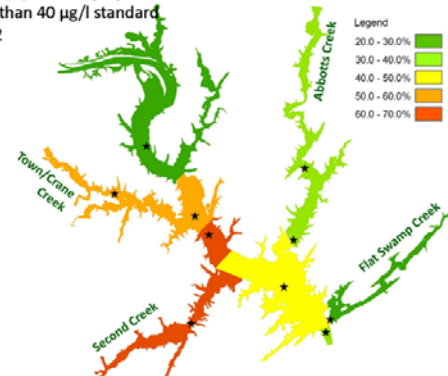
SEGMENTATION

- Consider whether WS-IV, WS-V, or critical areas result in necessary differences in segmentation
- Segmentation selection should also consider different segments based on similarities in response or physical differences

Classification



2014 303(d) Chlorophyll-a % greater than 40 µg/l standard 2008-2012



DURATION OVERVIEW

- Available information, from positive endpoint data, indicates several durations have been used:
 - Growing season averages (using months of April – September and April – October)
 - Annual geometric means (used where there are less defined seasons)
 - Instantaneous maximums
 - **Still working to refine based on available duration information that may exist in literature
- Additional analysis could be completed to determine whether September and October are similar or not, in order to settle on the specific months for the growing season average.

DURATION SUMMARY

Designated Use	Chlorophyll a Concentrations	Other Information
Aquatic Life	Growing Season Average of 15-35 µg/L	Instantaneous Concentration of 30-40 µg/L ?
Water Supply	Growing Season Average of 5-20 µg/L	
Recreation	Growing Season Average of 15-25 µg/L	

DURATION – FOLLOW UP QUESTIONS

- If a growing season average is selected, does the SAC recommend any additional protections to address the non-growing season, either narrative or numerically?
 - In a location with more defined seasons, as is the case in North Carolina, it seems appropriate to consider growing season.
 - To address any concerns about non-growing season loadings, with modeling, it is possible to determine what annual TN/TP loads and concentrations would support the seasonal chlorophyll a criterion, to ensure conditions are met throughout the year to meet the critical response time period.
- Do we have enough information to also recommend an instantaneous value?

FREQUENCY OVERVIEW

- The use of a 1-in-3 allowable excursion frequency is consistent with EPA's recommendations when protecting aquatic life against long-term effects.
- Other example of frequencies include:
 - 1 in 5 years
 - Shall not exceed
 - Shall not exceed, with variability handled in assessment
 - Shall not exceed, implemented with a 10% exceedance rate

FREQUENCY – FOLLOW UP QUESTIONS

- How will the criteria be assessed, permitted to, and used in TMDL development?
- What frequency would the state be able to monitor HRL, moving forward? This may further inform whether the 1-in-3 is the best option for the chlorophyll *a* criterion or an alternative frequency may be more appropriate.
- How is follow up monitoring done after a TMDL is completed? What role do management strategies have in the implementation of newly developed criteria and TMDLs?

Other Questions and Possible Analyses

- Given the three ranges for the uses, what is the best way to weight these competing uses to derive a single criterion?
 - Can we model natural conditions to see what would be expected in this modified system?
 - For drinking water and recreation uses, concentrations above 30 µg/L were generally negative endpoints.
 - What data were used for the recommendation of 42µg/L at YAD169F? The highest growing season arithmetic mean I saw for YAD169F was 40.2 in 2011 and the period of record growing season arithmetic average was 33.3.

Other Questions and Possible Analyses- Continued

- Should we consider the average of the other ecoregion 45, piedmont lakes for a comparison?
 - Average POR of 25µg/L
 - Growing season average POR 30.8µg/L
- For Maintain Existing Use Support Approach
 - Shouldn't consideration be given to lessening water treatment costs through increased prevention of chlorophyll *a* impacts?
 - Whit Wheeler's October 2016 presentation indicated one of their treatment goals is no taste and odor calls.
- For placeholder discussion:
 - One possible TP/TN option would be to model the annual concentrations and loads necessary to meet a growing season chlorophyll *a* concentration.

QUESTIONS?
